

Bharat. Kathod

Instant HORTICULTURE

-
- Part-I** : Fruits and Plantation Crops
Part-II : Vegetables, Spices, Medicinal and Aromatic Plants
Part-III : Floriculture, Post Harvest Technology and General Horticulture
Part-IV : Multiple Choice Questions and Match the Pairs
Part-V : Tables
-

S. N. Gupta

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PREFACE TO TWELFTH EDITION

Horticulture is the vast industry, which is expanding and deepening its roots on account of strong research and development in India. Competitive examination have become a procedure of recruitment and admission for higher studies in this field. Questions asked in these exams are of objective type, many in numbers and are of varied in nature, which require quick answering within a limited period of time. ICAR has started conducting separate examination in this field for JRF, SRF, NET, ARS etc. I have made an attempt to compile the latest information on all facts of horticulture based on experience in this field.

This book contain three volumes —

1. PART-I : **Fruits and Plantation Crops.**
2. PART-II : **Vegetables, Spices, Medicinal and Aromatic Plants.**
3. PART-III : **Floriculture, Post Harvest Technology and General Horticulture.**
5. PART-IV : **Multiple Choice Questions and Match the Pairs**
6. PART-V : **Tables**

These three volumes contain all latest and handy information regarding horticulture. I am sure that this book will be very useful to the students who are preparing for JRF, SRF, ARS, NET etc. in horticulture field. I am grateful to Lord Krishna for providing His mercy upon me. I am also grateful to our parents, teachers and friends who extended full cooperation during preparation of this book. I express my deep sense of gratitude to Jain Brothers for taking up this assignment within a short span.

In this edition all the errors pointed out by readers have been removed and matter has been up-dated as per the requirement of the readers and examinations. I hope that readers shall find this revised edition much useful for their studies and examination preparations.

Suggestions for further improvement of this book are most welcomed.

September, 2015

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PREFACE TO ELEVENTH EDITION

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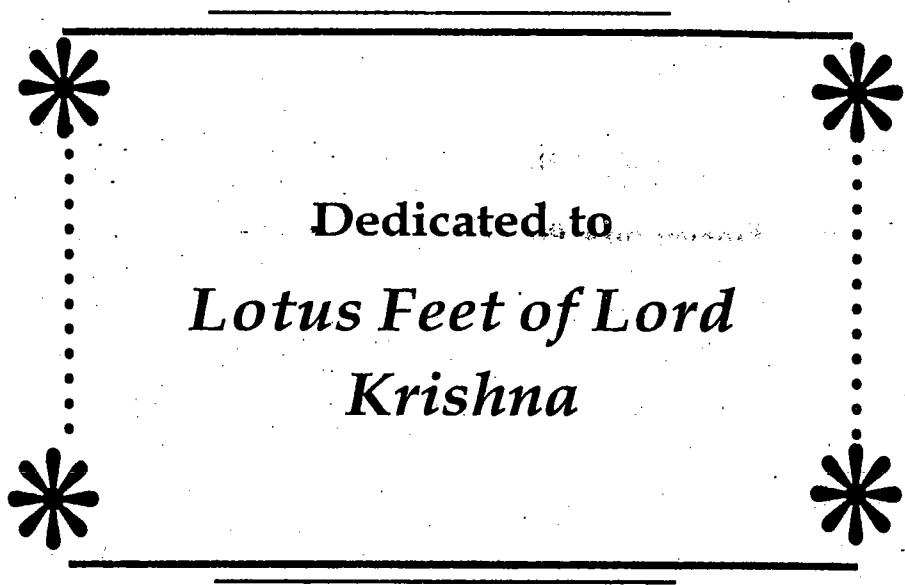
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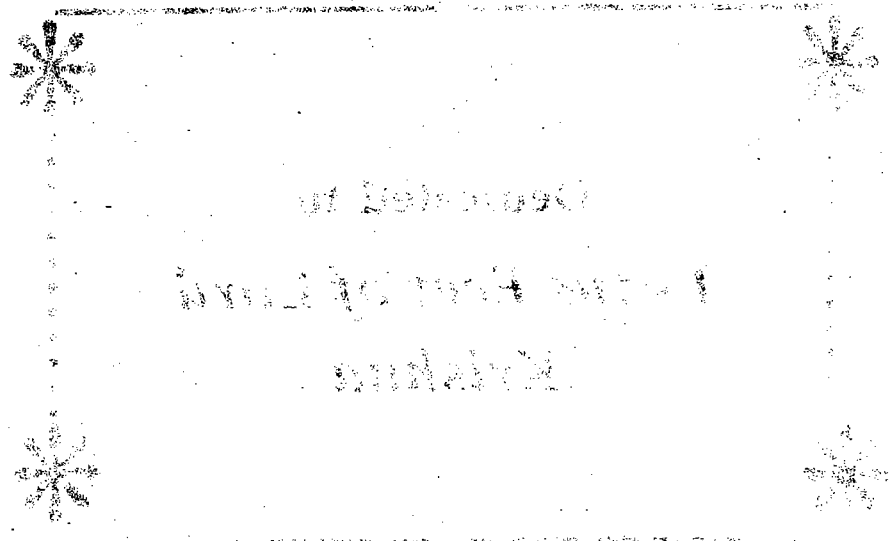
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Dedicated to
Lotus Feet of Lord
Krishna



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PART-I

**FRUITS AND PLANTATION
CROPS**

H/4
KONKANI CHA ETIHA
ROAD

AREA AND PRODUCTION OF FRUIT AND PLANTATION CROPS (2013-14)

FRUIT CROPS

Sr.No.	Fruit crop	Total fruits	
		% share in area	% share in production
1.	Mango	34.9	20.7
2.	Citrus	14.9	12.5
3.	Banana	11.1	33.4
4.	Apple	4.3	2.8
5.	Guava	3.7	4.1
6.	Papaya	1.8	6.3

PLANTATION CROPS

Sr.No.	Plantation crop	Total plantation crops	
		% share in area	% share in production
1.	Coconut	58.2	90.4
2.	Cashew	27.5	4.6
3.	Areca nut	12.2	3.8

Sl.No.	Particular	Largest area	Highest production	Highest productivity
1.	Fruit crops	I-MH (21.6%)	I-MH (15.1%)	I-MP (28 MT/hac)
		II-AP (8.8%)	II-AP (11.8%)	II-TN (22.4 MT/hac)
2.	Plantation crops	Kerala	Kerala	Kerala

MH- Maharashtra ; TN-Tamil Nadu; AP- Andhra Pradesh; MP-Madhya Pradesh.

CLASSIFICATION OF FRUIT CROPS

(A) Botanical classification

Sr.No.	Family	Common Name	Botanical Name	Chromosome No. (2n)
(a) Monocotyledoneae				
1.	Arecaceae (Palmae)	1. Coconut	Cocus nucifera	32
		2. Arecanut	Areca catechu	32
		3. Oil palm	Ealias guinensis	32
		4. Palmyra palm	Borasus flaballifer	32
		5. Date palm	Phoenix dactylifera	36
2.	Bromeliaceae	6. Pineapple	Annanas comosus	50
3.	Musaceae	7. Banana	Musa paradisica	22, 33, 44
(b) Dicotyledoneae				
1.	Anacardiaceae	8. Mango	Mangifera indica	40
		9. Cashew	Anacardium occidentale	42
		10. Pistachio nut	Pistachia vera	30
2.	Annonaceae	11. Custard apple	Annona squamosa	14
		12. Bullock's heart	Annona reticulata	14
3.	Apocyanaceae	13. Karonda	Carrisa carandas	22
4.	Caricaceae	14. Papaya	Carica papaya	18
5.	Ebenaceae	15. Persimmon	Diospyras kaki	90
6.	Euphorbiaceae	16. Aonla	Emblica officinalis	28
7.	Guttiferae	17. Mangosteen	Garcinia mangosteena	24
8.	Juglandaceae	18. Walnut	Juglans regia	32
		19. Pecanut	Carya illieonsis	36
9.	Lauraceae	20. Avocado	Persia americana	24
10.	Leguminoceae	21. Tamarind	Tamarindus indica	24
11.	Moraceae	22. Jack fruit	Artocarpus heterophyllus	56
		23. Fig	Ficus carica	56
12.	Myrtaceae	24. Guava	Psidium guajava	22
		25. Jamun	Syzygium cumunii	40
13.	Oxalidaceae	26. Carambola	Averrhoa carambola	24
14.	Passifloraceae	27. Passion fruit	Passiflora edulis	18
15.	Punicaceae	28. Pomegranate	Punica granatum	18

Sr.No.	Family	Common Name	Botanical Name	Chromosome No. (2n)
16.	Proteaceae	29. Macadamia nut	Macadamia ternifolia	48
17.	Rhamnaceae	30. Ber	Zizyphus mauritiana	48 (4x)
18.	Rosaceae	31. Loquat	Eriobotrya japonica	34
		32. Apple	Malus domestica	34
		33. Almond	Prunus communis	16
		34. Apricot	Prunus armeniaca	16
		35. Sweet cherry	Prunus avium	16
		36. Plum	Prunus domestica	16 (Japanese) 48 (European)
		53. Strawberry	Fragaria ananasa	56
19.	Rutaceae	37. Pear	Pyrus communis	34
		38. Peach	Prunus persia	16
		39. Bael	Aegle marmelos	18
		40. Mandarin	Citrus reticulata	18
		41. Sweet orange	Citrus sinensis	18
		42. Kagzi lime	Citrus aurantifolia	18
		43. Grape fruit	Citrus paradisi	18
		44. Wood apple	Feronia limonica	18
		45. Lemon	Citrus limon	18
		20.	Sapindaceae	46. Litchi
21.	Sapotaceae	47. Sapota	Achras zapota/ Manilkara achras	26
22.	Tilliaceae	48. Phalsa	Grewia subinequalis	36
23.	Vitaceae	49. Grape	Vitis vinifera	38
24.	Sterculiaceae	50. Cacao	Theobroma cocoa	20
25.	Rubiaceae	51. Coffee	Coffea robusta	22
26.	Theaceae or camaliaceae	52. Tea	Camelia sinensis	30
27.	Actinidaceae	54. Kiwi fruit	Actinidia deliciosa	58

* Passifloraceae is the smallest family of fruit crops

(B) Climatic adaptability

(A) Tropical	1. Mango	6. Sapota	11. Coconut
	2. Banana	7. Custard Apple	12. Cashew
	3. Papaya	8. Jackfruit	
	4. Pineapple	9. Carambola	
	5. Guava	10. Persimon	
(B) Temperate	1. Apple	4. Peach	7. Cherry
	2. Pear	5. Apricot	8. Strawberry
	3. Plum	6. Almond	9. Pecanut
	10. Walnut		

	1. Mandarin	7. Jamun	13. Pomegranate
	2. Sweet orange	8. Karonda	14. Aonla
(C) Subtropical	3. Ber	9. Grape	15. Avocado
	4. Fig	10. Annona	16. Loquat
	5. Litchi	11. Bael	
	6. Phalsa	12. Date palm	

(C) Fruit morphology

(a) Simple fruit : 1. Berry—Banana, Papaya, Grape, Sapota, Arecanut, Avocado

2. Modified berry— (i) Balausta— Pomegranate

(ii) *Amphisarca* : Wood apple, Bael

(iii) *Pepo* : Water melon

(iv) *Pome* : Apple, Pear, Quince, Loquat

(v) *Drupe (stone)* : Mango, Peach, Plum, Ber, coconut, cherry, Cocoa, Coffee

(vi) *Hesperidium* : Citrus

(vii) *Nut* : Cashew, Litchi, Chestnut, Walnut, Pecanut, Rambutan

(viii) *Capsule* : Aonla, Carambola

(b) Aggregate fruits : Eteario of berries—Custard Apple, Raspberry

(c) Multiple fruit : (i) Syconus-Fig

(ii) Sorosis—Jack fruit, Pineapple, Mulberry, Breadfruit

(D) Rate of Respiration

(A) climacteric		(B) Non-climacteric	
*Sharp rise in respiration after harvesting		*Steady respiration at the time of harvesting	
1. Mango	7. Fig	1. Citrus	7. Jamun
2. Banana	8. Peach	2. Grape	8. Cashew
3. Sapota	9. Pear	3. Pineapple	9. Cherry
4. Guava	10. Plum	4. Pomegranate	10. Strawberry
5. Papaya	11. Annona	5. Litchi	
6. Apple		6. Ber	

* Climacteric fruits produce much larger amount of ethylene than non climacteric fruits.

* Highest ethylene production : (i) Apple—(25-2500 $\mu\text{L/L}$)

(ii) Passion fruit (466-530 $\mu\text{L/L}$)

(E) Photoperiodic responses

1. Long day plant	2. Short day plant	3. Day neutral plant
Passion fruit	Strawberry	Papaya, Guava
Banana, Apple	Pineapple, Coffee	Banana

(F) Relative salt tolerance

<i>Highly tolerant</i>	<i>Medium tolerant</i>	<i>Highly sensitive</i>
Date palm, Ber	Pomegranate,	Mango, Apple,
Aonla, Guava,	Cashew, Fig,	Citrus, Pear
Coconut, Khirni	Jamun, Phalsa	Strawberry

(G) Relative acid tolerance

<i>Highly tolerant</i>	<i>Medium tolerant</i>	<i>Highly sensitive</i>
Strawberry, raspberry	Pineapple, Avocado,	—
Fig, Bael, Plum	Litchi	—

(H) Self incompatibility

- (a) **Heteromorphic** : No fruit crop
 (b) **Homo morphic** : (i) *Sporophytic*—Mango, Aonla, Cocoa
 (ii) *Gameto phytic* : Ber, Loquat, Pipeapple, Apple, Pear, Apricot, Almond, Cherry

(I) Type of dichogamy

- (i) **Protoandry** : Coconut, Sapota, Walnut, *A muricata*
 (ii) **Protogyny** : Banana, Fig, Pomegranate, Plum, *Annona spp.* except *A. muricata*
 (iii) **Heterodichogamy** : Pistachonut, Pecanut
 (iv) **PDS D** : Avocado
 (v) **Duodichogamy** : Chestnut
 (vi) **Heterostyly** : (a) *Pin type* : Sapota, litchi, Pomegranate (b) *Thrum type* : Almond, carambola, litchi.

(J) Type of pollination

<i>Self pollination</i>		<i>Cross pollination</i>	
(i) Cleistogamy	1. Grape (<i>vitis</i>)	(i) Monoecious— <i>V. rotundifolia</i> (muscadine grape)	
	2. Papaya	(ii) Dioecious :	
	3. Sapota	1. Papaya	5. Betal vine
(ii) Homogamy	4. Apricot	2. Date palm	6. Nutmeg
	5. Citrus	3. Kokum	7. Grape (muscadine)
	6. Dwarf coconut	4. Kiwi fruit	8. Palmyra palm
	7. Peach	(iii) Gynodioecious—Fig.	
	8. Phalsa		

(K) Centre of Origin

<i>Origin</i>	<i>Fruit crop</i>	<i>Origin</i>	<i>Fruit crop</i>	<i>Origin</i>	<i>Fruit crop</i>
1. China	Litchi	4. Tropical America	Custard Apple	10. Iran	Pomegranate
	Sweet orange	(mexico)	Papaya	11. Indo-China	Walnut
	Mandarin	5. Mexico	Sapota	12. Indo-Malaya	Aonla
	Persimon		Avocado		Carambola
	Mulberry				Jamun
	Loquat			13. Indo-Burma	Mango
	Peach	6. Peru	Guava	14. Black to Caspian sea	Mango
	Apricot		Banana		Grape
	Japanese plum	7. South-east Asia	Coconut	15. USA	Pecanut
			Pummelo	16. Asia minor to Western Himalayas	Apple
2. India	Bael		Quince	17. Man made hybrid	Strawberry
	Jackfruit		Lemon		Atemoya
	Kagzilime	8. West Asia (Iraq)	Date palm	18. Europe	Pear
	Phalsa		Fig	19. Japan	Plum
3. Brazil	Cashewnut	9. Afganisthan	Almond		
	Passion fruit				
	Pineapple				

(L) Ploidy level of different crops

<i>(A) Allo-polyploid</i>	<i>(B) Auto polyploid</i>
1. Allo-tetraploid/Amphidiploid -Mango	1. Autotriploid-Tahati lime
2. Allo-Hexaploid- European plum	2. Auto tetraploid-Aonla, Bael, litchi, Jackfruit, Phalsa, Umran Ber
3. Allo-octaploid- Villiacolumban (80) Strawberry (56)	3. Auto Hexaploid -Persimmon Kiwifruit
	4. Auto-octaploid- 'Gola' and 'Illaichi' Ber

(M) Aroma of some fruits

Sr.No.	Fruit crop		Compound
1.	Apple	Ripe	Ethyl-2-methyl butyrate
		Green	Hexanal
2.	Banana	Green	Hexanal
		Ripe	Eugenol
		Over ripe	Isopentanol
3.	Grape fruit		Nootakatone
4.	Lemon		Citral
5.	Orange		Valencene

(N) Acid present in fruit crops

(a) Citric acid :	1. Berries	2. Citrus	3. Guava	4. Pear
	5. Pineapple			
(b) Mallic acid :	1. Apple	2. Banana	3. Cherry	4. Plum
	5. Melon			

(O) Growth curve

1. Kiwi fruit	→ Triple sigmoid curve
2. Sapota	→ Double sigmoid curve
3. Seedless Banana	→ Double sigmoid curve
4. Ber	→ Double sigmoid curve
5. Papaya	→ Double sigmoid curve
6. Guava	→ Double sigmoid curve
7. Fig	→ Double sigmoid curve
8. Grape	→ Double sigmoid curve
9. Plum	→ Double sigmoid curve

(P) Max. Area, Production, Productivity and Introduction year

Sr.No.	Crop	Maximum Area	Maximum Production	Maximum Productivity	Introduction year
1.	Apple	J & K	J & K	J & K	—
2.	Mango	UP	AP	AP	—
3.	Citrus	MH	AP	AP	—
4.	Banana	TN	MH	TN*	—
5.	Guava	UP	UP	Gujarat	17th century
6.	Grape	MH	MH	—	1300 AD

Sr.No. Crop Maximum Area Maximum Production Maximum Productivity Introduction year

Sr.No.	Crop	Maximum Area	Maximum Production	Maximum Productivity	Introduction year
7.	Litchi	Bihar	Bihar	—	17th century
8.	Sapota	MH	MH	TN	1898
9.	Pomegranate	MH	MH	—	—
10.	Ber	MP	MP	—	—
11.	Pear	J & K	HP	—	—
12.	Walnut	HP	J & K	—	—
13.	Jackfruit	—	Assam	—	—
14.	Coconut	—	Kerala	MH	—
15.	Arecanut	—	KN	—	—
16.	Cashew	AP	Kerala	MH	—
17.	Tea	—	Assam	—	—
18.	Coffee	—	KN	—	17th century
19.	Cocoa	Kerala	Kerala	—	—
20.	Rubber	AP	Kerala	—	—
21.	Oil palm	AP	AP	—	—
22.	Pineapple	Assam	WB	WB	1548
23.	Papaya	AP	AP	AP	1611
24.	Sweet orange	MH	AP	AP	1498
25.	Persimmon	—	—	—	1921
26.	Plum	—	—	—	1870
27.	Pecanut	—	—	—	1937
28.	Pear	HP	—	—	—
29.	Custard Apple	—	A.P.	—	—
30.	Aonla	UP	UP	—	—

J&K : Jammu & Kashmir UP : Uttar Pradesh KN : Karnataka MP : Madhya Pradesh HP : Himachal Pradesh

MH : Maharashtra AP : Andhra Pradesh WB : West Bengal TN : Tamil Nadu

(Q) Common Name of fruit crops

<i>Sr.No.</i>	<i>Fruit crop</i>	<i>Common Name</i>
1.	Mango	Bathroom fruit, king of fruits
2.	Banana	Adam's fig, Tree of wisdom, Tree of Paradise, Kalpataru, Apple of paradise
3.	Jack fruit	Monkey jack
4.	Avocado	Butter fruit
5.	Kiwi fruit	China miracle, Horticulture Wonder of Newzeland, National symbol of Newzeland, Chinese Goosberry
6.	Mangosteen	Queen of fruits
7.	Phalsa	Star apple
8.	Guava	Apple of tropics
9.	Ber	Poor man's fruit, king of arid fruits, chinese Fig, Chinese date
10.	Carambola	Star fruit, kamrakh, five corner fruit
11.	Apple	King of temperate fruits
12.	Pecanut	Queen of nuts
13.	Coconut	Kalpavriksha
14.	Water chestnut	Panifal, Singhara
15.	Makahana	Gorgon nut
16.	Tea	Queen of beverage crop
17.	Cocoa	Food of God
18.	Oil palm	Small holders irrigated crop
19.	Cashew	Dollar earning crop, plough crop, gold mine of waste land
20.	Black pepper	King of spices
21.	Small cardamon	Queen of spices
22.	Sapota	Sapodilla plum, Bully
23.	Mandarin	Fancy fruit
24.	Jamun	Indian Black berry, Black plum, Java plum
25.	Loquat	Japan plum, Japanese maldar
26.	Papaya	Melon tree
27.	Walnut	King of nuts
28.	Aonla	Indian Gooseberry, Malacca tree, Myrabalan

(R) Harvesting period, yield, storage temperature and storage life of fruit crops

Sr.No.	Fruit crop	Harvesting period	Yield (t/hect)	Storage temp.	Storage life
1.	Mango	March-Mid August	8.0	8-9 °C	—
2.	Banana	—	—	13 °C	—
3.	Guava	Nov.-Dec. (Winter)	—	8-10 °C	—
		March-April (Spring)	—	—	—
4.	Grape	—	16.0	0-1 °C	—
5.	Papaya	—	60-75	9-10 °C	—
6.	Pineapple	May-August	—	—	—
7.	Sapota	—	15-20	—	—
8.	Pomegranate	—	60-70 kg/tree	5 °C	2 months
9.	Sweet orange	Dec.-Feb.-(North India) Oct.-March (South India)	—	2-5 °C	2-3 months
10.	Acid lime	July-September	—	8-10 °C	6-8 weeks
11.	Mandarin	Feb.-March (Central) December-April (S.I.) December-February (N.I.) August-October (Nillgiri hills)	—	8-10 °C	—
12.	Litchi	May-June	—	5-7 °C	—
13.	Ber	Oct.-Nov. (S.I.) Feb.-April (N.I.)	80-200 kg/tree	3-0 °C	1 month
14.	Aonla	—	15-20	—	—
15.	Avocado	Aug.-Sept.	—	—	—
16.	Custard apple	Aug.-Oct (SI) Sept.Nov. (NI)	7.0	—	—
17.	Jack fruit	—	40-50	—	—
18.	Jamun	June-July	—	—	—
19.	Karonda	July-Sept.	3-5 kg/tree	—	—
20.	Lemon	Dec.-Feb. (NI) May-Sept. (SI)	—	—	—
21.	Loquat	March-May	30-40 kg/tree	11 °C	—
22.	Macadamia	July-August	—	—	—
23.	Mangosteen	August-October	—	4-6 °C	2-3 weeks
24.	Passion fruit	August-December	12-20	—	—
25.	Phalsa	March-May	—	—	—

Contd...

Sr.No.	Fruit crop	Harvesting period	Yeild (t/hect)	Storage temp.	Storage life
26.	Fig	May (NI) July-Sept. & Feb.-March (SI)	—	—	—
27.	Coconut	—	44 nuts/palm	—	—
28.	Apple	Sept-Oct.	—	-1-1-0 °C	4-8 months
29.	Apricot	May-June	15-22	0 °C	1-2 weeks
30.	Cherry	April	15-20 kg/tree	—	—
31.	Pear	May-June	30-35	-1-0 °C	4-5 months
32.	Peach	May-July	7-10	0-0.3 °C	2-4 weeks
33.	Plum	May-July	60-70 kg/tree	0 °C	2-4 weeks
34.	Walnut	Aug.-Sept.	—	—	—
35.	Pecanut	October	20-25 kg/tree	—	—
36.	Bullock heart	Jan.-February	50-75 kg fruit	—	—
37.	Cherimoya	Dec.-January	—	—	—

NI = North India ; SI = South India

(S) Commercially adopted propagation method, spacing and planting time of fruit crops

Sr.No.	Fruit crop	Commercially followed propagation method	Spacing (m ²)	Planting time	Optimum temp. for growth
1.	Acid lime	Seed	—	—	—
2.	Cape gooseberry	Seed	—	—	—
3.	Coconut	Seed	7.5 × 7.5	—	27 °C
4.	Arecanut	Seed	2.7 × 2.7	—	—
5.	Papaya	Seed	1.8-3 × 1.8-3	—	—
6.	Passion fruit	Seed	—	—	—
7.	Phalsa	Seed	—	—	—
8.	Karonda	Seed, hard wood cutting	—	—	—
9.	Mangosteen	Seed, inarching	—	—	—
10.	Pummelo	Seed, T-budding	6 × 6	—	—
11.	Wood apple	Seed, insitu budding	—	—	—
12.	Oil palm	Seed	—	—	—
13.	Cocoa	Seed	C : 3.0 × 7.5 A : 5.4 × 27	Dec.-January	—
14.	Coffee	Seed	—	—	—
15.	Fig	Hardwood cutting	5 × 5	—	—

Sr.No.	Fruit crop	Commercially followed propagation method	Spacing (m ²)	Planting time	Optimum temp. for growth
16.	Grape	Hardwood cutting	—	—	—
17.	Pomegranate	Hardwood cutting	5 × 5	—	—
		Air layering	—	—	—
18.	Tea	Softwood cutting	—	—	—
		Leaf node cutting	—	—	—
19.	Lemon	Air layering, seed	5 × 5	—	—
20.	Litchi	Air layering	8 × 8	—	30 °C
21.	Avocado	Air layering	—	—	—
22.	Cherry	Air layering	—	—	—
23.	Guava	Stooling	7 × 7	—	—
24.	Banana	Sword sucker	1.8 × 1.8	—	20-30 °C
25.	Date palm	Offshoot (sucker)	10 × 10	—	—
26.	Pineapple	Suckers, slips	22.5 × 60 × 75 cm ³	April-June	22-32 °C
27.	Strawberry	Runners	—	—	—
28.	Almond	T-budding	6 × 6	—	—
29.	Aonla	T-budding/patch	8 × 8	—	—
30.	Bael	Patch budding	8 × 8	—	—
31.	Ber	Ring & T-budding	8 × 8	—	—
32.	Custard apple	T-budding	4.5 × 4.5	—	—
33.	Grape fruit	T-budding	6 × 6	—	—
34.	Jamun	Shield & patch budding	12 × 12	—	—
35.	Mandarin	T-budding	—	—	—
36.	Sweet orange	T-budding	6 × 6	June-July	16-20 °C
37.	Peach	T-budding	5 × 5	—	—
38.	Plum	T-budding	7 × 7	—	—
39.	Olive	T-budding	—	—	—
40.	Pecanut	Patch	—	—	—
41.	Rubber	Forket budding	—	—	21-35 °C
42.	Apple	Tongue grafting	—	—	—
43.	Pear	Tongue grafting	—	—	—
44.	Apricot	Tongue grafting	6 × 6	—	—
45.	Cashewnut	Softwood grafting	—	—	—
46.	Jack fruit	Inarching	—	—	—
47.	Loquat	Inarching	—	—	—
48.	Sapota	Inarching	10 × 10	—	—
49.	Mango	Veneer grafting	10 × 10	—	—
50.	Persimon	Crown grafting	6 × 6	Jan.-Feb.	—

(T) Largest producer in the world

Country	Fruit crop	Country	Fruit crop	Country	Fruit crop
1. USA	1. Grape fruit	3. Brazil	9. Guava	6. India	18. Mango
	2. Pummelo		10. Sweet orange		19. Banana
	3. Almond		11. Papaya		20. Acid lime
	4. Walnut		12. Coffee		21. Sapota
			13. Cocoa		22. Cashew
2. China	5. Apple				23. Arecanut
	6. Litchi	4. Indonesia	14. Coconut		24. Tea
	7. Mandarin		15. Clove	7. Srilanka	25. Cinnamon
6. Yugoslavia	8. Plum	5. Thailand	16. Pineapple	8. Italy	26. Pear,
			17. Rubber		27. Grape

(U) Alternate bearing habit

- | | | | |
|----------|--------------|------------------|--------------|
| 1. Mango | 3. Olive | 5. European plum | 7. Date palm |
| 2. Apple | 4. Persimmon | 6. Pecanut | |

(V) Type of parthenocarpy

Vegetative	Stimulative	Sternospermocarpy
1. Banana	1. Litchi	1. Grape
2. Fig	2. Black corianth variety of grape	2. Sindhu variety of mango
3. Pineapple	3. Bread fruit	

(W) Polyembryony present in fruit crop

- | | | |
|----------|-----------|----------|
| 1. Mango | 2. Citrus | 3. Jamun |
|----------|-----------|----------|

(X) Apomixis

Parthenogenesis	Recurrent apomixis	Non-recurrent/Nucellar budding/Polyembryony
1. Mangosteen	1. Apple Raspberry	1. Mango-Adventive 2. Citrus-Nucellar 3. Jamun/Javaplum-Nucellar

(Y) Inflorescence

<i>Solitary</i>	<i>Racemose</i>	<i>Cymose</i>	<i>Spadix</i>	<i>Hypanthodium</i>
1. Almond	A. Raceme-	C. Corymb	A. Solitary- Cherry	Coconut Fig
2. Peach	Black berry	Pear	Sapota	Date palm Pomegranate
3. Apricot	Gooseberry	Citrus	C. Panicle	Arecanut
4. Guava	Raspberry	Strawberry	Grapes	Banana
5. Quince		Phalsa	Litchi	
6. Trifoliate	B. Catkins-	Persimmon	Mango	
-Orange	Mulberry	Papaya	Loquat	
	Chestnut	B. Fascicle-	Pistachionut	
	Walnut	sweet oranges		
	Pecanut	Ber		
		Plum		

(Z) Pollination

<i>Insects (entomophilous)</i>	<i>Wind (anemophilous)</i>	<i>Birds (Ornithophilous)</i>
Citrus	Apple	Coconut
Guava	Pear	Cashewnut
Litchi	Peach	Banana
Ber	Plum	Pineapple
Annona	Cherry	Mango-House fly
Mango	Almond	Fig-wasp
		Oil palm-Weevil
		Jackfruit
		Sapota
		Pomegranate
		Datepalm
		Chestnut

(a) Edible part-

<i>Edible part</i>	<i>Fruit crop</i>	<i>Edible part</i>	<i>Fruit crop</i>	<i>Edible part</i>	<i>Fruit crop</i>
1. Mesocarp	Aonla	3. Pericarp	Custard apple	6. Fleshy thalamus	Apple
Endo carp	Apricot		Avocado		Pear
	Banana		Ber		loquat
			Date palm		Strawberry
2. Mesocarp	Olive				Quince
Epicarp	Peach	4. Mesocarp	Passion fruit	7. Cotyledon	Pecannut
	Persimon		Papaya		Cashew
	Phalsa		Mango		Almond
	Cherry		Mulberry		Pistachionut
	Plum		Tamarind	8. Succulent Placenta	Bael
	Jamun		Sapota		
	Karonda	5. Endosperm	Coconut		

Edible part	Fruit crop	Edible part	Fruit crop	Edible part	Fruit crop
9. Fleshy receptacle	Fig	13. Succulent placenta	Wood apple	17. Fleshy peduncle	Cashew apple
10. Pericarps, placenta	Grape	14. Thalamus & Pericarp	Guava		
11. Juicy placental hairs	Citrus	15. Bracts/Perianth	Jackfruit, Pineapple		
12. Juicy seed coat	Pomegranate	16. Fleshy aril	Litchi		

(b) Classification based on ethylene production

Class	$\mu\text{L C}_2\text{H}_4/\text{kg/hr}$	Crops
Very low	<0.1	Grape, citrus
Low	0.1-1.0	Pineapple, watermelon
Medium	1-10	Banana, Mango, Guava, Fig Tomato
High	10-100	Apple, Papaya, Avocado, Plum
Very high	>100	Passion fruit, sapota, apple

(c) Respiration rate

	Release of CO_2
(A) Very low : Nut, Dried fruits and Vegetables, Potato, Onion.	< 5 mg
(B) Low : Apple, Citrus, Grape, Cucumber, Turnip, Sweet Potato	5-10 mg
(C) Medium : Mango, Banana, Peach, Pear, Fig, Carrot	10-20 mg
(D) High : Strawberry, Avocado, Cauliflower, Lettuce, Raddish	20-40 mg
(E) Very high : Cut flowers, Leek, Brusselsprout, Snap melon	40-60 mg
(F) Extremely high : Spinach, Asparagus, Green Peas, Mushroom, Broccoli	> 60 mg

(d) Bearing Habit

- (A) Terminal : (i) Old season growth : Mango, Litchi, Banana, Pineapple.
(ii) Current season growth : Jackfruit, Pecanut, Loquat.
- (B) Axillary : (i) Current season : Coconut, Papaya, Orange, Guava, Passion fruit.
(ii) Old season growth : Apple, Custard Apple, Pear, Peach, Plum
- (C) Mix bearing : Pomegranate, citrus, carambola

(e) Fruit bud

- (A) Mixed bud : Apple, Pear, Cashew, Guava, Grape, Ber, Pomegranate
- (B) Simple bud : Cherry, Coconut, Date Palm, Mango, Peach, Palm, Apricot.

(f) Sex ratios

	♂	♀
1. Date palm →	3	100 (10% male plant)
2. Aonla →	1	307/1:197
3. Apple →	33	67
4. Papaya →	1	20 (but in pusa delicious 50 : 50)
5. Mango →	♂ high	♀ less (1-36%)

(g) Flower bud differentiation

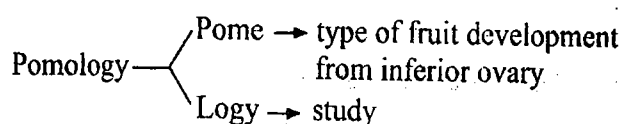
1. Mango →	Oct.- Dec (but in Dasheheri May-June and September-October)
2. Grape →	March-April
3. Banana →	September-April
4. Aonla →	Ist week of march
5. Pineapple →	At 40 leaves stage

(h) Branches of Pomology

1. Fundamental pomology → Deals with fundamental aspect of fruit production like environment, soil type and growth habit.
2. Systematic pomology → Deals with classification and nomenclature of fruit crops.
3. Commercial pomology → Deals with commercial aspect of fruit production like propagation, planting and layout etc.

(i) Placentation:

1. Axil- Banana, citrus
2. Marginal- Litchi
3. Parietal- Papaya
4. Basal- Ber

(j) Vivipary: Grape Fruit, Cocoa, Jack Fruit**(k) Heterostyly:** Litchi, Cashew, Walnut, Sapota, Pomegranate**(l) Pomology:** Greek word

FRUIT CROPS

MANGO

- * Botanical Name : *Mangifera indica*
- * Family : *Anacardiaceae*
- * Origin: Indo-Burma region
- * Mango malformation was first observed in 1891 in Bihar.
- * Malbhog variety of mango is most susceptible to water logged conditions.
- * Dasheheri variety have high fruit retention.
- * Langra variety have highest number of perfect flowers.
- * Mango can withstand deficiency of P but not K.
- * Mango variety Mulgoa is mono-embryonic in India and polyembryonic in Florida.
- * National fruit of India
- * About 39% of world mango are produced in India.
- * Highest productivity in the world : Venezuela
- * North Indian varieties : Alternate Bearer, monoembryonic, self incompatible
- South Indian varieties : Regular bearer, polyembryonic
- * Pollinator-house fly; Pollinising variety Bombay green-Highest Vit-C
- * Maturity indices : Alphonso-SG-1.01 to 1.02 (SG)- Specific gravity
 Dashehari-SG-1.0
- * Mangoes are highly susceptible to low temperature injury that's why they should be stored above 5 °C temperature during storage.
- * VHT (Vapour heat treatment) is recommended for disinfection of mango against fruit flies and stone weevil.
- * Two crop of mango is taken in Kanyakumari district of TN.
- * Mango hybridization work was first started by Burns and Prayag in 1911 at Pune.
- * Caging technique of breeding was used in mango by Dr. R.N. Singh.
- * Good mango varieties have a TSS of 20%.
- * Polyembryonic rootstocks of mango:
 1. Bappakai 2. Chandrakaran 3. Goa 4. Olour 5. Kurukkan 6. Solan 7. Mulgoa 8. Bellary
 9. Villiacolumban 10. Nileshwar dwarf
- * Rumani is used for dwarfing effect in Dashehari
- * Olour is used for dwarfing effect in Langra & Himsagar
- * Villiacolumban is used for dwarfing effect in Alphonso.
- * Salt resistant rootstock of mango : Kurukkan, Moovandan, Nekkare
- * No. of perfect (bisexual) flower Highest- 68.9% in langra variety
 Lowest- 0.74% Rumani variety
- * In mango, only 0.1% flower (perfect) develops fruits to maturity. (Spray 2-4-D 10 PPM, to overcome this problem)
- * Spongy tissue was first observed by Cheema and Dhani in 1934.
- * India contributes 54.2% of total mango production in the world.
- * Temperature between 24-27 °C is ideal for mango cultivation.
- * Introduced polyembryonic rootstock of mango :
 - 1 Apricot 2. Simmonds 3. Higgins 4. Pico 5. Sabre 6. Strawberry 7. Combodiana 8. Terpentine
 9. Carabao 10. Saigon
- * **Ambika** : Amrapali × Janardan.Pasand- Regular bearer, yellow colour with red bluish -suitable for domestic and export market

- * Dashehari, Langra, Chausa and Bombay green are self incompatible mango cultivars
- * Xavier- variety have highest TSS-24.8 Brix.
- * **Storage temperature : (A) mature fruit 6-7 °C (B) Ripened fruit 20 °C**
- * Longevity of mango seeds : 30 days (4 weeks)
- * Black tip was first observed in 1909 by Woodhouse
- * Rumani variety of mango has apple shape fruit.

Varieties

1. **Alphonso** : Most popular variety of India susceptible to spongy tissue. It has export quality.
2. **Banganpalli** : Main commercial variety of A.P.
3. **Bombay Green** : Earliest variety of North India. It is called Malda in UP and Sehroli in Delhi.
4. **Chausa** : Sweetest variety of mango.
5. **Dashehari** : Most popular variety of North India
6. **Fazli** : Late maturing variety.
7. **Kesar** : It has good processing quality.
8. **Langra** : It has characteristic turpentine flavour, most prone to fruit drop.
9. **Niranjana** : Off season bearer
10. **Neelum** : Best combiner variety. Ideal for long transport, two crop in a year.
11. **Rosica** : Mutant variety of mango.
12. **Madhulica** : Most precocious cultivar of mango.
13. **Lal sindhuri** : Powdery mildew resistant variety of mango.
14. **Gulab khas** 15. **Himsagar** 16. **Kishanbhog** 17. **Mankurad** 18. **Pairi** 19. **Totapuri** 20. **Banglora** 21. **Rumani**— Apple shaped variety.
- * **Regular bearing varieties**: Neelum, Gulabkhas, Himsagar, Pairi, Totapuri.
- * **Off season bearer** : Niranjana, Madhulica.
- * **Exotic coloured cultivars** : Tommy Atkins, Zilette, Haden, Sensation, Julie
- * **Mulgoa** is mother of all coloured cultivars of mango and useful for making preserve.

Hybrids

1. **Mallika** : Neelum × Dashehari— Regular bearer, highest Vitamin-A content.
2. **Amrapalli** : Dashehari × Neelum, Dwarf, suitable for high density planting (2.5 × 2.5 m²) 1600 plants, triangular method.
3. **Ratna** : Neelum × Alphonso, Regular bearer, free from spongy tissue and fibre, pulp % = 78.62%
4. **Sindhu** : Ratna × Alphonso, seedless variety of mango, stone account 3% of total fruit weight, stone weight 6.75 g, pulp 83%, pulp to stone ratio 26 : 1, Result from stenopericarpic parthenocarp
5. **Arka puneet** : Alphonso × Banganpalli, Free from spongy tissue
6. **Arka Aruna** : Banganpalli × Alphonso, Dwarf, free from spongy tissue
7. **Arka Anmol** : Alphonso × Janardan Pasand, free from spongy tissue
8. **Arka Neelkiran** : Alphonso × Neelum, free from spongy tissue
9. **Manjeera** : Rumani × Neelum
10. **Prabha sankar** : Bombay × Kalapady

New varieties Released by IARI

1. **Pusa surya**
2. **Pusa Arumina** : Cross between Amrapalli × sensation (USA variety)

* Besides alphonso, kesar, gulabkhas, Lakhan bhog, safdar pasand are exported

3. Akshay : Selection from Dashehari
4. Saisugartha: Cross between Totapuri × Kesar Regular bear, free from malformation suitable for pulp making.

BANANA

- * Botanical Name : *Musa paradisiaca*
- * Family : Musaceae
- * Origin : South East Asia
- * Bunchy top of Banana was first observed in 1891 in Fiji.
- * Ripe banana contain 27% sugar.
- * In monthan variety of Banana only Glucose sugar is found.
- * *Musa acuminata* is the source of today's edible banana.
- * Gross Michel variety of Banana is susceptible to Panama wilt while Basarai is immune and Poovan is resistant to this disease.
- * Bunchy top is also called as cabbage top.
- * Male flower of Banana are resistant to panama wilt disease but susceptible to bunchy top disease.
- * Growth of Banana is influenced by temperature. It grows well at temperature of 26.5 °C.
- * Temperature between 20-30 °C is ideal for good plant growth.
- * India's share in world production of Banana : 31.6%
- * Banana is a calcifuge crop calorific value : 67-137/100 g
- * Sigatoka is a serious disease of Banana
- * Removal of male bud after completion of the female phase is referred as, denavelling.
- * In Tamil Nadu, banana is specially grown for leaf production.
- * Banana is moisture loving plant.
- * Banana is herbaceous, monocotyledonous and monocarpic fruit crop.
- * Weight of sword sucker : 750 g.
- * Desuckering, propping and mettocking are important cultural practices followed in banana.
- * Finger tip disease is serious in high density planting (HDP).
- * Tetrazolium test for Bunchy top virus detection.
- * Most of cultivated banana is triploid in nature.
- * Two spray of KH_2PO_4 at fruit development stage increases the bunch weight.
- * Genetic classification of Banana was given by Simmond & Shephard.
- * Ripe banana fruit contain over 26% of sugar.
- * It is referred as a kalpataru (A plant of virtues)
- * Temperature above 36-38 °C causes scorching effect with increased transpiration.
- * Apart from sword sucker (weighing 500-750 g), cut rhizomes called 'Bits' and 'peepers' are also used for propagation.
- * Poovan, Rasthali, Nendran and Robusta : 2.1 × 2.1 (m²), Basari, Kulhan, Jawari : 1.8 × 1.8 m² spacing.
- * In Gujrat and MH : Furrow method and in TN trench method of planting is followed.
- * AAB, AAA clones are grown under irrigated conditions.
ABB clones are grown under rainfed conditions [Monthan, Kanthali, Kunnan]
- * Trench method is especially followed in wetland system of cultivation.
- * Descuckering once in 45 days is common practice in Banana cultivation.
- * For getting maximum yield a minimum of 10-12 leaves are required to be retained on the mother plant.

- * Strong wind is a threat for successful banana production.
- * For long distance transportation, harvesting is done at 75-80% maturity.
- * Post harvest technology to delay ripening of banana are skin coating with waxol (12% wax emulsion)
- * All AAA clone are susceptible to sigatoka leaf spot.
- * Banana cultivar are screened for virus by ELISA test.
- * Hybridization work– CBRS, Adhuthurai (TN) * **CBRS** : Central Banana Research Station.
- * Seedlessness of Banana is controlled by spray of 2, 4-D @ 25 PPM.
- * Maturity 90-150 days
- * About 23% of world banana are produced in India.
- * Sigatoka leaf spot disease of Banana was first observed in 1913.
- * Banana improvement work was started in the year 1949 in Tamil Nadu.
- * Leading in production : Poovan, monthan, karpuravalli
- * Banana is staple food of South Africa.

Varieties

1. *Dwarf cavendish (AAA)* : Basrai– leading commercial cultivar contributing 58% of total production
* Gandeve selection (Hanuman or pardase) from Basrai.
2. *Robusta (AAA)* : Bombay green, Harichal– semi tall sport of dwarf cavendish. Highly susceptible to sigatoka leaf spot but resistant to panama wilt.
3. *Grand Naine (AAA)* : Tall mutant of dwarf cavendish. It require propping.
4. *Poovan (AAB)* : Rasthali, Amritpani, mortman– choicest table banana (Best) Hard lumps and fruit cracking are the major physiological disorders.
Tolerant to many Abiotic & biotic stresses.
5. *Poovan mysore (AAB)* : Pink pigmentation on ventral side of midrib when young, susceptible to banana streak virus, leading cultivar of south India.
6. *Nendran (AAB)* : French plantain, Rajeli– Most prized cooking variety used in Kerala. Good for making Banana chips.
7. *Hill banana (AAB)* : Virupakshi, Sirumalai, Laden– Suitable for cultivation on hills, fruits having unique aroma and flavour (taste). Suitable for Jam making.
8. *Lal velchi (AAA)* : It is grown for red skin.
9. *Monthan (ABB)* : Good for culinary purpose.
10. *Ney Poovan (AB) Safed Velchi*– diploid variety, it fetches double price than other cultivars. Horizontal bunch orientation.
11. *Pey kunnan (ABB)–Karpuravalli, kanthali*– tolerance to biotic and abiotic stresses. Good for making baby food, Juice, wine, popular in marginal soils.
12. Amritsagar 13. Dudhsagar 14. Chakia 15. Monohar
13. *Lady finger (AB)* : diploid banana variety.

Hybrids

1. FHIA-1 (Gold Finger)– (AAAB)– Belong to pome group. Resistant to wilt and sigatoka leaf spot.
2. *Bodles Altafort*– (AAAA)– synthetic hybrid, a result of cross between Gross michel (AAA) × Pisanglin (AA).
3. Klue teparod (AABB)– natural tetraploid.
4. *CO-1* : Kellar Laden × M. balbasiana × kadali
* Poovan & Ney poovan are preferred in multistory system.
* Salt water treatment reduces duration of Banana fruits.

- * Banana is a rich source of dietary potassium (K) used in nervous impulses and good source of energy.
- * *Rajapuri*– Resistant to cold.
- * *Nendran*– remain starchy even on ripening.
- * *Moongli*– mutant of Nendran.
- * *Edible part*– starchy parenchyma.
- * Brinjal, cucurbits should not be grown in Banana orchard because they attract nematodes.

PAPAYA

- * Botanical Name : *Carica papaya*
- * Family : *Caricaceae*
- * Origin: Tropical America
- * Papain contain 72.2% protein.
- * Papaya is commercially propagated by seed.
- * Seed rate– 250-300 g/hac (Gynodioecious).
- * 400-500 g/hac (Dioecious)
- * Yellow pigment in papaya– Caricaxanthin
- * Enzyme present in dried latex of papaya (papain) is pepsin.
- * Recommended spacing for Pusa Nanha is 1.25 × 1.25 m² (6000 plants/hac)
- * Frost is the most limiting factor in papaya cultivation in north India.
- * Papaya is a polygamous plant.
- * 1 gram = 20 seeds of papaya.
- * Carpine obtained from papaya, is utilized as a diuretic and heart stimulent.
- * Damping off is most serious disease of papaya seedlings.
- * 10% male plant is planted where dioecious varieties are cultivated.
- * Papaya plants are very susceptible to water logging.
- * Papaya is thermosensitive crop.
- * *Carica candamarcensis*– Mountain papaya.
- * Highest productivity after Banana.
- * Highest producing state in India–Andhra Pradesh
- * Sunrise solo type of papaya produce no male plants.
- * Seed are enclosed in gelatinous sarcotesta.
- * Irrigation by ring method.
- * India has 4th rank in papaya production in the world.

Varieties (A) Gynodioecious varieties

1. *Pusa delicious*
2. *Pusa majesty* : One of highest papain yielders
3. *CO-3* :
4. *Coorg honey dew* : Selection from honey dew (madhu Bindu) Hermaphrodite
5. *Sunrise solo* : Pink flesh.
6. *Taiwan* : Blood red colour.
7. *Surya*

(B) Diecious varieties :

1. *Pusa giant*: Suitable for tooty fruity and candies used in canning industry and have good wind resistance.
2. *Pusa dwarf*

3. Pusa Nanha– extremely dwarf, suitable for high density planting. (Pot garden)
4. CO-1 : dwarf
5. CO-2
6. CO-6 : Selection from Pusa majesty.
7. CO-5 : Cultivated mainly for papain extraction (Papain yield 1500-1600 kg/hac).
8. *Pink flesh sweet* : TSS– 12-14 Brix
9. Pant-C-1 10. Hatras gold 11. Sunny bank 13. Betty 14. Improved petersons

(C) Hybrid varieties

1. CO-3 : CO-2 × Sunrise solo
2. CO-4 : CO-2 × Washington
3. CO-7 : CO-3 × Pusa delicious × coorg honey dew

PINEAPPLE

- * Botanical Name : *Ananas comosus*
- * Family : *Bromeliaceae*
- * Origin : Brazil
- * Pineapple is CAM, monocarpic, herbaceous plant.
- * It contain enzyme– Bromelin.
- * Ethrel (Ethepon) is used for inducing flowering in pineapple.
- * Average sugar content in pineapple is 10-12%
- * Any acid content in pineapple is : 0.6–0.8%
- * Plant density of 63,400 plants/hac ($22.5 \times 60 \times 75 \text{ cm}^3$) is ideal for subtropical and mild humid condition where as 53,300 plant/hac ($25 \times 60 \times 90 \text{ cm}^3$) is ideal for tropical condition.
- * Earthing up is an essential operation in pineapple cultivation.
- * NAA and NAA based compound– Planofix and celemone @ 10-20 PPM-induce flowering in pineapple but they are less effective. So ethrel is used.
- * Fruit which mature in winter are acidic.
- * Multiple crown disorder found in cayenne group (kew).
- * Pineapple does not contain starch.
- * Sugar loaf– sweetest and best flavoured fruit.
- * *Propagation*: Slips– wt. 300-400 g
Sucker– wt. 500-750 g
- * Aluminium sulphate– best N_2 fertilizer for pineapple.

Varieties

1. Kew– leading commercial variety valued particularly for canning, late variety.
2. Giant kew 3. Charlotte rothchild
4. Queen– grown on hills, Early variety, best desert cultivar.
5. Mauritius– mid season variety of queen group, mainly grown in Kerala.
6. Jaldhup & Lakhat : Both under queen group
* Jaldhup have characteristic alcoholic flavour.
7. Cayenne– triploid variety– cultivated commercially in phillipines.
8. Carbenzona triploid variety

GUAVA

- * Botanical Name : *Psidium guajava*
- * Family : *Myrtaceae*
- * Origin : Peru
- * Guava improvement work was started in 1907 at Pune.
- * Guava- Bahar season

Bahar	Flowering	Fruiting	Quality
Ambe Bahar	Feb- March	July- Sept.	Watery, Poor
Mrig Bahar	June- July	Nov.- Jan.	Excellent
Hasth Bahar	October	Feb.- April	Good, yield low

- * Fruit bearing takes place 3 times in South India.
- * Two type of fruits, completely seedless and partly seeded are borne on the plant of seedless variety.
- * Guava harvested throughout year except May and June.
- * Chinese guava- *P. fridrichsthalianum*- dwarfing rootstock and resistant to guava wilt and nematodes.
- * High density planting reduces TSS, sugars and ascorbic acid but increases titrable acidity.
- * L-49 is more susceptible to Bronzing than Allahabad safeda.
- * Fruit quality of winter crop is best, it escapes the attack of fruit flies.
- * Practice of taking winter crop instead of rainy season crop is known as crop regulation.
- * Rainy season crop can be removed by spraying of urea (10%) on Allahabad safeda and 20% on Lucknow-49 at the time of peak flowering period.
- * UP produce-best quality Guava.
- * Vit-C content highest in fruit peel at mature stage.
- * Guava wilt is most common in Alkali soil.
- * *Dwarfing rootstock* : Anueploid-82.
- * Bending in Guava- practiced in MH.
- * *Prunning* : Above 90 cm, lateral shoots are not allowed to grow.
- * Most useful in human diet for avoiding *scury disease*
- * Rich source of pectin.

Varieties

1. *Lucknow-49 (Sardar)* : Chance seedling selection from Allahabad Safeda in 1927 in Pune by Dr. Cheema.
2. *Allahabad safeda* :
3. *Chittidar* : Fruits are characterised by numerous red dots on skin.
4. *Harijha* : Most popular in Bihar.
5. *Hafsi* : Red fleshed guava.
6. *Apple colour* :
7. *Behat coconut* : Seedless Guava
8. *Arka mridula* : Seedling selection from Allahabad safeda, soft seeded variety.
9. *Allahabad round*: Parthenocarpic variety
10. *Allahabad Surkha* : Uniform pink fruit with deep pink flesh.
11. Saharanpur seedless.
12. Nagpur seedless

13. *Arka Amulya* : Arka safeda × seedless
14. Hissar surekha
15. Lalit : 24% higher yield than Allahabad Safeda. Suitable for Jelly making.
16. Shweta : high TSS (140° Brix)

Hybrids

1. Kohir safed : Kohir × AS (Allahabad Safeda)
2. Safed Jam : AS × Kohir

* Meadow orcharding technique was developed in guava for horizontal utilization of space.

SAPOTA

- * Botanical Name : *Achras zapota*
- * Family : *Sapotaceae*
- * Origin : Mexico
- * Temperature above 43 °C during summer causes flower & fruit let drop.
- * Rootstock :
 1. Khirni (Manilkara hexandra)
 2. Adam's Apple (Manilkara kauki)
 3. Mahua (Madhuca latifolia)
 4. Mee tree (Bassia longifolia)
- * Fruit is good source of digestible sugar (12-18%)
- * Propagation of sapota by inarching using rayan as rootstock is most accepted and commercial method.
- * For uniform and rapid ripening Ethephon (1000 PPM) can be utilized at 20-25 °C.
- * Rayan rootstock of sapota is the best in respect of plant vigour productivity and longevity.
- * Softwood grafting using rayan as rootstock is best method of propagation which gives 93% success.
- * Central leader system of training is most common method in sapota.
- * Square system of planting is recommended in sapota.
- * Fruits are dipped in GA 300 PPM + Bavistein 1000 PPM solution at prepacking stage to extend shelf-life and avoid storage loss.
- * Largest producing state in India : Maharastra followed by Karnataka

Varieties

1. Kirti Bharti : Popular in Andhra Pradesh, thick skin, good transport value.
2. Cricket ball : Famous in Andhra Pradesh,
3. Kalipatti : Popular in Maharashtra.
4. Murrabba : Popular in Maharashtra.
5. CO-2 : Clonal selection from Baramasi.
6. PKM-1 : Clonal selection from Guthi—dwarf variety
7. Guthi
8. Calcutta special round
9. Oval
10. Baramasi
11. Chhatri
12. Pala
13. Pilli patti: Suitable for high density planting
14. Bangalore

Hybrids

1. CO-1 : Cricket ball × oval
2. PKM-2 : Guthi × Kirtibharti
3. PKM-3 : Kalipatti × Cricket ball
4. DSH-1 : Kalipatti × Cricket ball
5. DSH-2 : Kalipatti × Cricket ball
6. CO-3 Cricket ball × Vavivalsa, suitable for high density planting.

CUSTARD APPLE

- * Botanical Name : *Annona squamosa*
- * Family : Annonaceae
- * Origin : Tropical America
- * Ramphal– (Bullock's heart) : *Annona reticulata*– common rootstock.
- * *Lakshman Phal* : Atemoya– *Annona atemoya* (*A. squamosa* × *A. cherimola*).
- * *Hanuman Phal* : Cherimoya– *Annona cherimola* (Assam and South India).
- * Sour sap– *Annona muricata* (Largest Annona)
- * Pond Apple– *Annona glabra*.
- * Among Annonaceous fruit, custard Apple is most favourite in India.
- * Cherimoya– Prefer subtropical climate.
- * Cherimoya is considered to be best fruit of Annonaceae family.
- * Custard apple contains Sugar-20%
- * Bullock's heart is more commonly found in South India than North India.
- * Cherimoya is mostly restricted to Assam and hills of South India.
- * Most annonaceous fruits are acclimatized to tropical climate.
- * *Annona reticulata* is commonly used as a rootstock for most of the annonas.
- * Custard apple produce single crop in a year during August-October in South India and September-November in North India.

Varieties

- | | | |
|-----------------|----------------------|-------------------|
| 1. Balanagar | 2. Barbados seedling | 3. British Guinea |
| 4. Kakarlapahad | 5. Mahaboobnagar | 6. Washington |

Hybrids

1. Arka sahan– less no. of seeds (10/100g wt), high brix-31° cross between *Annona atemoya* (Island gen) × *Annona squamosa* (mammoth).
2. *African pride*– is cross between cherimoya × custard Apple.

JACKFRUIT

- * Botanical Name : *Artocarpus heterophyllus*
- * Family : *Moraceae*
- * Origin : India
- * It contain 20% of carbohydrates
- * Largest Fruit grown in India.
- * They cannot tolerate cold & frost.
- * They are considered as 'Good source of Pectin'.
- * Seeds are sown immediately after extraction.
- * Cauliflorus bearing habit.
- * Soaking seeds in 25 ppm NAA for 24 hr improves their germination and seedling growth.

Varieties

- | | | |
|-------------------|-----------------------------|-------------------|
| 1. Gulabi | 2. Champa | 3. Hazari |
| 4. Rudrakshi jack | 5. Singapore or ceylon jack | 6. Muttam varikka |
| 7. Monkey jack | | |

PERSIMMON

- * Botanical Name : *Diospyrus kaki*
- * Family : *Ebenaceae*
- * Origin : China
- * *Dispyros letus* is used as rootstock in India.
- * National fruit of Japan.
- * Brix level at time of maturity : 14 to 17%.
- * Temperature 8-11 °C for 888 hrs is enough to complete dormancy of persimmon.

Varieties

- (A) Non astringent : 1. Fuyu 2. Jiro 3. 20th century 4. Mastumoto
- (B) Astringent : 1. Hachiya 2. Nightingale 3. Triumph 4. Hiratanenashi

CARAMBOLA

- * Botanical Name : *Averrhoa carambola*
- * Family : *Oxalidaceae*
- * Origin : Indo-Malaya
- * Fruit cum ornamental tree, root extract used as antidote for poisoning.
- * Produce flower and fruits on trunk (cauliflorus in nature)
- * Two type (A) sour type : 1% acid variety-- Gold star, Icambola
(B) sweet type : 0.4% acid variety-- Golden star
- * It contains oxalic acid.
- * Propagation-- By seeds.

CITRUS GROUP

(A) Mandarin

- * Botanical Name : *Citrus reticulata*
- * Family : *Rutaceae*
- * Origin : China
- * Mandarin occupies 50% area under citrus spp.
- * Seeds of citrus don't have dormancy so they should be sown immediately after extraction.
- * Blooming—three time in a year
 - (A) *February flowering* : Ambe bahar
 - (B) *June flowering* : Mrig bahar
 - (C) *October flowering* : Haste bahar
- * Mandarins are highly susceptible to water logging.
- * *Rootstock for HDP*—Troyer citrange ($1.8 \times 1.8 \text{ m}^2$)
- * *Best time for Pruning*—Late winter or early spring.
- * Mandarin, sweet orange, Acid lime, grape fruit : Highly polyembryonic
Pummelo, Tahiti lime, Citron : Monoembryonic
- * Rangpur lime— most promising rootstock for mandarin and sweet orange.
- * *Rootstock*— Adajamir [*C. assamensis*] are resistant to Greening.
- * Citrus fruits have a special kind of fruit skin referred as 'leathery rind'.
- * Citrus is micro-nutrient loving plant.
- * Trifoliolate orange-resistant to phytophthora and nematodes.
- * Limolin-glycoside is responsible for bitter taste of citrus fruit Juice.
- * Kinnow variety of citrus was developed by H.B. frost in USA in 1935.
- * Kinnow was introduced in India in 1959.
- * Nagpur mandarin was introduced in India in 1894 by Shuji Raja Bhosle.
- * Irrigation requirement of mandarin is higher than other citrus species.
- * Kinnow can be grown in high density planting by using 'Troyer citrange' as a rootstock by spacing the plants at $1.8 \times 1.8 \text{ m}^2$ (3000 plants/hac)
- * Weeds are serious problem in nursery. So, bromocial is most effective weedicide in controlling monocot and dicot weed.
- * State with highest production of citrus in India is Andhra Pradesh followed by Maharashtra.

Varieties

1. *Coorg* : Most important commercial variety in South India.
2. *Khasi* : Locally known as Sikkim or kamla mandarin.
3. *Nagpur (Ponkan)* : Finest mandarin in the world. Grown in Satpuda hills in Maharashtra.
4. *Satsuma (seedless)* : Commercial mandarin of Japan.
5. *Emperor and Fuetrelles* : Introduction from Australia.

6. *Sutwal* : Introduction from Nepal.

7. *Laddu*

Hybrid

Kinnaw : King × willow leaf

(B) Sweet Orange

- * Botanical Name : *Citrus sinensis*
- * Family : *Rutaceae*
- * Origin : China
- * Preharvest fruit drop is common in citrus. It is due to
 - (a) Physiological factors
 - (b) Pathological factors
- Control measure**-spray of 2, 4-D (20 PPM), Most prone variety mosambi & Blood Red.
- * Degreening of citrus fruits is done by CaC_2 (calcium carbide)
- * Best time for pruning— late winter or early spring.
- * Sweet orange is susceptible to water logging and phytophthora rot, so water stagnation in orchard should be avoided.
- * Double ring method-best for irrigation.
- * Defecieincy of zinc along with N_2 is major nutritional problem of sweet orange.
- * Pineapple and Valencia-indicator of greening.

Varieties

1. *Hamlin* : early variety
2. *Pineapple* : mid season variety
5. *Mosambi* : Most popular in Maharashtra, Best rootstock— Rangpur lime
6. *Satgudi* : Most popular in Andhra Pradesh, Best rootstock— Rough lemon.
7. *Blood red* : Most popular in North India Best rootstock— Karnakhatta, Jatti khatha.
8. *Shamouti* : Seedless variety
9. Washington navel
10. Batavin
11. Mudkhed-Bud mutant of Nagpur mandarin.

(C) Lime & Lemons

- * India rank 5th among major lime and lemon producing country in the world.
- * *Sweet lime* : *Citrus limetoides*, Native-India, self incompatible.
- * *Tahiti lime* : *Citrus latifolia*— seedless triploid.
- * *Rangpur lime* : *Citrus limonica*, native-India
- * *Pummelo* : *Citrus grandis* (largest fruit), self incompatible.
- * Kagzilime is the indicator plant for tristiza and it is highly susceptible to this disease.
- * Citrus cankar is most serious disease of acid lime.
- * Acid-lime is tropical plant.
- * Lemons are divided into 4 groups : 1. Eureka 2. Lisbon 3. Anamalous 4. Sweet lemon.
- * Gajanimma (*Citrus Pennivesiculata*) is most promising rootstock followed by rough lemon for acid lime.

* Sweet lime contain– non acid Juice.

* Sweet lime is resistant to greening.

(i) Acid lime/kagzi lime varieties

1. *Pramalini* : Canker tolerant
2. *Vikram*
3. *Chakradhar* : Seedless variety of Acid lime.
4. *PKM-1* :
5. *Sai sarbati* : Tolerant to tristiza and canker.
6. *Jai devi* : Pleasant Aroma.

(ii) Sweet lime Varieties

1. *Mitha chikna*
2. *Mithotra*

(iii) Lemon Varieties

1. *Eureka*
2. *Lisbon*
3. *Villafrance*– belong to Eureka group.
4. *Lucknow seedless*
5. *Kagzikalan*
6. *Nepali oblong*
7. *Nepali round*
8. *Pant lemon-I-self incompatible.*

(D) Grape Fruit

* Botanical Name : *Citrus paradisi*

* Family : Rutaceae

* Grape fruit is also known as forbiddin fruit, break fast fruit.

* Citron– Persian apple.

* Citron– glucoside present-Hesperidin.

Varieties

1. *Duncan*
2. *Marsh seedless*
3. *Foster*
4. *Red Blush*
5. *Triumph*
6. *Sharanpur special*
7. *Thompson*
8. *Star ruby* : From Hudson grape fruit through mutation breeding.

* Classification of citrus was given by Tanka & Swingle (1945).

* Spain is largest exporter of citrus.

* Ultra dwarf rootstock of citrus : Flying dragon.

* Fruit ripening : 9 month after planting.

* Sikkim is the only place where mandarin are packed in wooden boxes.

GRAPE

- * Botanical Name : *Vitis vinifera*
- * Family : Vitaceae
- * Origin : Black to Caspian sea
- * Skin of grape berry is covered with wax like layer which is called as cutin.
- * **October** : Ideal time for planting.
- * Fe deficiency is very common in black soil.
- * Thompson seedless variety with its clone occupies 55% area under grape cultivation.
- * Rains during ripening causes berry cracking and rotting.
- * Pruning— North India— once – winter season (December-January).
South India – twice – I. April – Back or foundation pruning
II. October – Fruit or Forward pruning.
- * Bower system of training is mostly adopted in India. (High economic ratio). Cost benefit ratio = 1 : 2.09
- * Mg deficiency is universal in Grape.
- * **Growth regulators** :
 1. CCC : For suppressing vigour of vine & increase fruit-fullness of bud.
 2. GA₃ : For increasing berry size.
 3. HCN : To hasten bud break at winter pruning.
 4. NAA (50 PPM) : To reduce post harvest fruit drop.
 5. MH : For induction of male sterility.
- * Pink berry formation is common problem in Thompson seedless and its clone.
- * Average productivity of Grape in India (16.95 t/hac) Highest in the world.
- * Pruning intensity lowest (3-4 bud) in Bangalore blue, Bokhri.
- * Pruning intensity highest (10-14 buds) in Thompson seedless.
- * Calyptra a cap like structure of grape formed as a result of union of sepals and petals.
- * Highest mean bunch weight + Berry weight is obtained under bower system of training.
- * Berry drop in Grape due to defective and improper pollination and fertilization.
- * Pink pigmentation develops in green grapes, if the diurnal differences are more than 20 °C during ripening.
- * *In nematode prone soil* : (rootstock) rootstock-1613 can be used for Anab-a-shahi and TS. (Thompson seedless)
- * In saline soil-dogridge is better.
- * For Thompson seedless, the spacing of 1.8 × 2.5 m² is ideal for bower system.
- * For Thompson seedless, the spacing of 1.8 × 3.0 m² is ideal for 'y' trellies system.
- * Raisins are only processed product in India.
- * Dipping berries in Soda oil containing ethyl oleate + K₂CO₃ and shade drying is most common method of preparing raisins in India.
- * Fruit-multiseeded berry.
- * *Queen of wineyard, Pusa seedless are used as Male parents to transmit seedlessness in progeny.*
- * H.D. Olmo— Grape Breeder.
- * Kishmish Beli— Outstanding raisin grape cultivar.
- * Substance responsible for aroma in grapes is methyl anthranilate (muscat flavour).
- * Tartaric acid is commercially extracted from grapes.
- * Dogridge and 110 R are tolerant to drought and salinity.

Varieties

Thompson seedless is the ruling grape variety which occupies 55% of the area with its clone.

- (A) Coloured seeded : Bangalore blue, Gulabi (muscat), Kishmish chorni.
 (B) Coloured seedless : Beauty seedless, sharad seedless.
 (C) White seeded : Anab-a-shahi, Dilkhush.
 (D) White seedless : Perlette, Pusa seedless, Tas-A-Ganesh, Sonnaka, Manik chaman.

Clone	Parent	Hybrid	Parents	Character
1. Pusa seedless	TS	1. Arkavati	Black champax TS	Good for raisins, Seedless variety
2. Tash-A-Ganesh	TS	2. Arka Neelmani	BC × TS	Good for Red wine
3. Manik chaman	TS	3. Arka krishna	BC × Queen of vineyard	Juice
4. Sonnaka	TS	4. Arka Hans	Banglore Blue × Anab-A-Shahi	White wine
		5. Arka Shyam	BB × BC	Double cropping
5. Dilkhush	Anab-A-Shahi	6. Arka Trishna	BB × Convent large black	Wine
6. Rao sahebi	Cheema Sahebi	7. Arka Shweta	Ana-A-Shahi × TS	Table
7. Cheema	Pandari	8. Arka Majestic	AS × BC	Table
Sahebi	Sahebi	9. Arka Chitrah	Angoor kalan × AS	Table
9. Sharad	Kishmis	10. Puva Urvashi	Hur × beauty seedless	Tolerant to Anthracnose
Seedless	Chorni	11. Pusa Navrang	Madeline angavine × Ruby Red	Tenturier

TS : Thompson seedless ; BC : Black champa ; BB : Bangalore blue ; AS : Anab-a-Shahi

- * *Arka Kanchan* : Late maturing variety
- * TSS of TS : 22-24%, Juice-69%
- * Kishmish, Black Hamburg, Black prince, Foster seedlings, Delight, Perlette, Bhokri, Champion
- * *Cane pruned varieties* : 1. Gulabi 2. PS 3. Kismis charini 4. T.S.
- * *Spur pruned varieties* : 1. BB 2. BS 3. Bhokri 4. Delight 5. Perlette
- * Raisin- dried seedless grape. They should not have more than 17% moisture.
e.g. Pusa seedless, TS, sultana.
- * *Rootstocks* : (i) *Dogridge*- Resistant to nematode, salt, phylloxera.
(ii) *1613*- Resistant to nematode, Phylloxera.
(iii) *Salt creek*- Resistant to nematode, salt.
(iv) *Temple*- Resistant to Pierce's disease.
- * *Shot berries*- Perlette - cause-B deficiency + Poor pollination.
- * *Stem girdling* : Removal of 5 mm wide ring at full bloom stage.
- * Grape gaurd-craft paper coated with KMS and plastic polymer.
- * Muscat flavour of grape-methyl anthranilate.
- * Delight and perlette varieties were evolved by H.P. Olmo.

LITCHI

- * Botanical Name - *Litchi chinensis*
- * Family : Sapindaceae
- * Origin : China
- * Single seeded nut Vit. C-40-90 mg/100 g
- * Air layering is called "Marcottage" in China and "Gootee" in India.
- * Rootstock- *Litchi philippinensis*.
- * IBA (2-10 g/lit of water) is most effective in root promotion in air layering of litchi.
- * Largest producer of litchi-China
- * Leading state of India in litchi production-Bihar
- * Shahi- suitable for canning.
- * Flowers are petalless.
- * Subtropical evergreen fruit tree- prefer moist climate.
- * Moist summer and cool winter favour litchi production.
- * Dry hot wind in summer-Fruit cracking. Spray with boron reduces cracking.
- * Red pigment-Anthocyanin.
- * Pulp is out growth of the seed in litchi.
- * Roots- Mycorrhizal association.
- * Litchi plants grow luxuriantly at 30°C.
- * Swaran roopa is grown commercially in Chootanagpur area.
- * The most common and easiest method adopted all over the world is air layering.
- * July-October is most appropriate time for propagation.
- * January end to the onset of monsoon in critical period for irrigation in litchi.
- * Harvesting of litchi is usually done in May and June.
- * India rank second in litchi production.
- * Wet spring, dry summer and light winter are desirable conditions for fruiting in litchi.

Varieties

1. Early seedless (Early Bedana) Table & Processing purpose variety
2. Rose scented
3. Dehradun
4. Gulabi
5. Calcutta (Kolkatta)
6. Purbi
7. Shahi-Table purpose variety
8. Kasba
9. Bombai
10. Late seedless (Late Bedana)
11. China
12. Desi
13. Swaran roopa : early, non cracking seedless variety
14. China-table purpose variety
15. Elachi-table purpose variety
16. Lath large red (Muzaffarpur)
17. Maclean
18. Bvewster

POMEGRANATE

- * Botanical Name : *Punica granatum*
- * Family : Punicaceae
- * Origin : Iran
- * Bahar treatment is followed in pomegranate.
- * More incidence of fruit cracking (Internal break down) takes place in mrig bahar season.
- * Daru-wild type.
- * Amlidana– New pomegranate hybrid. It is a cross between Ganesh × Nanha. Dwarf, suitable for HDP, TSS-12.6 °C Brix, released by IIHR.
- * Wood younger than 6 months and older than 18 months is unsuitable for cutting.
- * Multistem training system is followed in India.
- * It is considered to be highly drought tolerant.
- * Anti-transpirants such as 10% kaolin, 10⁻⁵ m phenyl mercuric acetate, 1.5% power oil, 1% liquid paraffin is beneficial for increasing its productivity.
- * Juice of pomegranate is useful for patient suffering from leprosy.
- * Summer crop maximum demand.
- * Pomegranate is cultivated commercially in Maharashtra.
- * Root treatment with 3000 ppm IBA gives maximum survival.
- * July-August is ideal time of planting in tropics.
- * Anti transpirants (10% Kaolin, 10⁻⁵ phenyl mercuric acetate, 1.5% power oil 1% liquid paraffin) increases fruit productivity.

Varieties

- | | | |
|--|---------------------|-----------------|
| 1. Paper shelled | 2. Muskati red | 3. Spanish Ruby |
| 4. Alandi | 5. Karadi | 6. Muskat |
| 7. Madhugiri | 8. Bassein seedless | 9. Dholka |
| 10. Jalore seedless | 11. Chawla | 12. Nabha |
| 13. Country large red | | |
| 14. <i>Ganesh</i> (GBI) : Selection from Alandi, it has revolutionized cultivation of pomegranate in Maharashtra | | |
| 15. <i>G-137</i> : Clonal selection from Ganesh. | | |
| 16. <i>P26</i> : Seedling selection from muscat. | | |
| 17. <i>Mridula</i> : Ganesh × Gul-a-Shah red | | |
| 18. <i>Jyoti</i> : Bassein seedless × Dholka | | |
| 19. Arakta | | |

Hybrid

1. **Ruby** : Ganesh × Kabul × Yercaud.
- * *Softseeded var* : 1. Jyothi 2. Ganesh 3. Bassein seedless 4. Paper shell
- * *Hardseeded var* : 1. Khandhari 2. Alandi

FIG

- * Botanical Name : *Ficus carica*
- * Family : Moraceae
- * Origin : West Asia
- * Ficin-active compound present in Fig.
- * *Ficus glomerata* (Gular)– Resistant to Nematode.
- * Notching is practiced in Poona fig for activating dormant buds.
- * About 90% of the fig, produced in the world, are dried.
- * Pruning is done in month of December.
- * Fig have highest fibre content among fruits.
- * Fig has nutritive index 11 as against 9, 8 and 6 for apple, raisin and date respectively.
- * Fig has been classified into 4 groups.

1. Edible fig	2. Smyrna Fig	3. San Pedro Fig	4. Wild capri fig
Long styled pistillate flower	Long styled pistillate flower	—	Short style pistillate flower
1. Poona Fig	Calimyrna	1. Dauphine	1. Samson
2. Conardia	Zidi	2. Lampeiria	2. Stanford
3. Mission	Taranimt	3. King gentile	3. Brawley
4. Kadota		4. San Pedro	
5. Brown turkey			

- * Poona fig is most popular cultivar grown in India. ($5 \times 5 \text{ m}^2$).
- * Excel and conardia-suitable for high density planting (Spacing : $2.5 \times 2.5 \text{ m}^2$)
- * Conardia– For drying purpose
Excel– For canning purpose
Deanna– For table purpose.
- * Excessive irrigation or heavy rains during ripening result in fruit cracking and production of insipid fruits.
- * Fig is one of the 1st fruit preserved by drying.
- * San pedro fig is intermediate between common fig and smyrna fig.
- * Common fig is grown parthenogenetically which doesn't require caprification.
- * *Ficus carica* is gynodioecious spp.
- * Capri fig is monoecious spp.
- * Common fig is pistillate.
- * Rich in sugar next to dates
- * Salt and drought resistant crop.
- * It is a soft fruit with purple or green skin and lot of small seeds inside.

Varieties

- | | | |
|--------------|-----------------|---|
| 1. Merselies | 2. Black Ischia | 3. Kabul |
| 4. Bangalore | 5. Lucknow | 6. Dinkar– improvement over Daulatabad. |

AONLA

- * Botanical Name : *Emblica officinalis*
- * Family : Euphorbiaceae
- * Origin : Indo-China
- * Time of fruit bud differentiation (FBD) in Aonla is March-April.
- * Trifla and chavan-prash are well known indigenous medicine in Ayurvedic system using Aonla.
- * Training : Modified central leader system.
- * Irrigation should be avoided during flowering (mid March-mid April).
- * Pruning is done during March-April (height 0.75-1 m).
- * Aonla is deciduous tree with deep rooted and sparse foliage.
- * Bearing—3rd year after planting.
- * Vitamin C content of Aonla is 600 mg/100 gm of edible portion.
- * Heavy frost during winter is not suitable for its cultivation.
- * Most commonly propagated through patch/modified ring budding in North India during Mid May to September.
- * In aonla orchard, ber, guava and lemon are ideal filler plants.
- * Aonla being a deep rooted, deciduous tree with sparse foliage is an ideal plant amicable for 2 or 3 tier cropping system.
- * Self incompatibility is found in aonla varieties
- * Large sized, sound fruits are mostly utilized for preservation and candy.
- * Necrosis-physiological disorder is observed in aonla varieties.

Varieties

1. *Banarasi* : early maturity, Best cultivar for muramba.
2. Francis (Hathihool)— suffers from severe incidence of fruit necrosis.
3. Chakiya— Alternate bearer, free from necrosis.
4. Kanchan (NA-4) : Seedling selection from chakiya, Regular Bearer.
5. NA-6 : Seedling selection from Chakiya, ideal for candy.
6. NA-7 (Amrit) : Seedling selection from Francis, Ideal for preparation of products.
7. NA-9 (Neelum) : Early maturing, selection from Banarasi.
8. NA-5 (Krishna) : Seedling selection from Banarasi.

AVOCADO

- * Botanical Name : *Persia americana*
- * Family : Lauraceae
- * Origin : Mexico
- * Avocado is a dense and evergreen tree can grow about 80 feet height.
- * Origin: Southern Mexico.
- * Fruit of New world
- * Single seeded berry, Fat-24-26%, Sugar 1%, Rich in K, Fe, vitamin B:
- * It's energy value is twice as much as Banana fruit.
- * Most leading avocado cultivar in the world- Fuerte.
- * Avocado are classified into 3 distinct horticultural races-
 - (A) *Mexican*- Gotfried, Duke, Pernod.
 - (B) *West Indian*- Pollock, Simmonds, Black Prince, Fushsia, Peterson, Waldin.
 - (C) *Guatemalan*- Taylor, Linda, Queen, Benit.
- * Duke seedlings are resistant to root rot and cold hardiness.
- * Important salad fruit
- * Pollock- can overcome salinity problem.
- * Girdling of alternate bearing varieties increase the yield.
 - Indian- varieties :
 - (1) Green (Guatemalan type)- Oval shape fruit
 - (2) Purple (West Indian type)- Pear shape fruit.
- * In India, it is grown in the hill slopes of Nilgiris coastal region of Karnataka, Kerala and Maharashtra.
- * Fruits are harvested in August-September in South India.
- * Commonly recommended spacing of avocado is 7 × 7 m.
- * Since the fruit contain not more than 1% Sugar, it is recommended as high energy food for diabetics.
- * Intake of Avocado improves cholesterol levels in human body.

Hybrid :

1. Furete- Mexican × Guatemalan, alternate bearer

DATE PALM

- * Botanical Name : *Phoenix dactylifera*
- * Family : Arecaceae
- * Origin : West Asia
- * Date contains 75-80% carbohydrates in form of invert sugars
- * Single seeded berry.
- * In India-Date is harvested at Doka stage.
- * In other countries date is harvested at Dang stage.
- * Metaxenia is common in Date palm.
- * Fruits for fresh eating are preferred at Dang stage.
- * Drink of Date palm is known as 'Dibbis'.
- * Liquor prepared from date palm is 'Arrack', popular in Iraq.
- * Developmental stage of Date
 - I. Hababouk
 - II. *Gandora or chirmi* : Fully grown, Hard, yellow in colour.
 - III. *Dang or Rutab* : Softening.
 - IV. *Pind or Tamer* : Fully ripe and dehydrated.
- * One kg fully ripe fresh dates provide approximately 3150 calories.
- * It is said that— "Its feet in running water and its head in the fire of the sky".
- * 10% male should be raised in orchard to provide adequate pollen grains.
- * Time of leaf pruning : June
- * Ethephon is an effective fruit thinning agent.
- * Date harvested at doka stage have 70-80% moisture.
- * Doka fruits are successfully processed to prepare chuhara.
- * Exploitation of metaxenia— to induce earliness improvement in quality.
- * Khadrawy and medjool developed by somatic embryogenesis.
- * Trailer mounted palm duster is used for pollination.
- * A fine date variety requires 3300 units of heat for full maturity.
- * Date juice suitable varieties : Zagloul, Hayani.

Varieties

1. Chuhharah making : Khadrawy, medjool, sharan.
2. Fresh eating : Halawy, Barhee, Khalas, Sevi, Khunezi.
3. Zahidi : Pind khajoor (soft dates)
4. Sharan : Uneven-ripening.

- Type
- (A) *Bread type dry date* : Thoory
 - (B) *Cane sugar date (semi dry date)* : Dayari, Deglet Noor, Zahidi.
 - (C) *Invert sugar date (soft date)* : Halawy, Khadrawy, Barhee, Medjool.

BER

- * Botanical Name : *Ziziphus mauritiana*
- * Family : Rhamnaceae
- * Origin : China
- * Best time for pruning : End of May-Middle June.
- * Ber is extremely drought hardy.
- * Spraying of 3% thio-urea or KNO_3 once in 2 days before pruning induces bud sprouting from maximum no. of nodes.
- * Irrigation during October causes flower shedding and that during March-April causes fruit spoilage and delays ripening.
- * Sanuar 2 : resistant to powdery mildew.
- * Dodhia : resistant to fruit fly.
- * Ber also shows strong self incompatibility (Gametophytic)
- * *Ziziphus nummularia*— dwarfing rootstock for high density planting.
- * Illaichi— 90% pollen sterility.
- * Umran : Originating from Rajasthan, processed and used as 'chuhara'.
- * Goma kirti (Ganesh kirti) : Selection from umran, early variety.
- * Maturity : 150-175 Days after flowering.
- * Storage temperature : 3 °C + 85-90% RH
- * Most common method of propagation of ber is I or T budding (shield)
- * Beginning of monsoon is best time for planting .
- * Training -Ideal time is March.
- * Pruning is done during the hot and dry season between April end to May end.
- * In South India, the fruits are harvested during October-November, in North India during February-April.
- * Pre harvest spray of 750 PPM Ethephon at colour turning stage induces early maturity.

Varieties

- (A) Extremely dry area-early maturing varieties : Gola, Seb
- (B) Dry Area- Late maturing varieties: Umran, Illaichi.
- (C) Humid area : Mehrun.
- (D) Mid maturing varieties: Rashmi, Mundia, Banarasi

BAEL

- * Botanical Name : *Aegle marmelos*
- * Family : Rutaceae
- * Origin : India
- * Unripe or half ripe fruit contains 31.3% - 31.8% carbohydrates, 1.8% proteins and 2.9% fibre.
- * Other names: Bengal quince, Indian quince, Golden apple.
- * Richest source of Vit-B₂ (Riboflavin)
- * Marmelosin— Active ingredient present in Bael, extracted from bark.
- * Leaves are used to offer 'Lord Shiva'.
- * Vars: Kagzi Gonda, Kagzi Etawah, Kagzi Banarasi, Mitzapuri.
- * Mature green fruits are ideal for harvesting.
- * It can withstand sodicity upto 30 ESP and salinity upto 9 EC.
- * Ripe fruits are used for beverage making, hence they should be harvested at ripe stage.
- * Storage temperature : 9°C + 85-90% RH.
- * Mature green or raw fruits are most suitable for making preserve.
- * It is a sacred tree for Hindus.

JAMUN

- * Botanical Name : *Syzygium cumunii*
- * Family : Myrtaceae
- * Origin : Indo-Malaya
- * Budding is the most common method of propagation.
- * Syzygium jambos— Rose Apple or Gulab Jamun.
- * Vars : 1. Raj Jamun 2. Paras (Large size) 3. Narendra Jamun-6 (Seed less).
- * Generally grown as Avenue or as wind break.
- * Good source of Iron, used as an effective medicine against diabetics, heart and liver trouble.
- * *Syzygium densiflora* rootstock of Jamun resistant against attack of termites.
- * The most common type grown in North India is known as Raj jamun.
- * Seeds of jamun have no dormancy, hence fresh seed can be grown.

KARONDA

- * Botanical Name : *Carrisa carandus*
- * Family : Apocynaceae
- * Origin : India
- * *Carrisa grandiflora*— Natal plum.
- * Richest source of Iron.
- * Karonda behave as a Xerophyte plant.
- * Type (A) Green fruited (B) White fruited (C) Dark purple fruited
- * Variety-maroon
- * Fruit have antiscorbutic property and useful for care of anaemia.
- * *Carrisa ovata*-Jam preparation
- * *Carrisa edulis* : scented flowers.

KIWI FRUIT

- * Botanical Name : *Actinidia deliciosa*
- * Family : Actinidaceae
- * Origin : China
- * Native to Southern China.
- * Largest producing countries are Italy and New Zealand.
- * National symbol of New Zealand.
- * Hayward– most popular cultivar of the world.
- * It is a deciduous vine.
- * It was first planted in the Lal Bagh Garden at Bangalore.
- * T-bar or Pergola is adopted for planting.
- * Also known as Chinese gooseberry.
- * Varieties :
 1. Abbott 2. Allison (male) 3. Bruno 4. Monty 5. Tomuri (male) 6. Hayward 7. Skelton
- * Rich source of vitamin C.
- * Skin is good source of flavonoid antioxidant.
- * Major disease- crown gall.

LOQUAT

- * Botanical Name : *Eriobotrya japonica*
- * Family : Rosaceae
- * Origin : South China
- * Subtropical, evergreen, pome fruit.
- * It was introduced in India under the name of 'Japanese Medlar'.
- * *Mid varieties* : 1. Fire ball 2. Large agra 3. Mammoth 4. Matchless 5. Safeda 6. Large round
- * *Early varieties* : 1. Golden yellow 2. Pale yellow 3. Thames pride
- * *Late varieties* : 1. California advance 2. Tanaka
- * California advance, Golden yellow and Thames pride should be harvested at 11% TSS.
- * It is available in market during mid March-May
- * There is self unfruitfulness in loquat varieties.
- * The variety California advance is the best pollinizer for improved golden yellow.
- * Air layering is the best method of propagation.
- * Monsoon is the best time for planting.
- * Frost is the limiting factor for its cultivation.
- * Application of Paclobutrazol (500 PPM) around the base of trunk is recommended for increased fruit size.
- * Leading producer: Japan followed by China.
- * Loquat is high in vitamin A, potassium and manganese.

APPLE

- * Botanical Name : *Malus domestica*
- * Family : Rosaceae
- * Origin : Asia minor to Western Himalayas
- * Liberty variety of Apple is resistance to all fungal diseases.
- * Flower colour : White to Pink.
- * Apple is most widely grown temperate fruit in the world.
- * India-rank 11th in Apple production in the world.
- * Apple account 55% of total area and 75% of total production of temperate fruits in the country.
- * Apple is typical temperate fruit.
- * HP is known as "Apple bowl of India".
- * Almost all varieties have a chilling requirement of 1000 hours at or below 7.2 °C temperature.
- * In India, 11 to 33% pollinizing trees are recommended for regular cropping.
- * There are usually 6 size grades of Apple.
- * Early fruit drop— due to lack of pollination and competition.
- * June drop— due to moisture stress and environmental conditions.
- * Preharvest drop— due to development of Abscission layer, formation of ethylene.
- * Scarlet gola, Red fuji : High yielding varieties.
- * San Jose scale got it's entry into India from France in 1906.
- * Optimum temperature for pollen germination and fruit setting is 21.1 – 26.7 °C.
- * Cider-fermentated wine prepared from Apple.
- * J & K is leading apple producing state.
- * Average Summer temperature should be around 21-24 °C during active growth period.
- * Most critical period for water requirement : April-August.
- * Thomas Andrew knight produced the 1st Apple cultivar.
- * Pruning in apple is essential to maintain balance between vegetative growth and spur. develop-ment.
- * Early varieties experience 40-60% loss.

Rootstock

- (A) Seedling : Crab apple – *Malus baccata* - most commonly used rootstock in India.
- (B) Clonal :
1. M-9 : dwarf— suitable for high density planting.
 2. M-4, M-7 and MM-106— Semi dwarf— suitable for high density planting, Resistant to woolly Apple aphids.
 3. MM-111 : Semi vigorous : Resistant to woolly Apple Aphids, Resistant to drought.
 4. Merton-793 : Vigorous : Wooly Aphid resistant.
 5. M-27 : Ultradwarf : (M-13 × M-9).
 6. MM-104 : Most winter hardy clonal rootstock.
- * Commercial method of propagation of rootstock— stooling
 - * EMCA series of rootstock resistant to virus.

Varieties

- (A) Early : 1. Tydemans early 2. Irish peach 3. Benoni 4. Fenny 5. Early shanburry.
- (B) Mid : 1. Red delicious 2. Richard 3. Top red 4. Lord lambourne (P) 5. Red chief 6. Red gold 7. American mother 8. Jonathan 9. Rome beauty 10. Razakwar 11. McIntosh 12. Cortland 13. Golden delicious.
- (C) Late : 1. Yellow newton 2. Winter banana 3. Granny smith 4. Lal Ambri 5. Rymer 6. Buckingham.
- * Akbar--New Apple cultivar, cross of Ambri × Cox orange pippins.
 - * **Green English varieties:** 1. Baldwin 2. COX's orange pippin 3. Black bendavis 4. Pippins
 - * **Spur type :** 1. Stark-crimson 2. White spur 3. Red chief
 - * **Standard colour mutant :** 1. Top Red 2. Skyline supreme 3. Hardiman
 - * Scarlet gala, Red fuzi, maharaji
 - * **Scab resistant varieties :** 1. Prima 2. Priscilla 3. Sir prize 4. Jonafree 5. Florina 6. Macfree 7. Nova easy 8. Red free 9. Nova mac 10. Liberty 11. Freedom 12. Firdous 13. Shireen, 14. Florina (France),
 - * **Low-chilling varieties:** 1. Michel 2. Schlomit 3. Anna 4. Tamma 5. Vared 6. Neomi 7. Tropical beauty 8. Parlin's beauty : suitable for processing
 - * **Crab variety :** Red flush, Crimson gold, Yellow drops, Nodrift

Hybrid

1. **Lal Ambri :** Red delicious × Ambri
 2. **Amb Red :** Red delicious × Ambri
 3. **Amb starking :** Starking delicious × Ambri
 4. **Ambroyol :** Royal delicious × Ambri
 5. **Amrich :** Rich-a-Red × Ambri
 6. **Sunheri :** Ambri × Golden delicious
 7. **Chaubattia princess :** Red delicious × Early shanburry
 8. **Chaubattia anupam :** Red delicious × Early shanburry.
- } Mainly grown in Himachal Pradesh
- } Mainly Grown in Jammu & Kashmir
- * Golden delicious, Yellow newton, Northern spy, McIntosh : Good seed viability.
 - * Delicious group of varieties are self-incompatible and cross pollinated.
 - * English varieties are self pollinated and act as suitable pollinizer for delicious group.
 - * Red delicious-- most popular variety of India.
 - * Red Gold-act as pollinizer for Red delicious and starking delicious.
 - * Golden delicious-- commercial variety of USA and Europe.
 - * McIntosh leading variety of Canada.
 - * Ambri : Indigenous variety grown in Kashmir and it have longest storage life.
 - * Rymer : Indigenous variety grown in Kashmir.
 - * **Triploid cultivars :** 1. Baldwin 2. Gravenstin 3. Winesap.
 - * **Northern spy :** Resistant to wooly apple aphids.
 - * Seeds stratification at 4-7 °C for 60-90 days.
 - * Scions cannot be used for grafting at their active stage of growth.
 - * **Meadow orcharding :** 20,000-70000 plants/ha (super high density).
 - * **Bitter pit of apple :** Golden delicious, yellow newton
 - * **Internal browning :** Yellow Newton
 - * Ambri possess long keeping quality but biennial in bearing.

Exotic Varieties

Country	Table Purpose	Processing Table's	Progressing Table's
Italy	Golden Delicious, Braeburn, Mongendy, Lonas Gold, Gloster, Jonathan, Fuji, Pink Lady, Red delicious, Granny.	Spackle Geala.	—
USA	Golden Delicious, Granny Smith, Gala Sales, Fuji, Washington, Red Delicious, Empire Liberty, Jonathan.	Delicious, Rome Beauty, York Imperial, Stayman winsap, Northern Spy, Rhode Island, Greening, Prize, Freedom, Redfree.	McIntosh, Cortland, Grany-Smith, Redfree.
Hungary	—	—	Delicious, GoldenLi, Wellspur-Delicious.
Germany	—	—	Gloster, Tonagold.
France	Colapters, Cabarett, Rainette, De Flandres	—	—
China	—	—	Bolero, Maypole, Polka, Walts
UK	MacIntosh, Empire	—	—

PEAR

- * Botanical Name : *Pyrus communis*
- * Family : Rosaceae
- * Origin : Europe
- * Willo leaf pearl (*Pyraus Salicifolia*) is frost, draught and salt resistant root stock.
- * European/common/soft pear-*Pyrus communis*.
Japanese/oriental/Hard pear- *Pyrus pyrifolia*.
- * Perry- Wine prepared from Pear.
- * Mehal/Kainth (*Pyrus pashia*) and shaira (*Pyrus serotina*) are important rootstock of pear.
- * Old home or Beurre hardy used as interstock between Bartlett and Quince.
- * Quince-C : dwarfing rootstock for pear.
- * Chilling requirement- 1,200 hrs
(A) Bartlett : 1500 hrs (B) Patharnakh : 150 hrs.
- * Spring frosts are detrimental to pear production and tempeature at -3.3°C or below kills the open blossoms.
- * Quince-A is most commonly used rootstock producing trees of 50-60% of standard size.
- * Training-modified central leader method.
- * Cultivars grown on hills are partially self fruitful and require pollinizer-planting to be done every forth tree in every 4th row as pollinizers are adequate.
- * For active growth of pear, soil depth should be 180 cm.
- * Bartlett is famous for dry pear slices.

Varieties

There are categories in 3 groups (A) European (B) Asian (C) Hybrids

- (A) European : 1. Bartlett : (Baggughosha) : Interspecific hybrid variety.
2. Flemish beauty : Self fertile, good pollinizer
3. Starkimson delicious 4. Anjou 5. Max red Bartlett.
6. Comice 7. Winter Nellis 8. Dr. Jule's Guyot
9. Laxton's superb 10. Fertility.
- (B) Hybrids & (C) Asian type :
11. Kiffer-cross between French pear \times oriental pear self fruitful, processing suitability, can be grown in south India.
 12. Leconte-low chilling variety
 13. Patharanakh (Sand pear), self pollinated variety-low chilling variety.
 14. Gola-low chilling variety
 15. China pear
 16. Vars. Free from Grit cell : 1. Flemish beauty 2. Magness.

Punjab variety : 1. Red blush 2. Punjab gold 3. Punjab nectar.

* High N_2 is not suitable : because incidence of pear psylla and fire blight is more.

* Premature ripening : Pink colouration near blossom end. It is due to-

Night temperature $< 7.1^{\circ}\text{C}$ day temperature $> 21^{\circ}\text{C}$

PEACH

- * Botanical Name : *Prunus persia*
- * Family : Rosaceae
- * Origin : China
- * Flower colour : Pink,
- * Regular pruning is required for getting fruits.
- * **Prunus behmi** : A natural hybrid of Almond × Peach.
- * Fruits have TSS about 8-13° Brix.
- * Prunacin is the principle glycoside present in pulp of peach.
- * Among temperate fruits, peach has lowest chilling requirement and earliest in flowering.
- * Swelling buds injured at -6.5°C.
- * Tatura trellies system of high density planting is followed in peach.
- * Mild winter (December-January) is the best time for pruning in peach.
- * **Rootstock** : 1. Nemaguard-Resistant to root knot nematode.
2. Myran : tolerant to drought. Poor soil, root knot nematode and verticillium wilt.
- * Fruiting takes place laterally on previous seasons growth.
- * Blooming period can be delayed by the Application of GA₃ (200 PPM) before leaf fall or by Application of ethephon to avoid risk of spring frost.
- * Peach is very susceptible to Fe deficiency.
- * Application of ethephon (300 PPM) within-20 at petal fall in Julie Elberta is recommended for optimum fruit thinning.
- * Peach requires high N and K.
- * Bear fruits after 2 years.

Varieties

- (A) **Early** : 1. Alton 2. World's earliest 3. Red haven 4. stark red gold 5. Early candor 6. Quetta 7. Saharanpur Prabhat.
- (B) **Mid** : 8. Julie Elberta 9. Alexander 10. Co smith
- (C) **Late** : 11. J.H. Hale 12. Parrot-delux 13. Peregrine
- (D) **Midhills** : 14. Stark earlyglo 15. white giant 16. candor
- (E) **Subtropical region** : 17. Flordasum 18. Dawn Rambler 19. Dawn rose 20. Sharbati
21. Nectarine : It is a fuzzless peach variety, possesses strong flavour and aroma.
- * J.H. Hale : Self unfruitfull (male sterile variety)
- * Nemaguard : Cross between *P. persia* × *P. devidiana* (Nematode resistant rootstock).
- * Saharanpur prabhat : Sharbati × Flordarsum
- * **For canning** : Yellow flush, stone free.
- * **For dehydration** : White flushed.

PLUM

- * Botanical Name : *Prunus domestica*
- * Family : Rosaceae
- * Origin : Japan
- * Plum trees grows 5 to 7 m and have greenish white flowers.

Two races : (A) European plum : *Prunus domestica* ($2n = 16$)

(B) Japanese plum : *Prunus salicina* (more popular in India) ($2n = 48$)

- * Training-central modified leader system.
- * Rootstock (A) vigorous : 1. myrobalan-B 2. St. Julien-C 3. Myro-29-C (B) Dwarf-1. Pixy.
- * Fruits TSS at time of maturity : 12.5% Brix.
- * **Chilling requirement :** (A) 1000-1200 hrs-European (B) 700-1000 hrs-Japanese
- * Deficiency of B in plum results in misshapen fruits.
- * Clean basin + permanent sod in orchard is most common practice of floor management in plum.
- * Peak water requirement period in plum is may to June.
- * Plums are graded into 3 grades.
- * Open centre is oldest training system followed in plum.
- * In plum heavy bearing is a problem.
- * Most of the varieties grown in India belong to Japanese group.
- * Seeds of wild apricot called 'zardali' are used for raising seeding rootstock.
- * Planting of plum is done during December-January.
- * Plums are available in the market from second week of May (Titron) to third week of July (Jamuri)
- * Excellent source of vitamin A, calcium, magnesium, iron, potassium.
- * Plums stimulate bowel movement.
- * Honey bees are major pollinator.
- * Country peach is common root stock used for plum in India.

Varieties

- (A) Early : 1. Methley 2. Kelsey 3. Santa Rosa 4. Beauty 5. Settler 6. Cloth of Gold 7. Early subza.
- (B) Mid : 8. Satsuma 9. Elephant heart 10. Frontier 11. Victoria 12. Burbank.
- (C) Late : 13. Mariposa 14. Red Ace 15. Late Yellow 16. Grand Duke 17. Silver wilkson.
- (D) Low hills : 18. Alucha purple 19. Titron 20. Satluj purple 21. Alubukhara.
- (E) European : 1. Prune 2. Green Gage 3. Yellow egg 4. Golden drop 5. President 6. Grand duke 7. Diamond 8. Tragedy 9. Victoria 10. Lambard 11. Stonley 12. Imperial brooks.
- (F) Japanese : 1. Santa rosa 2. Beauty 3. Meriposa 4. Kelsey 5. Frontier 6. Elephant heart 7. Satsuma
- (G) Alu Kokhara : The fruit is large having yellow skin tinted with red colour. Pulp is juicy and sweet.
- (H) Hybrid variety: Plum coat or pluot

CHERRY

- * Botanical Name : *Prunus avium*
- * Family : Rosaceae
- * Origin : Black to Caspian sea
- * Chilling requirement : 2000-2700 hours which is highest among temperate fruits.
- * Heavy rainfall during flowering causes – ‘Blossom wilt’.
- * Heavy rainfall during ripening causes – ‘Fruit cracking’.
- * In Europe, a wine – “Kirschwascer” is distilled from pulp of cherries.
- * Most of commercial varieties of cherry are self sterile.
- * Seedling rootstock : 1. Paja 2. Mahaleb 3. Mazzard.
- * Clonal rootstock : 1. Colt 2. Mazzard F-12/1 (semi vigorous, difficult to root)
- * Cherry fruits reach 1st in market among temperate fruits.
- * Highest chilling requirement.
- * Cherry has more calorific value than apple.
- * Donar varieties. : Stella, vista, vic, seneca, vega.
- * Trained by modified leader system.
- * Cherry is grown under rainfed conditions in India.
- * Red pigment in Cherries: Anthocyanins (anti oxidant)

Varieties

1. Black heart 2. Napoleon white 3. Stella 4. Lambert 5. Pink early 6. Black Republican 7. White heart
 8. Early rivers 9. Governors wood 10. sunbrust 11. Compact stella 12. Summit 13. Sam
- * Cherry is first temperate fruit which come first in market.

ALMOND

- * Botanical Name : *Prunus communis*
- * Family : Rosaceae
- * Origin : Afganistan
- * Chilling requirement : 800 hrs.
- * Damage to blossom due to early spring frosts is the major constraint in almond cultivation.
- * Almond can withstand temperature of -2.2 to -3°C
- * Central modified system of training is adopted.
- * Almond tree become productive after 5 years.
- * Almond contains 49% oil. Oleic acid 62%; linoleic acid 24% and palmitic acid 6%
- * Major producers : USA, Spain, Syria and Italy.
- * Rich source of vitamin E.
- * Its kernels contains 20.8% protein, 59.8% fat and 10.5% carbohydrates.

Varieties

- | | |
|---|---------------------------------|
| 1. Sloe (Peach × Almond) – self fertile | 2. Drake-self fruitful variety |
| 3. Katha-self fruitful variety | 4. Dhebar-self fruitful variety |
| 5. Makhdoom | 6. IXL 7. Jordanolo |
| | 8. Merced |
| 9. Non-pareil : Most popular variety | |
| 10. Neplus ultra | 11. Texas (mission) |
| | 12. Peerless |

APRICOT (Armenian Plum)

- * Botanical Name : *Prunus armeniaca*
- * Family : Rosaceae
- * Origin : China
- * It is rich source of protein and oils (40-45%)
- * Moor park : One of the best Apricot for outdoor cultivation in small garden.
- * Largest producer: Turkey
- * Highly perishable fruit.
- * Wild apricot – Zardalu (chuli).
- * Chilling requirement : 300-900 hrs. below 7 °C, for fruiting.
- * Peak water use period : April end-Mid June.
- * Summer temperature : 16.6 – 32.2 °C
- * Laetrile a purported alternative treatment for cancer is extracted from apricot seeds.
- * Used for treatment of tumors and ulcers.
- * High contents of anti oxidant (carotenoids)

Varieties

- | | | | |
|------------------|-------------|-------------------------|-----------------|
| 1. New castle | 5. Nugget | 10. St. Ambroise | 15. Farmingdale |
| 2. Early shipley | 6. Royal | 11. Chaubattria Alankar | 16. Alfred |
| 3. Shakarpara | 7. Charmagz | 12. Chaubattria Madhu | |
| 4. Kaisha | 8. Halman | 13. Chaubattria kesari. | |
| 5. Bebeco | 9. Moorpark | 14. Khante | |

WALNUT

- * Botanical Name : *Jaglans regia*
- * Family : Juglandaceae
- * Origin : Indo-China
- * Nuts are harvested at PTB stage (when packing tissues turn brown).
- * Rootstock-paradox.
- * Trees: Deciduous 10- 40 metres tall.
- * Temperature of 29-32 °C near harvesting results in well filled kernels.
- * Hot summer with low humidity results in blank nuts.
- * Sensitive to low temperature during spring and high temperature in summer.
- * Chilling requirement about 200-800 hrs.
- * Modified central leader system is most ideal for training.
- * Walnuts have high antioxidant contents (vitamin E) and fibres.
- * Walnuts contain omega 3 fatty acid (good fats).
- * The nut contains 14-20% protein and 60-70% fat.
- * Immature fruits are rich in ascorbic acid.

Varieties

- | | | | |
|-----------------|-------------|---------------|--------------|
| 1. Lake English | 2. Gobind | 3. Eureka | 4. Placentia |
| 5. Wilson | 6. Chakrata | 7. Franquette | 8. Roopa |
| 9. Karan | | | |

PECANUT

- * Botanical Name : *Carya illieonsis*
- * Family : Juglandaceae
- * Origin : Asia minor
- * Queen of nuts
- * Requires warm temperate climate.
- * It shows tendency of biennial bearing.
- * Most important nut fruit of world, ranking 5th in production.
- * Chilling requirement - 400 hrs. at or below 7.2 °C.
- * Heterodichogamy is found in pecanut.
- * It contain 70% fat and good amount of phosphoric acid
- * Desirable and Cheyenne varieties are suitable for high density planting.

Varieties

- | | | | |
|-------------|--------------|-------------|------------|
| 1. Mahan | 2. Nellis | 3. Burkett | 4. Stuart |
| 5. Western | 6. Desirable | 7. Cheyenne | 8. Wichita |
| 9. Chicksaw | | | |

STRAWBERRY

- * Botanical Name : *Fragaria ananasa*
- * Family : Rosaceae
- * Origin : Man made hybrid
- * It is a cross of *F. Chilonensis* × *F. Virginiana*.
- * Fruit of strawberry is complete fruit with 98% Edible portion.
- * Flower colour-white.
- * All cultivated varieties are octaploid.
- * Mulching is an important cultural operation in strawberry cultivation.
- * It is commercially propagated by runner plants
- * Strawberry grows well under temperate climate
- * Excellent source of vitamin C.
- * Matted row system of training is commonly followed in India.
- * USA is highest producer of strawberry.

Varieties

- | | | | |
|-------------|---------------|-----------|------------|
| 1. Chandler | 2. Tioga | 3. Torrey | 4. Selva |
| 5. Belrubi | 6. Fern | 7. Pajaro | 8. Premier |
| 9. Red coat | 10. Dilpasand | | |

PLANTATION CROPS

COCONUT

- * Botanical Name : *Cocos nucifera*
- * Family : Arecaceae
- * Origin : South East Asia
- * Generic name *cocos* is derived from Spanish word *coco* means monkey face.
- * Coconut industry provides employment to 10 million people.
- * Monoluron content of coconut oil has anti HIV property.
- * Dwarf coconut is self pollinated while tall coconut are cross pollinated in nature.
- * Coconut yield → 80- 100 nuts/palm/year.
- * Fully mature nut have 30- 40% coir.
- * India rank IIIrd in coconut production after Indonesia and Phillipines in the world.
- * Kerala's share in coconut production : 45% (Highest) followed by Tamil Nadu (22%), Karnataka (12%)
- * Productivity of coconut (7608 nuts/hac) in India is the best in the world (India rank- Ist in productivity in the world.)
- * Fruit-single seeded drupe.
- * Optimum temperature for growth : 27 °C
- * Maximum productivity of coconut : In Maharashtra (20, 621 nuts/hac).
- * In India, 9-12 months old seedlings are generally transplanted.
- * Two form of copra :
 1. Edible copra (a) Ball copra (b) Cup copra
 2. Milling copra
- * In Kerala, 60-65% of total coconut product is converted into milling copra.
- * Mesocarp-Husk-used for coir making.
- * Coconut husk
 - (i) Coir (70%)
 - (ii) Fibre (30%)
- * Endocarp-used for making toys, buttons etc.
- * Secondary growth in coconut stem as well as in root is absent.
- * Coconut is a heliotropic plant (loves sun-shine).
- * Kurumba—An immature coconut containing a refreshing clear liquid.
- * In drip irrigation, 30-40 lits water/day is optimum for west coast condition.
- * Coconut ripens in 12-13 months from the opening of the inflorescence.
- * 55% of coconut production is consumed as raw.
- * Laccadive ordinary is suitable for making ball copra and oil extraction.
- * Laccadive Micro is also suitable for making ball copra.
- * Male parent for hybrid : Choughat orange dwarf, Gangabondan.
- * Coconut water : 94.5% water + vit-C + vit-B + sugar + fibre pH : 4.8 – 5.3
- * Indonesia, Philippines, India & Sri Lanka together account for 79.73% area and 89.29% of total production in the world.
- * Kangayan in Tamil Nadu is considered as the second major market centre for copra coconut oil in the country.
- * First hybrid between Tall and Dwarf coconut was released in year 1932.

Varieties

- (A) Tall : 1. West coast tall 2. Laccadive ordinary 3. East west tall 4. Andaman ordinary 5. Sanramon 6. Pratap 7. Laguna
- (B) Dwarf : 1. Chowghat green dwarf 2. Chowghat orange dwarf 3. Gangabondam 4. Gudanjali 5. Coco Nino 6. Mangipod 7. Nuleka.
- Improved types
 1. Chandra Kalpa
 2. Pratap – Selection from Benalin tall
 3. Chadratara – Selection from Philippines ordinary
 4. Double century – Selection from Philippines ordinary
 5. Kera Chandra – Selection from Philippines ordinary

CASHEW NUT

- * Botanical Name : *Anacardium occidentale*
- * Family: Anacardiaceae
- * Origin : Brazil
- * Kernel contain 47% Fat 21% protein and 22% carbohydrate.
- * Kernel do not have cholesterol.
- * Collection of Fallen nuts is called as gllining.
- * USA is the largest importer of cashew kernels.
- * Cashew is restricted to altitude below 700 m where the temperature does not fall below 20 °C for prolong period.
- * More than 8 pH is not suitable for its commercial cultivation.
- * Pruning : August-September
- * Most popular method of roasting : steam method
- * Best quality kernals are obtained from : Drum roasting– Highest whole kernals are obtained.
- * Max. recovery of oil : Oil bath roasting.
- * Cashew is very sensitive to waterlogging.
- * Inflorescence : Poly gamomonocious
- * IIIrd important agriculture commodity exported from India.
- * Commonly used drier for drying of kernel : Broma dryer
- * Moisture content of dried kernel is 2–4%
- * If Moisture content of dried kernel exceeds 75%, kernel becomes susceptible to microbial attack.
- * There are 26 grades of export cashew kernel.
- * India export 65% of cashew in the world
- * Dwarf rootstock of cashew-Anacardium pumilum.

- * Softwood grafting is commercially followed method of propagation.
- * Best production is noticed upto the altitude of 400 m with atleast 9 hr sunlight/day from December-May
- * India is largest producer and exporter of raw cashewnut.
- * India is second largest consumer of cashew karnel.
- * Top working is practiced in cashew for rejuvenation of old plant called gllining.

Varieties

1. Andhra Pradesh : BPP
2. Karnataka : Ullal-1, Chintamani-1, Ullal-2, Ullal-3, UN-50
3. Kerala : Dhana, madakhathara, priyanka—export variety
4. Maharashtra : Vengurla-1 to 7.
5. Tamil Nadu : VRT-1 to 3.
6. Ven-3 : Ven 1 × Vetore 56
7. Ven-4 : Midnapur Red × Vetore 56
8. Ven-6 : Verore 56 × Ven 1
9. Damodar: Anakkayam- 1 × H—313.

TEA

- * Botanical Name : *Camellia sinensis*
- * Family : Theaceae
- * Origin : China
- * Four tea research institutes setup in India are : Tocklai, UPASI, DTRC & IHBT.
- * China contributes only 22% of the world production from 44% crop area.
- * Asia accounts for 89% of the world tea area.
- * India accounts for 18.5% of the world tea area with 26.2% of total world production (India rank 1st in production)
- * Amongst India tea, Darjeeling is known for its unique muscatel flavour, Assam for cup character while Nilgiris have a characteristic taste flavour.
- * Orthodox method : Light strength tea.
- * CTC method : strong strength tea.
- * In tea stimulant is— Thein, aroma is due to— Theol and bitter taste is due to— Tannin.
- * Assam state is leading producer of tea in India (55%).
- * India is largest producer, consumer and exporter of tea in the world.
- * Tea is a calcifugre crop (Best grown in acidic soil).
- * Skiffing is practiced in tea (light pruning).
- * Collar pruning— severe most pruning.
- * Compound responsible for colour of tea— Theaflavins and Thearufigens.
- * Best harvesting time— two leaves and a bud stage.
- * The 1st plucking of recovering bushes is called 'tipping'.
- * 1st step in processing of tea is 'withering'.
- * Tea is processed by CTC method (cut, tear and curl) or orthodox method.
- * It is 11nd important agriculture commodity exported from India.

- * Most of tea gardens are located at altitudes ranging from 1,000 to 1,200 m.
- * The mean maximum temperature below 30 °C is good for cultivation.
- * For tea sprinkler irrigation is most common.
- * The end product of fermentation are the aflavins and arubigins– responsible for brightness and colour.
- * Made tea contains 2.5-3% moisture.
- * Tea requires 18-20 months from planting to reach plucking.
- * Single or double hedge style of planting is recommended in tea.
- * Calcium amonium nitrate (CAN) is the best source of nitrogen in Winter in South India.
- * Main objective of withering is remove about 15-20% moisture from the leaves.

Varieties

- * 1. Sundaram 2. Singara 3. Athrey 4. Jayaram 5. Golconda 6. Brooklands.

COFFEE

- * Botanical Name : *Coffea spp.*
- * Family : Rubiaceae
- * Origin : Ethopia
- * Two races (A) Arabia coffee– *Coffea arabica*– self-pollinated (2n-22)
(B) Robusta coffee– *Coffea robusta*– cross pollinated (2n-44)
- * India's rank in coffee production in the world is VIth.
- * Arabica-coffee for higher elevation while robusta coffee for lower elevation.
- * Coffee fruit with single seed called "Pea berry".
- * Tree coffee (*coffea liberica*) is source of resistance to leaf rust.
- * Coffee is 11nd important commodity in world trade after petroleum products.
- * Coffee contains– Niacin which is useful to cure skin diseases.
- * Training : By single stem is followed in India.
- * Processing : (A) By wet method– to produce parchment coffee.
(B) By dry method– to produce cherry coffee.
- * In India– Arabica is processed as parchment coffee.
Robusta is processed as cherry coffee.
- * The cured coffee is called green coffee which is traded in the market.
- * In India, single stem system of training is practiced.
- * Pruning– June-July to August-September.
- * Scuffling (soil stirring) is practiced in coffee.
- * Arabia coffee is most widely grown.

Varieties

1. S-795 (Robusta)– Most popular variety, occupy 70% of total coffee area.
2. C × R : Interspecific hybrid. 3. Cauvery 4. Agro 5. San ramon (mutant)
7. Cioccie 8. Kent– mutant variety.
9. Cauvery– Cattura × hybrido-de-timor, Rust resistant variety suitable for high density planting.
10. Chicks 11. Blue mountain.

ARECANUT

- * Botanical Name : *Areca catechu*
- * Family : Arecaceae
- * Single seeded berry.
- * Arecotine- (0.1%) stimulating agent, present in arecanut.
- * Polyphenol and tanins are responsible for astringent taste of nuts.
- * Plants are susceptible to sun scorch especially in south or south west direction.
- * Trade type (A) *Kalipak*- Processed green nuts.
- (B) *Kottapak or chali*- Dried ripe nuts (most popular trade).
- (C) Scented supari.
- * Nuli is made from tender nuts.
- * Young seedlings are best protected by raising Banana crop during the early years.
- * India is largest producer and consumer of Arecanut.
- * Fully ripe nuts with minimum weight of 35 gram is used for propagation.
- * Propagation by seednut (35 gram).

Varieties

1. Sreevardhani : *Areca catechu* × *Areca triandra* (Interspecific cross)
 2. Mangla : Indonesian introduction
 3. Sumangla : Srilankan introduction
 4. Sree mangla : Singapore introduction
 5. Mohitnagar : Indigenous
 6. Samrudhi
- * Takes 8 months to attain maturity.

BETEL VINE

- * Botanical Name : *Piper betle*
- * Family : Arccaccac
- * It is a dioecious crop.
- * Vit.A : 9600 IU.

Varieties

1. Bangla
 2. Sanchi
 3. Mitha
 4. Karpoori
 5. Kallipatti
- * It is trained on Bareja or Boroj.

COCOA

- * Botanical Name : *Theobroma cocoa*
- * Family : Sterculiaceae
- * Cocoa improvement work was started in 1980 in Karnataka.
- * Bearing habit- cauliflorous, shade loving.
- * The horizontal branches are called as Fan or Jorquette.
- * Vertical continuous stem is called- chupan.

- * Cocoa trees grow naturally in tiers.
- * **Training** : December-January and July-August.
- * Spacing of cocoa in (A) Arecanut Garden : $5.4 \times 2.7 \text{ m}^2$ (686 plants/hac.)
(B) Coconut Garden : $3.0 \times 7.5 \text{ m}^2$ (444 plants/hac.)
- * Young cocoa fruits are called as "cherelle" and its wilting prior to maturity is called "cherelle wilting" (disorder).

Varieties

1. Forestero
 2. Criollo
 3. **Trinitarion** : Criollo \times forestro
- * Criollo type produce best quality cocoa.

RUBBER

- * Botanical Name : *Hevea brasiliensis*
- * Family : Euphorbiaceae
- * In world, consumption ratio of natural to synthetic rubber is 39:61.
- * Tapping is done in rubber for removal of latex.
- * India ranks 3rd in rubber production and 5th in area and 1st in productivity in the world.
- * A budded tree is considered as tappable when it attains a girth of 50 cm at a height of 125 cm from the bud union.
- * Latex contain average 32% dry matter.
- * National average yield : 1.6 t/hac/year.
- * Processed product— sheet rubber (latex + acetic or formic acid).
- * In smoke house 40-60 °C, temperature is maintained.
- * Hybrid clone— RR11-105 occupy 80% area under rubber cultivation. It is the highest yielding in the world.
- * Major physiological disorder : Brown blast or TPD (tapping panel dryness).
- * Tapping cut (tapping panel) should be at a slope of 30° in budded plants and 25° in seedling trees.
- * India is 3rd largest producer of rubber next to Thailand and Indonesia, sharing 9% of global output.
- * Ridley— tapping technique.
- * Matrola— (latex meter) to measure % of rubber.
- * Tapping is initiated when about 70% of trees in plantation attain tappable girth.
- * Best yield is obtained by tapping a depth of less than 1 mm close to cambium.
- * 70% of rubber is used in tyres and tubes.

Varieties

- 1) RFU-112,600,605,703,513,625
 - 2) RR11-105,118,203,287
 - 3) PB-86,206,213,217,235
 - 4) GT-1
 - 5) PR-107
 - 6) TJIR-1
- * 70% of rubber is used in tyres and tubes
 - * In India, consumption ratio of natural to synthetic rubber is 80 : 20.

OIL PALM

- * Botanical Name : *Elias guinensis*
- * Family : Arecaceae
- * Origin : Africa
- * Palm wine is prepared by tapping male inflorescence.
- * Palm wine is important source of vitamin B complex.
- * Palm oil is used in production of margarine.
- * Oil palm is the highest edible oil yielding crop among perennial crops.
- * Ablation : Removal of male & female flowers produced in early stage of plantation.
- * Palmolin is prepared from crude oil.
- * Types
 - (A) Dura-shell is present
 - (B) Pisifera— shell is absent.
 - (C) Tenera : Cross of Dura and Pisifera.
- * Tenera types are only used for planting because of their high mesocarp content widely cultivated in the world.
- * Palm oil is rich in palmitic acid.
- * Oil is called as crude palm oil, rich in vitamin A & E.
- * Separated kernels are dried to final moisture of 6-8%.
- * Parton dolly—dwarf, having large fruit.
- * Stripping is done in oil palm.
- * Oil palm improvement work was started in 1976 in Andhra Pradesh.
- * Hybrid:- 1) DD × AVROS
2) DD × DUMPY AVROS
- * RBD – Refined bleached deodoured.

PALMYRA PALM

- * Botanical Name : *Borokus fleballifer*
- * Family : Arecaceae
- * Jaggery obtained from palm is called Neera.
- * Mainly grown in Tamil Nadu.
- * Dioecious in nature.
- * Tapping is done in January.
- * Neera on fermentation becomes toddy.
- * 3 seeded drupe.
- * Toddy—5% alcohol.
- * Tender fruit : Nungu.
- * It is known as source of sweetening agent since time immemorial.
- * It is a tropical crop.
- * It is generally propagated by seed.

DISEASE MANAGEMENT

Sl.No.	Name of disease	Causal organism	Scientific name	Remark
1.	Mango			
(i)	Powdery mildew	Fungus	<i>Oidium mangiferae</i>	Loss upto 30-90%.
(ii)	Anthracnose	Fungus	<i>Colletotrichum gloesporoides</i>	—
(iii)	Canker	Bacteria	<i>Xanthomonas campestris</i> <i>pv. mangiferae</i>	—
(iv)	Rust	Algal	<i>Cephaleoros mycoides</i>	—
2.	Banana			
(i)	Panama wilt	Fungus (Acidic soil)	<i>Fusarium oxysporum</i> <i>pv-cubensis</i>	Soil borne fungus (Basrai dwarf Immune, Poovan-Resistant)
(ii)	Sigatoka leaf spot	Fungus	<i>Cercopora musicola</i> (Asexual)	AAA clones- susceptible ABB clones- Resistant
(iii)	Bunchy top	virus	transmitted through aphids,	Resistant variety Virupakshi
(iv)	Moko disease	Bacteria	<i>Pseudomonas solanacearum</i>	Vector-insect.
3.	Citrus			
(i)	Gummosis	Fungus	<i>Phytophthora</i> spp.	—
(ii)	Bacterial canker	Bacteria	<i>Xanthomonas campestris</i> <i>pv. citri</i>	Transmitted by leaf miner Resistant variety-Tenali.
(iii)	Triestiza	Virus	(Acid lime indicator plant)	Transmitted by aphids
(iv)	Greening	MLO's		Transmitted by citrus psylla
(v)	Exocortis	Viroids	<i>Rang pur lime and citron-indicator</i>	—
(vi)	Xyloporosis		<i>Bud wood transmission.</i>	—
4.	Guava			
(i)	Guava canker	Fungus	<i>Pestalotiopsis psidii</i>	—
(ii)	Guava wilt	Fungus (Alkaline soil)	<i>Fusarium oxysporum</i> <i>pv. psidi</i>	Soil drenching with carbendazin Resistant variety- Allahabad Safeda
5.	Grape			
(i)	Downy mildew	Fungus	<i>Plasmopora viticola</i>	Major disease
(ii)	Powdery mildew	Fungus	<i>Uncinula necator</i>	—
(iii)	Pierce's disease	Fungus	<i>Xylella fastidiosa</i>	Resistant rootstock- temple
6.	Fig			
	Fig rust	Fungus	<i>Cerotolium fici</i>	—
7.	Pineapple			
(i)	Wilt	Virus	Transmitted thorough lace/ mealy bug	—

Continued...

Sr.No.	Name of disease	Causal organism	Scientific name	Remark
8.	Papaya			
(i)	Damping off	Fungus	<i>Pythium aphanidermatum</i>	
(ii)	Ring spot	Virus	Transmitted by Aphids	Mottling of leaves.
(iii)	Leaf curl	Virus	Transmitted by white fly.	
9.	Aonla			
(i)	Ring rust	Fungus	<i>Ravenelia emblica</i>	
10.	Ber			
(i)	Powdery mildew	Fungus	<i>Oidium jujube var indica</i>	
11.	Sapota			
(i)	Leaf spot	Fungus	<i>Phleopheospora indica</i>	
12.	Pomegranate			
(i)	Leaf spot	Fungus	<i>Cercospora punicae</i>	
13.	Banana			
(i)	Streak virus	Virus	Transmitted by mealy bugs.	
(ii)	Bract mosaic	Virus	Transmitted by Aphids	Nendran-highly susceptible.
(iii)	Kokkan disease	BM Virus	—	
14.	Apple			
(i)	Crown Gall	Bacteria	<i>Agrobacterium tumefaciens</i>	
(ii)	Fire blight	Bacteria	<i>Erwinia amylovera</i>	
(iii)	Apple scab	Fungus	<i>Venturia subinaequalis</i>	Yield reduction upto 70-80%.
15.	Peach			
(i)	Peach leaf curl	Fungus	<i>Taphrina deformans</i>	Nacked asci present.
(ii)	Bacterial gummosis	Bacteria	<i>Pseudomonas-spp.</i>	Mashobra paste is applied.
(iii)	Wisker's rot	Fungus	<i>Rhizopus stolonifer</i>	
16.	Pear			
(i)	Pear decline	MLO's	Transmitted by pear psylla	
17.	Coconut			
(i)	Root wilt	MLO's	Transmitted by lace bug.	
(ii)	Basal end rot	Fungus	<i>Ganoderma lucidum</i>	
18.	Arecanut			
(i)	Mahali or koleroga	Fungus	Vector-spindle bug	
(ii)	Bud rot or Anab-a-roga	Fungus	<i>Gonaderma lucidum</i>	
19.	Coffee			
(i)	Leaf rust	Fungus	<i>Hemelia vestratrix</i>	Introduced from Srilanka Resistant variety—Coffea liberica.
20.	Cashew			
(i)	Dieback or pink disease	Fungus	<i>Pellicularia salmoni color</i>	

PEST MANAGEMENT

Sr.No.	Pest	Scientific Name	Nature of damage	Remarks/ Control measure
1.	Mango			
(i)	Hoppers	<i>Amritoides atkinsoni</i>	Nymph and adult, most serious pest of North & East India.	—
(ii)	Stem borer	<i>Bactocera rufomaculata</i>	Nymph and adult, most serious pest of North & East India.	Vapour heat treatment
(iii)	Fruit fly	<i>Dacus dorsalis</i>		Vapour heat treatment
(iv)	Stone weevil	<i>Sternochetus mangiferae</i>		Use of irradiations Alphonso susceptible
(v)	Mealy burg	<i>Drosicha mangiferae</i>	—	Tillage
2.	Banana			
(i)	Rhizome weevil	<i>Cosmopolitus sordisus</i>	Fruits become undersized.	—
(ii)	Aphids	<i>Pentalonia nigronervosa</i>	Vector of Bunchy top virus	—
3.	Citrus			
(i)	Psylla	<i>Diphorina citri</i>	Vector of greening disease	—
(ii)	Leaf minor	<i>Phyllocnistis citrella</i>	Vector of citrus cankar	—
(iii)	Aphids	<i>Toxoptera auranti</i>	Vector of tristiza disease	—
(iv)	Lemon butterfly	<i>Papilo demolens</i>	—	Bagging
4.	Apple			
(i)	San Jose scale	<i>Quadraspidiotus perniciosus</i>	—	Notorious pest.
(ii)	Wooly Apple Aphids	<i>Eriosoma lanigerum</i>	Infestation period Aug.-Oct.	Serious pest.
5.	Guava			
(i)	Striped mealy bug	<i>Ferrisa virgata</i>	Serious pest in South India	—
(ii)	Fruit fly	<i>Bactocera dorsalis</i>	Infested fruit rot and fall	—
(iii)	Green shield scale	<i>Chloropulvinaria psidii</i>	—	—
6.	Grape			
(i)	Defoliating beetles	<i>Adoretus lasiophagus</i>	—	—
(ii)	Thrips	<i>Rhipiphorothrips cruntatus</i>	—	—
7.	Pineapple			
(i)	Mealy/lace bug	<i>Pseudococcus breviceps</i>	Vector for pineapple wilt disease	—

Sr.No.	Pest	Scientific Name	Nature of damage	Remarks/ Control measure
8.	Papaya			
(i)	Aphids	<i>Aphis gossipi</i>	Transmit mosaic virus.	—
9.	Pomegranate			
(i)	Anar butterfly	<i>Virachola isocratis</i>	Major pest	Covering fruit with butter paper
10.	Litchi			
(i)	Litchi mite	<i>Aceria litchi</i>		
11.	Ber			
(i)	Fruit fly	<i>Carpomya vesuviana</i>	Damage upto 80% in North India	Resistant variety : Mehrun, Katha, Tikadi, Dodhia
(ii)	Fruit borer	<i>Meridarchis scyroides</i>	Major pest in South India	Resistant variety : Gola, Kadaka, Pewandi
12.	Aonla			
(i)	Shoot gall maker	<i>Betanosa styloffera</i>	Gall formation	All varieties susceptible.
(ii)	Bark eating caterpillar	<i>Inderbela quadrinata</i>	Damage upto 80%	—
13.	Jack fruit			
(i)	Shoot and fruit borer	<i>Diaphania caesalis</i>	Major pest	—
14.	Peach			
(i)	Leaf curl aphid	<i>Brachycaudas helichrysi</i>	—	—
15.	Coconut			
(i)	Rhinoceros beetle	<i>Oryctus rhinoceros</i>	Fan like appearance of leaves larval parasitism-Bracon brevicornis	—
(ii)	Red palm weevil	<i>Rhynchophorus ferrugineus</i>	—	—
(iii)	Eryophide mite	—	—	—
16.	Cashew			
(i)	Tea mosquito bug	<i>Helopeltis antonii</i>	—	—
(ii)	Leaf minor	<i>Conopomorpha syngamma</i>	—	—
17.	Coffee			
(i)	White stem borer	<i>Xylotrachus quadripes</i>	Serious pest of Arabia coffee	—
(ii)	Coffee cherry borer	<i>Hypothenemus hampii</i>	—	—

PHYSIOLOGICAL DISORDERS

Sl.No.	Name of disorder	Cause	Control measures/ Remarks
1. Mango			
(i)	Black tip	Due to smoke of brick kilns+ deficiency of B.	Borax spray (0.6%)
(ii)	Malformation	Due to low temperature Bombay green—highly susceptible	Resistant vars—Bahaduran, Illaichi, Mangeera, Aliff
(iii)	Spongy tissue	Due to heat convection	Resistant variety : Ratna, Arka Aruna, Arka Puneet, Arka Anmol major problem in Alphonso
(iv)	Alternate bearing	Alphonso is highly susceptible	Cultar (PBZ) application
(v)	Jhumka (clustering)	Low temp. in February – March + Improper pollination & fertilization.	—
(vi)	Leaf scorch	Chloride toxicity, Excess K	—
(vii)	Internal necrosis	B. deficiency	Highly susceptible—Dashehari Free—Neelam, langra-
(viii)	Jelly seed	—	Highly susceptible variety Tomy atkins
(ix)	Taper tip	—	Deshehari is susceptible
(x)	Girdle necrosis	—	—
(xi)	Softnose	Excess of Ca and N ₂ deficiency	—
2. Banana			
(i)	Neer vazhai (water banana)	—	Nendran-susceptible
(ii)	Kotta vazhai (seed banana)	—	Poovan-susceptible.
(iii)	Improper bunch filling	Deficiency of K.	—
3. Citrus			
(i)	Granulation	High temperature & RH during ripening	Spray of lime
(ii)	Leaf mottling/frenching	Zn deficiency	—
(iii)	Exanthema/Ammoniation or dieback	Cu deficiency	—
(iv)	Yellow leaf of citrus	Mo deficiency	—
4. Guava			
(i)	Bronzing	Zn deficiency	L-49 is more tolerant than Aallahabad Safeda

Sl.No.	Name of disorder	Cause	Control measures/ Remarks
5.	Grape		
(i)	Hen & Chiken disease	Bo deficiency	—
(ii)	Millerandage in Grape	Bo deficiency	—
(iii)	Berry or Blossom-drop in Grape	Improper pollination & fertilization	—
(iv)	Coulure & shot berries	Bo deficiency, Improper pollination	—
(v)	Calyx end rot	Ca deficiency	—
(vi)	Pink berry formation	High temperature	Common in Thomson seedless and its clone
(vii)	Uneven ripening	Gulabi, Bangalore blue, susceptible	Application of Ethephon (250 PPM)
6.	Litchi		
(i)	Little leaf + leaf bronzing	Zn deficiency	—
(ii)	Fruit cracking	Excessive water + high temperature	—
7.	Aonla		
(i)	Fruit Necrosis	Bo deficiency	Francis—highly susceptible Chakaiya—Resistant variety
8.	Pomegranate		
(i)	Fruit cracking	Bo deficiency + moisture imbalance more in Mrig bahar	Tolerant varieties : Khandari, Alandi, Bedana Bosec
(ii)	Internal break down	More in Ambe Bahar	—
9.	Persimmon		
(i)	Calyx end rot	Ca deficiency	—
10.	Avocado		
(i)	Dry neck	—	—
11.	Apple		
(i)	Water core	Bo deficiency	—
(ii)	Bitter pit + cracking	Ca deficiency	—
(iii)	Wither tip	Cu deficiency	—
(iv)	Rosette leaves	Zn deficiency	—
(v)	Interveinal chlorosis	Mg deficiency	—
(vi)	Endoxerosis (June drop)	Water deficiency	—
(vii)	Early drop	Improper pollination and fertilization.	—
(viii)	Scald	Storage at high temperature	—
(ix)	Internal browning	—	Susceptible variety : Yellow Newton

FRUITS AND PLANTATION CROPS

Sl.No.	Name of disorder	Cause	Control measures/ Remarks
(x)	Storage breakdown	—	Susceptible variety : Golden delicious, yellow newton.
(xi)	Jonathan spot	Water deficiency	—
12. Pear			
(i)	Black end	Water deficiency	—
(ii)	Pear scald	Prolong handling of fruits in storage.	Susceptible : Conference
13. Apricot			
(i)	Tip burning	Due to high temperature	—
(ii)	Apoplexy	—	—
14. Mangosteen			
(i)	Gamboge	Heavy rainfall	Yellow exudation of gum on fruits
15. Pineapple			
(i)	Multiple crown (fasciation)	Genetical/Nutritional factor	Susceptible variety Kew
(ii)	Sun scald	Exposure of fruit to sun rays	—
16. Strawberry			
(i)	Albinism	Lack of fruit colour during ripening	—
17. Cocoa			
(i)	Cherelle wilt	—	—
18. Coffee			
(i)	Black bean/Black Jolloo/ Normal Jolloo	Depletion of carbohydrate reserve during bean development	—
19. Rubber			
(i)	Tapping Panel dryness (TPD) or Brown Blast	Excessive harvesting of latex	Tapping rest
20. Tea			
(i)	Tea yellow disease	Sulphur deficiency	—
21. Sapota			
(i)	Cock's comb	—	—
22. Coconut			
(i)	Crown chocking	Boron deficiency	—
(ii)	Little leaf	Zinc deficiency	—
23. Arecanut			
(i)	Band disease	Improper drainage	—
24. Custard apple			
(i)	Stone fruits	High relative humidity, low temperature	—
25. Peach			
(i)	Woolliness	—	—

MINOR FRUIT CROPS

1. Mangosteen

- * Botanical Name : *Garcinia mangosteena*
- * Family : Guttiferae
- * Finest fruit of the world.
- * Typical example of parthenogenetic development.
- * It is the only fruit in which glucose is present in readily available form.
- * It contain tannins up to 13%.
- * Very high humid or dry condition leads to 'Gamboge' a disorder in which excessive exudation of latex take place.
- * Variety : Jolo

2. Passion fruit

- * Botanical Name : *Passiflora edulis*
- * Family : Passifloraceae
- * Rich source of vit-A.
- * Vine, bears hen's egg sized fruits in adundance.
- * Two arm kniffin system– ideal for training.
- * type (A) Purple–more productive (B) Yellow
- * Hybrid : Kaveri-Purple × Yellow
- * Variety: Noel's special.

3. Phalsa

- * Botanical Name : *Grewia subinequalis*
- * Family : Tilliaceae
- * Phalsa is most perishable fruit crop and is tolerant to draught.
- * Pruning : December-January
- * Varieties-- Sharbati, local
- * Self pollinated crop
- * Suitable for multistoried cropping.
- * Red colour-due to Anthocynin.

4. Tamarind

- * Botanical Name : *Tamrindus indica*
- * Family : Leguminoceae
- * It's plup has antiscorbatic properties.
- * Variety : Urigam.

5. Wood apple

- * Botanical Name : *Feronia limonica*
- * Family : Rutaceae
- * 2n = 18
- * Varieties : kowath, kainth

6. Water chestnut

- * Botanical Name: *Trapa bispinosa*
- * Family: Trapaceae
- * Edible part-Kernel

7. Makahana

- * Botanical Name: *Euryale ferox*
- * Family: Nymphaeaceae

8. Mulberry

- * Botanical Name : *Morus alba*
- * Origin: China,
- * Family : Moraceae.
- * Plant of temperate region.
- * Max. production and area-Karnataka.
- * Edible portion mesocarp.
- * Hocky sticks are prepared from *Morus* spp.

9. Durian

- * Botanical Name : *Durio zibethinus*
- * Native: Malaysia
- * Family : Bombaceae
- * Odour-like rotten onion
- * Edible part-aril
- * Devoid of root hair (Absent)
- * Rich in vitamin-E
- * Fruit-Aphrodisiac activity.

10. Egg fruit

- * Botanical Name : *Pouteria compechiana*
- * Family : sapotaceae
- * Vit. A-2000 IU, Propagation : By seeds

11. Macadamia

- * Botanical Name : *Macadamia ternifolia*
- * Family : Proteaceae
- * Australian nut/Queensland nut
- * Protein 10%
- * Propagation : Wedge grafting

12. Mahua

- * Botanical Name : *Basia latifolia*
- * Family : Sapotaceae
- * Native: India
- * Corolla is rich source of sugar.
- * Mahua oil-linoleic fatty acid-useful to reduce blood cholesterol level.
- * Polyembryony is found.
- * Highest gestation period (15-20 years)

13. Chestnut

- * Botanical Name: *Castania sativa*
- * Family : Fagaceae

14. Filbert

- * Botanical Name: *Corylus avellana*
- * Family : Betulaceae

15. Hazelnut

- * Botanical Name: *Corylus colurana*
- * Family: Betulaceae

16. Gooseberry

- * Botanical Name : *Emblia officinalis*
- * Family : Euphorbia ceae
- * Origin : India

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PART - II

**VEGETABLES, SPICES, MEDICINAL
AND
AROMATIC PLANTS**

VEGETABLE CROPS

AREA AND PRODUCTION OF VEGETABLE AND SPICES (2013-14)

VEGETABLES

Sr.No.	Vegetable crop	Total vegetables	
		% share in area	% share in production
1.	Potato	21.0	25.5
2.	Onion	12.8	11.9
3.	Tomato	9.4	11.5
4.	Brinjal	7.6	8.3
5.	Tapioca	2.4	5.0

SPICES

Sr.No.	Spice crop	Total spices	
		% share in area	% share in production
1.	Chillies	24.5	25.27
2.	Garlic	7.3	21.1
3.	Turmeric	7.3	20.1
4.	Ginger	4.2	11.0
5.	Cumin	27.1	8.7
3.	Coriander	14.1	5.3

Sl.No.	Particular	Largest area	Highest production	Highest productivity
1.	Vegetable crops	I. WB (14.6%) II. UP (9.1%)	I. WB (14.1%) II. UP (11.3%)	I. TN (30 MT/hac) II. ANP (25 MT/hac)
2.	Spices	I. Raj (25.9%) II. MP (9.0%)	I. Guj (14.3%) II. AP (13%)	I. ANP (6.3 MT/hac) II. HR (5.1 MT/hac)

WB- West Bengal; UP-Uttar Pradesh; TN- Tamilnadu; ANP-Arunachal Pradesh, MP-Madhya Pradesh; Raj.-Rajasthan, Guj.- Gujarat; HR- Haryana.

CLASSIFICATION OF VEGETABLES

(A) Botanical Classification

Sr. No.	Family	Common Name	Botanical Name	Origin	Edible Part	2n no.
(I) MONOCOTYLEDONEAE						
1.	Amaryllidaceae (Alliaceae)	1. Onion	Allium cepa	Central Asia	Bulb	16
		2. Garlic	Allium sativum	Central Asia	Cloves	16
		3. Leek	Allium porum	Central Asia	Stem and leaves	32
		4. Shallot	—	—	—	16
		5. Chive	—	—	—	16
2.	Araceae	4. Taro	Colocasia esculenta	Srilanka	Corms	28
		5. Tannia	Xanthosoma sagittifolium	—	Corms	26
		6. Elephant foot yam	Amorphophyllus campanulatus	—	Corms	26
3.	Dioscoraceae	7. Greater yam	Dioscorea alata	Indo-burma	Tuber	40
		8. Lesser yam	Dioscorea esculenta	Indo-burma	Tuber	40
		9. White yam	Dioscorea rotundata	Indo-burma	Tuber	40
4.	Graminae	10. Sweet corn	Zea mays	—	Kernel	20
5.	Liliaceae	11. Asparagus	Asparagus Officinalis	Europe, Asia	Spears (young shoots)	20
(II) DICOTYLEDONAE						
6.	Amaranthaceae	12. Amaranthus	Amaranthus spp.	India	Leaves, stem	32
7.	Chenopodiaceae	13. Beet root	Beta vulgaris	Mediterranean	Root	18
		14. Palak	Beta Vulgaris var bengalensis	Indo-china	Leaves	18
8.	Compositae	15. Spinach	Spinacea oleracea	Iran	Leaves	12
		16. Lettuce	Lactuca sativa	Mediterranean region	Leafy heads	18
		17. Globe artichoke	Cynara scolymus	Mediterranean region	Flower bud	34
		18. Jerusalem artichoke	Helianthus tuberosus	USA	tuber	102
		* Chicory	—	—	leaves	18
		* Endive	—	—	leaves, roots	18
9.	Convolvulaceae	19. Sweet Potato	Ipomea batatas	South America	Tuber	90
10.	Crucifereae	20. Cabbage	Brassica oleracea var. capitata	Mediterranean	Head	18

Contd.....

Sr. No.	Family	Common Name	Botanical Name	Origin	Edible Part	2n no.
	(Brassicaceae)	21. Cauliflower	Brassica oleracea var. botrytis	region -do-	Curd	18
		22. Brussel's sprout	Brassica oleracea var. gemmifera	-do-	Head	18
		23. Sprouting Broccoli	Brassica oleracea var. italica	Mediterranean region	Flower bud	18
		24. Knol-khol	Brassica oleracea var. gongylodes or Brassica caulorapa	Mediterranean region	Knob	18
		25. Kale	Brassica oleracea var. acephala	-do-	Leaves & shoot	18
		26. Chinese Cabbage	Brassica Chinensis	China	Leafy heads	20
		27. Turnip	Brassica rapa	China, India	Root	20
		28. Raddish	Raphanus sativus	Europe	Root and leaves	18
		* leaf mustard	Brassica juncea var. cunefolia	-	tender leaves	36
11.	Cucurbitaceae	29. Cucumber	Cucumis sativus	India	Fruit	14
		30. Musk Melon	Cucumis melo	Tropical Africa	Fruit	24
		31. Snapmelon (Phoot)	Cucumis melo var. momordica	Tropical Africa	Fruit	24
		32. Long melon (Kakri)	cucumis melo var. utilissimus	Tropical Africa	Fruit	24
		33. Gherkin	Cucumis anguria	Tropical Africa	Fruit	24
		34. Water Melon	Citrullus lanatus	Tropical Africa	Fruit	22
		35. Round melon	Citrullus lanatus var. fistulosus	Tropical Africa	Fruit	22
		36. Pumpkin	Cucurbita moschata	Mexico, Peru	Fruit	40
		37. Summer squash	Cucurbita pepo	Mexico	Fruit	40
		38. Winter squash	Cucurbita maxima	Mexico	Fruit	40
		39. Bottle gourd	Lagenaria siceraria	South Africa India	Fruit	22
		40. Bitter gourd	Momordica charantia	Indo-burma	Fruit	22
		41. Ridge gourd	Luffa acutangula	Asia	Fruit	26
		42. Sponge gourd	Luffa cylindrica	Assam	Fruit	26
		43. Pointed gourd	Trichosanthes dioica	India	Fruit	22
		44. Snake Gourd	Trichosanthes anguina	India	Fruit	22
		45. Wax (Ash) gourd	Benincasa hispida	Java, Japan	Fruit	24
		46. Ivy gourd	Coccinia indica	India	Fruit	24
		47. Chow-chow	Sechium edule	Mexico	Fruit	28
		48. Spine gourd	Momordia Cochinchinesis	-	Fruit	28
12.	Euphorbiaceae	49. Cassava	Manihot esculanta	Brazil	Tuberous root	36
		50. Chekurmanis	Sauropus androgynous	Indo-burma	Green leaves	-
13.	Labiatae	51. Chinese Potato	Coleus pervriflorus	Africa	Tuber	-

Sr. No.	Family	Common Name	Botanical Name	Origin	Edible Part	2n no.
14.	Leguminosae	52. Peas	Pisum sativum	Central Asia	Tender seeds	14
		53. French Bean	Phaseolus vulgaris	Mexico	Pod, seed	22
		54. Cluster Bean	Cyamopsis tetragonolobus	India	Pod, seed	14
		55. Winged Bean	Psophocarpus tetragonolobus	Africa	Pod, seed	18
		* Lima Bean	Phaseolus lunatus	Guatemala	Pod	
		56. Dolichos bean	Lablab purpureus	India	Pod	22
		57. Cow pea	Vigna unguiculata	Africa	Pod	22
		58. Agathi	Sesbania grandiflora	—	Flower	24
		59. Fenugreek	Trigonella foenu-graceum	—	Leaves	16
		* Winged Bean	Psophocarpus tetragonolobus	Africa	Pod	18
15.	Malvaceae	60. Okra	Abelmoschus esculantus	Africa	Fruits	130
16.	Moringaceae	61. Drum stick	Moringa Oleifera	Africa, India	Green pods	28
17.	Solanaceae	62. Potato	Solanum tuberosum	South America	Stem, tuber	48
		63. Tomato	Lycopersicon esculentum	South America	Fruit	24
		64. Brinjal	Solanum melongena	Indo-Burma	Fruit	24
		65. Sweet pepper	Capsicum annum	Mexico	Fruit	24
		66. Chilli	Capsicum annum	Mexico	Fruit	24
18.	Umbeliferae	67. Carrot	Daucus carota	Afganistan	Root	18
		68. Coriander	Coriandrum sativum	—	Leaves	22
		69. Celery	Apium graveolens	—	Leaves	22
19.	Lauraceae	70. Bay leaf	Paurus nobilis	Mediterranean region	Leaves	—
20.	Aizoaceae	71. New Zealand Spinach	Tetragonia tetragonioides	New Zealand	Tender leaves and tops	—
21.	Basillaceae	72. Indian spinach	Basella rubra	India	Fleshy stem and roots	24
22.	Polygonaceae	73. Rhubarb	Rheum rhapontium	—	Thick leaf stalk	44

(B) Acid Present in vegetables

1. *Citric acid* : Tomato, Beet root, Leafy vegetables, Legumes, Potato
2. *Malic acid* : Carrot, Celery, Lettuce, Onion, Broccoli

(C) Aroma Containing Compounds

1. *Cucumber* : Nonadienal
2. *Cabbage* : (a) Raw - Allyl isothiocyanate
(b) Cooked - Dimethyl disulphide
3. *Potato* : Dimethyl pyrazine
4. *Radish* : Isothiocyanate
5. *Onion* : Allyl propyl disulphide
6. *Garlic* : Diallyl disulphide

(D) A/c to Respiration

1. *Climacteric* : Musk melon, Watermelon, tomato
2. *Non climacteric* : Cucumber

(E) Temperature Requirement

Sr. No.	Optimum temperature	Crop
1.	25-27.0°C	Okra, Chilli, Sweet Potato, Water Melon, Musk Melon
2.	20-25°C	Tomato, Brinjal, Pepper, Cucumber, Pumpkin, Onion, Garlic
3.	18-25°C	Cauliflower, Cabbage, Raddish, Potato, Carrot, Lettuce

(F) A/c to Photoperiod

(a) Long day plant	(b) Short day plant	(c) Day neutral crop
1. Potato	1. Sweet Potato	1. Tomato
2. Onion	2. Indian spinach	2. Brinjal
3. Cabbage	3. Dolichos Bean	3. Chilli
4. Cauliflower	4. Cluster Bean	4. Okra
5. Raddish	5. Winged Bean	5. Cucurbits
6. Lettuce		6. Amarnathus
7. Spinach		7. French Bean
8. Palak		8. Cowpea
9. Turnip		9. Sweet pepper
10. Carrot		
11. Beet		

(G) Isolation Distance

		Foundation Seed (m)	Certified Seed (m)
(a) Self Pollinated	1. Tomato 2. Lettuce 3. Globe Artichoke 4. Broad bean 5. Peas 6. Cowpea 7. Winged bean 8. Fenugreek	50	25
(b) Often cross Pollinated	1. Okra 2. Brinjal 3. Chilli 4. Lima Bean	200	100
(c) Cross Pollinated	Other vegetable crops	800	400

(H) Sex Forms

Monoecious	Dioecious	Sporophytic Self incompatibility	Male sterility	Protoandry
Cucurbits	Pointed Gourd	Cole Crops	Tomato	Onion
Amarnathus	Scarlet Gourd	Raddish	Brinjal	Carrot
Sweet Corn	Spine gourd	Turnip	Chilli	Beet
Cassava	Asparagus	Beet	Onion	Leek
	Spinach	Gametophytic	Carrot	Celery
	Yams	Self incompatibility	Sweet Potato	
	Beet root	Tomato		

(I) Tolerance to Soil Acidity

<i>Less tolerant (pH→6.8-6)</i>	<i>Moderate (pH→6.8-5.5)</i>	<i>Highly tolerant (pH→6.8-5)</i>
Cole crops	Brinjal	1. Potato 4. Rhubarb
Okra, Musk Melon	Chilli	2. Sweet Potato 5. Fennel
Onion	Tomato	3. Water Melon

(J) Tolerance to Soil Salinity

<i>Less tolerant</i>	<i>Moderate</i>	<i>Highly tolerant</i>
Potato, Sweet Potato	Chilli, Cole crops	Bitter Gourd, Ash Gourd, Palak
Brinjal, Raddish	Tomato	Turnip, Lettuce, Beet,
Peas	Onion	French Bean

(K) Water Requirement

<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Very Low</i>
Colecrops	Brinjal, Chilli	Beans	Water Melon, Musk Melon
Raddish	Tomato, Potato	Ridge Gourd	Pumpkin, Ash Gourd
Leafy vegetables			

(L) Rooting Depth

(a) Very Shallow (15-30 cm)	1. Onion 2. Lettuce 3. Small raddish
(b) Very Deep (120-180 cm)	1. Sweet Potato 2. Water Melon 3. Pumpkin 4. Tomato 5. Asparagus 6. Cluster bean
(c) Moderately Deep (80-100 cm)	1. Brinjal 2. Chilli 3. Musk Melon 4. Turnip

(M) Respiration Rate of Produce

<i>Very low</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Very High</i>
Potato	Sweet Potato	Chilli	Peas	Leafy greens, Green Onion,
Onion	Cabbage	Carrot	Beans	Musk Melon, Water Melon
		Tomato		Cauliflower, Asparagus

(N) Lime Requirement

<i>Don't require</i>	<i>Moderate</i>	<i>High</i>	<i>Very High</i>
Potato	Carrot	Brinjal	Chilli
Tomato	Peas	Cabbage	Onion
Water melon	Cucumber	Cauliflower	Spinach, Lettuce

(O) Transplanting

<i>Easy to transplant</i>	<i>Transplanted with care</i>	<i>Not Transplanted</i>
Brinjal, Tomato	Onion, Chilli,	Okra, Beans, Peas, Cucurbits
Lettuce, Cole crops	Celery	Turnip, Amaranthus Fenugreek

(P) Suitable Age for Transplanting

<i>Age in Weeks</i>	<i>Crop</i>
1. 6-8 week	Onion, Brussels Sprout, Celery
2. 4-5 weeks	Lettuce, Cabbage
3. 3-4 weeks	Tomato, Brinjal, Cauliflower, Sprouting Broccoli

(Q) Largest Producer in the World

1. USA	Sprouting Broccoli
2. India	Cauliflower, Chilli, Okra
3. China	Garlic, Capsicum, Sweet Potato, Brinjal
4. Nigeria	Cassava
5. Africa	Yams

(R) Toxic Substances found in vegetable crop

<i>Sr. No.</i>	<i>Toxic Substance</i>	<i>Crop</i>	<i>Sl. No.</i>	<i>Toxic Substance</i>	<i>Crop</i>
1.	Apiin	Celery	8.	Saponine	Spinach, Tomato,
2.	Ca Oxalates	Colocasia			Asparagus
	Elephant's foot	Yam	9.	Sinigrin	Cole crops
			10.	Solasodine	Brinjal
3.	CN Glycosides	Cassava	11.	Trypsin inhibitor	Peas and Beans
4.	Cucurbitacins	Cucurbits			Sweet potato
5.	Dioscorine	Yams	12.	Serotonin	Water melon
6.	Haemaglutine	French Bean	13.	Choline esterase	Pumpkin
7.	Oxalic acid	Amaranthus portulaca			

(S) Common Name of Different Vegetables

<i>Sr.N.</i>	<i>Vegetable crop</i>	<i>Common Name</i>
1.	Tomato	Wolf Apple, Vilayati Baigan
2.	Brinjal	Egg Plant, Aubergine
3.	Lima Bean	Baby Potato, Double Bean, Butter Bean
4.	French Bean	Kidney Bean, Haricot Bean, Snap Bean, Navy Bean
5.	Dolichos Bean	Indian Bean, Hycainth Bean
6.	Broad Bean	Horse Bean, Faba Bean
7.	Winged Bean	Goa Bean, Four angled Bean, Vegetable of 20 th century
8.	Yam Bean	Potato Bean, Misrikand
9.	Bitter gourd	Bitter cucumber, Balsam Pear
10.	Summer squash	Bush Squash, Chappan kaddu, Field pumpkin, Vilayati kaddu
11.	Pumpkin	Bütternut squash, Vegetable of immense value
12.	Ash gourd	White gourd, Wax gourd

Sr.N.	Vegetable crop	Common Name
13.	Ash gourd	White gourd, Wax gourd
14.	Spinach beet (Palak)	Swiss chard, Garden Beet, Beetleaf
15.	Cassava	Tapioca, Mardioca, Yuca, Manioc
16.	Drumstick	Horse raddish tree, Ganigana, Sahijan, Mullakkai, Murrurgi, Muringa
17.	Chekurmanis	Multivitamin Greens, Madura kheera, vegetable of 21 st century
18.	Cylon spinach	Water leaf
19.	Capsicum	Bell pepper, Sweet pepper
20.	Cowpea	Black eyed pea, Southern Pea
21.	Musk Melon	Wholesome food

(T) Seed Rate, Yield, Maximum Area Production and Productivity of Different Vegetables

Sr. No.	Crop	Seed Rate	Yield (t/hac)	Max. Area	Max. Production	Max. Productivity	Introduction Year
1.	Potato	20-35 qnt/hac	-	UP	UP	WB	17th Century
2.	Tomato	125-175 g/hac	-	-	UP	-	-
3.	Chilli	1.5 kg/hac	7.5-10	AP	AP	-	1584
4.	Brinjal	200 g/hac	45-90	WB	-	-	-
5.	Cabbage	375-500 g/hac	-	Orissia	UP	TN	-
6.	Cauliflower	Early : 500-600 g/hac Mid : 350-400 g/hac	12-15 20-30	- Bihar	- Bihar	-	- 1822
7.	Carrot	5-6 kg/hac	-	-	UP	-	-
8.	Onion	Rabi : 10-12 kg/hac Kharif : 12-15 kg/hac	- -	MH MH	MH MH	- -	- -
9.	Garlic	500 kg/hac	10-20	Gujrat	Gujrat	-	-
10.	Okra	Summer, 18-22 kg/hac Kharif : 8-10 kg/hac	-	UP	UP	-	-
11.	Capsicum	250 g/hac [hybrid] 300 g/hac [local]	45.0 25.0	- -	- -	- -	- -
12.	Knol-khol	1-1.5 kg/hac	12-30	-	-	-	-
13.	Sprouting Brocoli	400-500 g/hac	10-15	-	-	-	-
14.	Brussel sprout * Kale	500 g/hac 350-400 g/hac	10-16 10-25	- -	- -	- -	- -
15.	Raddish	9-12 kg/hac	Asian : 15-20 European : 5-7	- -	- -	- -	- -
16.	Turnip	3-4 kg/hac	20-25	-	-	-	-
17.	Cucumber	2.5-3.5 kg/hac	8-12	-	-	-	-
18.	Water Melon	3.5-5 kg/hac	-	-	-	-	-
19.	Musk Melon	3-7 kg/hac	-	-	-	-	-
20.	Bottle gourd	3-4 kg/hac	-	-	-	-	-
21.	Pumpkin	1-5 kg/hac	-	Orissia	Orissia	-	-

Sr. No.	Crop	Seed Rate	Yield (t/hac)	Max. Area	Max. Production	Max. Productivity	Introduction Year
22.	Ridge gourd	3.5-5 kg/hac	—	Orissa	Orissa	—	—
23.	Sponge gourd	2.5-3.5 kg/hac	—	—	—	—	—
24.	Peas - Early	100-120 kg/hac	2.5-3	—	UP	—	—
	Mid and late	80-90 kg/hac	6-10	—	—	—	—
25.	Cowpea	25 kg/hac	5-8	—	—	—	—
26.	Cluster Bean	25-30 kg/hac	3-4	—	—	—	—
27.	Lettuce	400-500 kg/hac	—	—	—	—	—
28.	Amaranthus	1.5-2 kg/hac	10-50	—	—	—	—
29.	Ash gourd	3.5-4 kg/hac	25-30	—	—	—	—
30.	Beet root	7.5-8 kg/hac	25-30	—	—	—	—
31.	Bitter gourd	4-5.5 kg/hac	10-15	—	—	—	—
32.	Drumstick	500 g/hac	52.0	—	—	—	—
33.	French Bean	50-70 kg/hac Bush	5-6	—	—	—	—
34.	Pumpkin	5-6 kg/hac	25-40	—	—	—	—
35.	Spinach	37-45 kg/hac	8-10	—	—	—	—
36.	Sponge Gourd	4.0 kg/hac	15-20	—	—	—	—

(U) Photosynthesis

(a) C₄ Plant : Amaranthus, Globe amaranth (Artichoke)

(b) C₃ Plant : Lettuce, Carrot, Potato, Sweet Potato, Tomato, Sugarbeet

(V) Size of Nursery Bed

Sl. No.	Crop	Area	Size of Nursery Bed
1.	Tomato	1 hectare	50 m × 1.2 m
2.	Brinjal	1 hectare	54 m × 1.2 m
3.	Chilli	1 hectare	180 m × 1.2 m
4.	Cole crops	1 hectare	115 m × 1.2 m

* Double transplanting is most successful in tomato, Brinjal, Cabbage and Cauliflower.

(W) Optimum Soil Moisture Range

Sr. No.	Crop	Optimum Soil Tension	Soil depth (cm)
1.	Potato	30%	15
2.	Tomato	40-50%	30
3.	Brinjal	20-40%	30
4.	Onion	50-65%	10
5.	Chilli	20-40%	30
6.	Cauliflower	25-30%	15

(X) Storage Temperature

Sr. No.	Crop	Temp(°C)	RH(%)	Storage life (Weeks)
1.	Potato	3-4.4	85	34
2.	Tomato ripe	7.2	90	1
3.	Tomato Unripe	8.9-10	85-90	4-5
4.	Brinjal	10-11	92	3-4
5.	Okra	8.9	90	2
6.	Onion	0	70-75	20-24
7.	Cole crops	0-1.7	92-95	4-6
8.	Garlic	0	65	28-36
9.	Sprouting broccoli	4	65	1-2
10.	Carrot.	0.4-4	93-99	6 months

* PGPR (Plant Growth Promoting Rhizobacteria) → Azospirillum, Azotobacter, Pseudomonas fluorescens
Phosphate solubilising bacteria, Bacillus subtilis.

(Y) Types of Vegetable Gardens:

1. Home or Kitchen or Nutritional Garden → Area required for home garden is 250 square meters.
2. Market Garden → Mostly situated near big cities. Intensive cultivation is followed. Many crops are grown simultaneously.
3. Truck Garden → Extensive cultivation is followed one or two crops are grown.
4. Processing Vegetable Garden → Specialized cultivation practices are followed. Mainly grown on contract basis.
5. Vegetable forcing or control environment agriculture → Intensive cultivation is followed. Very small area is used.
6. Vegetable garden for seed production → Special type of vegetables are grown. Contract cultivation.
7. Floating Vegetable Garden → Mainly found in Jammu and Kashmir Shallow rooted vegetables are grown.
8. Roof Garden → Fresh leafy vegetables are grown.

GENERAL

- Vegetable are rich source of vitamins and minerals than other nutrients.
- Vegetable consumption/capita/day.
 1. Recommendation → 300 grammes
 2. Availability → 145 grammes in India
- Out of 300 gram → 125 g of green leafy vegetables + 100 g of roots + 75 g of other vegetables
- India - IInd largest producer of vegetable after china.
- Vegetable crops in India occupy only 2.8% of the total cropped (cultivated) area.
- India accounts for 13.38% of world production of vegetables.
- Productivity of vegetables in India is 14.9 tonnes/hac.
- State having largest area under vegetables → West Bengal
- State having maximum production of vegetables → West Bengal
- State having maximum productivity of vegetables → Tamil Nadu
- Olericulture is a latin term.
- Home or kitchen garden is most ancient type of garden.
- Market garden is very intensive method of vegetable cultivation.
- Truck garden is very extensive method of vegetable cultivation.
- Daily requirement are;
 1. Cereals - 475 gm;
 2. Pulses - 80 gm;
 3. Fruits - 92 gm;
 4. Milk - 200 ml;
 5. Sugar - 40 gm;
 6. Oil - 40 ml
- Green leafy vegetables are rich source of Folic acid.
- Major mineral present in fruits and vegetables → potassium
- Highest potassium content → 1200 mg/100 g.
- Vegetables are not rich in fat content which is less than 0.1% in most of the vegetables.
- Country which is highest consumer of vegetables per unit
 1. Greece → 377 kg/year
 2. Turkey → 327 kg/year

POTATO

- Botanical Name : *Solanum tuberosum*
- Family : Solanaceae
- Origin : South America
- 4th major food of the world after rice, wheat and maize.
- China is 1st in area and production of potato in the world.
- Potato was introduced in India from Europe in early 17th century.
- It is grown in all states except kerala.
- Late blight is most devastating disease in potato.
- Self pollinated but propagated by vegetative means.
- Maximum area under potato is in Alluvial soil.
- Maximum day temperature required below 35°C while max night temperature below 20°C.
- Most of varieties do not tuberize when night temperature in more than 23°C.
- Potato tuber dormancy → 8-10 weeks.
- Hills accounts for only 5% of area under potato.
- Ridge and furrow-most popular method of potato planting.
- Harvesting of Potato is done before the temperature rise from 30°C. It is completed by end of January.
- About 82% area under potato lies in the plains where crop is grown during short days of winter from October-March.
- Seed plot technique in potato was developed by Dr. Puskarnath.
- Dehauling in Potato is done 10-12 days before harvesting (Jan.)
- India's rank - 5th in area and production of Potato.
- Tubers are treated with 1% thiourea + 1 PPM GA₃ for 1 hour to break dormancy.
- 40-45 g TPS (true potato seed) is enough to plant one hac. crop.
- It is important crop for higher population areas of Asia because it produces more dry matter food.
- Late blight of potato occurs every year in the hills but in plains only occasionally.
- Cyst Nematode-southern hills; potato tuber moth - warm regions of Maharastra, Karnataka and MP.
- Wart disease is confined to the Darjeeling hills of West Bengal.
- For best yield potato needs long day conditions during growth and short day conditions during tuberization.
- N₂ is most important nutrient for potato crop.
- Upto date is most popular variety of potato in India.
- Solanin - 5 mg/100 g
- Potato is unfit for consumption if solanin is greater than 20 mg/100 g
- Earthing up of potato is done 40 days after sowing.
- Potato contains → 2% high value protein
- It contain 17 mg/100 g Vitamin-C and 568 mg/100 g potassium.
- CPRI was established in year 1949 at Shimla. (CPRI : Central Potato Research Institute)
- Potato contains 22% carbohydrates.

VARIETIES :**(A) Early Maturing**

- | | |
|-----------------------|------------------|
| 1. Kufri Chandramukhi | 2. Kufri Lavkar |
| 3. Kufri Ashoka | 4. Kufri Jawahar |

(B) Late Maturing

- | | |
|---------------|----------------|
| 1. Kufri Deva | 2. Kufri Megha |
|---------------|----------------|

(C) Mid Maturing

- | | |
|-------------------|------------------|
| 1. Kufri Sindhri | 2. Kufri Jyoti |
| 3. Kufri Lalima | 4. Kufri Swarna |
| 5. Kufri Chipsoma | 6. Kufri Badshah |
| 7. Kufri Sutlej | 8. Kufri Giriraj |
| 9. Kufri Pukhraj | |

(D) Introduced Variety

Upto date (from North Ireland) → most popular variety

(E) Clonal Selection

Kufri Red, Kufri Safed

(F) Hybrids

- | | |
|--|--|
| 1. Kufri Chandramukhi : S-4485 × Kufri Kuber | 2. Kufri Sheetman : Phulwa × Craigs defiance |
| 3. Kufri Alankar | 4. Kufri Chamatkar |
| 5. Kufri Jyoti | 6. Kufri Naveen |
| 7. Kufri Jeevan | 8. Kufri Khasigaro |
| 9. Kufri Moti | 10. Kufri Luvkar |
| 11. Kufri Deva | 12. Kufri Kuber |
| 13. Kufri Kundan | 14. Kufri Sindhuri (K. Red × K. Kundan) |
| 15. Kufri Badshah : K. Jyoti × K. Alankar | |

(G) Late blight Resistant Varieties

- | | |
|-----------------|-----------------|
| 1. Kufri Jyoti | 2. Kufri Moti |
| 3. Kufri Megha | 4. Kufri Kundan |
| 5. Kufri Jeevan | 6. Kufri Naveen |
| 7. K. Kuber | |

(H) Variety Suitable for Plains

- | | |
|---------------|---------------|
| 1. K. Ashoka | 2. K. Alankar |
| 3. K. Pukhraj | 4. K. Anand |

* *Kufri Thenamalai* : Cyst nematode and late blight resistant

* *Kufri Kuber* : Resistant to black scurf

* *Kufri chipsona II* : Tolerant to frost and late blight

* *Kufri Sherpa and Kufri Jyoti* : Immune to wart disease and susceptible to cracking

* *Kufri Suvarna* : Resistant to late blight and cyst nematode

* *Kufri Badshah* : Resistant to late blight, early blight and potato virus × (Multiple resistant variety)

* *Kufri Chipsona I and II* : Suitable for processing purpose

* *Kufri Pukhraj and Kufri Sindhuri* : Resistant to early blight

* *Kufri Sheetman* : Resistant to frost

* Best temperature during planting of potato is 20-30°C

TOMATO

- Botanical Name : *Lycopersicon esculentum*
- Family : Solanaceae
- Origin : South America
- Tomato is universally treated as 'Protective food'.
- No. 1 processing vegetable in the world.
- Export quality tomato are produced in Nasik and Pune in Maharashtra while Bangalooru in Karnataka.
- Tomato puree and tomato paste have great export demand.
- Tomato has 5 forms :
 - (i) Cherry tomato ; (ii) Pear tomato ; (iii) Common tomato ; (iv) Potato leaf type ; (v) Upright tomato.
- Lycopene is responsible for red colour in tomato and it is highest at 21-24°C. Production of this pigment drops rapidly above 27°C.
- Seed treatment with 2, 4 D @ 2-5 ppm gives early fruit set and leads to parthenocarpy.
- Training and Pruning are followed in indeterminate type of tomato. (Single stem system)
- Staking is followed in indeterminate type of tomato.
- About 33% of total area (tomato growing) is covered by F₁ hybrids which is highest among vegetables.
- Excessive rains adversely affect its fruit set causing flower drop.
- In Punjab, only spring summer crop is taken due to heavy incidence of tomato leaf curl virus in Autumn.

VARIETIES

(A) Introduction

- | | |
|----------------|----------------|
| 1. Roma | 2. Labonita |
| 3. Sioux | 4. Marvel |
| 5. Best of all | 6. Money maker |
| 7. Tip Top | 8. Ageti |

(B) Selection

- | | |
|---------------------|---------------|
| 1. Improved meeruti | 2. Sonali |
| 3. Pant Bahar | 4. Arka Vikas |
| 5. Arka Saurabh | |

(C) Hybrid

1. Pusa early dwarf : Improved Meeruti × Red cloud
2. Pusa ruby : Sioux × Improved Meeruti : Best combiner variety
3. Pusa Gaurav : Glamour × Watch
4. Marglobe : Marvel × Globe
5. Pusa Red Plum : *L. esculentum* × *L. pimpinifolium*
6. Sweet-72 : Pusa Red Plum × Sioux
7. Pusa Sheetal
8. Hissar Lalima
9. Hissar Lalit

10. Hissar Arun
11. Punjab Chhuhara
12. *Pusa Uphar* : Suitable for processing

(D) Mutants

- | | |
|----------|---------------------|
| 1. S-12 | 2. Maruthan |
| 3. PKM-1 | 4. Pusa Lal Meeruti |

(E) Public Sector Hybrid

- | | |
|-----------------|----------------|
| 1. Arka Vishal | 2. Arka Vardan |
| 3. Arka Abhijit | 4. Rajeshree |
5. Pusa Divya (F₁ Hybrid) - developed using Male sterile line.

(F) Private sector hybrid

- | | |
|--------------|------------|
| 1. Naveen | 2. Avinash |
| 3. Meenakshi | 4. Manisha |
5. Krishna
- Nematode and Bacterial wilt resistant variety : Arka Vardan
 - Bacterial wilt resistant varieties —

1. Shakti	2. Arka Alok
3. Arka Abha	4. Sonali
 - Sel-120 : Ist root knot resistant variety of tomato
Hissar and lalit
 - Verticillium wilt and Fusarium wilt resistant variety : 1. Pant Bahar
 - Leaf curl resistant variety : 1. Hissar Gaurav 2. Hissar Anmol
 - F₁ Hybrid variety of tomato : Pusa Divya
 - Indeterminate type

1. Pusa Ruby	2. Arka Saurabh
3. Arka Vikas	4. Pant Bahar
5. Best of All	6. Sioux
 - For Low temperature region : Pusa Sheetal
 - For High temperature region : Pusa H-1
 - High and low temperature region : Pusa Sadabahar
 - Extreme early variety : Hissar Arun
 - Breaker stage : (10% lycopene) suitable for long distance transport
 - B and Zn are important micronutrient required for tomato cultivation
 - Foliar spray of PCPA (20 PPM) is very effective in increasing fruit set and yield of tomato.
 - Cluster of flowers known as - 'Truss'
 - Pusa Rohini : Recently released variety
 - Hissar Anmol and Pusa Red Plum are Interspecific hybrids.
 - Arka Meghali : Suitable for rainfed condition
 - Arka vikas : Suitable for drought condition
 - Tomato variety developed by use of biotechnology – Flaursaur.
 - Genetically modified (GM) tomatoes are resistant to Alzheimers disease.
 - Arka Abhijit- Suitable for long transport.

BRINJAL

- Botanical Name : *Solanum melongena*
- Family : Solanaceae
- Origin : Indo-Burma
- India-IInd rank after China in brinjal production.
- Dry fruit contain goiterogenic principle.
- Anthocynin pigment present in Brinjal.
- Heterostyly is common in Brinjal.
- Orobusche is serious weed affecting solanaceous crops in some areas.
- 2 4-D chemical is used to control weeds.
- Dark purple brinjal have more vitamin-C than those of white skin.
- Maximum fruit setting takes place in "long styled flowers" (70-80%)
- 14% area under brinjal is covered by hybrid varieties.
- Brinjal fruits are good source of Vitamin-B.
- Opening of flower in Brinjal at 6-7.30 am in summer (11.15 am in winter)
- White brinjal is preferred by diabetics patient.

VARIETIES

(A) Selection

- | | |
|------------------------------|-------------------------------|
| 1. Pusa Purple long | 2. Pusa Purple cluster |
| 3. Pant Samrat | 4. Pusa purple round |
| 5. Arka Shirish : Green type | 6. Arka Kusumkar : Green type |
| 7. Arka Sheel | 8. Punjab Chamkila |
| 9. Punjab Neelum | 10. Punjab Bahar : Round type |
| 11. Azad Kranti | 12. Arka Nidhi |

(B) Hybrid

1. Pusa kranti : PPLX Hyderpure × Wynad local → long type
2. Pant Rituraj : T-3X PPC → Round type
3. Pusa Anupam : Pusa Krantix PPC → long type
4. Punjab Barsati : PPC X H-4
5. Pusa Uttam : GR × Rituraj
6. Pusa Bindu : GR × Rituraj
7. Hissar Shyamal
8. Hissar Jamuni
9. Pusa Upkar

(C) Public sector hybrid

1. Pusa Anmol

2. Arka Navneet - Round type → IHR-22-1 × supreme – highest yielding

3. Vijay

4. Azad

(D) Private Sector Hybrid

1. Vardan

2. Nisha

3. Suphal

4. Shiva

5. Vaishali - Bicolour Variety

● Bacterial wilt resistant varieties

1. Pusa Anupam

2. Pusa Purple cluster

3. Arka Nidhi

4. Arka Keshav

5. Neelkantha

6. Pant Rituraj

● Phomopsis blight resistant varieties

1. Pusa Bhairav

2. Pusa Anupam

3. Florida market

● Phomopsis blight and Bacterial wilt resistant variety : Pant Samrat

● NDB-25 : It has soft joint and is easy to harvest.

● There is no fruit setting in pseudo - short and short styled flowers.

● Aphid resistant variety of Brinjal : Annamalai

● Extra early maturing variety of Brinjal : Pusa purple long.

● Diabetes : White brinjal

● Mimosa pudica increases insect activity

● Pusa Ankur : New variety

● Little leaf of Brinjal resistant varieties : Arka Sheel, Manjarigota.

● Yield increased by Cu application in Brinjal.

● Brinjal is susceptible to severe frost.

● Foliar spray of potassium nitrate (KNO_3 - 2000 ppm), boron and zinc sulphate (500 ppm) increase yield of brinjal.

● Arka Anand : Suitable for long transport.

CAPSICUM AND CHILLI

- Botanical Name : *Capsicum annum*
- Family : Solanaceae
- Origin : Mexico
- Chilli and capsicum both belong to same family as well as same spp. that is capsicum annum.
- Capsicin is pungent principle found in chilli.
- *C. annum* and *C. frutescence* have 'white flower' while *C. pubescence* have purple flowers.
- China - major capsicum (Bell pepper) producing country of the world.
- India is a major producer, consumer and exporter of chilli in the world.
- Long dry periods are likely to result in flower shedding and fruit fall.
- June-October is the major chilli growing period in South India.
- Dry chilli generally contains about 6% stalks + 40% pericarp + 54% seeds.
- Paprika - Capsicum fruitscence; variety - Arka Abir → Suitable for colour extraction
- 7 g good quality seed provides 100 plants.
- Chilli has bidirectional root system.
- Chilli is richest source of vitamin C.

CAPSICUM VARIETIES —

(A) Introduced

- | | |
|----------------------|------------------|
| 1. California wonder | 2. Yolo wonder |
| 3. World beater | 4. Chinese Giant |
| 5. Golden wonder | 6. Bullnose |
| 7. Sweet Banana | |

(B) Selection

1. Arka Mohini
2. Arka Gaurav
3. Arka Basant

(C) Public Sector Hybrid

1. Pusa Deepti
2. Green Gold

(D) Private Sector Hybrid

- | | |
|-----------------|-----------|
| 1. Early Bounty | 2. Bharat |
| 3. India | 4. Lario |
| 5. Hira | |
- Pusa Meghdoot : First F1 hybrid by public sector.

CHILLI VARIETIES —**(A) Selection**

1. Kalyanpur Yellow

2. Sabour Angar

3. Arka Lohit

4. Bhagyalaxmi

5. Sindhur

(B) Hybrid

1. G-S

2. Bhaskar

3. NP-46-A

4. Pusa Jwala → NP-46-A × Puri Red

5. Punjab Lal

6. Pant-C-1 → NP-46-A × Khandari

7. Andhra Jyoti → Cherry type fruits

(C) Mutant → MDU-1**(D) Private sector hybrid**

1. Tejawini

2. Champian

3. Gayatri

4. Agni

5. Delhi hot

6. Skyline

(E) Public Sector Hybrid : CH-1 → Released by PAU - Ludhiana using male sterile line.

- Fruit rot resistant variety → K-2
- Leaf curl resistant variety → Pusa Jwala, Pusa Sadabahar, Pant-C-1
- 15 Irrigations are required in capsicum
- NAA and tricontinol (vipul) is used to control fruit drop.
- Leaf curl, TMV, wilt and dieback resistant variety → Punjab Lal, Punjab Surakh → Multiple disease Resistance.
- Bacterial wilt resistant variety → Utkal Rashmi, Arka Gaurav.
- Jwalamukhi : Suitable for HDP
- Arka lohit : Tolerant to powdery mildew
- Bhaskar : Yellow anther type, Resistant to thrips and mites
- India's share in total export of chilli in world is 4%
- Rains during Dec-Nov, result in the incidence of powdery mildew.
- Opening of flower at 5 am.
- Pusa Sadabahar variety of C. frutescence is perennial in nature.
- 3-10 days for sun drying to lower moisture from 80 to 10%.
- Punjab Lal : for colour extraction.
- HP - leading supplier of capsicum in off season.
- Green to dry chilli ratio = 10 : 1
- Chilli variety - CH-1 → developed by using Genetic Male sterile (GMS) line.
- Excess of N with water stress : Blossom end rot of fruits of capsicum.
- Variety with thin pericarp, less seeds, strong spike is suitable for drying.

OKRA

- Botanical Name : *Abelmoschus esculantus*
- Family : Malvaceae
- Origin : Africa
- After onion it accounts 70% of the 30% exchange earnings from export of vegetables.
- Resistance to YVMV have been the major breeding objective in Okra.
- Pusa Sawani is adopted to larger pH range and has tolerance to salinity.
- Arka Abhay and Pusa-A-4 give quick branching after pruning.

VARIETIES

(A) Selection

1. Pusa Mukhmali
2. Gujrat Behdi No. 1

(B) Introduction

1. Clemon's spineless - Introduction
2. Perkins Long Green

(C) Hybrid

1. Pusa Sawani : Pusa Makhmali × IC-1542 : day neutral variety, spinless
2. Punjab Padmani : *A. esculentus* × *A. manihot* spp. manihot
3. Parbhani kranti : *A. esculentus* × *A. manihot* spp. manihot
4. Arka Anamica : *A. esculentus* × *A. manihot* spp. tetraphyllus
5. Arka Abhay : *A. esculentus* × *A. manihot* spp. manihot

(D) Private sector hybrid

Panchali, Adhunik, Supriya, Varsha

(E) Mutant

EMS-8

(F) YVMV resistant varieties

1. Arka Anamira
 2. Arka Abhay
 3. Parbhani kranti
 4. Punjab Padmani
 5. Pusa Sawani
 6. Varsha Upkar
 7. Hissar Barsati
- Pusa ; Susceptible to YVMV

- Varsha Upkar : Suitable in disease prone areas (YVMV)
- It is a tropical crop.
- ~~The roots and stems are used for clearing cane juice in preparation of Gur.~~
- High iodine content of fruit helps in controlling goitre.
- Arka Abhay is a sister line of Arka Anamika.
- Perkins long green : Suitable for hilly region of North India.
- Punjab Padmani : Possesses field resistance to YVMV and tolerance to jassids and cotton boll worm.
- Export standard : 6-8 cm long fruits.
- Dr. Harbhajan Singh started systematic research work on Bherdi.
- At temperature above 42°C, flower bud drops.
- For normal growth and development of Okra a temperature between 24°C and 28°C is preferred.
- Okra give 300-500% crop land use efficiency as an intercrop in cassava and cucurbits.
- Longer fruits are used for fresh market.

COLE CROPS

(I) CABBAGE

- Botanical Name : *Brassica oleracea ver capitata*
- Family : Cruciferae
- Origin : Mediterranean region
- Cabbage covers 4% of total area under vegetables
- India rank IIIrd in cabbage production.
- Hybrids occupy 30.0% of the area under cabbage production.
- It has anticancer property due to presence of Indole-3-carbinol.
- Fruit type - Siliqua.
- Round head variety mature earliest followed by conical varieties.
- Spraying 50 ppm boric acid at flowering enhance the seed yield.
- Sauerkraut : Value added product prepared from white cabbage. It is used to cure scurvy.
- Wild cabbage : *B. Oleracea var sylvestris*.
- Savoy cabbage - *B.O. var sabuda*.
- Cytoplasmic and genetic male sterility found in cabbage is also helpful for the production of F_1 hybrid.

Varieties —

(A) Introduction

- | | |
|-----------------------|--------------------------------------|
| 1. Golden Acre | 2. Copenhagen market – Early variety |
| 3. September | 4. August – Early variety |
| 5. Glory of Enkhuizen | 6. Red Acre |

(B) Selection

1. Pride of India – Early and round variety
2. Pusa Ageti

(C) Hybrids

1. Pusa Drumhead : F_1 hybrid from Japan → Black leg or dry rot resistant variety
2. Pusa Mukta : Black rot resistant variety
3. Pusa Synthetic
4. Pusa Sambandh : Suitable for High density planting, wider adaptability, early maturing, Synthetic variety

(D) Private Sector Hybrids

1. Questo
2. Sree Ganesh Gol
3. Uttam
4. Bajrang
5. Green Boy and Green express : Hot weather hybrids (30-35°C)
6. Sudha
7. Stone head

8. Green challenger

9. Green cornet

10. Savarna

11. Vishesh

- Cabbage grown in saline soil is more prone to black leg disease.
- A spray of CCC or SADH increases the low temperature resistance in cabbage.
- Cabbage produces seeds in the temperate areas only.
- Cabbage bears seeds in special kind of bicarpillary pod called as "Siliqua".
- The popularity of F_1 hybrid cultivars in cabbage is due to comparatively easier and cheaper method of hybrid seed production due to presence of genetic mechanism of self incompatibility.
- Pusa Ageti : 1st tropical variety developed for cultivation under high temperature conditions.
- September : Introduction from Germany, Popular in Nilgiri hills.
- Seedling : Sowing of seed in thermocole plates : followed in cabbage.
- Growth of most of cabbage vars is arrested when temperature rises above 25°C.
- Early variety : 60-80 days, Late : 100-120 days.

(II) CAULIFLOWER

- Botanical Name : *Brassica oleracea* var. *botrytis*.
 - Family: Cruciferae
 - Origin : Mediterranean region
 - Cauliflower is thermo-sensitive crop.
 - Varieties
- | Varieties | Seed rate | Yield | Sowing time | Maturing time |
|--------------|---------------|-------------|------------------|---------------|
| Early | 500-600 g/hac | 12-15 t/hac | Mid May-Mid June | Sept-Oct |
| Mid and late | 350-400 g/hac | 20-30 t/hac | July-Aug | Nov-Dec |

Cauliflower	Sowing Time	Harvesting Time	Growth Temperature
(A) Early	Mid May-Mid June	July end	20-27°C
(B) Mid early	July end	Sept end	12-16°C
(C) Mid late	Aug-end	Sept-end	12-16°C
(D) Late	Sept end	Oct end	10-12°C

- Blanching is a method to protect curd from attaining yellow colour after their direct exposure to sun and to arrest enzymatic activity.
- Cauliflower is only crop in group of cole crops in which the intermediate stage of curding lies between vegetative and reproductive stage.
- Most of late type (snowball) have self blanched habit.
- It was introduced in India in 1822 by Dr. Jenson from London
- Pusa Himjyoti has self blanched habit.
- It requires 5-8 irrigation during growth.
- pH of soil for maximum yield : 5.5 to 6.5

Varieties —

(A) Introduced

1. Improved Japanese

(B) Selection

1. Pusa Himjyoti

2. Pusa Snowball K-1

- 3. Pusa Ketki
- 4. Pusa Deepali
- 5. Pant Shubhra
- 6. Pusa Aghani
- (C) Hybrid
 - 1. Pusa Shubhra
 - 2. Pusa Aghani
- (D) Synthetic
 - 1. Pusa early synthetic
 - 2. Pusa synthetic
 - 3. Pant Gobi-3
- (E) Private Sector Hybrid
 - 1. Candid charm
 - 2. White flesh
 - 3. Cash more
 - 4. Early Himlata
 - 5. Himani
 - 6. Nath Ujwala
 - 7. Nath Shweta

● Sclerotia rot resistant → Pusa Snowball K-2 S.

(F) Blackrot, Curd and inflorescence blight resistant varieties –

- 1. Pusa Shubhra
- 2. Pusa Snowball K-1
- (G) Early variety
 - 1. Early Kunwari
 - 2. Pusa early synthetic
 - 3. Pusa Deepali
 - 4. Pusa Ketki
- (H) Mid Early
 - 1. Improved Japanese
 - 2. Pusa Sharad
 - 3. Pusa Aghani
- (I) Mid Late
 - 1. Pusa Synthetic
 - 2. Pant Shubhra
 - 3. Pusa Shubhra
 - 4. Pusa Himjyoti
- (J) Late
 - 1. Pusa Snowball
 - 2. Pusa Snowball K-1 : Tolerant to black rot disease

- Pusa Himjyoti is only variety which can be grown from April to July in the hills.
- Scooping : Removal of central portion of curd for easier initiation of flower stalk in cauliflower.

(III) KNOL KHOL

- Botanical Name : *Brassica oleracea var. gongylodes*
- Family : Cruciferae
- Origin : Mediteranean region
- Best time for planting : October

Variety —

- (A) Introduced
 - 1. White vienna
 - 2. Purple vienna
 - 3. King of North
 - 4. Golithwhite (Sadashiv)
 - 5. Sutton's earliest purple
 - 6. Purple speck - earliest variety

- In India, knol-khol is more popular in Kashmir. Early purple vienna - (Verma, Pocha)
Knol-khol (a) for seed production - Annual (b) for flowering, fruiting → Biennial
- Brussel sprout and knol-khol are typically biennial crops while Broccoli comprises of both annual as well as biennial.

(IV) BRUSSELS SPROUT (Mini Cabbage)

- Botanical Name : *Brassica oleracea* Var. *gemmifera*
- Family : Cruciferae
- Origin : Mediterranean region
- Fairly Rich in Vitamin A
- Protein content : 4.4%

Varieties —

- | | | |
|--------------------|-----------------------------------|-------------------|
| 1. Hilds ideal | 2. Rubine - F ₁ hybrid | 3. Jade cross |
| 4. Amager Market | 5. Danish Prize | 6. Catskill |
| 7. Long Island | 8. Early Mom | 9. Dwarf improved |
| 10. Frontier Zuerg | 11. Kvik | |

- Excessive Application of Potash imparts bitterness, affects quality

(V) SPROUTING BROCCOLI

- Botanical Name : *Brassica oleracea* Var. *italica*
- Family : Cruciferae
- Rich source of sulphoraphane - Compound associated with reducing risk of cancer.

Varieties —

- | | | |
|-------------------|---------------------|------------------|
| 1. Palam Samridhi | 2. Decicco | 3. Greenbud |
| 4. Sparten early | 5. Green Mountain | 6. Italian Green |
| 7. Green Head | 8. Coastal Atlantic | 9. Pusa KTS-1 |

- Early aid type are Annual while late type are - biennial in nature.
- It has 130 times more vitamin A than cauliflower and 22 times more than cabbage.
- Excessive use of cole crops result in swelling of thyroid glands and goitre disease.
- In Dry condition - the crop becomes fibrous.
- Order of cole crops - Papaverals
- Inflorescence - Cymose.
- Mass selection is most common method used in cross-pollinated-crop for the improvement of qualitative characters governed by single or few genes.
- Back cross method is used to transfer resistance governed by one or few dominant or recessive genes.
- Palam Samridhi : Mainly recommended for subtropical condition.

(VI) KALE

- Botanical Name : *Brassica oleracea* Var. *acephala*
- Family : Cruciferae

Varieties —

- | | | |
|----------------------------|---------------|---------------------|
| 1. Dwarf green | 2. Dwarf Moss | 3. Hamburger Market |
| 4. Karamsag - Tall variety | 5. Scottish | 6. Siberian |

- It is the hardiest crop.
- Karamsag is mostly grown in J & K.

ROOT CROPS

(I) RADDISH

- Botanical Name : *Raphanus sativus*
- Family : Cruciferae
- Origin : Europe
- Arka Nishant : Resistant to white rust, pithiness, premature bolting, forking (Multiple disease resistance)

(A) Asiatic Varieties

- | | | |
|-----------------|--------------|-------------------|
| 1. Pusa Chetki | 2. Pusa Desi | 3. Pusa Rashmi |
| 4. Arka Nishant | 5. Newari | 6. Japanese White |
| 8. Punjab Safed | | |

(B) European Varieties

- | | |
|-----------------|---|
| 1. Chinese Pink | 2. Rapid Red, White tipped – Globe Shaped |
| 3. Scarlet long | 4. Scarlet Globe |
| 5. White Icicle | 6. Pusa Himani |

(C) Hybrid Varieties –

1. Pusa Himani : Raddish black × Japanese White
2. Pusa Safed : White-5X × Japanese White
3. Pusa Rashmi : Green type × Desi type

- Pusa Chetki is suitable for growing in hotter months.
- Sporohytic self incompatibility.
- Temperature varieties are biennial in nature.
- Tropical variety can produce seeds both in tropical and temperate region of India.
- Pusa Himani only variety which can be grown throughout the year.

(II) CARROT

- Botanical Name : *Daucus carota*
- Family : Umbelliferae
- Origin : Afganistan
- Kangi – beverage is prepared from black carrot.
- Protandry found in carrot.
- 2 groups of carrot – (A) Tropical (B) Temperate

(A) Asiatic/tropical

1. Pusa Kesar
2. Pusa Meghali : highest vitamin A

(B) European/temperate

1. Pusa Yamdagini
2. Chantenay - Suitable for processing and storage
3. Zeno : Suitable for Nilgiri hills, introduced from Germany
4. Danvers
5. Nantes half long
6. Early nantes

- Carrot grown on heavy soils are rough and coarse than on light soils.
- Selection - Hissar Garlic

- Temperate type form roots both under temperate and tropical climate but seed setting only in temperate climate.
- Hybrid

1. Imperator : Nantes × Chantenay
2. Pusa Kesar : Local red × Nantes half long
3. Pusa Meghali : Pusa Kesar × Nantes
4. Pusa Yamdagni : EC-9981 × Nantes

- Asiatic type - high yielder but poor in quality and carotene and rich in anthocyanin
- European - Orange coloured, rich in carotene, stump and blunting core.
- Temperate biennial where as tropical types are annual.
- Carrot is an annual herb for root production and biennial for flowering and fruit set.

(III) BEET ROOT

- Botanical Name : *Beta vulgaris*
- Family : Chenopodiaceae
- Origin : Mediterranean region
- Colour of root is due to presence of
 - (a) Red Violet pigment → β -cyanins
 - (b) Yellow pigment → β -xanthins

Varieties —/

1. Detroit dark red
2. Crimson Globe
3. Early wonder
4. Crosby Egyptian

- Inflorescence - Spike.
- Beet root does'nt have any Indian variety.
- A gram of seed ball counts about 50 seeds.
- Most productive at : 20-22°C.
- Thinning is compulsory in beet root.
- Beets are harvested when they attain a diameter of 3.5 cm.
- Beet root is a rich source of folic acid, essential for pregnant women to reduce risk of *spina bifida*.

(IV) TURNIP

- Botanical Name : *Brassica rapa*
- Family : Cruciferae
- Origin : Indo-China
- Inflorescence : Terminal raceme.
- Turnip has strong sporophytic self incompatibility.
- NaCl and CO₂ is used to overcome self incompatibility.
- Thinning is important in turnip to maintain optimum plant to plant spacing and required population.
- Two types :

(A) Asiatic

1. Pusa kanchan
2. Pusa swati
3. Punjab Safed

(B) European

1. Golden Bold
2. Pusa Swarnima
3. Pusa Chandrima

- It can be grown at an elevation of 1500 msl or above but it is not suitable for growing in low lands of wet tropics.

BULB CROPS

(I) ONION

- Botanical Name : *Allium cepa*
- Family : Alliaceae
- Origin : Central Asia
- Rich source of vitamin B
- India's rank-IInd in area and production after china.
- India's rank IIIrd in export in the world (12% of total world's export).
- Netherlands is the leading exporter of onion (21%), IInd → Spain
- Onion accounts for 77% of total foreign exchange earning among fresh vegetables
- Maharashtra-leading state with 23.4% area and 27.5% production under onion.
- Potato onion/underground onion/Multiplier onion - *Allium cepa* var *aggregatum*.
- Tree onion - *Allium cepa* var *viviparum*.
- Pollinated chiefly by honey bees.
- Optimum temp. for bulb development – 20-25°C.
- Temperature is more important than day length in seed production.
- Daylength more important than temperature for bulb production.
- Zn Application (1-3 ppm) increases yield as well as improves quality.
- Lassaogon in Maharashtra is the biggest onion market in India.
- Umbellate inflorescence.
- Flower colour - white or bluish.
- Highly cross pollinated due to protandry.
- Anthesis → 5-9 am

Varieties —

(A) Introduction

1. Brown Spanish
2. Early Grano
3. Bermuda Yellow

(B) Selection

- | | |
|--|------------------------|
| 1. Pusa Ratnar | 2. Pusa Red |
| 3. Pusa White Round | 4. N-53 |
| 5. Arka Niketan | 6. Arka Kalyan |
| 7. Arka Pragati | 8. Arka Bindu |
| 9. Nasik Red | 10. Agrifound Dark Red |
| 11. Patna Red | 12. Bangalore Rose |
| 13. Pusa White Flat → Suitable for dehydration | |

(C) Selfing Variety : Pusa Madhvi

(D) Hybrid

1. Arka Pitambar → White × Red

2. Arka Kiritiman

3. Arka Lalima

- Kharif season : Arka Kalyan, N-53, N-241 (Both season = Arka Pragati)
- Purple blotch resistant varieties : 1. Arka kalyan ; 2. Nasik Red.
- Long day variety : 1. Brown spanish 2. Early Grano → Good for Salad [Both yellow coloured variety]
- Male sterile lines have been isolated in Pusa red.
- Arka Bindu and Agrifound Rose are suitable for export.
- Three variety of onion are recommended for growing as Green Onion →
 1. Early Grano
 2. Pusa white flat
 3. Pusa white round
- Small onion varieties : 1. Bangalore Rose 2. Arka Bindu 3. Agrifound Rose → Pickling type variety
- Multiper onion varieties : 1. Agrifound Red, CO-3, CO-4
- Dehydration ratio - 10 : 1
- Largest cultivated onion varieties : Orange and yellow
- Onion is used against sunstroke

(II) GARLIC

- Botanical Name : *Allium sativum*
- Family : Alliaceae
- Origin : Central Asia
- India's rank : IInd in Area
IIIrd in Production
- Egypt - ranks 1st in productivity.
- Garlic is sexually sterile diploid.
- Frost hardy crop.
- In India, mostly short day types are grown.
- Harvesting period → March - April.
- Allicin is the antibacterial substance of Garlic.
- Curing is done to remove excess moisture.
- Export quality bulb → 40-60 mm diameter with 10-15 cloves in each bulb.
- Allin - Water soluble amino acid present in Garlic.
- Garlic is produced only in one season - winter.

Varieties —

- | | |
|-------------------------------------|------------------------------|
| 1. Godavari | 2. Sweta |
| 3. Agrifound white (G-41) → TSS-41% | 4. Yamuna safed (38-40% TSS) |
| 5. Agrifound Parvati | 6. G-282 → Big size clove |
- Agrifound Parvati → long day type variety, Big sized clove, can be grown only in northern hills.
 - Critical day length for bulbing → 12 hrs.
 - Borax @ 10 kg/hac increases bulb size and yield.
 - (G-282) → earliest maturing variety, suitable for export.
 - Longer the day length given to variety, higher the yield.

CUCURBITS

(I) CUCUMBER

- Botanical Name : *Cucumis sativus*
- Family : Cucurbitaceae
- Origin : India
- Optimum temperature for growth → 26.4°C.
- Ethrel increases no. of female flower and fruit yield (150-200 PPM).
- Open pollinated cultivars of cucumber are monoecious.
- GA₃ and Silver Nitrate (AgNO₃) induce male flower on gynoecious cucumber.
- Cucumber-IInd most widely cultivated cucurbit after water melon.

Varieties —

(A) Introduction

1. Japanese long Green
2. Straight eight
3. Poinsett
4. China long

(B) Selection : Sheetal

(C) Hybrid

1. Himangi → Poinsetta × Kalyanpur Ageti, Resistant to Bronzing.
2. Phule subhangi → Poinsetta × Kalyanpur Ageti, Resistant to Bronzing.

(D) Public Sector Hybrid

1. Pusa Sanyog : It has gynoecious female parents

(E) Private Sector Hybrid : 1. Priya

- Daria cultivation is followed in cucurbits.
- Among cucurbits : Muskmelon - most suitable for daria cultivation
- Poinsetta Resitant to PM, DM, anthracnoses, angular leaf spot (Multiple disease resistant variety)
- Cucumber mosaic resistant varieties —
 1. Tokoyo Long Green
 2. Chinese long
 3. Winscrimson
 4. Table green
- Fruits are good for people suffering from constipation, jaundice and indigestion.
- It is thermophilic and frost susceptible crop
- Optimum temp favouring anthesis and dehiscence is → 13-18°C
- Japanese long Green, straight Eight and Pusa Sanyog - restricted to temperature region only
- White spine colour is indication for edible maturity in slicing cucumber while Black in pickling cucumber.
- Light intensity and day length influence anthesis than temperature. Temperature influences another anther dehiscence and pollen fertility.

(II) WATER MELON

- Botanical Name : *Citrullus lanatus*
- Family : Cucurbitaceae
- Origin : Tropical Africa
- Fruits contain 95% water.
- White heart at central position shows poor quality fruits.
- Harvesting at full mature stage.
- Anthracnose + Powdery mildew + downey mildew resistant var → Arka Manik
- Cucurbitacin E is main bitter substance (Tetracyclic terpenes).
- Potassium contains 160 mg per 100 g.
- Arka Manik is suitable for long distance transport.

Varieties —**(A) Introduction**

- | | |
|---------------------|----------------------------|
| 1. Asahi Yamato | 2. Sugar Baby → 11-13% TSS |
| 3. Improved Shipper | 4. Dixie cream |
| 5. Furken | 6. New Hemisphere midget |

(B) Selection

- | | |
|---------------------|---|
| 1. Durgapura Meetha | 2. Durgapura Kesar — Yellow fleshed variety |
| 3. Pusa Rasal | |

(C) Hybrid

1. Arka Manik : IIHR × Crimson Sweet, 11-12% TSS
2. Arka Jyoti : IHR-20 × Crimson Sweet, 11-12% TSS
3. Pusa Bedana (triploid) : Tetra-2 × Pusa Rasal (Seedless Variety)

It is released by Dr. Kihara.

(D) Private Sector Hybrid

- | | |
|-----------|----------|
| 1. Madhur | 2. Milan |
|-----------|----------|

- Seed maturity and edible maturity coincide with each other.
- TSS range : 8-13%
- Yield losses upto 30% have been observed due to weeds.
- Metallic sound at the time of Harvesting shows : immaturity
Heavy dull sound at the time of Harvesting shows : maturity
- Yellow tinge/brown spot where it rests on ground, indicate maturity.
- Presence of Pigment + Anthocyanin + lycopene.

(III) MUSK MELON

- Botanical Name : *Cucumis melo*
- Family : Cucurbitaceae
- Origin : Tropical Africa
- Whole some fruit
- Pickling Melon : *C. Melo var conomon*
- Mangō or Lemon Melon : *C. Melo var chito*
- High temperature at the time of fruit maturity and ripening increases the sweetness.

- Musk melon is harvested at full slip stage (except Hara Madhu) - Netting.
- Anthesis take place at 10 am at temperature of 22-29°C.
- Maximum no. of fruits with highest TSS is produced between 9th and 12th (bud) nodes on the main stem.
- Musk Melon is used in icecream in Western countries.
- TSS range 11-17% present in most of varieties.

Varieties —

(A) Selection

- | | |
|------------------------------------|-----------------|
| 1. Durgapura Madhu | 2. Arka Rajhans |
| 3. Arka Jeet | 4. Hara Madhu |
| 5. Pusa Madhuras : mid, 12-14% TSS | |

(B) Hybrid

1. Pusa Sharbati : Kutana × Cantaloupes, early variety 11-12% TSS
2. Punjab Sunheri : Hara Madhu × Edisto, 11-12% TSS
3. Hissar Madhur : Pusa Sharbati × 75
4. Punjab-Rasila : Resistant to PM and DM (Powdery Mildew and Downy Mildews)
5. MHY-5: Durgapura Madhu × Hara Madhu

(C) Public Sector Hybrid

1. Pusa Rasraj : Developed using monoecious sex form as female parent, 11-12% TSS

(D) Private Sector Hybrid

- | | |
|-----------|-----------|
| 1. Shweta | 2. Swarna |
|-----------|-----------|

- Downey Mildew resistant var : Punjab Rasilla
- Powdery Mildew resistant var : Arka Rajhans : Excellent keeping quality.
- Arka Jeet : Excellent flavour and high vitamin C, relatively dwarf habit.
- Insitu sowing is practiced.
- Arka sheetal is an improved cultivar of long melon.

(IV) BOTTLE GOURD

- Botanical Name : *Lagenaria siceraria*
- Family : Cucurbitaceae
- Origin : South Africa
- Kofta and Petha are most popular preparations from Bottle gourd.
- It is highly sensitive to photoperiod.
- Dry shell is used for preparation of musical instrument.
- Processed product - tooty-fruity.
- Fruit pulp is very good source of fibre free carbohydrates.
- Germination : 25-30°C, Brownish or whitish brown seeds germinate well.
- High temperature and High N₂ induce maleness in Bottle gourd.
- Heterosis is present through its life cycle in all stages.

Varieties —**(A) Selection**

- | | |
|------------------------------|-------------------------------|
| 1. Pusa Summer Prolific long | 2. Arka Bahar |
| 3. Pusa Naveen | 4. Pusa Summer Prolific round |
| 5. Punjab Round | 6. Punjab long |
| 7. Samrat → Highest Yield | |

(B) Hybrid

- | | |
|---|-------------------------------|
| 1. Punjab Komal | 6. Varad |
| 2. Pusa Mangari | 7. NDBG-1 - Diara |
| 3. Pusa Meghdoot : 1 st F ₁ hybrid by public sector | 8. PBOG-1 → for N. Plains |
| 4. Gutka | 9. Pusa sandesh - new variety |
| 5. Harit | |

(V) BITTER GOURD

- Botanical Name : *Momordica charantia*
- Family : Cucurbitaceae
- Origin : Indo-Burma
- Bitter principle - momordicin.
- Immature, tender fruits are harvested.
- Bitter gourd fruits are rich in iron.
- If temperature goes above 40°C, induces maleness.

Varieties —**(A) Selection**

- | | |
|--------------------|--------------------------------------|
| 1. Pusa-Do-Mausami | 2. Pusa Vishesh |
| 3. Coimbatore long | 4. Preethi |
| 5. Priyanka | 6. Konkan Tara – Suitable for export |
| 7. Harkani | |

- Sowing Time : Jan-Feb : in North East India

(B) Hybrid

- | | |
|--|------------------|
| 1. Phule Green Gold : Green long × Delhi local | 2. Pusa hybrid-1 |
|--|------------------|

- Fruits ready : 60-70 DAS.

(VI) SUMMER SQUASH

- Botanical Name : *Cucurbita pepo*
- Family : Cucurbitaceae
- Origin : Mexico
- Harvesting stage : at 1/3rd maturity
- It is also known as bushy cucurbit, ornamental cucurbits
- Introduced variety : 1. Patty Pan 2. Australian Green
- Selection : 3. Early yellow Prolific
- F1 Hybrid : 4. Pusa Alankar : Chappan × Early yellow prolific

(VII) SNAKE GOURD

- Botanical Name : *Trichosanthes anguina*
- Family : Cucurbitaceae
- Origin : India
- Bower system of training is best for it.
- Variety Konkan Shweta
- Winter Squash - Vilayati Kaddu
- Variety - Arka Suryamukhi, Pink Banana

(VIII) PUMPKIN

- Botanical Name : *Cucurbita moschata*
- Family : Cucurbitaceae
- Origin : Mexico
- Amphidiploid ($2n = 40$) in nature
- Orissa - 85% Area and 90% production
- Yerusseri : Prepared from immature fruits.
- *Cucurbita ficifolia* : Fig leaf Gourd or Malabar Gourd

Varieties —

- | | |
|--|----------------|
| 1. Arka Chandan → Pleasant Aroma | 2. Pusa Viswas |
| 3. Arka-Surya Mukhi : Resistant to fruit fly | 4. Pusa Vikas |
| 5. Ambili | |
- 'Channel and hill' system of cultivation is most useful for higher yield.
 - Chief pollinator - Honey bees.
 - Male and Female parent can be grown in a 1 : 3 ratio.
 - Flowers of Pumpkin are more nutritive than fruits.

(IX) POINTED GOURD

- Botanical Name : *Trichosanthes dioica*
- Family : Cucurbitaceae
- Origin : India
- Propagation by vine cutting @ 2000-2500 cuttings/hac.
- Fruits are particularly recommended during convalescence (Regains health after illness).

Varieties —

- | | |
|-----------------|-------------------|
| 1. Bihar Sherif | 2. Dandli |
| 3. Kalyani | 4. Damodar |
| 5. Shankolia | 6. Swarna Alaukik |
| 7. Swarna Rekha | 8. Chhota Hilli |
- 10% male plant is necessary to get high yield

(X) ASH GOURD

- Botanical Name : *Benincasa hispida*
- Family : Cucurbitaceae
- Origin : Japan

- Fruits at maturity have white waxy surface.
- Annual hipsid (Rough with bristle like hairs).
- Variety : 1. Mudlier 2. Pusa Ujjwal.
- It is also known as chinese preserving melon.
- Longest storage life, among cucurbits.

(XI) CHOW-CHOW

- Botanical Name : *Sechium edule*
- Family : Cucurbitaceac
- Origin : Mexico
- Single seeded fruit in cucurbits.
- Most nutritious among cucurbits.
- Herbaceous, perennial, monoecious, climbing vine.
- Common name, → Chayote, Choco, askas.
- High Calcium content.
- Propagation → By fruits (Vivipary)
- Spine Gourd (Kakrol)
- Dioecious
- Propagation by tuberous roots

(XII) RIDGE GOURD

- Botanical Name : *Luffa acutangula*
- Family : Cucurbitaceae
- Origin : Asia
- Commercially trained on kniffin system.
- Used in Bathing Sponge.

Varieties —

- | | |
|-------------------------------------|---------------------|
| 1. Pusa Nasdar | 2. Konkan Harita |
| 3. Satputia → Hermaphrodite variety | 4. Punjab Sadabahar |
| ● Hybrid | |
| 5. Surekha | 6. Arka Sujat |

(XIII) SPONGE GOURD

- Botanical Name : *Luffa cylindrica*
- Family : Cucurbitaceae
- Origin : Asia
- Sponge Gourd contains higher protein and carotene than ridge gourd.
- Both Luffa spp. contain, a gelatinous compound called - luffien
- Fruits are harvested at tender stage.

Varieties —

- | | |
|--|-----------------------------------|
| 1. Pusa Chikni : Selection and early variety | 2. Pusa Supriya |
| 3. Phule prajakta | 4. Harita → F ₁ hybrid |
| ● Anthesis : 4-8 am (morning) | |

PEA AND BEANS

(I) PEA

- Botanical Name : *Pisum sativum*
- Family : Leguminosae
- Origin : Central Asia
- Field Pea - *Pisum arvense*
- F1 hybrid seed production is almost restricted due to less no. of seeds per in pod.
- Maturity of Pea is measured by tendrometer.

Varieties —

(A) Introduction

- | | | |
|-----------------|-----------------|------------------------|
| 1. Bonneville | 2. Early Badger | 3. Arkel |
| 4. Early superb | 5. Meteoror | 6. Little marvel |
| 7. Lincoln | 8. Sylvia | 9. Perfection new line |

(B) Selection

1. Arka Ajit - Resistant to powdery mildew and rust
 2. Asauji
 3. Harbhajan → Extra early variety
 4. Pant upkat
 5. Palam Priya- resistant to powdery Mildew.
- Arkel - Introduced from England
 - Rich source of protein (25%)
 - Mithiphali - edible pods : JP-19 - Edible pod
 - Whole pod is edible - JP-19, Sylvia, UN-53
 - Bonneville : Suitable for dehydration

(II) FRENCH BEAN

- Botanical Name : *Phaseolus vulgaris*
- Family : Leguminosae
- Origin : Mexico
- Edible portion - 94% of the pods
- Staking is important operation in pole type varieties.
- Three types

(A) Pole type

- | | |
|--------------------|-----------------|
| 1. Kentucky wonder | 2. Tweed wonder |
| 3. Pusa Himlata | |

(B) Bush type

1. Contender : tolerant to powdery mildew and mosaic.

2. Pusa Parvati : Mutant variety

3. Arka komal

4. Arka suvidha

5. Pant Anupama

6. Top cross

7. Giant Stringless

8. Bountiful

9. Jampa

(C) Semipole type

- Most of varieties are day neutral except semipole type - they are short day types.
- Pusa Parvati → developed through mutation.
- It is sensitive to both water excess and water stress conditions.
- Blossom drop and ovule abortion are common problems at high temp (35°C)
- Seed moisture below 12% enhances cracking of cotyledon.

(III) COW PEA

- Botanical Name : *Vigna unguiculata*
- Family : Leguminoceae
- Origin : Africa
- Most propable progenator of cowpea is variety - mensensii.
- Sensitive to water logging.

Varieties —

(A) Introduced

1. Phillipines early

2. Yard long bean

(B) Selection

1. Pusa Barsati

2. Arka Suman

3. Arka Garima

4. Arka Samrudhi : Bush type, photo insensitive

5. Pusa Phalguni - dwarf variety

(C) Hybrid

1. Pusa Dofasli : Photo insensitive → Pusa Phalguni × Phillipines bush

2. Pusa Rituraj : Bush type, dual purpose variety

3. Pusa Komal : Pusa Rituraj × P-246 → Resistant to bacterial blight

- It is grown as cash crop.
- It is draught tolerant crop.
- *Vinga cylindrical* : Catjang Bean
- *Vigna sesquipedalis* : Asparaqus Bean
- Cowpea pods are rich in vitamin B.
- Vitamin A contains 941 I.U. per 100 g. adiable.

(IV) CLUSTER BEAN

- Botanical Name : *Cyamopsis tetragonolobus*
- Family : Leguminoceae
- Origin : India
- It is hardy and drought tolerant crop.
- Some varieties are suitable for extraction of gum.

Varieties —

1. Pusa Sadabahar : Non branching variety suitable for summer and rainy season

2. Pusa mausmi
3. Sharad Bahar
4. Pusa Navbahar → Hybrid var.

(V) DOLICHOS BEAN

- Botanical Name : *Lablab purpureus*
- Family : Leguminoceae
- Origin : India

Varieties —

- | | |
|---|---------------------|
| 1. Pusa early prolific | 2. Pusa early Rajni |
| 3. Arka Jay - Photoinsensitive, Bush type | 5. Konkan Bhushan |
| 6. Rajni | 7. Deepali |
- It is grown for its whole pod.
 - Pusa early prolific - pole type, suitable for autumn and spring season.
 - Mutant variety : CO-10

(VI) LIMA BEAN

- Botanical Name : *Phaseolus lunatus*
- Family : Leguminoceae
- Origin : Guatemala
- It is used to prepare wine
- Varieties —

(A) Pole type

- | | |
|-------------------|--------------------|
| 1. King of Garden | 2. Karolina butter |
| 3. Challenger | 4. Florida butter |

(B) Bush type

- | | |
|-------------------|------------------|
| 1. Baby Potato | 2. Baby fordhook |
| 3. Handerson bush | |

(C) Semipole type

- | | |
|-----------|---------|
| 1. Wilbur | 2. Hopi |
|-----------|---------|

(VII) BROAD BEAN

- Botanical Name : *Vicia faba*
- Family : Leguminoceae
- It is pollinated by insect.

Varieties —

1. Red Epicure - long pod type
 2. Windsore type
 3. Pusa sumeet
- It is the only bean which is grown as autumn and winter crop.

LEAFY AND SALAD VEGETABLES

(I) PALAK/SPINACH BEET

- Botanical Name : *Beta Vulgaris var bengalensis*
- Family : Chenopodiaceae
- Origin : Indo-China
- As palak is leafy vegetable it requires more N_2 for crown growth.

Varieties —

(A) Selection

1. Pusa Jyoti
2. Pusa Bharti → Polyploid variety
3. Punjab Green
4. All Green
5. Pusa Hans

(B) Hybrid

1. Pusa Palak → Swiss chard × Local Palak
2. Pusa Harit → Sugar beet × Local Palak
3. Banerjee's Giant → Local Palak × Beet root

(C) Mutant Variety

1. Jobner Green
- Palak leaves contain low oxalic acid
 - Palak contains 9.5% Oxalate

(II) VILAYATI PALAK/SPINACH

- Botanical Name : *Spinacea oleracea*
- Family : Chenopodiaceae
- Origin : Iran
- Long day plant.
- It has very high respiration rate, due to presence of large leaf surface.

Varieties —

1. Prickly seeded cultivar → Virginia savoy
 2. Smooth seeded cultivar → Early smooth leaf
 3. Banerjees Giant
 4. Khara Lucknow
 5. Khara Palak
- Prickly seed variety best suited for autumn winter crop in the hills.
 - Smooth seed variety best suited for spring summer crop in the hills.
 - Sex form - tetramorphic, 5 sex form.

(III) AMARANTHUS

- Botanical Name : *Amaranthus spp*
- Family : Amaranthaceae
- Origin : India
- Warm season crop (most common vegetable grown in summer and rainy season).
- Susceptible to water logging.

Varieties —

1. Pusa Kirti
2. Pusa Kiran
3. Pusa Lal Chawli
4. Chhoti Chawli
5. Badi Chawli
6. Arka Saguna

- It is C-4 plant.
- It can be grown in soil pH as high as 10.
- Chhoti Chawli → *A. tricolor*
- Badi Chawli → *A. blitum*

(IV) LETTUCE

- Botanical Name : *Lactuca sativa*
- Family : Compositae
- Origin : Mediteranean region
- Cool season crop.
- Thermodormancy is found in lettuce.
- Mulching is recommended in case of lettuce.
- Lettuce includes 4 salad types.

(A) Crisphead

(B) Butter head

(C) Leaf type

(D) Romaine or Cos type

Varieties —

1. Great lakes : Crisp head type, resistant to tip burn
 2. Imperial-859 : Crisp head type, resistant to tip burn
 3. Slobott : Leaf type
 4. Chinese yellow : Leaf type
 5. White Boston : Butter head type
 6. Dark Green : Cos type
 7. Punjab lettuce No. 1 : Crisphead type
- Seeds donot germinate properly when soil temperature is above 22°C.
 - Pre & post harvest spray of BA 15-10 PPM helps delay senescence in storage and improves the shelf life.

(V) CHINESE CABBAGE

- Botanical Name : *Brassica chinensis*
- Family : Cruciferae
- Origin : China
- Low O₂ (2%) in combination with CO₂ (2%) improves shelf life of chinese cabbage.

(VI) PARSLEY

- Botanical Name : *Peteroselinum hortensis*
- Edible part → Leafy stalks and petioles.
- Rich source of Fe and Vitamin - C.
- Seed rate → 250-300 g/hac.
- 3 types : Plain leafed, double curled and moss curled.

(VII) CELERY

- Botanical Name: *Apium graveolens*.
- Family: Umbelliferae
- Edible part - Fleshy leaf stalk.
- Propagation → by seeds
- 2 types
 - (A) Yellow or self blanched : Florida golden, Golden
 - (B) Green leaved : Preferred in India. Wrights grove giant, Ford hook emperor.
- Exposure to high temperature : Bitterness in leaves
- Below 15°C bolting takes place.

TROPICAL TUBER CROPS

(I) SWEET POTATO

- Botanical Name : *Ipomea batatas*
- Family : Convolvulaceae
- Origin : South America
- India is largest producer in south east Asia and VIth largest in the world.
- Most probable ancestor of sweet potato - *Ipomea trifida*
- It is a perennial vine.
- Moderately drought tolerant crop.
- Ridge and furrow - best for raising crop.
- Excessive rainfall and long photoperiods encourage vine growth, reducing tuber yield.
- Varieties —

1. Kalmegh	2. Samrat	3. Kiran
4. Gouri	5. Shankar	6. Varsha
7. Bhuban	8. Sree Vardhani	9. Sree Bhadra
10. Sree Nandini	11. Pusa Suffaida	12. Pusa Lal
13. Pusa Sunderi	14. Gold Rush	
- China - rank 1st in area and production of sweet potato.
- Anthesis → 4-5 am.
- New released variety
 1. Shree Arun
 2. Shree Varun
- Shree Bhadra : Excellent trap crop for root knot nematode.
- Cercospora leaf spot of sweet potato was first reported in Africa.
- Propagation by vine cutting (4000 vine cuttings/hac).

(II) CASSAVA OR TAPIOCA

- Botanical Name : *Manihot esculenta*
- Family : Euphorbiaceae
- Origin : Brazil
- Major starchy root crop of tropics (Tropical Crop).
- The plant is perennial shrub.
- Yellow colour of flesh is due to presence of carotene.
- It is drought tolerant crop.
- Vascular blue lining or “vascular streaking” is present in cassava.
- Cassava is photo insensitive crop.
- Sago important food product derived from cassava starch.
- It produces 250000 calories of energy per hectare.

Varieties —

1. Sree Harsha : triploid clone from sree sahya, contains maximum starch (39.05%)
2. Sree Prakash

3. Sree Jaya

4. Sree Vijaya

5. Nidhi

● Hybrid

1. Sree Vishakam 2. Sree Sahya

(III) YAMS

- Botanical Name : *Greater yam = Dioscorea alata*
Lesser yam = Dioscorea esculenta
White yam = Dioscorea rotundata
- Family : Dioscoraceae
- Origin : Indo-Burma
- Greater Yam : also known as Ratalu (water yam).
- Fuyu is a product made from yam.
- Yam flour is also used for human consumption as kokonte.
- Africa alone produces 90% tubes and covers 95% area.
- Chinese Yam Asiatic Yam is common name of lesser yam.
- Lesser Yam matures early as compared to other spp.
- Greater yam Varieties —
 1. Sree Kirthi
 2. Sree Roopa
 3. Sree Shilpa - Ist hybrid variety of Greater Yam
- Lesser Yam Varieties —
 1. Sree Latha
 2. Sree Kala
 3. Konkan Kanchan
- White Yam Varieties —
 1. Sree Subhra
 2. Sree Priya
 3. Sree Dhanya
- Lesser Yam is sweeter than other yams.

(IV) ELEPHANT FOOT YAM OR AMARPHOPHALLUS

- Botanical Name: *Amorphophyllus companulatus*
- Family : Araceae
- Blood purifier.
- Variety- Gajendra, Santragachi, Kovvur, Sree Padma, Bidhan Kusum.
- Propagation - By tubers Harvest : 7-8 months after planting.
- Paste of this yam is used to reduce pain.

(V) COLEUS (Chinese Potato/Koorka)

- Botanical Name: *Solenostemon rotundifolium*
- Family - Labitac
- Propagation - By Vine cuttings, Suckers, tubers.
- Native-Africa
- Variety - Sree Dhara

(VI) QUEENSLAND ARROW ROOT/PURPLE ARROWROOT

- Botanical Name: *Maranta arundinacea*.
- It is used for production of carbonless paper for computer print.
- Biscuit of it is popular in India.

(VII) JERUSALEM ARTICHOKE

- Botanical Name: *Helianthus tuberosus*.
- It is commercial source of levulose, used as sweetening agent by diabetic patients.
- Glucofractons - Principle carbohydrates in tubers.

(IX) CHINESE WATER CHEST NUT

- Botanical Name: *Eleocharis dulcis*.
- Perennial leafless plant.
- It is sold in Calcutta under the name of "Singapuri Keysur".
- Edible part - tuber.

(X) COLOCASIA OR TARO

- Botanical Name: *Colocasia esculenta*
- Family : Araceae
- Origin : Srilanka
- Propagation - By cormels
- Africa Ranks 1st in area and production of taro.
- Varieties —

1. Satamukhi	2. Saharsmukhi
3. Sree Rashmi	4. Sree Pallavi
- Two types : (A) eddoe - arvi (B) Dasheen - bunda
- Eddoe type is most prevalent as vegetable.

(XI) YAM BEAN

- Botanical Name: *Pachyrrhizus erosus*
- Propagation - By seeds
- Variety - Rajendra Misrikand No. 1
- Eddoe : *Colocasia esculenta* variety antiquorum
- Dasheen/Bunda : *Colocasia esculenta* variety esculenta.

PERENNIAL VEGETABLES

(I) BREAD FRUIT

- Botanical Name: *Artocarpus altilis*
- Native - Malaysia
- Family - Moraceae (2n = 56)
- Variety : Yellow Heart
- Stimulative Parthenocarpy is found in Bread fruit.
- Propagation - By root cuttings.

(II) DRUM STICK

- Botanical Name : *Moringa oleifera*
- Family : Moringaceae
- Origin : India, Africa
- In India, it is commercially grown in Tamil Nadu.
- Deciduous crop, Flower white colour.
- Propagation - Limb cuttings (Perennial), Annual seeds.
- Drought tolerant crop
- Variety - Jaffna, PKM-1, PKM-2
- Fruit weight - 230 g containing 10-20 seeds each.

(III) ASPARAGUS

- Botanical Name : *Asparagus officinalis*
- Family : Liliaceae
- Origin : Europe, Asia
- Most serious disease - Asparagus rot
- Optimum pH requirement of soil - 6.0 to 6.7%
- Tender shoots called 'spears' are used as vegetable.
- Spear contain 'asparagine' which is used in medicine as diuretic in cardiac dropsy and chronic gout.
- Blanching is done to produce - White Asparagus.
- Takes 3 years for the real yield.

(IV) GLOBE ARTICHOKE

- Botanical Name : *Cynara scolymus*
- Family : Compositae
- Propagation : Sucker
- Variety : Bull, Tudella
- Edible part : Flower bud
- Thick receptacle (Heart) is used for canning.

(V) RHUBARB

- Botanical Name: *Rheum rhaponticum*
- Family : Polygonaceae
- It is a cold resistant plant.
- Edible Part - thick leaf stalk or petiole.
- Variety : Strawberry, Mcdonold, Valentine, Victoria, cherry Red.
- Propagation - By corms.
- Rich in Vitamin C

(VI) CHOW-CHOW

- Botanical Name : *Sechium edule*
- Family : Cucurbitaceae
- Origin : Mexico
- Single seeded fruit
- Richest source of nutrition among gourds.
- Fruits are viviparous in nature.
- Prop -By sprouted fruits.

(VII) CHEKURMANIS (Madura Keera)

- Botanical Name : *Sauropus androgynus*
- Native : India
- It is also known as vegetable of 21st century.
- Due to high nutritive value, it is commonly called as "Multivitamin greens".
- Propagation By stem cuttings.

(VIII) CYLON SPINACH or WATER LEAF

- Botanical Name: *Talinum triangulare*
- Native: Brazil
- It is a soft mucilaginous vegetable (leafy)
- It is a shade loving leafy vegetable.

(IX) BASELLA (INDIAN SPINACH or MALABAR SPINACH)

- Botanical Name: *Basella spp.*
- Family: Basellaceae
- Native: South Africa
- Edible Part - Succulent leaves with petiole.

(X) LEEK

- Botanical Name : *Allium porrum*
- Family : Alliaceae
- Origin : South America
- Leek is a non bulb forming member of the onion family, grown for its blanched stem and leaves.
- It is a biennial crop.
- Varieties —
 1. London Flag
 2. American Flag.

DISEASE MANAGEMENT

(A) Potato

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Late blight	Fungus	<i>Phytophthora infestans</i>	Most serious disease of potato Immune variety : Kufri Jyoti, Kufri Kanchan, Kufri Sherpa Kufri Kuber – Resistant variety
2.	Wart	Fungus	<i>Synchytrium endobioticum</i>	
3.	Black Scurf	Fungus	<i>Rhizoctonia solani</i>	–
4.	Dry rot	Fungus	<i>Fusarium spp.</i>	–
5.	Bacterial wilt	Bacteria	<i>Ralstonia solanaceum</i>	–
6.	Soft rot	Bacteria	<i>Erwinia carotovera</i>	–
7.	Potato Scab	Bacteria	<i>Streptomyces spp.</i>	Alkaline soil – Favourable
8.	Latent or Faint mosaic	PV-X and S	–	Transmitted by Aphids
9.	Severe mosaic	PV-Y	–	Transmitted by Aphids
10.	Leafroll	Virus	–	Transmitted by Aphids

(B) Tomato

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Spotted wilt	Virus		Transmitted by thrips Most serious disease Reduced by application of CCC (500 ppm)
2.	Leaf curl	Virus		Transmitted by white fly
3.	Mosaic	Virus		Transmitted by contact and seed
4.	Fern leaf	Virus		Transmitted by Aphids

(C) Brinjal

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Little leaf	Mycoplasma		Transmitted by leaf hoppers

(D) Chilli

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Anthraxnose or dieback	Fungus	<i>Colletotrichum capsici</i>	–
2.	Leaf curl	Virus		Transmitted by white fly + thrips
3.	Mosaic	Virus		Transmitted by Aphids

(E) Okra

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Yellow vein mosaic	Virus	—	Most serious disease Transmitted by white fly
2.	Enation leaf curl	Virus	—	Transmitted by white fly

(F) Cucurbits

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Powdery mildew	Fungus	<i>Erysiphe cichoracearum</i>	—
2.	Downy mildew	Fungus	<i>Pseudoperonospora cubensis</i>	—
3.	Witches broom	Mycoplasma	Transmitted by leaf hoppers	Mostly occurs in bitter gourd
4.	Green Mottle Mosaic	Virus	Transmitted by seeds	Mostly occurs in cucumber
5.	Bud Necrosis	Virus	Transmitted by seeds	Mostly occurs in water melon

(G) Cole Crops

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Black rot	Bacteria	<i>Xanthomonas compestris</i> <i>pv compestris</i>	V-shape chlorosis on margin of leaves
2.	Curd rot or soft rot	Bacteria	<i>Erwinia crotonera</i>	Most destructive during storage
3.	Stalk rot	Bacteria	<i>Sclerotonia scleratium</i>	—
4.	White rust or White blisters	Fungus	<i>Albugo candida</i>	Acidic soil - favourable
5.	Black leg or dryrot	Fungus	<i>Fusarium spp.</i>	Transmitted by seed

(H) Peas

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Powdery mildew	Fungus	<i>Erysiphe polygoni</i>	—
2.	Ascochyta foot rot	Fungus	<i>Ascochyta pisi</i>	—
3.	Wilt	Fungus	<i>Fusarium oxysporum pv pisi</i>	—
4.	Rust	Fungus	<i>Uromyces pisi</i>	—

(I) Beans

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Anthraco nose	Fungus	<i>Colletotrichum lindemuthianum</i>	—
2.	Web blight	Fungus	<i>Rhizoctonia solani</i>	—
3.	Angular leaf spot	Bacteria	<i>Isariopsis griseola</i>	—
4.	Floury leaf spot	Bacteria	<i>Ramularia phaseoli</i>	—
5.	Yellow flecks	MLO's	transmitted by white fly	Cowpea
6.	Phyllody	MLO's	transmitted by leaf hoppers	French Bean
7.	Golden Mosaic	Virus	transmitted by white fly	French Bean

(J) Onion and Garlic

Sr. No.	Common Name	Causal Organism	Scientific Name	Remarks
1.	Purple Blotch	Fungus	<i>Alternaria porii</i>	Most favourable temperature for disease is 28-30°C Resistant Variety Nasik Red, Arka Kalyan
2.	Bottom rot or Basal rot	Fungus	<i>Fusarium oxysporum</i>	—
3.	Black mould	Fungus	<i>Aspergillus niger</i>	Very common storage disease
4.	Yellow dwarf	MLO	—	—

PEST MANAGEMENT

Sr. No.	Crop	Common Name	Scientific Name	Remark
1.	Potato	1. Tuber moth	<i>Pthorimea opercullela</i>	30-70% damage in tuber in storage
		2. Cut worm	<i>Agrotis ipsilon</i>	—
		3. Aphids	Vector of potato virus	—
		4. Mite	<i>Hemitarsonemus latus</i>	Major pest in Deccan Plateau
		5. Cyst Nematode or Golden Nematode	<i>Globodera spp.</i>	Kufri Suvarna - Resistant variety
2.	Tomato	1. Fruit borer	<i>Helicoverpa armigera</i>	—
		2. White fly	<i>Bemisia tabacii</i>	transmitted by leaf curl virus
		3. Serpentine leaf miner	<i>Liriomyza trifoli</i>	—
		4. Mustard saw fly	<i>Athalia lunus</i>	—
3.	Raddish	2. Painted bug	<i>Bagrada cruciferum</i>	—
		1. Shoot and Fruit borer	<i>Earias vittela</i>	—
4.	Okra	2. Leaf hoppers	<i>Amarasca biguttula</i>	Most serious pest of okra
		3. Blister Beetle	<i>Mylabris pustulata</i>	—
		4. Stem and Bulb Nematode	<i>Ditylen-chus dipsaci</i>	—
		1. Thrips	<i>Thrips tabacii</i>	—
5.	Garlic & Onion	2. Mite	<i>Aceria tulipae</i>	—
		3. Onion fly	<i>Delia antiqua</i>	—
		4. Bulb nematode	—	—
		1. Stem fly	<i>Ophiomyia phaseoli</i>	80-90% mortality of plant
6.	French Beans & cowpea	1. Red Pumpkin Beetle	<i>Aulacophora foveicollis</i>	—
		2. Fruit fly	<i>Bactocera cucurbitae</i>	Arka Suryamukhi-Resistant variety
		3. Thrips	<i>Thrips tabaci</i>	—
8.	Chilli	1. Thrips	<i>Scirtothrips dorsalis</i>	Transmits leaf curl of chilli
9.	Colecrops	1. Dimmond	<i>Plutella xylostella</i>	Most damaging pest

Sr. No.	Crop	Common Name	Scientific Name	Remark
		Black moth 2. Stem borer	<i>Hellula undalis</i>	-
10.	Brinjal	1. Fruit and shoot borer	<i>Leucinodes orbanalis</i>	Tolerant variety - Punjab Barsati
		2. Stem borer	<i>Euzophera perticella</i>	-
		3. Ash weevil	<i>Mylocerous subfasciatus</i>	Saw like damage in the margin of leaves
		4. Epilachna (Hadda) beetle	<i>E. vigintictopunctata</i>	-
11.	Leafy vegetables	1. Leaf eating caterpillar	<i>Hymenia recurvalis</i>	-
12.	Tomato & Brinjal	1. Root knot Nematode	<i>Meloidogyne spp.</i>	Tomato Resistant Variety: Hissar lalit, Arka vardan, Mangla Selection-120 Brinjal Resistant Variety: Black beauty, Mangrigota
13.	Sweet Potato	1. Sweet potato weevil	<i>Cylas formicarius</i>	Monophagous pest
14.	Black pepper	1. Pollubettle	<i>Longitarsus nigripennis</i>	40% damage in Back Pepper
15.	Cardamon	1. Aphids	<i>Pentalomia nigronervroa</i>	Transmit vector of katte disease
		2. Shoot and capsule borer	<i>Dichocracis puntiferalis</i>	-
16.	Turmeric & Ginger	1. Rhizome-Fly	<i>Mimegralla coeruleferons</i>	Cause Rhizome rot of Ginger

PHYSIOLOGICAL DISORDERS

Sr. N.	Crop	Name of Disorder	Cause
1.	Potato	1. Internal Brown spot	Moisture deficiency
		2. Greening	Excessive exposure to sunrays
		3. Black Heart	Poor Ventilation
		4. Hollow Heart	Excessive Nitrogen
		5. Chilling injury	Low temperature
		6. Freezing injury	Low temperature
2.	Tomato	1. Cracking	Boron Deficiency
		2. Blotchy ripening	Potassium deficiency
		3. Puffiness or pocket	low or high temperature + lack of fertilization
		4. Blossom end rot	Calcium deficiency+High temperature+irregular moisture supply
		5. Sun scald	excessive exposure to sun-rays
		6. Cat face	Abnormal growing conditions
		7. Golden flake	excess of ca-oxalate/low K : Ca ratio
		8. Radical cracking	-
3.	Cauliflower	1. Ricyness	Fluctuation in temperature, High Humidity, Excess Nitrogen
		2. Fuzziness	Cultivation in abnormal time
		3. Blindness	Frost
		4. Leafyness	High temperature
		5. Buttoning	Nitrogen deficiency, sowing early variety in late season
		6. Hollow stem	Excessive Nitrogen
		7. Whiptail	Molybdenum deficiency
		8. Chlorosis	Magnesium deficiency
		9. Browning or Brown rot or Red rot	Boron deficiency
4.	Carrot	1. Splitting	Boron deficiency, Excessive Nitrogen, Change in soil moisture
		2. Cavity spot	Calcium deficiency, Excessive Nitrogen, change in soil moisture
		3. Bitterness	Excessive ethylene
		4. Forking	Hard soil pan
		5. Pithiness	-

Contd....

Sr. N.	Crop	Name of Disorder	Cause
5.	Beet root Raddish	1. Brown Heart or crown heart or heart rot	Boron deficiency
6.	Water Melon	1. Blossom end rot	High temperature+irregular moisture supply+Calcium deficiency
7.	Colocasia	1. Metsubre	Calcium deficiency
8.	Sweet potato	1. Growth crack	Moisture Imbalance
9.	Celery	1. Black Heart	Calcium deficiency
		2. Cracked stem	Boron deficiency
		3. Pencil strip	Excess of Phosphorus
10.	French Bean	1. Blossom drop	High temperature
		2. Hypocotyl cracking (necrosis)	Calcium deficiency
11.	Garlic	1. Bulb sprouting	Excess Nitrogen + soil moisture
		2. Splitting	Delays Harvesting
12.	Lettuce	1. Tip burn	Ca deficiency + Unfavourable climate
		2. Rossette spotting	Ethylene injury
13.	Chilli	1. Blossom end rot	Excess Nitrogen + water stress
		2. Frog eye rot	
14.	Raddish	1. Akashin	Boron deficiency
15.	Cucumber	1. Pillow	Calcium deficiency

MISCELLANEOUS

Sex Forms

1. Cleistogamy : Lettuce
2. Chasmogamy : Tomato, capsicum
3. Protogyny : Cole crops
4. GMS : Tomato, Musk Melon, Water Melon, Cole crops, Beet Onion
5. CMS : Carrot, Sweet Pepper, Cucumber
6. CGMS : Onion, Carrot, Raddish, Beet, Tomato
7. Protandry : Onion, Carrot
8. Herkogamy : Lima Bean
9. Peas and Beans are self pollinated crops due to presence of 'Keel'

● Sex Forms in Cucurbits

1. Hermaphrodite : Satputia (Ridge Gourd), Cucumber - Original form.
2. Andromonoecious : Musk Melon
3. Gynoecious : Cucumber
4. Gynoecious : Monoecious : Cucumber
5. Trimonoecious : Cucumber, Musk Melon, Ridge Gourd

● *Broccoli* : Highest Cross Pollination (95%)

● *Spinach* : 5 Sex forms present

● Pollination

1. Anemophily : Spinach, Beet Root, Palak, Amaranthus
2. Entomophily : Onion, Carrot, Raddish, Cole Crops.

● Anthesis

1. Bottle gourd - evening 5-8 pm
2. Snake gourd - evening 6-9 pm
3. Ridge gourd - 5-8 pm
4. Musk Melon : Morning 5.3 - 6.30 am
5. Cucumber - Morning
6. Sponge gourd - Morning

● Fruit type

1. Peas and Beans : Pod/Legume
2. Orka : Capsule
3. Sweet potato, Yams : Capsule
4. Berry - Tomato, Potato, Taro
5. Carrot : Shizocarp
6. Seed ball - Turnip, Beet root

7. Rat tail Raddish - Pod
- **Inflorescence type**
 1. Racemose : Peas, Beans, Tomato, Colecrops
 2. Panicle : Cassava, Drumstick
 3. Umbel : Celery, Onion, Garlic
 4. Spike : Beet, Amaranthus, Palak
 5. Capitulum : Globe artichoke
 6. Spadix : Taro, EFY (Elephant foot yam)
 7. Catkin : Cabbage
 - **New Released Varieties —**
 1. Pusa Rohini : Tomato
 2. Pusa Sneha : Sponge Gourd
 3. Pusa ujawal, Pusa Shakti : Ash Gourd
 4. Pusa Uday : Cucumber
 5. Pusa Shandar : Snap melon
 6. Pusa Meghana : Cauliflower
 7. Pusa Saag No. 1 : Leafy Mustard
 - Savoy Cabbage : B.O. variety sabauda, conical shape
 - Pusa snowball K-25 : Field resistance to sclerotia rot.
 - Onion : Red - Anthocyanin
Yellow - Quercetin
 - Carrot : More prod/unit time/unit area
 - Iodine - Onion, Okra
 - Tapioca - Highest Carbohydrates
 - Incidence of colletotrichum and Purple blotch is more severe in kharif and late kharif in Onion
 - Blight - damages Rabi Crop in onion
 - Nematode : Ditylenchus is very common in Onion and Garlic
 - Sauerkraut : White cabbage
 - Pickling : Red cabbage
 - 1st hybrid development
 1. 1st commercial hybrid in cucumber in Japan (1940)
 2. 1st commercial hybrid by IARI in vegetable - Pusa Meghdoot, Pusa Manjari (1971)
 3. 1st commercial hybrid of tomato - Karnataka hybrid
 4. 1st commercial hybrid sweet pepper - Bharat
 - 1970 - Separate division of floriculture and vegetables crops at IARI
 - 1971 - AICVIP by ICAR
 - Inbreeding depression : Loss of vigour due to inbreeding (selfing)
High : Carrot; Moderate - Onion, cole crops, Low : Cucurbits
Nil : Tomato, brinjal
 - Sweet potato is cheapest source of calories
 - Agathi : High Ca

- Cool season crops are hardy while warm season crops are tender
- Recalcitrant seeds : Pointed gourd, chow-chow
- GRs in cucurbits

(A) GA₃, AgNO₃, Silver thiosulphate : ♂ flower (Male)

(B) NAA, CCC, MH, ethere (200 PPM) : ♀ flower (Female)

- Catkins : Cabbage
- Improvement in Onion : Hetrosis breeding
- Pedigree method : Most popular breeding method in India
- Tomato 12 : 1 (Male : Female Ratio)
- Pumpkin 9 : 1 (Male : Female Ratio)
- Varieties —
 1. Pusa Sandesh : Bottle gourd
 2. Pusa Pragati : Garden Pea
 3. Pusa Sumeet : Broad bean
 4. Pusa Bathua : Chenopodiun
 5. Standard bearer, ford hook emperor, wrights grove giant - celery
- Highest mineral : Amaranthus > Bathua leaves > Coriander
- Highest Mg : Chilli > Amaranthus > Spinach
- Highest Cu : Pointed gourd
- Highest Mn : Cowpea
- Highest Mo : Cowpea
- Highest Zn : Cowpea
- Highest S : Cauliflower > Brussels sprout > Fenugreek > Cowpea
- Highest Cl : Cuccumber > Drumstick > Fenugreek
- Oxalic acid : Amaranthus > Spinach
- Red Cabbage : B. Oleracea variety capitata fsp. rubra
- Savoy Cabbage : B. Oleracea variety subauda
- Highest calorific value : Tapioca > Garlic > Lima bean
- Highest CHO : Tapioca > Garlic > Sweet potato > Potato
- Highest Proteins : Lima bean > Pea > Garlic
- Highest B complex : Chilli > Fenugreek > Colocasia leaves
- High Ca : Amarnathus > Fenugreek leaves > Beet leaves
- High Fibre : Potato > Chilli > Pea
- High vitamin C : Coriander leaves > Kale > Chilli > Broccoli
- High vitamin A : Bathua leaves > Colocasia leaves > Amaranthus > Turnip green > carrot
- High P : Garlic > lima bean > colocasia > Drumstick
- High Fe : Amarnathus > Knol-Khol > Spinach
- High K : Spinach > Potato > Colocasia > Garlic > Limabean
- High Nitrate : Spinach > Beet root
- Major Mineral nutrients obtained from leafy vegetables : Ca, Fe and P
- Only 30 g of leaves will be sufficient to meet requirement of vitamin - A and C

- Bitter gourd : Useful for patients with weak nervous system.
- Pea and beans are rich in amino acid.
- Raddish : Used in urinary troubles.
- Biflavoids : Quercetin - Onion and Garlic - Protection against cancer and heart disease.

Other Compounds

1. Cheratin : Bitter gourd - effective against diabetes
2. Diphenyl amine : Onion
3. 3-n butyl pthalids : Celery - effective against hypertension
4. Diosgenin - Yam - useful in manufacture of cortisone and contraceptive drugs.

Resistant spp of different vegetable crops →

Resistance	Disease	Resistant spp.
Potato	Late blight	Solanum demissum, S. curtiobum, S. stoloniferum
Tomato	Fusarium wilt	L. pimpneifolium
	Early blight	L. pimpneifolium, L. peruvianum, L. glabratum
Brinjal	Bacterial wilt	S. sisymbriifolium, S. integrefolium
	Phomopsis blight	S. sisymbriifolium, S. integrefolium
	Little leaf	S. gilo
Chilli	TMV	C. chacoense
	Phytophthora root	C. frutescence
Okra	YVMV	A. manihot spp. manihot
Onion	Purple blotch	A. fistulosum

Varieties of different vegetable released by private sector →

Crop	Variety	Source	Crop	Variety	Source
Tomato	Rupali	Indo-American	Chilli	Delhi Hot	Hung Nong
	Vaishali			Delhi Green	-
	Naveen	Indo American		Skyline	-
	Rashmi, Sheetal	Indo American		Tejaswini	-
	Avinash-2	Novartis		Agni	Noverties
Brinjal	Sonali, Samridhi	Machyo	Capsicum	Champion	Seoul
	Suphal	Indo-American		Indra, Lario	Novartis
	Kanhya	Sungrow		Bharat	Indo - American
Cabbage	Shyamal	Ankur seeds	Okra	Early Bounty	Suttons
	Nisha, Vardan	Century seeds		Hira	Nath seeds
	Sree Ganesh Gol.	Mahyco		Varsha, Vijay	Indo-American
	Green challenger	Hung Nong →		Panchali, Adunik	Century seeds
	KK cross	Takii		Supriya	Pioneer seeds
	Takii	Cauliflower	Himani	Indo-American	
OS corss	Takii		Serrano	Nowarties	

- Thinning is compulsory in beet root and turnip.
- Dr. Kihara developed Pusa Bedana (seedless variety of watermelon) in 1972
- Cercospora leaf spot of sweet potato – 1st reported in Africa
- Cassava – Sree Saya – Multiple hybrid
- Temperate vegetables grown in warm season 1. New Zealand spinach 2. Sweet potato
- Spineless variety of Okra – Pusa Sawani
- All vegetables come under category – spermatophyta
- All vegetables lack fat content (0.1%)
- Mature seeds of Pea and Bean contain Phytic acid
- Inter specific hybrid of Tomato –
 1. Hissar Anmol – Hissar Arun x *L. hirsutum*
 2. Pusa Red Plum – *L. esculentum* x *L. pimpinifolium*
- Ash gourd – longest storage life among cucurbits
- Yellow coloured Onion varieties are mostly grown in the world.
- Tomato – Juice extraction → Pusa Ruby, Angur Lata, Kalinpur
Processing + Fresh market → Arka Saurabh
- P increases number of flowers in tomato
- Cu increase numbers of flowers in Brinjal
- Zn increases weight of fruit in Brinjal
- Little leaf of Brinjal is due to mycoplasma and Zn deficiency
- Carrot – Asiatic type : core is distinct
European type : core is indistinct, Stump and blunt.
- Varieties of savoy cabbage – Perfection, Chieftain, Wake field, Charlatan, Jercey.
- 6 Stamens are present in cruciferae and alliaceae family of vegetables,
- 5 Stamen are present in Solanaceae family of vegetables.
- Among crucifers – Knol khol has highest seed rate – 1-1.5 kg/ha
- Flower colour – 1. Cruciferae – Yellow
 2. Brinjal – Purple, Blue
 3. Chilli – White
 4. Tomato – Yellow
 5. Pointed Gourd, Snake Gourd, Bottle Gourd – White
- Cabbage trap crop – Bold mustard (25:1) prevents attack of Red Pumpkin beetle.

SPICES AND CONDIMENTS

Sr. N.	Common Name	Botanical Name	Family	Origin	Plant Part Used	Important Chemical content	Essential oil%	2n. no.
1.	Black pepper	<i>Piper nigrum</i>	Piperaceae	Indo-burma	Fruit, seed	Piperine	1-3	128
2.	Cardamom (small)	<i>Elettaria cardamomum</i>	Zingibera- ceae	India	Fruit seed	Cineol		48
3.	Ginger	<i>Zingiber officinalis</i>	Zingibera- ceae	South east Asia	Rhizome	Zingiberene	1.9-2.2	22
4.	Turmeric	<i>Curcuma longa</i>	Zingibera- ceae	South east Asia	Rhizome	Curcumine	0.24	62
5.	Cinnamon	<i>Cinnamomum verum</i>	Lauraceae	Srilanka	Bark	Cinamaldehyde	.5-2	24
6.	Nutmeg	<i>Myristica fragrans</i>	Myrticaceae	Indonesia	Seed, Aril	Terbein	-	-
7.	Clove	<i>Syzygium aromaticum</i>	Myrtaceae flower	Indonesia	Unopened flower bud	Eugenol	-	44
8.	All spice	<i>Pimenta dioca</i>	Myrtaceae	West Indies	Fruit seed	Phenol	-	-
9.	Capsicum	<i>Capsicum annum</i>	Solanaceae	S. America	Fruit	Solanine	0.1-2.6	-
10.	Curry leaf	<i>Murraya koenigi</i>	Rutaceae	-	Leaves	Koenigine	-	18
11.	Asafoetida	<i>Ferulla foetida</i>	Apiaceae	-	Oleoresin Gum	Ferumine	10-17	-
12.	Saffron	<i>Crocus satiyus</i>	Iridaceae	India	Stigma	Cicrocrocin	0.5-1.0	-
13.	Sweet flag	<i>Acorus calamus</i>	Araceae	-	Rhizome	Acorin	-	-
14.	Dill	<i>Anethum graveolens</i>	Apiaceae	Eurasia	Fruit	Carvone	1.5-4.0	-
15.	Coriander	<i>Coriandrum sativum</i>	Apiaceae	Meditereanean region	Leaves, seed	Linalool	0.1-1.0	22
16.	Cumin	<i>Cuminum cyminum</i>	Apiaceae	Meditereanean region	Fruit	Cuminol	2.5-3.5	14
17.	Fennel	<i>Foeniculum vulgare</i>	Apiaceae	Meditereanean region	Fruit	Limone	0.7-1.2	-
18.	Aniseed	<i>Pimpinella anisum</i>	Apiaceae	Meditereanean region	Fruit	Anithol	-	-
19.	Bishop's weed		Apiaceae	Meditereanean region	Fruit	Thynol	-	-
20.	Vanilla	<i>Vanilla planifolia</i>	Orchidaceae	America	Fruit	Vanillin	-	-
21.	Fenugreek	<i>Trigonella foenum- graceum</i>	Fabaceae	Europe	Seed	Diosgenin	-	-
22.	Kokum	<i>Garcinia indica</i>	Guttiferae	India	Fruit	β-hydroxy acetic acid	-	24

* The global market for spices is estimated to be around US \$ 4.6 trillion.

* India is the world's largest manufacturer of oleo resins.

- India's share in world trade of spices is around 18%.
- Spice oil is obtained by steam distillation method.
- India is known as home of spices
- Largest area under spices → Rajasthan.
- Highest production under spices → Andhra Pradesh.
- Black pepper and turmeric constitute more than 50% of total export earnings among spices.

1. Kerala	Black Pepper	94% Production
	Cardamom	60% Production
	Ginger	25% Production

2. A.P.	Turmeric
	Chilli

3. Rajasthan	Fenugreek-80% Area
	Fennel
	Coriander

4. Gujarat - Cumin

5. India	Black pepper 54% Area
	26.3% Production
	Ginger 70% Production
	Turmeric 76% Production

- USA - major importer & consumer of leoresins (50%)

1. BLACK PEPPER

- Chemical compound found in black pepper is piperine.
- King of spices
- Largest producer - Vietnam
- India accounts for 54% of total area and 26.6% of total production in the world
- Fruiting branches : Plagiotropes
- Top shoots : Orthotropes
- Hanging shoots : Geotropes
- Propagation - By shoot cutting
- Average pepper yield - 273 kg/hac
- Harvesting - Nov-Feb in plains ; Jan-March in Hills
- Kerala accounts - 96% of total production
- Varieties —

1. Karimunda	2. Panniyur - 2, 4, 6
3. Sreekara	4. Subhakara
5. Poornima	6. Panchami
- Hybrids —

1. Panniyur-1	2. Panniyur-3
---------------	---------------
- Self sterile variety - Balankotta, Kalluvalli,
- Tripod-stand for harvesting
- North America - major importer of Indian pepper.
- The mean annual rainfall, maximum and minimum temperature for black pepper is 2000-3000 mm, 10°C and 40°C

2. SMALL CARDAMOM

- Queen of spices
- 2nd important national spice
- Kerala (60%) leading producer of cardamom
- Propagation - By rhizomes
- Harvesting : Oct-Nov
- Yield : 500 kg/hac (150 kg/dry /ha.)
- Varieties —
 1. Mysore type
 2. Malabar type
 3. PV-2
 4. Mudigree-1
 5. Vazukha type : Cross between Mysore × Malabar
- Summer showers are essential for flowering
- Inflorescence - Panicle
- The mean annual rainfall, maximum and minimum temperature for cardamom is 1500 mm - 5750 mm, 10°C and 35°C.

3. LARGE CARDAMOM

- Botanical Name: *Amomum subulatum*
- Sikkim is the largest producer of large cardamom
- It is shade loving plant (seophyte)
- Propagation - Suckers
- Varieties —
 1. Bebo
 2. Golsey
 3. Ramla
 4. Ramsey

4. GINGER

- India accounts 70% of total world production and 50% in world export.
- Kerala leading producer of ginger (60% area and 25% production)
- Propagation : By Rhizome bits of 15-20 g @ 1200-1800 kg/hac.
- Average yield : 15-30 t/hac
- It is known for its anti nausea effects.
- Varieties —
 1. Riode Janerio (Introduced)
 2. Surbhi (Mutant)
 3. Suphrabha
 4. Suruchi
 5. Wynad manantody - Contribute 50% of total production
 6. Hingiri - tolerant to rhizome rot
- Cochin ginger/Indian ginger best in the world.

5. TURMERIC

- India accounts - 76% of total world production
- AP - leading turmeric producer.
- Propagation - By rhizome @ 2500 kg/hac
- Average yield : 25-30 t/hac
- The mean annual rainfall, maximum and minimum temperature for turmeric is 640 mm to 4290 mm, 18.2°C and 27.4°C

- Trade type - Allepe finger turmeric, famous for its colour in trade.
- Varieties—

1. Rajendra Sonia

2. Prabha

3. Pratibha

4. Kranti

5. Krishna

6. Rashmi

6. Roma

7. Srobha

8. Sudarshana

9. Sugandham

10. Saguna

11. Suroma

12. Suvarna

13. Allepy turmeric - Best in the world

- Turmeric is antioxidant due to phenolic character of curcumin.

6. CLOVE

- Indonesia accounts for 68% of world production.
- About 11,000 - 15,000 dried cloves makes 1 kg.
- Varieties - Pevang, Lenzipore, Amulya
- Alternate bearing habit.
- 2nd most important spice next to Black pepper in the world.
- Tree medium size, evergreen reaching upto 20 m.
- Single seeded drupe

7. NUTMEG

- Major producing areas are Indonesia and Genada (West Indies).
- Nutmeg - dried kernel of seed have oil content from 5 to 15% of the seed weight.
- Mace - dried aril surrounding the seed have oil content from 20 to 35%.
- Harvesting - June-August.
- Dioecious tree
- Tree : conical reaching a height of 4 to 10 meters.
- Average weight of individual nutmeg → 60 g.
- Seed weight - 6-7 g, Mace → 3-4 g
- Pericarp is used for making Jara, Jelly, pickles.
- Unproductive male is converted into female by top working.
- Pericarp-rich source of pectin (12-14%).
- Volatile oil have - Weedicidal property

8. CINNAMON

- Oldest known spice.
- Tejpat - (Indian cassia) - Cinnamon tamala
- Commercially propagation method - seed
- Harvesting - Sept-November
- Varieties—
- 1. Navashree
- 2. Nithyashree
- 3. Konkan Tej
- 4. Yercaud-1
- Bark after drying forms a quill
- Srilanka largest producer of cinnamon bark.

9. FENUGREEK

- Seed contains diosgenin - which is used to prepare contraceptive pills.
- More than 80% area and production is contributed by Rajasthan.
- Sowing time - last week of oct.
- Seed rate - 25 kg/hac
- Average yield - 10-11 Qnt/hac
- It is IIIrd largest seed spice in India after coriander and cumin.
- Two species —
 - (i) Common Methi
 - (ii) Kasuri Methi - *T. corniculata*
- Variety —
 1. Rajendra Kranti
 2. Hissar Sonali
- Fenugreek is both a tropical and temperate crop.
- India is major producer and exporter of fenugreek seed.

10. CORIANDER

- Rajasthan leads in area and production.
- Drying is done to maintain moisture level below 13% in seeds.
- Seed rate - 25-30 kg/hac (Rain fed), 12-15 (irrigated), 40-42 kg/hac (leaf vegetables).
- Yield - 7-5 qnt/hac
- Varieties —
 1. Sindhu
 2. Sadhana
 3. Swathi
 4. Rajendra Swathi
 5. Merrocane
 6. Pant Harithna
 7. Karan - small seeded variety
- Leading seed spice crop grown in India.
- Fruits - Schizocarp.
- Most heavily consumed herb plant.

11. CUMIN

- Best sowing time - November.
- Seed rate - 12-15 kg/hac.
- Yield - 7-8 qnt/hac
- Varieties —
 1. RZ-19
 2. RZ-209
 3. GC-1
 4. GC-2
 5. Vijapur-5
- Fruits rich in thymol.
- Iran - main cumin exporter

12. FENNEL

- Best sowing time - Mid Sept - Mid Oct.
- Seed rate - 10-12 kg/hac
- Yield - 9-10 qnt/hac
- Varieties - RE-101, RE-125, RE-35

13. ALL SPICE

- Double Seeded Berry.
- Jamaica - major producer of All spice
- Varieties : 1. Jamaican Allspice. 2. Mexican Allspice, 3. Honduran Allspice.
- Berries Vitamin-A(144SIU)
- It contain flavour of cinnamon, clove and nutmeg.
- Functionally, it is dioecious.
- Edible part - dried immature fruits (Berries)
- Cultivar shows (+)ve response to flowering and fruiting in all spice.

14. CURRY LEAF

- Crystalline glucoside 'ksenigin' obtained from leaves and 'Muragin' obtained from flowers.
- Self pollinated crop.
- Rich in Ca.
- Variety - Suwasani
- Propagation - by seeds

15. KOKUM

- Dioecious in nature
- Variety - Konkan Amrit
- Kokum contains - Hydroxy citric acid

16. VANILLA

- Madagasy republic (70-80%) is leading producer in the world.
- Natural pollination is impossible due to presence of Rostellum which prevent contact of anther cap and stigma.
- Propagation - stem cutting
- Oil is called Balsam of vanilla (vanillin) - 2.3-2.9% in beans.
- Vanillin is developed due to action of enzymes. (β -glycoside).
- Vanillin is extracted by hydro alcoholic extraction.
- Coumarin - Cheap substitute for vanilla.
- Tender, green pods are harvested for use.

17. SAFFARON

- Most expensive spice in the world.
- Fennel shaped stigma is used as spice.
- In India - only cultivated in Kashmir under rain conditions.

- Most expensive saffron - shahi saffron.
- Yield - 5 kg dried saffron/hac
- Planting season : July to September.
- About 1.5 million flowers on drying give 1 kg of saffron.
- Main uses cooking and colouring foods and in perfumes.
- Harvesting season : Oct-Nov.

18. CHILLI

- India largest producer of chillis in the world accounting 45% of total area under cultivation.
- Bird chilli - *Capsicum frutescens*
- Var suitable for Pickle - Sindhur
- Var suitable for extraction of capsaicin - Aparna, Pachas yellow.
- About 90% of the capsaicin in chilli has been noticed in placenta, connecting seed with pericarp.
- Green chillies retard cancer due to natural enzyme - 'Asperginase'.

19. ASAFOETIDA

- Stage of tapping - foliage turns green to yellow.
- Hadda - most priced and strongest, trade.
- Ayurvedic medicine - 'Hingashakt' is prepared from asafoetida.

20. JUNIPER

- Botanical Name : *Juniperous communis*
- Dioecious in nature.
- Juniperin - mixture of tannins and sugar, is obtained from Juniper.

21. TAMARIND

- Botanical Name: *Tamarindus Indica* Linn.
- Major Producers : India, Bangladesh, Myanmar, Srilanka, Thailand and African Countries.
- States of India : T.Nadu, A.P., Karnataka, Orissa and Kerala.
- Useful part of plant : Pod (composed of 55% pulp, 34 seed, and 11% shell and fibre.)
- Tree : Moderate size of large evergreen tree upto 24 m in height.
- Yield : A good fully grown tree yields 180-225 kg of fruits per season.
- Irrigation : Regular watering is essential till plants establish well in the field.

22. THYME

- Botanical Name: *Thymus vulgaris*.
- It is cultivated in a hot and sunny location with well drained soil. It is planted in the spring and grows a perennial. It can be propagated by seed, cuttings or by dividing rooted sections of the plant.
- Rich in Antioxidants
- It contains health boosting flavonoids are known to protect and boost the percentage of healthy fats in cell membranes
- It is potential preventer of heart disease and premature ageing

Miscellaneous

- Area under spices in India is 2.6 million hectare with a production of 4.1 million tonnes.
- Spice share 13% of the area and 2% of production of the total horticultural crops in India.

AROMATIC AND MEDICINAL PLANTS

Aromatic and Medicinal Plants Scenario

1. *Aromatic plants* are those plants which contain essential oils in them. Essential oils are mainly complex mixture of acyclic and monoterpenoids.
2. *Medicinal plants* are those plants which are rich in secondary metabolites and are potential source for drugs.
 - Highest No. of medicinal spp. are under family - *Asteraceae*.
 - Maximum demand in the world market
(A) Senna leaves (B) Isabgol seed (C) Cassia tora seeds.
 - India is 1st largest producer of
(i) Kewada oil (ii) Senna (iii) Davana oil (iv) Isabgol
 - India - IInd largest producer of
(i) Opicum latex (ii) Jasmine (Concrete) (iii) Tuberose concentrate.
 - India - IIIrd largest producer of - Periwinkle
 - India - largest exporter of - Psyllium and senna leaves
 - Thailand largest exporter of Sarpagandha roots.
 - China is the major producer of (i) Geranium Oil (ii) Citronella Oil.
 - World production of essential oil is dominated by Brazil (40%) followed by USA (20%) and India (15%).
 - Essential oils are the odoriferous steam volatile constituents of aromatic plants.
 - International market of medicinal plants related trade is estimated at US\$ 60 billion/year, having growth rate of 7% per annum.
 - Sandal wood : Spike disease.
 - National Aromatic and Medicinal Plant Board is situated at New Delhi.
 - Central institute for Medicinal and Aromatic Plants is located at Lucknow.
 - National research centre for Medicinal and Aromatic Plants is located at Anand-Gujarat.
 - The global demand for medicinal and aromatic plants is growing at the rate of 15% per annum.
 - About 627 plant drugs are being traded in India.
 - Hippocrates is known as father of modern medicine.
 - Theophrastus is known as father of pharmacognosy.
 - We have 90% collection of medicinal plants is from wild source.
 - The world production of essential oil is estimated at about 1,00,00-1,10,00 t and India stands third with share of 16-17%.
 - USA is largest producer and consumer of essential oils.
 - Methods of essential oil extraction are
 - A) Distillation : i) Water distillation—Rose petals, ii) Water and steam distillation—seeds and roots, iii) Steam distillation—herb and leaf material
 - B) Enfleurage or cold fat extraction—Flower
 - C) Maceration or hot fat extraction
 - D) Solvent extraction
 - E) Expression
 - F) Super critical fluid extraction.
 - India ranks third in volume and second in value of world trade in aromatic oils and exports.

MEDICINAL PLANTS

Sr. No.	Common Name	Botanical Name	Family	Origin	Plant Part Used	Variety	Chemical Content	Uses
1.	Belladonna	<i>Atropa belladonna</i>	Solanaceae	Europe	Leaves	-	Atropine	Neurologic pains, Ampholinergic property
2.	Foxglove	<i>Digitalis purpurea</i>	Scrophulariaceae	Europe	Leaves	-	Hyoscyamine Digitoxin	Hyoscyamine used as truth confessor in criminological investigations. Cardiotonic property. Used to cure heart diseases.
3.	Henbane	<i>Hyoscyamus niger</i>	Solanaceae	Europe	Leaves	Aela	Hyoscyamine	Used to cure Asthama and whooping cough. Antispasmodic and Anticholinergic property
4.	Senna	<i>Cassia angustifolia</i>	Leguminosaceae	Europe	Leaves	Soona ALFT-2	Sennosides A, B, C, D	Laxative property, constipation.
5.	Dill or sowa	<i>Anethum graveolens</i>	Apiaceae	Europe	Seeds	-	Carvone	Oil is used to make Gripe Water.
6.	Ashwagandha (Winter chum) (Indian Ginseng)	<i>Withania somnifera</i>	Solanaceae	Africa	Roots	Jawahar asgandh	Withanine sommiferine	Used to make general tonics.
7.	Sarpagandha	<i>Rauwolfia serpentina</i>	Apocynaceae	India	Roots	R S-1	Serpentine Reserpine Saponins	Used as treatment for hypertension as a sedative (Reduce nervous excitement)
8.	Safed Musali	<i>Chlorophytum spp.</i>	Liliaceae	Africa	Roots	-	Saponins	To make vital tonics, to cure general diabetes. Ind silajet

Contd.....

Sr. No.	Common Name	Botanical Name	Family	Origin	Plant Part Used	Variety	Chemical Content	Uses
9.	Liquorice or Mulathi	<i>Glycyrrhiza glabra</i>	Leguminosaceae	Iraq	Roots	Haryana Mulathi No-1	Glycyrrhizin	Used to cure intestinal and peptic ulcers 150 times sweeter than sugar.
10.	Periwinkle or Vinca	<i>Catharanthus roseus</i>	Apocynaceae	West Indies	Roots and leaves	Nirmal Dhawal	Ajmaline, vincristine, vinblastine	Used as tranquilizer (Blood pressure control), cancer therapy
11.	Opium (poppy)	<i>Papaver somniferum</i>	Papaveraceae	Europe	Fruits (capsule)	Kirtiman Trishna Chetak	Morphine, Codeine, Narcotine	God of sleep, Painkiller, Analgesics (Reduces pain) and hypotonic effect, used to cure leukamia
12.	Isabgol (Psyllium)	<i>Pantago ovata (Stemless)</i>	Plantagonaceae	West India	Husk, seed	Niharika GI-I, GI-II	Mucilage	Laxative, soothing and cooling agent, Used against irritation in gastrointestinal tract.
13.	Medicinal Solanum	<i>Solanum khasianum</i>	Solanaceae	New Zealand	Fruits	Arka Sanjeevani Galaxo	Solasodine	Major source of steroid in India
14.	Aloe	<i>Aloe (vera) barbadensis</i>	Liliaceae	-	Leaves	-	Aloin oil	Skin tonic and herbal cosmetics
15.	Medicinal Yam	<i>Dioscorea floribunda</i>	Dioscoreaceae	-	Roots	Arka upkar	Diosgenin	Production of sex hormones and contraceptive pills
16.	Neem	<i>Azadirachta indica</i>	Meliaceae	India	Fruits & leaves	-	Azadiractin	diabetics treatment
17.	Cinchona	<i>Cinchona spp.</i>	Rubiaceae	South America	Bark	-	Quinine	Treatment of malaria
18.	Rye Ergot	<i>Cleviceps purpurea</i>	Clavicipitaceae	-	Sclerotia	-	Ergatamine	Used in obstetrics, migraine headache
19.	Datura	<i>Datura innoxia</i>	Solanaceae	Mexico	Whole Herb	-	Hyoscine, Tropane	Prenasthetic in surgery In relief of withdrawal symptoms in morphine.
20.	Ipecac	<i>Cephaelis ipecacuna</i>	Rubiaceae	Brazil	Roots	Metograsso	Cephaline, Emetin	To induce vomiting, use against amoebiasis
21.	Long pepper	<i>Piper longum</i>	Piperaceae	India	Roots	Viswan	Piperine	Improve appetiti, Laxative
22.	Guggal	<i>Commiphora spp.</i>	Burseraceae	Africa	Oleo gum resin	Manusudha	Guggulipids	Treatment of obesity, arthritis

AROMATIC PLANTS

Sr. No.	Common Name	Botanical Name	Family	Origin	Plant Part Used	Variety	Oil Content	Uses
1.	Davana	<i>Artemisia pallens</i>	Asteraceae	India	Leaves	-	hydrocarbons	Delicate fragrance for floral decoration, bouquets, cosmetics
2.	Rose geranium	<i>Pelargonium graveolens</i>	Geraniaceae	South Africa	Leaves and flowers	Hemanti Kunti	Geraniol, Rhodinol	Perfumes, powder, creams, body lotions.
3.	Japanese mint	<i>Mentha arvensis</i>	Labiatae	-	Leaves	Shivalik	Menthol, carvone, Linalool	Scenting in the supari
4.	Bergamot-mint	<i>Mentha citrata</i>	Labiatae	-	Leaves	Kiran	Carvone	
5.	Oil bearing rose	<i>Rosa damascena</i>	Rosaceae	-	Flowers	Sher-A Khasmir	Citronellol Geraniol	Auto of Rose, Ruha Gulab, Rose Oil
6.	Lemon grass (Kochin oil)	<i>Cymbopogon flexuosus</i>	Gramineae	India	Leaves	Sugandhi Kaveri	Citral Farnesol	Starting material for ionones and Vitamin-A manufacturing.
7.	Patchouli	<i>Pogostimon patchouli</i>	Lamina ceae	-	Leaves	Johori	Patch ouliol	Fixative property
8.	Vitever grass	<i>Vetevaria zizanoides</i>	Viteveraceae	India	Roots	-	Viteverol	Carminative property
9.	Java citronella	<i>Cymbopogon winterianus</i>	Graminae	Ceylon.	Leaves	Mandakini Manjusha	Citronellal	Mosquito repellents, deodrants, scented soaps
10.	Palmrosa grass	<i>Cymbopogon martini</i>	Graminae	-	Leaves	Trishna	Geraniol	soaps, perfumery

Contd.....

Sr. No.	Common Name	Botanical Name	Family	Origin	Plant Part Used	Variety	Oil Content	Uses
11.	Keweda	<i>Pandanus fascicularis</i>	Pandanaceae	Tropical Africa	Flowers	-	lupulin	Kewada water (rooh or attar)
12.	Hops	<i>Humulus lupulus</i>	Cannabinaceae	-	Flowers	-	-	-
13.	Ambrette or muskdana	<i>Abelmoschus moschatus</i>	Malvaceae	India	Seeds	-	Farnesol	Musk odour used in incense sticks, panmasala, perfumery, cosmetics, scent
14.	Jamalagota	<i>Croton tiglium</i>	Euphorbiaceae	-	Fruits	-	-	Violent purgative
15.	Celery	<i>Apium graveolens</i>	Unbelliferae	Italy	Seeds	-	Limonine	Seeds : spice seed oil Seasoning, flavouring sauces, purees
16.	Indian Basil	<i>Occimum basilium</i>	Lamiaceae	Africa	Leaves and inflorescence	-	Methyl Chavicol	Flavouring foods
17.	Rosemary	<i>Rosemaris officinalis</i>	Lamiaceae	Europe	Whole herb	-	Camphene, cineol	Anticancer and Antioxident property
18.	Melissa	<i>Melissa officinalis</i>	Lamiaceae	-	Whole herb	-	Citrol, Nerol	Perfumery, cosmetics

PART - III

**FLORICULTURE,
POST HARVEST TECHNOLOGY
&
GENERAL HORTICULTURE**

POST HARVEST TECHNOLOGY
&
FRUIT NUTRITION

FLORICULTURE

FLORICULTURE INDUSTRY

- * Leading flower product exporting country :
(i) Netherlands (57%) (ii) Columbia (14%)
- * Leading flower product importing country :
(i) Germany, (ii) USA
- * Leading cut greens exporting country :
(i) Italy, (ii) Netherlands
- * Leading dry flower product exporting country : Australia
- * Leading dry flower product importing country : U.K.
- * Largest producer of perfumery products : Bulgaria
- * Leading country with highest per capita consumption of cut flower—
(i) Switzerland, (ii) Norway
- * Leading country with highest per capita consumption of live plants :
(i) Norway, (ii) Germany
- * Country having largest market of cut flowers :
(i) Germany, (ii) USA
- * International flower market is situated at Aalsmeer in the Netherlands
- * Head Quarter of International cut flower growers association : USA
- * Head Quarter of International Society for Horticultural Science : Belgium
- * International Registration authority for Rose : USA
- * International Registration authority for Bouganvillia : New Delhi
- * No. one foliage plant at global level : Diffenbachia
- * No. one cut flower at global level : Rose
- * Total area under floriculture in the world : 25 lakh hectare
- * Total area under Green House floriculture in the world : 60,000 hectare.
- * Total floriculture trade in the world is 20 billion US\$/annum
- * India's share in global floriculture trade : 0.6%
- * Total area under floriculture in India : 1 Lakh hectare (Approximately)
- * State having maximum area under floriculture in India : (Karnataka)
- * State having maximum production under floriculture in India : (Tamilnadu)
- * In India, total area under Green House : 500 hectare
- * Largest importer of floriculture products from India : USA (27%)

- * Share of dry flower product in India's total export : 60%
- * Maximum cut flower production in India : West Bengal
- * ~~Division of ornamental crops started at IHR in : 1969~~
- * Division of floriculture and landscaping started at IARI in : 1983
- * 1st AICRP on floriculture started in 1971
- * Flower crop covering maximum Area in India : Jasmine
- * Leading Bulbous plant producing country : Netherlands
- * Leading Bulbous plant importing country : USA
- * India is largest producer of loose flowers in the world.
- * 'Hedera'-Number one pot plant in global flowers market.
- * Helichrysum-1st rank in dried ornamentals in global flower market.
- * Flower capital of world : California, USA
- * Foliage capital of the world : *Apokka*, Florida, USA
- * Asparagus-rank-1st in cut greens in global flower market.
- * Countries involved in production and export of specific cut flower :
 - (i) Carnation & Rose—Columbia & Kenya
 - (ii) Orchids— Thailand, Sigapore, Malaysia
 - (iii) Anthurium— Mauritius
- * Hogarth course is also known as line of beauty.
- * Biggest formal garden : Vrindavan Garden, Mysore.
- * Heaven of Man— Italian Garden
- * Stevia— 'Wonder Plant' (Sweeteners of future)
- * 'Beautiful Gardens' book is written by M.S. Randhwa
- * 'Garden Flowers' book is written by Vishnu Swarup
- * 'Garden Through Ages' book is written by M.S. Randhwa
- * Complete Gardening in India was published by Hoseli Press
- * Introductory Ornamental Horticulture Arora is published by Kalyani Publishers
- * Optimum level of CO₂ enrichment for most green house crops range from 800 to 1200 ppm.
- * Phenology refers to flowering behaviour which includes timing of flower emergence.
- * Chrysanthemum are photosensitive in nature where flowering is affected by photoperiodic control
- * Low temperature frost injury is found in Rose and Gladiolus

FAMOUS GARDENS IN INDIA

1. **Lalbagh:** Bangalore (Karnataka) Floral clock (free style).
2. **Brindavan Garden:** Mysore (Karnataka) - Biggest formal Garden
3. **Sim's Park:** Conoor (TN)
4. **Byrant Park:** Kodaikanal (TN)
5. **The Indian Botanical Garden:** Sibpur, Kolkata (WB)
6. **Lyod Botanical Garden:** Darjeeling (WB)
7. **National Botanical Garden:** Lucknow (UP)
8. **Rastrapathi Bhavan Garden:** New Delhi
9. **Buddha Jayanti Park:** New Delhi
10. **Mughal Garden:** (Pinjore) Haryana
11. **Rose Gardens:** Chandigarh (Punjab)
12. **Mandoor Garden:** Jodhpur (Rajasthan)
13. **Sayaji Park:** Vadodra (Gujarat) Branching palm
14. **Roshnara Park:** New Delhi
15. **Botanical Garden:** Forest Research Institute Dehradun (Uttarakhand)
16. **Botanic Garden:** Coimbatore (TN)
17. **Chasme a Shahi:** Srinagar (J&K)
18. **Tulip Garden :** Srinagar (J&K)

NATIONAL FLOWERS OF THE DIFFERENT COUNTRIES

- | | |
|--|--|
| 1. Lotus : India, Egypt | 14. Blue eyed grass : Bermuda |
| 2. Rose : England, Iran, Maldives,
Laos, Bulgaria, Persia, Turkey, U.S. | 15. Poppy : Belgium, Italy |
| 3. Narcisuss : China | 16. Daisy : Litiva, Russia |
| 4. Chrysanthamum : Japan | 17. Calendula : Netherland |
| 5. Tulip : Netherlands, Holand | 18. Cyclomen : Sen Mariro |
| 6. Lily : Italy, Canada | 19. Cattelye orchid : Argentina, Brazil |
| 7. Corn flower : Germany | 20. Clover : Denmark |
| 8. Daffodil : Wales | 21. Jasmine : Pakistan, Paraguay, Philippines, Indonasia |
| 9. Carnation : Spain | 22. Lavender : Portugal |
| 10. Golden rose : USA | 23. Kowhai : New Zealand, |
| 11. Cresent : Pakistan | 24. Dahlia : Mexico |
| 12. Water lily : Bangladesh | 25. Blossom : Libiya |
| 13. Shamrock : Northern Ireland | 26. Hibiscus : Malaysia |
| | 27. Catteliya orchid : Argentenina, Brazil |

FLOWERS FOR DIFFERENT PURPOSES

Sr No.	Name	Purpose	Sr No.	Name	Purpose
1.	Rose	love	7.	Daffodil	Regards
2.	Carnation (White)	Women's love	8.	Amaryllis	Pride
3.	French Marigold	Jealously /Sorrow	9.	Iris	Message
4.	African Marigold	Vulgar mind	10.	Lily	Purity
5.	Pansy	Thoughts	11.	Stock	Luxury
6.	Narcisuss	Self esteem	12.	Sweet Pea	Departure

HISTORY OF GARDENING

Plants which have originated in India :

Sr No.	Category	Sr.No.	Name of Plant	Botanical name
1.	Flowering Annuals	1.	Orchids	<i>Cymbidium, Dendrobium sp.</i>
		2.	Rhododendrons	<i>Rhododendron spp.</i>
		3.	Musk Rose	<i>Rosa moschata</i>
		4.	Balsam	<i>Impatiens balsamina</i>
		5.	Primula	<i>Primula denticulata</i>
		6.	Blue poppy	<i>Maconopsis spp.</i>
		7.	Gloriosa lily	<i>Gloriosa superba</i>
		8.	Tulip	<i>Tuplica stellata</i>
		9.	Gomphrena	<i>Gomphrena globosa</i>
		10.	Lady's lace	<i>Pimphenella monoisa</i>
2.	Trees	1.	Sita Ashoka	<i>Saraca indica</i>
		2.	Pipal	<i>Ficus religiosa</i>
		3.	Banyan	<i>Ficus bengalensis</i>
		4.	Nag Kesar	<i>Mesua ferrea</i>
		5.	Palas	<i>Butea monosperma</i>
		6.	Kadam	<i>Neuclea cadamba</i>
		7.	Swarna Champa	<i>Michelia Champaka</i>
		8.	Neem	<i>Azadirachta indica</i>
		9.	Arjun tree	<i>Terminalia arjuna</i>
		10.	Kachnar	<i>Bauhinia variegata</i>
		11.	Karanj	<i>Pongamia glabra</i>
		12.	Bhendi	<i>Thespesia populnea</i>
		13.	Chalta	<i>Dillenia indica</i>
		14.	Barna	<i>Crataeva roxburghi</i>
		15.	—	<i>Sterculia colorata</i>
		16.	Mahua	<i>Bassia latifolia</i>
		17.	Amaltas	<i>Cassia fistula</i>
		18.	Indian Mahagoni tree	<i>Cedrella toona</i>
		19.	Pangara	<i>Erythrina varigata</i>
		20.	Monkey tail	<i>Heterophragma heterophyllum</i>
		21.	Pride of India	<i>Lagerstromia speciosa</i>
		22.	False Almond	<i>Terminalia cattapa</i>
3.	Shrubs	1.	Bela	<i>Jasminum sambac</i>
		2.	Pili chameli	<i>Jasminum humile</i>
		3.	Rukmani	<i>Ixora coccinea</i>

Sr No.	Category	Sr.No.	Name of Plant	Botanical name
		4.	Har shringar	<i>Nyctanthus arbotristis</i>
		5.	Cup and soucer	<i>Holmoskioldia sanguinea</i>
		6.	Hamiltonia	<i>Hamiltonia sauveolens</i>
		7.	Clerodendron	<i>Clerodendron inerme</i>
		8.	Chandni	<i>Ervatamia coronaria</i>
		9.	Crossandra	<i>C. infundibiliformis</i>
		10.	Chitra	<i>Plumbago rosea</i>
		11.	Barleria	<i>Barleria cristata</i>
		12.	Weeping merry	<i>Russelia juncea</i>
		13.	Kund	<i>Jasminum multiflorum</i>
		14.	—	<i>Daedalacanthus nervosus</i>
4.	Climbers	1.	Passion flower	<i>Passiflora spp.</i>
		2.	Butterfly pea creeper	<i>Clitoria terneata</i>
		3.	Bridal bouquet	<i>Porana paniculata</i>
		4.	Virgin flower	<i>Clematis montana</i>
		5.	Madhvi lata	<i>Hiptage bengalensis</i>
		6.	Railway creeper	<i>Ipomea palmata</i>
		7.	Indian Ivy	<i>Ficus repens</i>
		8.	Chameli	<i>J. grandiflorum</i>
		9.	Sky flower	<i>Thunbergia grandiflora</i>
		10.	Nepal trumpet flower	<i>Beaumontia grandiflora</i>
		11.	Bauhinia	<i>Bauhinia vahlii</i>

- * Kadam tree is associated with Lord Krishna
- * Semal tree is associated with Shiva
- * Bauhinia tree is associated with Saraswati
- * Amaranthus tree is associated with Kali
- * Yellow Amaltas tree is associated with prosperity in trade
- * Ashoka, Sal and Palash tree is associated with Buddha
- * Babar was Ist Mughal emperor who started gardening in India. He made Aram Bagh at Agra.
- * Akbar : Garden in Fatehpur Sikri (Agra), Tomb Garden in Sikandara (Agra).
- * Jahangir : Shalimar Garden (Kashmir), Dilkhush Garden (Lahore).
- * Shah-Jahan : Chasma-a-shahi (Sri Nagar), Shalimar Garden (Lahore)
- * Taj Mahal Garden (Agra), Redfort (Agra & Delhi)
- * Fadai Khan : Pinjore Garden
- * King Hyder Ali : Lalbagh Garden (Bangalore)
- * Maharaja Ranjit Singh : Garden at Amritsar
- * King Bhupinder Singh : Baradari Garden at Patiala
- * Poet kalidas mentioned plant in the play Shakuntala : Madhvi
- * Noorjahan discovered otto of rose while taking bath.
- * Garden which is considered as genesis of gardening : Garden of Edens (UK)
- * Moorish Garden were developed in Spain
- * Famous french garden designer : Le Notre

ANNUALS

- (a) **Summer Annuals** : Sowing of seeds : February-March
1. Zinnia 2. Kochia 3. Portulaca 4. Tithonia 5. Gilalardia 6. Sunflower 7. Cosmos 8. Gomphrena 9. Coreopsis
- (b) **Rainy Annuals** : Sowing of seeds : June-July
1. Balsam 2. Cock's comb 3. Amaranthus 4. Giallardia 5. Torenia 6. Gomphrena
- (c) **Winter annuals** : Sowing of seeds : September-October
They are able to tolerate low temperature during winter.
- (d) **For fragrant flower** : 1. Mignonette 2. Carnation 3. Sweet pea 4. Sweet sultan 5. Sweet william 6. Sweet alyssum 7. stock
- (e) **For hanging Basket** : 1. Daisy 2. Nasturtium 3. Verbena 4. Phlox 5. Sweet Alyssum 6. Portulaca 7. Torenia 8. Lobelia 9. Hymenatherum
- (f) **For shady situation** : 1. Salvia 2. Cineraria
- (g) **For rock garden** : 1. Ice plant 2. Nasturtium 3. Verbena 4. Phlox 5. Gamolepis
- (h) **For screening purpose** : Hollyhock 2. Sweet pea
- (i) **For Peculiar shape** : 1. Clianthus
- (j) **For pots** : 1. Carnation 2. Antirrhinum 3. Aster 4. Petunia
- (k) **For dry flower** : 1. Statice 2. Helichrysum 3. Acroclinum 4. Nigella 5. Lady's lace
- (l) **Herbaceous border** : Planting annuals in the border of a plot is called as herbaceous border.
Two types : (1) Single face (2) Double face : more ideal when border is to be made in between a big plot.
- (m) **Colour Scheme** : 1. Green colour dominant throughout the year in the garden. 2. Warm colour-Red : in winter 3. Yellow-spring 4. Red, yellow and Blue : Primary colours 5. Orange green, violet : Secondary colours 6. White, Black, grey : Neutral colours 7. Cream, Pink and Shades : Tertiary colours 7. Red, Orange and Yellow : Warm colours : 9. Green and Blue : Cool colours
- (n) **Blue colour (flower) annuals** : 1. Corn flower 2. Blue larkspur 3. Ageratum 4. Anchusa 5. Linaria 6. Browallia
- (o) **White flower Annuals** : 1. Allysum 2. China Aster 3. Mathiola 4. Nigella 5. Phlox 6. Papaver 7. Zinnia 8. Stock 9. Dimorphotheca
- (p) **Yellow and Orange flower Annuals** : 1. Pot marigold 2. Dimorphotheca 3. Eschscholtiza 4. Tagetes 5. Tropaeolum 6. Zinnia 7. Wall flower 8. Coreopsis 9. Helichrysum
- (q) **Self pollinated Annuals** : 1. Lupin 2. Sweet pea 3. Salvia
- (r) **Often cross pollinated** : 1. Antirrhinum 2. Larkspur 3. Linaria 4. Phlox 5. Pansy (50-100m Isolation distance)

* Leading flower seed producing state (i) Punjab (50%), (ii) Haryana (iii) Himachal Pradesh.

* Area under seed production in India : 800 hectare

* Annual having maximum no. of seed/gram : Petunia and Portulaca (over 10,000)

* Annual having minimum no. of seed/gram : Sweet pea & sunflower (15-20)

* Boldseed : Holyhock, morning glory, lupin, Nasturtium

(s) **Shortday Annuals** : Amaranthus 2. Cosmos 3. Chrysanthamum 4. Salvia 5. Aster

(t) **Long day Annuals** : Antirrhinum 2. Carnation 3. Petunia 4. Rudbeckia 5. Sweet William

(u) **Day Neutral** : 1. Gomphrena 2. Balsam

(v) **Intermediate day** : Coleus

(w) **Long short day** : Aloe

(x) **Short long day** : 1. Campanula 2. White clover

(y) **Hardy annual** : 1. Digitalis 2. Rudbeckia 3. Viola

(z) **Tender Annual** : 1. Oxalis

(aa) **Pink Colour Flower** : 1. Candy tuft 2. Acroclinum

(bb) **Seed germination only in light** : 1. Nicotiana 2. Lobelia 3. Echium

(cc) **Seed germination only in dark** : 1. Nigella 2. Phlox 3. Amaranthus 4. Allium

Sr.No.	Flower crop	Common Name	Botanical Name	Family	Remarks
(A) Summer & Rainy Season Annuals					
1.	Amaranthus	Love lies bleeding	<i>Amaranthus caudatus</i>	Amaranthaceae	Sunny situation
2.	Balsam	—	<i>Impatiens balsamina</i>	Balsaminaceae	—
3.	Cock's comb	—	<i>Celosia spp.</i>	Amaranthaceae	—
4.	Gaillardia	Blanket flower	<i>Gaillardia pulchella</i>	Compositae	Indian chief Red
5.	Gomphrena	Globe Amaranth	<i>Gomphrena globosa</i>	Amaranthaceae	—
6.	Kochia	Summer cypress	<i>Kochia scoparia</i> var	Chenopodiaceae	Sunny situation
	Foliage annual	Burning bush	<i>tricophylla</i>		Doesnot produce flowers
7.	Portulaca	Sunplant	<i>Portulaca grandiflora</i>	Portulacaceae	Dwarf
8.	Sunflower	—	<i>Helianthus annus</i>	Compositae	Sultan's autumn beauty
9.	Tithonia	Mexican Sunflower	<i>Tithonia speciosa</i>	Compositae	Tall
10.	Zinnia	—	<i>Zinnia elegans</i>	Compositae	Riverside beauty, Firecracker, Princess
(B) Winter Annuals					
1.	Acroclinum	Paper flower Everlasting flower	<i>Acroclinum roseum</i>	Compositae	Pink, White
2.	Ageratum	Floss flower	<i>Ageratum houstonianum</i>	Compositae	Blue
3.	Anchusa	—	<i>Anchusa capensis</i>	Compositae	Blue
4.	Annual chrysanthamum	Crown daisy Garland chrysanthamum	<i>Chrysanthamum coronarium</i>	Compositae	White
5.	Antirrhinum	Snap dragon Dog flower Bunny rabbit Bunny mouth	<i>Antirrhinum majus</i>	Scrophulariaceae	(F ₁ Hybrid) Rocket

Sr.No.	Flower crop	Common Name	Botanical Name	Family	Remarks
6.	Arctotis	African daisy	<i>Arctotis stoechadifolia</i>	Compositae	—
7.	Aster	—	<i>Callistephus chinensis</i>	Compositae	Ostrich feather, Giant perfection
8.	Bells of Ireland	—	<i>Molucella laevis</i>	Labitae	—
9.	Brachycome	Swan river daisy	<i>Brachycome-iberidifolia</i>	Compositae	Dwarf, white
10.	Calendula	Pot marigold	<i>Calendula officinalis</i>	Compositae	Yellow
11.	California poppy	—	<i>Eschscholtzia californica</i>	Papaveraceae	—
12.	Candy tuft	Hyacinth flower	<i>Iberis spp.</i>	Cruciferae	White, Pink (dwarf)
13.	Cineraria	Shade loving plant	<i>Senecio cruentus</i>	Compositae	—
14.	Clarkia	Semi shade situation	<i>Clarkia elegans</i>	Onagraceae	—
15.	Clianthus	Parrot's bill	<i>Clianthus dampieri</i>	Leguminoceae	—
16.	Coreopsis	Tick seed (Pusa Tara)	<i>Coreopsis tinctoria</i>	Compositae	Yellow
17.	Corn flower	Hurt sickle Blue bottle Bachelor's button Ragged sailor	<i>Centaurea cyanus</i>	Compositae	Tall White, Pink Blue
18.	Cosmos	Short day plant	<i>Cosmos bipinnatus</i>	Compositae	Masterpiece
19.	Dahlia	—	<i>Dahlia variabilis</i>	Compositae	Arabian Night
20.	Daisy	English daisy	<i>Bellis perennas</i>	Compositae	Dwarf
21.	Dimorphotheca	African daisy Cape Marigold	<i>Dimorphotheca aurantiaca</i>	Compositae	White
22.	Gamolepis	—	<i>Gamolepis tagetes</i>	Compositae	Dwarf
23.	Gazania	—	<i>Gazania splendens</i>	Compositae	Dwarf
24.	Gypsophila	Babys breath	<i>Gypsophila elegans</i>	Caryophyllaceae	—
25.	Helichrysum	Everlasting flower	<i>Helichrysum bracteatum</i>	Compositae	Tall, Yellow
26.	Hollyhock	—	<i>Althea rosea</i>	Malvaceae	Tall
27.	Ice plant	Living stone daisy Fig marigold	<i>M. criniflorum</i>	Aizoaceae	Sunny situation
28.	Lady's lace	—	<i>Pimphenella monoica</i>	Umbelliferae	—
29.	Larkspur	—	<i>Delphinium hybridum</i>	Ranunculaceae	Miss california
30.	Linaria	Trod flax	<i>Linaria bipartita</i>	Scrophulariaceae	Dwarf
31.	Linum	Flax	<i>Linum grandiflorum</i>	Linaceae	—
32.	Lupin	—	<i>Lupinus hartwegii</i>	Leguminoceae	—
33.	Mignonette	—	<i>Reseda odorata</i>	Resedaceae	—
34.	Mimulus	Monkey flower	<i>Mimulus tigrinus</i>	Scrophulariaceae	—

Sr.No.	Flower crop	Common Name	Botanical Name	Family	Remarks
35.	Nasturtium	—	<i>Tropaeolum majus</i>	Tropaeolaceae	Dwarf
36.	Nemasia	—	<i>Nemasia strumosa</i>	Scrophulariaceae	—
37.	Nigella	Love in a mist	<i>Nigella domascena</i>	Ranunculaceae	—
38.	Pansy	Viola	<i>Viola wittor ckiana</i>	Violaceae	King of Annual flowers
39.	Petunia	—	<i>Petunia hybrida</i>	Solanaceae	—
40.	Phlox	Star flower	<i>Phlox drummondii</i>	Polemoniaceae	—
41.	Salvia	Sage flower	<i>Salvia splendens</i>	Labiatae	—
42.	Rudbeckia	Cone flower	<i>Rudbeckia bicolor</i>	Compositae	—
43.	Saponaria	Soapwort	<i>Saponaria vaccaria</i>	Caryophyllaceae	—
44.	Schizanthus	Butterfly flower Poorman's orchid	<i>Schizanthus wistonensis</i>	Solanaceae	—
45.	Shirley poppy	Corn poppy	<i>Papaver rhoeas</i>	Papavaraceae	—
46.	Statice	Sea lavender	<i>Limonium sinuatum</i>	Plumbaginaceae	Pink
47.	Stock	—	<i>Mathiola incana</i>	Cruciferae	White
48.	Sweet Alyssum	—	<i>Alyssum maritimum</i>	Cruciferae	—
49.	Sweet pea	—	<i>Lathyrus odoratus</i>	Leguminosae	Little sweet heart
50.	Sweet sultan	—	<i>Centaurea moschata</i>	Compositae	—
51.	Sweet william	—	<i>Dianthus barbatus</i>	Caryophyllaceae	—
52.	Venidium	—	<i>Venidium fastuosm</i>	Compositae	Monarch
53.	Verbena	—	<i>Verbena hybrida</i>	Verbanaceae	Dwarf
54.	Wall flower	—	<i>Cherianthus cherii</i>	Cruciferae	Medium, Yellow
55.	Wish bone	—	<i>Torenia fournien</i>	Scrophulariaceae	Blue
56.	Phacelia	—	<i>Phacelia campanularia</i>	Hydrophyllaceae	—
57.	Godetia	—	<i>Godetia grandiflora</i>	Onagraceae	—
58.	Celosica	—	<i>Celosica argentia</i>	Amaranthaceae	—
59.	Browallia	—	<i>Browallia americana</i>	Solanaceae	Blue
60.	Lobelia	—	<i>Lobelia erinus</i>	campanulaceae	—

(A) Self incompatibility : 1. Ageratum 2. Antirrhinum 3. Daisy 4. Gerbera 5. Petunia 6. Nicotiana

(B) Cytoplasmic male sterility (CMS) : Ageratum 2. Petunia 3. Sunflower

(C) Heterostyly : Primula

* In Northern hills, all annual flowers are grown during summer (March-April)

* In mild climate (Banglore, Pune) all flowers can be grown.

* In South India : Sept.-Oct. ideal time for sowing annuals.

* Late flowering type : 1. China Aster 2. Carnation 3. Cineraria (sowing : August-September)

HEDGE

When shrub is planted on boundry for fencing, it is called as hedge.

Planting time : July-August

Spacing : Tall 60-90 cm, dwarf: 20-30 cm

Trimming : When hedge attain a height of 15 cm, they should be topped back to 10 cm height.

Classes of hedge

(a) Tall protective (1-3 mt height): 1. Inga dulcis 2. Karonda 3. Bouganvillia 4. Acasia fernesina

(b) Dwarf Protective (1 mt height) : 1. Euphorbia bojori 2. Opuntia spp. 3. Agave spp. 4. Pedilanthus spp.

(c) Tall ornamental : 1. Mehendi 2. Duranta 3. Casuarina 4. Hibiscus 4. Hamelia patens 5. Stonolobium stans 6. Thevetia peruviana 7. Murraya paniculata

(d) Dwarf ornamental : 1. Acalypha 2. Clerodendron 3. Thunbergia 4. Lantana spp.

EDGE

When low growing plants are grown on the border of plot they are called as edge plants.

They hardly grow upto 20-30 cm. A good edge plant is self supporting, tidy and compact. The important character of edge plant is reliable foliage that retains the colour and form of the plant.

Most widely used : 1. Alternanthera 2. Justicia 3. Eupatorium 4. Iresine lindenii. 5. Sunrose (Helianthemum.)

TOPIARY

It is an art of training the plants into different shapes, or it is the art of creating sculptures using clipped trees, shrubs and substrubs. Plant used in topiary are evergreen, have small leaves or needles produce dense foliage or columnar growth habits.

Suitable plants for topiary : 1. Duranta plumeri 2. Sesbenia egyptica 3. Inga dulcus 4. Acasia modesta 5. Murraya paniculata

The Samban-Lei Sekpil (Manipur) is the world's tallest topiary. Present heights 18.6 m (61 ft).

SHRUBS

(a) **Foliage shrubs** : 1. *Acalypha tricolour* 2. *Nandina domestica* 3. *Codium variegatum* 4. *Manihot variegata*

(b) **Flower and foliage shrubs** : 1. *Bougainvillea* 2. *Buddleia asiatica* 3. *Buddleia madagascariensis* 4. *Hamelia patens*

(c) **Fragrant flower** : 1. *Cestrum nocturnum* 2. *Cestrum diurnum* 3. *Jasminum sambac* 4. *Murrya paniculata* 5. *Jasminum auriculatum*

(d) **Specimen shrubs** : 1. *Bougainvillea* 2. *Hibiscus* 3. *Hamelia patens* 4. *Thevetia peruviana*

Propagation of shrubs

(a) **Seed** : 1. *Stenolobium stans* 2. *Thevetia peruviana* 3. *Calliandra* spp. 4. *Caesalpinia pulcherrima*

(b) **Cutting** : 1. *Hibiscus* 2. *Achania malvaviscus* 3. *Jasminum sambac* 4. *Hamelia patens* 5. *Bougainvillea* 5. *Cestrum diurnum* 7. *Cestrum nocturnum*

(c) **Layering** : 1. *Bougainvillea* 2. *Ixora* spp. 3. *Jasminum sambac* 4. *Jasminum multiflorum*

* **Planting time** : Rainy season and February-March

* **Spacing** : Tall : 150-180 cm, Medium : 120-150 cm, dwarf : 90-120 cm

* **Method of planting** : 1. Triangular system 2. Double row.

Sr.No.	Shrub	Common Name	Botanical Name	Family	Flower colour
(A) Dwarf					
1.	Mogra	—	<i>Jasminum sambac</i>	Oleaceae	White
2.	Weeping merry	—	<i>Russelia juncea</i>	Scrophulariaceae	Red
3.	Chitra	—	<i>Plumbago auriculata</i>	Phumbaginaceae	Blue
4.	Barleria	—	<i>Barleria cristata</i>	Acanthaceae	Violet-Blue
5.	Galphimia	—	<i>Galphimia gracillis</i>	Malphiaceae	Yellow
6.	Yesterday, today, tomorrow	—	<i>Brunfelsia calycina</i>	Solanaceae	Blue
7.	Daedalacanthus	—	<i>Daedalacanthus nervosus</i>	Acanthaceae	Blue
(B) Medium					
8.	Acalypha	—	<i>Acalypha</i> spp.	Euphorbiaceae	Foliage
9.	Achania	—	<i>Achania malvaviscus</i>	Malvaceae	Red
10.	Night Queen	Raat ki Rani	<i>Cestrum nocturnum</i>	Solanaceae	Cremish white
11.	Day king	Dinka Raja	<i>Cestrum Diurnum</i>	Solanaceae	White
12.	Kund	Bela	<i>Jasminum multiflorum</i>	Oleaceae	White
13.	Ghanari	—	<i>Lantana camera</i>	Verbanaceae	White, Red, Yellow
14.	Mussaenda	Colour ful bracts	<i>Mussaenda Luteola</i>	Rubiaceae	Yellow

Sr.No.	Shrub	Common Name	Botanical Name	Family	Flower colour
15.	Thunbergia	—	<i>Thunbergia erecta</i>	Acanthaceae	Violet
16.	Stachytarpheta	—	<i>Stachytarpheta indica</i>	Verbanaceae	Violet
17.	Tecoma	—	<i>Tecoma capensis</i>	—	Red, Yellow
(C) Tall shrubs					
18.	Buddleia	Summer lilac Butterfly bush	<i>Buddleia asiatica</i>	Loganiaceae	White
19.	Malti	Chandni	<i>Ervatamia divaricata</i>	Apocynaceae	White
20.	Ixora	—	<i>Ixora perviflora</i>	Rubiaceae	White
21.	Kamini	—	<i>Murraya paniculata</i>	Rutaceae	White
22.	Poinsettia	Colourful Bracts	<i>Poinsettia pulcherima</i>	Euphorbiaceae	White
23.	Tree of sadness	Night Jasmine Harshrinagar	<i>Nyctanthus arbotristis</i>	Oleaceae	White, Orange
24.	Lal kaner	—	<i>Nerium indicum</i>	Apocyanaceae	White, Pink, Red
25.	Shravani	—	<i>Lagerstromia indica</i>	Lythraceae	White, Red, Purple
26.	Peacock flower	—	<i>Caesalpinia pulcherrima</i>	Leguminaceae	Red, Yellow
27.	Hamelia	—	<i>Hamelia patens</i>	Rubiaceae	Red
28.	Azalea	—	<i>Azalea spp.</i>	Ericaceae	—
29.	Cup and saucer	—	<i>Holmskioldia sanguinea</i>	Verbanaceae	Red
30.	Jatropha	—	<i>Jatropha multifida</i>	Euphorbiaceae	Red
31.	Abutilon	—	<i>Abutilon indicum</i>	Malvaceae	Yellow
32.	Anar	—	<i>Punica granatum</i>	Lythraceae	Red
33.	Pili Kaner	—	<i>Thevetia peruviana</i>	Apocynaceae	Red
34.	Stenolobium	—	<i>Stenolobium stans</i>	Bignoniaceae	Yellow
35.	Doembeya	—	<i>Doembeya spectabilis</i>	Sterculiaceae	Pink
36.	Hamiltonia	—	<i>Hamiltonia suaveolens</i>	Rubiaceae	Mauve
37.	Lady of the Night	—	<i>Brunfelsia americana</i>	Solanaceae	Yellow
38.	Ficus	—	<i>Ficus pandanus</i>	Moraceae	—
39.	China shoe flower	Gurhal	<i>Hibiscus-rosa-sinensis</i>	Malvaceae	Scarlet
40.	Snow bush	—	<i>Phyllanthus nervosus</i>	Euphorbiaceae	Foliage
41.	Dancing lady	—	<i>Fuchsia hyrda</i>	Onagraceae	Red, Purple
42.	Duranta	Pigeon berry	<i>Duranta plumeri</i>	Verbanaceae	Blue
43.	Gardenia	Capejasmine	<i>Gardenia jasminoides</i>	Rubiaceae	White
44.	Lolypop plant	—	<i>Pachystachys spp.</i>	Acanthaceae	Golden yellow
45.	Tithonia	—	<i>Tithonia tagetiflora</i>	Asteraceae	Red-orange
46.	Weigela	—	<i>Weigela florida</i>	caprifoliaceae	Pink-red

Sr.No.	Shrub	Common Name	Botanical Name	Family	Flower colour
47.	Genista	—	<i>Spartium junceum</i>	Leguminoceae	Yellow
48.	Aralia	—	<i>Schefflera spp.</i>	Araliaceae	—
49.	Basant	—	<i>Reinwardtia indica</i>	Linaceae	Yellow
50.	Paonia	—	<i>Paeonia suffruticosa</i>	Ranunculaceae	—
51.	Dalina	—	<i>Osyris orborea</i>	Santalaceae	—
52.	Privet	—	<i>Ligustrum ovalifolium</i>	Oleaceae	—
53.	Jacobinia	—	<i>Jacobinia carnea</i>	Acanthaceae	Red, Pink
54.	Gamelina	—	<i>Gamelina asiatica</i>	Verbanaceae	Yellow
55.	Exocaria	—	<i>Exocaria bicolor</i>	Euphorbiaceae	Yellow, Red
56.	Cassia	—	<i>Cassia glauca</i>	Leguminoceae	Yellow

TREES

Trees are perennial, tall with marked trunk and grow for several years, bear flower and fruits.

(A) Trees for screening purpose : 1. Grevillea robusta 2. Eucalyptus spp. 3. Poplar spp. 4. Polyalthia longifolia 5. Polyalthia pendula

(B) Trees for checking air pollution : 1. Morus spp. 2. Poplar hybrida 3. Plumeria acutifolia 4. Ficus infectoria

(C) Trees for Alkaline and saline soil : 1. Casuarina equistifolia 2. Cassia fistula 3. Parkinsonia aculeata

(D) Two kind of flowering tree blooming at one time

1. Grevillea robusta (Yellow) : Jacaranda acutifolia (Blue)

2. Cassia fistula (Yellow) : Delonix regia (Red)

3. Cassia fistula (Yellow) : Cassia nodosa (Pink)

Sr. No.	Tree	Common Name	Botanical Name	Family	Flower colour	Flowering time
1.	Australiawattle	—	<i>Acacia auriculiformis</i>	Leguminosae	Foliage tree	—
2.	Golden acacia	—	<i>Acacia cyanophylla</i>	Leguminosae	Golden	—
3.	Siris	—	<i>Albizia lebbek</i>	Leguminosae	Green yellow	April-May
4.	Devils tree	Sapt parni	<i>Alstonia scholaris</i>	Apocynaceae	White	July-Aug.
5.	Monkey puzzle	—	<i>Araucaria cookii</i>	Coniferae	Foliage	—
	Monkey bread tree	—	<i>Adansonia digitata</i>	Bombaceae	Cream	July-Aug
6.	Necm	—	<i>Azadirachta indica</i>	Meliaceae	White	April-May
7.	Mahua	—	<i>Bassia latifolia</i>	Sapotaceae	Red	April-May
8.	Bauhinia	—	<i>Bauhinia variegata</i>	Leguminosae	Rose red	March
			<i>Bauhinia alba</i>	Leguminosae	White	March
			<i>Bauhinia triandra</i>	Leguminosae	Purple	November
			<i>Bauhinia blackeana</i>	Leguminosae	Purple	Dec.-Feb.
9.	Golden Rain tree	—	<i>Koelreutaria paniculata</i>	Sapindaceae	—	—
10.	Semal or Red cotton silk	—	<i>Bombax malabaricum</i>	Bombaceae	—	March
11.	Flame of forest	Dhak Palas	<i>Butea monosperma</i>	Leguminosae	Scarlet Orange	March
12.	Bottle brush	—	<i>Callistemon lanceolatus</i>	Myrtaceae	Red	March-April
			<i>Callistemon polandii</i>	Myrtaceae	Yellow	—
			<i>Callistemon salignus</i>	Myrtaceae	White	March-April

Sr. No.	Tree	Common Name	Botanical Name	Family	Flower colour	Flowering time
13.	Amaltas	Golden Laburnum	<i>Cassia fistula</i> (tree of prosperity)	Leguminosae	Deep Yellow	May-July
		Pink Amaltas	<i>Cassia nodosa</i>	Leguminosae	Pink	April-May
		Kassoda tree	<i>Cassia siamea</i>	Leguminosae	Yellow	July-Jan.
14.	Beefwood (Dioecious tree)	Jarglisuru Farash. Jor-Tor	<i>Casuarina equisetifolia</i>	Casuarinaceae	—	—
15.	Indian Mahagoni,	Toona	<i>Cedrella toona</i>	Meliaceae	White	April
16.	Mexican ma	—	<i>Chorisia speciosa</i>	Malvaceae	Pink	Oct.-Nov.
17.	Saru	Cypress Weeping cypress	<i>Cupressus semiperuirensis</i> <i>Cupressus funebris</i>	Coniferae	Foliage	Very Common tree of persian, mogul gardens
18.	Gulmohar (Fine texture)	Peacock or Flameboyant flower	<i>Delonix regia</i>	Leguminosae	Orange Red, scarlet	May-June
19.	Pangara tree	Parrot flower	<i>Erythrina variegata</i>	Leguminosae	Scarlet	April
20.	Blue gum	Safeda	<i>Eucalyptus spp.</i>	Myrtaceae	—	—
21.	Bodhi tree	Pipal	<i>Ficus religiosa</i>	Moraceae	—	—
22.	Banyan	Bor kalpavriksha	<i>Ficus bengalensis</i>	Moraceae	Symbol of fertility	—
23.	Pavar	Pilkan	<i>Ficus infectoria</i>	Moraceae	—	—
24.	Chilkan	—	<i>Ficus retusa</i>	Moraceae	—	—
25.	Makhan katora	Krishna butter cup	<i>Ficus krishnae</i>	Moraceae	—	—
26.	Rubber tree	—	<i>Ficus elastica</i>	Moraceae	—	—
27.	Fiddle leaf fig	—	<i>Ficus lyrata</i>	Moraceae	—	—
28.	Silver oak	—	<i>Grevillea robusta</i>	Proteaceae	Golden Yellow	April
29.	Monkey tail	—	<i>Heterophragma adeniophyllum</i>	Bignoniaceae	Yellow	Feb.-March
30.	Jangal Jalebi	—	<i>Inga dulcis</i>	Leguminosae	—	—
31.	Nilli gulmohar	—	<i>Jacaranda acutifolia</i>	Bignoniaceae	Blue	April
32.	Juniper	—	<i>Juniperous chinensis</i>	Coniferae	Foliage	—
33.	Balam khira	Sausage tree	<i>Kigelia pinnata</i>	Bignoniaceae	Crimson	May-June
34.	Queen flower	Pride of India	<i>Lagerstroemia speciosa</i>	Lythraceae	Mauve	April-Aug.
35.	Bara champa	—	<i>Magnolia grandiflora</i>	Magnoliaceae	White	April-May
36.	Persian lilac	—	<i>Melia azedarch</i>	Meliaceae	—	—
37.	Swam champa	Sone champa	<i>Michelia champaka</i>	Magnoliaceae	Yellow	May
38.	Akash Neem	Cork tree Tree Jasmine	<i>Millingtonia hortensis</i>	Bignoniaceae	White	Oct-Jan
39.	Moluemain	Rose wood	<i>Miletia ovalifolia</i>	Leguminosae	Purple	April
40.	Molsari	—	<i>Mimusops elengi</i>	Sapotaceae	White	May-Aug.
41.	Kadam tree	—	<i>Nauclea cadamba</i>	Rubiaceae	—	Aug.-Sept.
42.	Jerusalemthorn	Vedi-Bathal	<i>Parkinsonia aculeata</i>	Leguminosae	Yellow	April-May
43.	Pagoda tree	Temple tree	<i>Plumeria species</i>	Apocyanaceae	—	—

Sr. No.	Tree	Common Name	Botanical Name	Family	Flower colour	Flowering time
44.	Ashok	Scholar's tree	<i>Polyalthia longifolia</i>	Anonaceae	Pale green	April
45.	Weeping Ashok	—	<i>Polyalthia pendula</i>	Anonaceae	—	—
46.	Karanj	Sukh chain	<i>Pongama pinnata</i>	Leguminosae	Purple	May
47.	Kanak champa	—	<i>Pterospermum acerifolium</i>	Sterculiaceae	Yellow	April-June
48.	Jiva putra	—	<i>Putranjiva roxburghii</i>	Euphorbiaceae	Yellow	March-April
49.	Traveller's tree	Dancing peacock	<i>Ravenala madagascariensis</i>	Scitmineae	Tropical climate	—
50.	Weeping willow	—	<i>Salix babylonica</i>	Salicaceae	—	—
51.	Sita Ashoka	—	<i>Saraca asoca</i>	Leguminosae	Scarlet Red	April
52.	Kusum	—	<i>Schleichera trijuga</i>	Sapindaceae	—	—
53.	Fountain tree	(Rough texture)	<i>Spathodea campanulata</i>	Bignoniaceae	Red	—
54.	Small mahagoni	—	<i>Sweetenia mahagoni</i>	Meliaceae	—	—
55.	Mauve tabebuia	—	<i>Tabebuia rosea</i>	Bignoniaceae	—	—
56.	Tecoma	—	<i>Tecoma argentiana</i>	Bignoniaceae	—	—
57.	Tecomella	—	<i>Tecomella undulata</i>	Bignoniaceae	—	—
58.	Teak	Sagwan	<i>Tectona grandis</i>	Verbanaceae	White	March-April
59.	Arjun tree	—	<i>Terminalia arjuna</i>	Combretaceae	Yellow	May-July
60.	Badam	False Almond	<i>Terminalia catappa</i>	Combretaceae	White	May
61.	Bahera	—	<i>Terminalia belerica</i>	Combretaceae	—	—
62.	Pahari Pipal	—	<i>Thespesia populnea</i>	Malvaceae	Yellow	—
63.	Tree of Heaven	—	<i>Ailanthus excelsa</i>	Simaroubaceae	—	April-June
64.	Rose of Venezuela	—	<i>Brownea grandiceps</i>	Leguminosae	Scarlet Red	March-May
65.	Chalta/Elephant	—	<i>Dillenia indica</i>	Dilleniaceae	White	May-Aug.
66.	Apple	—	—	—	—	—
67.	Tree of life	—	<i>Guaicum officinale</i>	Zygophyllaceae	Blue	March-April

Flowering time :

1. **April-May :** Siris, Neem, Mahua, Pink Amaltas, Bara Champa, Akash Neem, Jerusalem thorn, Kanak champa, Tree of Heaven
2. **April :** Indias Mahagoni tree, Pangara, silver oak, Neel gulmohar, Rose wood, Pagoda tree, Sita Ashoka
3. **March :** Bauhinia alba, B. Variegeta, semal, flame of forest
4. **March-April :** C. salignoso, Jiva putra, Tree of life, Teak.
5. **May :** Swarna Champa, Karanj, Badam.
6. **May-June :** Gulmohar, Balam Khira
7. **May-July :** Amaltas, Arjun tree
8. **May-August :** Elephant apple, molsan
9. **July-August :** Devil's tree, Monkey bread tree
10. **April-August :** Queen flower
11. **July-January :** Kassod tree

CLIMBERS

Climbers are the group of plants which have weak stems and ability to climb up the support with the help of modified organs for sun, light and air.

(a) **Tendrils** : 1. *Antigonon leptopus* 2. *Bignonia gracilis* 3. *Pyrostegia venusta* 4. *Clematis panniculata*

(b) **Thorns** : 1. *Bougainvillea* 2. Climbing rose.

(c) **Roots and rootlets** : 1. *Campsis grandiflora* 2. *Ficus repens*

(d) **Sticky substances** : *Ficus repens*

Classification

(a) **For sunny situation** : 1. *Pyrostegia venusta* 2. *Quisqualis indica* 3. *Antigonon leptopus* 4. *Adenocalymma alliaceum* 5. *Bougainvillea* 6. *Campsis grandiflora*.

(b) **For partial shade** : 1. *Clerodendron splendens* 2. *Petrea volubilis* 3. *Lonicera japonica* 4. *Trachalosperrum jasminoidis*

(c) **Climbers for pots** : 1. *Bougainvillea* 2. *Clitoria ternatea*

(d) **Making hedge** : 1. *Clerodendron inerme* 2. *Bougainvillea*

(e) **Indoor decoration** : 1. *Pothos* 2. *Monstera deliciosa* 3. *Philodendron spp.* 4. *Asparagus spp.*

(f) **For screening** : 1. *Vernonia elegnaefolia* 2. *Pyrostegia venusta*

(g) **Annual climbers** : 1. Sweet pea 2. *Ipomea lobata* 3. *Clitoria ternatea*

Sr. No.	Climber	Common Name	Botanical Name	Family	Flower colour	Flowering time
1.	Adenocalymma	—	<i>Adenocalymma alliaceum</i>	Bignoniaceae	Lavender	Nov.
2.	Coralvine	Lovers chain	<i>Antigonon leptopus</i>	Polygonaceae	Red	Sept.-Nov.
3.	Duck flower	—	<i>Aristolochia grandiflora</i>	Aristolochiaceae	White	Sept.
4.	Bauhinia	—	<i>Bauhinia Vahlii</i>	Leguminoceae	White	April-May
5.	Nepal trumpet creeper	—	<i>Beaumontia grandiflora</i>	Apocynaceae	White	March
6.	Benisteria	—	<i>Benisteria Laevifolia</i>	Malphigiaceae	Yellow	—
	Vernonia	—	<i>Vernonia elaeagnifolia</i>	Compositae	—	—
7.	Bignonia	—	<i>Bignonia magnifica</i>	Bignoniaceae	Violet	Oct.-Nov.
8.	Bignonia	—	<i>Bignonia gracillis</i>	Bignoniaceae	Yellow	March-April
9.	Trumpet climber	—	<i>Campsis grandiflora</i>	Bignoniaceae	Orange	May-Nov.
10.	Virgin flower	Clematis	<i>Clematis panniculata</i>	Ranunculaceae	White	July-Aug.
	Grape flower vine	—	<i>Wisteria sinensis</i>	Leguminoceae	White	March
11.	Clerodendron	—	<i>Clerodendron splendens</i>	Verbanaceae	Deep Red	Dec.-March

Sr. No.	Climber	Common Name	Botanical Name	Family	Flower colour	Flowering time
12.	Butterfly pea creeper	—	<i>Clitoria ternatea</i>	Leguminosaceae	Blue	—
13.	Indian Ioy	—	<i>Ficus repens</i>	Moraceae	Semishady situation	
14.	Madhavi lata	—	<i>Hiptage bengalensis</i>	Malphiaceae	White	Feb.-March
15.	Railway creeper	—	<i>Ipomea palmata</i>	Convolvulaceae	Purple	Round the year
16.	Jasminum	Chameli	<i>Jasminum grandiflorum</i>	Oleaceae	White	June-Nov.
	Spanish Jasmine		<i>Jasminum officinale</i>	Oleaceae	White	June-Sept.
17.	Japanese honey suckle	—	<i>Lonicera japonica</i>	Caprifoliaceae	White	May-June
18.	Watch flower	Phoolghari	<i>Passiflora laurifolia</i>	Passifloraceae	Purple	—
19.	Purple wreath	—	<i>Petrea volubilis</i>	Verbanaceae	Blue	April-May
20.	Golden shower	—	<i>Pyrostegia venusta</i>	Bignoniaceae	Orange	Feb.-March
21.	Bridal bouquet	—	<i>Porana paniculata</i>	Convolvulaceae	—	—
22.	Blue potato creeper	—	<i>Solanum seaforthianum</i>	Solanaceae	—	—
23.	Rangoon creeper	Jhoomka Bel	<i>Quisqualis indica</i>	combretaceae	Pink-red	Throughout the year
24.	Sky flower	—	<i>Thunbergia grandiflora</i>	Acanthaceae	Blue	Feb.-March
25.	Star jasmine	—	<i>Trachelospermum jasminoidis</i>	Oleaceae	White	May-June
26.	Derris	—	<i>Derris scandens</i>	Papilionaceae	Light-rose	May-Sept.
27.	Morning glory	—	<i>Ipomoea learii</i>	Convolvulaceae	Purple-Red	Through out the year
28.	Cypress vine	—	<i>Ipomoea quamoclit</i>	Convolvulaceae	Red	Oct.-March
29.	Quamoclit	—	<i>Mina lobata</i>	Convolvulaceae	Orange. Yellow	Nov.-March
30.	Garanadilla	—	<i>Passiflora quadrangularis</i>	Passifloraceae		July-Oct.
31.	Honey suckle	—	<i>Passiflora laurifolia</i>	Passifloraceae		July-Oct.
32.	Creeping tuberose	—	<i>Stephanotis floribunda</i>	Asclepidaceae	White	April-Aug.

BULBOUS PLANTS

- * **Climate :** (a) Warm : 1. Canna 2. Dahlia 3. Tuberose 4. Crinum 5. Zephyranthes
- * (b) Cool : 1. Gladiolus 2. Narcissus 3. Daffodils 4. Freesia
- * **Propagation :** (a) *Tuber* : Dahlia
(b) *Corms* : 1. Gladiolus 2. Freesia
(c) *Bulbs* : 1. Amaryllis 2. Tuberose 3. Zephyranthes 4. Crinum (lily)
(d) *Rhizome* : 1. Canna 2. Iris.
- * **Planting time:** (a) *February-March* : 1. Tuberose 2. Zephyranthus
(b) *July* : Canna
(c) *Mid of September-Mid of November* : 1. Gladiolus 2. Narcissus 3. Daffadils
- * Bulbous plant having maximum area under cultivation : Gladiolus
- * Leading Bulbous plant growing Area in world : South Africa
- * Leading Bulbous plant growing Area in India : Kalimpong and Sikkim

Sr.No.	Name	Common Name	Botanical Name	Family	Remarks
1.	Belladonna lily	Kind or star lily	<i>Amaryllis spp.</i>	Amaryllidaceae	Mount everest star of India
2.	Magic flower	—	<i>Achimene longiflora</i>		
3.	Begonia	—	<i>Begonia spp.</i>	Bignoniaceae	Golden weeding
4.	Indian shot	—	<i>Canna indica</i>	Cannaceae	Status of liberty American beauty
5.	Sudarshan	St. John lily	<i>Crinum bulbispermum</i>	Amaryllidaceae	—
6.	Freesia	—	<i>Freesia refracta</i>	Iridaceae	—
7.	Gerbera	Transvaal daisy African daisy Barberton daisy	<i>Gerbera jamesonii</i>	Compositae	South Africa (Origin)
8.	Glory lily	—	<i>Gloriosa superba</i>	Liliaceae	—
9.	Red cape lily	Blood flower	<i>Haemanthes multiflorus</i>	Amaryllidaceae	—
10.	Hedychium	Shellginger	<i>Alpinia speciosa</i>	Zingiberaceae	—
11.	Day lily	—	<i>Hemerocollis fulva</i>	Liliaceae	—
12.	Montbretia	—	<i>Crocoshmia aurea</i>	Iridaceae	—
13.	Spider lily	—	<i>Hymenocallis litterolis</i>	Amaryllidaceae	—
14.	Flag flower	—	<i>Iris spp.</i>	Iridaceae	—
15.	Lily	—	<i>Lilium spp.</i>	Liliaceae	—

Sr.No.	Name	Common Name	Botanical Name	Family	Remarks
16.	Moraea	—	<i>Moraea Iridiodes</i>	Iridaceae	—
17.	Narcissus	Daffodils	<i>Narcissus spp.</i>	Amaryllidaceae	—
18.		Nargis			
19.	Tuberose	Rajni gandha	<i>Polianthus tuberosa</i>	Amaryllidaceae	Pearls
20.	Zephyr lily	—	<i>Zephyranthes spp.</i>	Amaryllidaceae	—
21.	Eucharis	—	<i>Eucharis amazonica</i>	Amaryllidaceae	—
22.	Hippeastrum	Night star lily Trumpet lily	<i>Hippeastrum spp.</i>	Amaryllidaceae	—
23.	Calla lily	—	<i>Zantedeschia spp.</i>	—	—
24.	Cyclamen	(Temperate)	<i>Cylamen persicum</i>	Primulaceae	—
25.	Watsonia	—	<i>Watsonia spp.</i>	Iridaceae	—
26.	Oxalis	—	<i>Oxalis spp.</i>	Oxalidaceae	—
27.	Nerine	—	<i>Nerine sarniensis</i>	Amaryllidaceae	—
28.	Gloxinia	—	<i>Gloxinia speciosa</i>	Gesneriaceae	—

SHADE LOVING PLANTS

Sr.No.	Name	Common Name	Botanical Name	Family	Remarks
1.	Agloanema		<i>Agloanema spp.</i>	Araceae	
2.	Alocasia		<i>Alocasia spp.</i>	Araceae	
3.	Anthurium		<i>Anthurium spp.</i>	Araceae	
4.	Aphelandra		<i>Aphelandra auriantica</i>	Acanthaceae	
5.	Araucaria		<i>Araucaria spp.</i>	Coniferae	
6.	Asparagus		<i>Asparagus spp.</i>	Liliaceae	
7.	Aspidistra		<i>Aspidistra elatior</i>	Liliaceae	
8.	Begonia		<i>Begonia spp.</i>	Bignoniaceae	
9.	Ribbon plant		<i>Chlorophytum comosum variegata</i>	Liliaceae	
10.	Spider plant		<i>Chlorophytum comosum vittatum</i>	Liliaceae	
11.	Shrimp plant		<i>Beloperone guttata</i>	Acanthaceae	
12.	Caladium		<i>Caladium hortulanum</i>	Araceae	
13.	Calathea		<i>Calathea spp.</i>	Marantaceae	
14.	Coleus		<i>Coleus blumeri</i>	Labiatae	
15.	Cordyline	Red Dracena	<i>Cordyline spp.</i>	Liliaceae	
16.	Crotons		<i>Codiaeum variegatum</i>	Euphorbiaceae	
17.	Dieffenbachia		<i>Dieffenbachia spp.</i>	Araceae	
18.	Dracaena		<i>Dracaena spp.</i>	Liliaceae	
19.	Exocaria		<i>Exocaria bicolor</i>		
20.	Ferns		<i>Nephrolepis spp.</i>	Coniferae	
21.	Ficus		<i>Ficus elastica</i>	Moraceae	
22.	Fittonia		<i>Fittonia spp.</i>	Acanthaceae	
23.	Graptophyllum		<i>Graptophyllum pictum</i>	Acanthaceae	
24.	Algerian Ivy	Ghost tree	<i>Hedera canariensis</i>	Araliaceae	
25.	Heliconia		<i>Heliconia spp.</i>	Musaceae	No. 1 pot plant
26.	Kalanchoe	Bryophyllum	<i>Kalanchoe spp.</i>	Crassulaceae	
27.	Maranta		<i>Maranta spp.</i>	Marantaceae	Leaf cutting
28.	Monstera	Carimen	<i>Monstera deliciosa</i>	Araceae	
29.	Pepper face		<i>Peperomea spp.</i>	Piperaceae	
30.	Artillery plant		<i>Pilea macrophylla</i>	Urtiaceae	
31.	Philodendron		<i>Philodendron spp.</i>	Araceae	
32.	Song of India		<i>Pleomele reflexa- variegata</i>	Liliaceae	
33.	Moses in the cradle		<i>Roheo spatheca</i>	Commelinaceae	
34.	Butcher's broom		<i>Ruscus aculeatus</i>	Liliaceae	
35.	—		<i>Sanchizianobilis glaucophylla</i>	Acanthaceae	
36.	Pothos	Money plant Devil's Ivy	<i>Scindapsus aureus</i>	Araceae	
37.	Syngonium		<i>Syngonium spp.</i>	Araceae	
38.	Tradescantia		<i>Tradescantia spp.</i>	Commelinaceae	
39.	Wandering Jew		<i>Zebrina pendula</i>	Commelinaceae	

CACTUS AND SUCCULENTS

These plants turn a barren landscape into a showcase of colour

Origin : America, Family-Cactaceae, Fruit-single seeded berry. The cactaceae is one of the most distinctive families of dicotyledens flowering plants, with around 90 genera and 2500 species.

Sr.No.	Name	Common Name	Botanical Name	Family
(A) Cactus				
1.	Opuntia	Most commonly used for fencing	<i>Opuntia cylindrica</i>	Cactaceae
2.	Rat's tail		<i>Aprocactus flagilleformis</i>	Cactaceae
3.	Chin cactus		<i>Gymnocalycium spp.</i>	Cactaceae
4.	Bird's nest cactus		<i>Mammalleria spp.</i>	Cactaceae
5.	Sea onion		<i>Bowea volubilis</i>	Cactaceae
(B) Succulents (Latin succos = juice, sap.)				
1.	Agave	Century plant	<i>Agave americana</i>	Amaryllidaceae
2.	Aloe		<i>Aloe vera</i>	Lilaceae
3.	Euphorbia	Mother in law's tongue	<i>Euphorbia splendens</i>	Euphorbiaceae
4.	Lithops	Flowering stone	<i>Lithops bela</i>	Aizoccae
5.	Yucca	Spanish day	<i>Yucca gloriosa</i>	Liliaceae
6.	Portulaca		<i>Portulaca afra</i>	Portulacaceae

Succulent : Plants from more than 60 families and 300 genera have evolved special water storage tissues in thickened or swollen leaves, stems or roots as an adaptation to arid environment. By making the most scarce available moisture these plants can survive in habitats that are far too dry for other plants.

Caudiciform Succulents store water in both roots and swollen stems and may be deciduous or long-lived fleshy leaves.

Examples : *Ceraria pygmaea*, *Tylecodon paniculata*, *Cyphostemma juttae*.

PALMS

Family : Arecaceae

Family of Flowering plants belonging to monocot order. There are roughly 202 currently known genera with around 2600 species restricted to tropical and subtropical climates.

Sr.No.	Common Name	Botanical Name
1.	Chinese palm	<i>Livingstonia rotundifolia</i>
2.	Fish tail palm	<i>Caryota urens</i>
3.	Royal palm	<i>Roystonea regia</i>
	Bottle palm	<i>Hyophorbe lexicaulis</i>
4.		<i>Kentia belmoreana</i> [⇒ (Indoor plants require a temp. of 15–21 °C)]
5.	Good luck palm	<i>Chamodera elegans</i>
6.		<i>Raphis excelsa</i>
7.		<i>Pritchardia filifera</i>
8.	Pygmy date palm	<i>Phoenix roebelenii</i>
9.	Sago palm	<i>Cycas revoluta</i>
10.	Date palm	<i>Phoenix</i>
11.	Butterfly palm	<i>Dypsis leptocheilos</i>

GROUND COVERS

Low growing plants used in landscape, popular as mass planting for covering large areas : Ground covers control erosion when planted on slopes or banks. They are effective lawn substitutes in areas too shady to support the growth of grasses. These plants also eliminate costly and time consuming maintenance such as mowing, edging and trimming.

(a) **Green colour foliage** : 1. *Wadelia trilobata* 2. *Alternanthera ficoidea* 3. *Cuphea gerlonica* 4. *Opheophogon japonicus*

(b) **Red colour foliage** : 1. *Iresine lindenii* 2. *Oxalis* 3. *Ipomea tricolour* 4. *Alternanthera versicolour* 5. *Tradescantia flamiensis* 6. *Zebrina pendula*

(c) **Golden colour foliage** : 1. *Duranta goldiana* 2. *Ipomea charyteuse* 3. *Alternanthera variegata*

LAWN (Heart of Garden)

- (a) Selection of grasses :
1. *Bermuda grass* : *Cynodon dactylon* (Doob or Haryali)
 2. *Korean grass* : *Zoysia japonica*
 3. *Manilla grass* : *Zoysia matrella*
 4. *Korean velvet grass* : *Zoysia tenuifolia*
 5. *Carpet grass* : *Axonopus affinis*
- (b) Planting of grasses :
1. *Dibbling of roots* : Most common and cheapest method, of planting
 2. Seedling
 3. *Turfing* : Quickest method
 4. *Bricking* : to replace the few unhealthy patches in well maintained lawn this method is used
 5. Planting on polythene 6. Turb plastering.
- (c) Disease of lawn :
1. *Fairy Ring* : Caused by fungus *Marasmius ordeades*
 2. *Pale or yellow lawn* : Due to N_2 deficiency
- * 60-75% Area of Garden should be devoted to lawn.
 - * *Seed rate* : 12 kg/Acre or 25-30 kg/hac or 2.5 g/m²
 - * *Weeds occuring in lawn* : 1. *Cyperus rotundus* 2. *Euphorbia* spp.
 - * *Glyphosate* : Most widely used pre emergence herbicide for lawn.
 - * Axis of lawn never divergent.
 - * *In shady region* : Kentucky in blue grass and St. Augustine grass are suitable.

STYLE OF GARDENING

- (a) **Formal style** : Plan is symmetrical
Ex : 1. Persian gardens 2. Mughal Gardens
- (b) **Informal style** : Plan is asymmetrical
 It reflects naturalistic effect of total view and represent natural beauty
Ex : 1. Japanese Garden
- (c) **Free style** : Combination of both formal and informal style.
Ex : 1. Rose garden of Ludhiana 2. English Garden 3. Lal Bagh

ART PRINCIPLES

1. **Rhythm** : Repetition of same object at equidistance is called rhythm.
2. **Balance** : To maintain optimum symmetry in a garden.
3. **Accent or emphasis** : It is created in the garden to avoid the monotonous view. Mostly unusual object like tall fountain, tree, statue etc. are used to create the effect on accent or emphasis.
4. **Contrast** : It is most useful in emphasising the best features of an object.
5. **Proportion** : It is the relation of one thing to another in magnitude.
6. **Harmony** : It is overall effect of various features, styles and colour schemes of the total scene
 * Beauty can be defined as the evident relationship of all parts of a thing observed.
7. **Axis** : In formal style, axis is central where as in informal style, it is oblique. Axis is an unifying element.
Maximum point of attraction or views of attraction are found in : Incircling type of axis.
8. **Vista** : It is a three dimensional confined view of terminal building or dominant element or feature.
 Best example of man-made vista is a view of main building of Taj Mahal from the entrance gate, Hanging Gardens of Babylon

BASIC PRINCIPLES AND ELEMENTS OF LANDSCAPE DESIGN

A) Element of Art:

- i) Color -
 - * Primary color-Red, Blue, Yellow
 - * Secondary color-Orange, Green and Violet
 - * Tertiary colors are of the fusion of one primary and one secondary color.
- ii) Line-
 - * It is related to eye movement or flow.
 - * In the overall landscape, line is inferred by bed arrangement and the way these beds fit or flow together.
- iii) Form-
 - * The concept of form is related to size of an object or area.
 - * Plant forms include upright, oval, columnar, spreading, weeping, etc.
- iv) Texture-
 - * Texture describes the surface quality of an object than can be seen or felt.
 - * Surface in landscapes includes building walks, patios, ground covers plants.
- v) Scale -
 - * Scale refers to the size of an object in relation to the surroundings.

B) Principles of Design:

- i) Unity-
 - * Unity means that all parts of the landscape go together.
 - * Unity can be achieved by using mass planting and repetition.
- ii) Balance-
 - * It refers to the equilibrium or equality of usual attraction.
 - * It is used to maintain optimum symmetry in garden.
- iii) Transition-
 - * It is a gradual change
 - * Transition can be obtained by the arrangement of object with varying texture forms or size in a logical sequential order.
- iv) Proportion-
 - * It refers to the size of parts of the design in relation to each other and to the design as a whole.
- v) Rhythm-
 - * Repetition of same object at equidistant is called rhythm.
- vi) Focalization-
 - * It involves the leading of visual observation towards a feature by a placement of this feature at the vanishing point between radical or approaching lines.
- vii) Repetition -
 - * It refers to repeated use of features like plants with identical shape, line, form, texture and color.
- viii) Simplicity-*

GARDENS

(a) **Mughal Gardens** : Main features of Mughal Gardens are :

1. Terraces 2. Running water 3. High protecting wall 4. Entrance gate 5. Baradari 6. Terminal building

Symbol : cypress—immortality

Flowering trees—renewal of life

Kachnar (*B. alba*)—Youth and life

Running water : Life

(b) **Japanese Gardens** : Types 'Nature in Miniature' (Peace)

Types : (i) *Hill Gardens* : Tsukiyama sansui

Features : 1. Trees 2. Ornamental water 3. Garden lanterns 4. Garden Pagoda 5. Garden Bridges 6. Dry landscape 7. Gate + fences 8. Wells

(ii) *Tea Gardens* :

(iii) *Flat Gardens* : Hiraniwa

e.g., Roshnara park, Budha Jayanti Park

(iv) *Sand Gardens* : Ryoanji

(Famous Garden—Kyoto, Japan)

(c) **English Gardens** : Main features are :

1. Herbaceous border—discovered by William Robinson

2. *Cottage Garden* : G. Jekyll

3. Lawn

4. Rockery

5. Royal botanical garden at Kew (1757)

6. *Royal Horticultural society* : 1804

7. Chelsea Physic Garden

8. *Indian Horticultural society* : 1942

(d) **Persian Garden** : Ex : Charbagh

(e) **Sunken Garden** : Ex : Rastrapati Garden

FLOWER ARRANGEMENT

Japanese style of gardening : Japanese flower arrangement : Ikebana

Types : 1. *Moribana* : Natural Ikebana where piled flowers are used, dwarf vases are used.

2. *Jiyubana* : Free flower arrangement

3. *Morimona* : Fruits, vegs, flowers are arranged. "English flower arrangement".

4. *Nagiere* : Tall vases are used

In western style, flowers are 1½ times taller than flower vase.

5. *Zeneika* : Straight material with uneven height are used.

6. *Zeneibana* : Beautiful sculpture is created by using wood, stone, rocks.

(a) *Japanese flower arrangement* : Emphasis is given on spritual and religious background, only few flowers are used.

(b) *English flower arrangement* : Emphaiss is given on mass flower arrangement.

Basic line in all Japanese flower arrangement :

1. Heaven—Shin

2. Man—Soe

3. Earth—Hikaie

4. Jushi—Fillers

BONSAI

Japanese art of growing miniature trees and shrubs by extreme dwarfing.

Origin- China

Mame bonsai : Plant height 15-20 cm

OIL EXTRACTION

- Rose :**
- (i) Rosa damascena : 0.05%
 - (ii) Rosa bourboniana : 0.04%
 - (iii) Rosa centifolia : 0.01%
 - (iv) Rosa Moschata : 0.04%
- Jasmine :**
- (i) Jasminum auriculatum : 0.29% (Maximum oil recovery)
 - (ii) Jasminum grandiflorum : 0.25-0.30%
 - (iii) Jasminum sambac : 0.04%
- Tuberose :**
- (i) Single : Shringar, Rajat Rekha
 - (ii) Double : Suvasini, Swarna Rekha

Bulgaria is largest producer of rose perfume.

Egypt is largest producer of jasmine perfume.

France is largest producer of tuberose perfume.

France is largest producer of carnation perfume.

Concrete : Non purified form of essential oil obtained by solvent extraction method.

It contains 45-55% absolute.

(ii) **Exhibition varieties:** Christian dior, Eiffel tower, Garden Party, Mischief, Pusa Sonia, Show girl, First prize, Rajkumar, Raktagandha.

~~(iii) **Scented varieties:** Lafrance, Seventh Heaven, Pusa Sugandha, The doctor, Blue moon, General Mc Arthur.~~

(iv) **Cut flower :** Gladiator, Happiness, Super star, Sonia, Mercedes, Arjun, Ratkagandha, Sindhoor.

(B) **Floribundas :** Hybrid tea X dwarf polyanthas

Ist variety-Rodhatte, produced by Poulsen (1912)

(a) *Red :* Week jock, Janter-Manter

(b) *Orange :* Independence, Shola

(c) *Yellow:* All Gold, Gold bunny

(d) *Pink :* Queen Elizabeth, Junior miss

(e) *White :* Iceberg, Himangini

(f) *Bicolour :* Red Gold, Danse

(g) *Colourblend :* Banjaran

(h) *Bicentennial :* Charisma Madhura

(C) **Grandiflora :** Hybrid teax-Floribundas

Ist variety Buccaneer

(D) **Polyantha :** R multiflora X R. wichuriana X R. Chinensis

Ist variety : La Paquette,

(Swati Rashmi)

(E) **Climbers :** Sympathy, Delhi White Pearl, Breath of life, Golden shower, Swan Lake, Delhi Pink Pearl

(F) **Ramblers :** American Pillar, Excelsa, Albertine

(G) **Miniature roses (Baby or fairy roses) :** Introduced by China as Pigmy Rose

Desert charm, Red Flush, Delhi scarlet, Summerbutter, Party Girl, Puppy love, Snow carpet, Yellow Doll, Cinderella, Delhi starlet.

(H) **Mutant varieties:** English– Golden Jewel, Heat wave, Independence

Indian : 1. *Abhisarika :* Mutant of kiss of Fire

2. *Priya :* Multicoloured mutant variety

3. *Pusa christina :* Mutant of Cristian dior

4. *Madhosh :* Mutant of Gulzar

5. *Paradise :* For garden display

IARI varieties : 1. *Mohini :* Hypertriploid with chocolate brown colour

2. *Mrinalini :* Appears on postage stamp

3. *Pusa mansaj*

4. *Pusa Mohit :* Thornless variety

Green House condition : Day temperature 25 °C, Night temperature—16 °C, CO₂ : 1000-3000 PPM

- Varieties:
1. Grand gala : thornless variety
 2. First Red : Mostly grown in green houses.
 3. Kiss
 4. Konfetti
 5. Vivaldi
 6. Black magic
 7. Starlite
 8. Frisco
 9. Yellow river
 10. Hollywood

- * Most of varieties take about 60-65 days for blooming after pruning.
- * Wintering of roses is very common in western part of India (September- october).
- * *Varieties of Rosa damascena* : 1. Noorjahan 2. Himroz (for hills) 3. Jwala (for plains)
- * *Topaz* : Best control over powdery mildew of rose.
- * *To increase shelf life*— Pulsing treatment is done.
- * Hosur in TN ranks 11th in the world for raising the roses.
- * *Pruning*— technical aspect of rose breeding.
- * *Most costly oil*— Rose oil
- * *Miniature roses*— resistant to pest and diseases.
- * *Limp neck*— Rose disorder
- * *Thornless variety of rose*— Suchitra
- * *Most common rootstock in European countries* : Rosa Canina
- * *Rose spp. having 4 florets* : Rosa sericia
- * *Rose spp. from which yellow colour is extracted* : Rosa foetida
- * *Madien type rose* : Does not require pruning.
- * *Flowering in hybrid tea roses* : 42 days after pruning.
- * *Flowering in Floribundas* : 45 days after pruning.
- * Commercial life of rose is 8 years.
- * Blue pigmentation in rose is due to Delphinine.
- * Blue colour rose variety is Samba.
- * Major problem in rose breeding is seed setting.
- * Gulkand is prepared by mixing petal and sugar in 1 : 1 ratio.
- * IARI varieties: 1. Pusa Abhishek; 2. Pusa Manhar; 3. Pusa Mukan; 4. Pusa Ranjana; 5. Pusa Urmil.
- * Bluing of rose petals is due to accumulation of ammonia.

GLADIOLUS

- * Botanical Name : *Gladiolus grandifloras*
- * Family : Iridaceae
- * Origin: Africa and Asia minor-Tetraploid, Europe-diploid
- * $2n = 60$ (tetraploid) $2n = 30$ (diploid)
- * Optimum temperature for growth : 16-30 °C
- * It require open sunny situation.
- * Longer day length improve spike quality.
- * Planting time– July-December, spacing $20 \times 30 \text{ cm}^2$
- * Corm should be treated with 0.2% Bavistin
- * Ethylene chlorohydrine is used to break dormancy of corms.
- * Gladiolus is 7 month crop.
- * Hilling is important operation of Gladiolus.
- * Preservative solution : 20% sucrose + 200 PPM HQC
- * Dormancy of corm brokes by storing at 4-5 °C for 3-4 month.

Varieties : 1. Jwala 2. Gazal 3. Priyadarshani 4. Melody 5. Suchitra 6. Friendship ($2n = 60$) 7. Happy end 8. Sancerre 9. Prabha 10. Oscar 11. Windsong 12. Hunting song 13. Her majesty 14. Blue sky 15. Mayur 16. Agnirekha 17. Peter pears 17. Chrysanthamum kirti : New variety.

- * **Mutant Varieties:** 1. Shobha 2. Pusa suwasini-- mutant of wildrose variety
- * **Export Varieties :** 1. Cartago 2. Eurovision 3. Priscilla 4. Peter pears 5. Mayur 6. American beauty 7. Topaz
- * **Corm size :** 5 cm (Bulb size of tuberose : 2.5 cm)
- * **Planting :** January-February
- * Seeds require 15-20 days to germinate.
- * Dormant cormels contain 5-10 times ABA than non dormant.
- * For cut spikes storage-temperature : 1-2 °C for 2 weeks.
- * Fluoride toxicity seen on tip of leaves, absorbed from air.
- * Toxicity is due to heavy application of super phosphate, rock phosphate which contains hydrogen fluoride.
- * Corm dormancy is broken by GA.
- * Scoring is very common in Gladiolus.
- * Dhiraj variety is resistant to fusarium wilt.
- * Sagar is fragrant variety of Gladiolus.
- * Geotropism disorder is due to transporting.
- * Gladiolus is also called as Sword lilly.
- * Short days at 1-2 leaf stage in Gladiolus leads to blind shoot.

CARNATION

- * Botanical Name: *Dianthus caryophyllus*
- * Family: Caryophyllaceae
- * Origin: France, $2n=30$
- * **Quantitatively long day plant**
- * It is a cool season crop
- * Ideal temperature range : 10-20 °C
- * Pinching is regular practice in carnation.
- * Disbudding is regular practice in carnation.
- * Staking is also done in carnation.
- * Pre-conditioning of cut flower in solution of AgNO_3 is important to avoid ethylene injury and prolong shelf life.
- * Storage temperature : 2-4 °C
- * Sim carnation have great commercial importance.
- * Sim group need regular pinching.

Types : (A) **Perpetual :** *D. caryophyllus* × *D. Chinensis* (Propagated by stem cutting)

Varieties : Winter cheer, Britania, Joker, Mr. Thomas lawson, Day Break, William sim, Lipstick. Pink Dona

(B) **Marguerite :** *D. chinensis*. × *D. caryophyllus* (Propagated by seed)

(C) **Malmaison :** Princess of wales, Mr. Martin Smith

(D) **Royal :** Malmaison × Perpetual

Varieties : Royal fancy, white perfection, wivel's field

(E) **Modern :** Pico variety

* **Pinching :** 1st : 4th week after planting (July)– It is done at 6th pair of leaf stage

2nd : 7th week after planting

* **Type of Pinching :** (1) Single pinching : Below 6th node : To get early crop. (2) Pinch and a half : Regular pinching + half pinching : Steady production without gap (3) double pinch : To delay flowering period.

* **Harvesting standard :** When 2-3 petals unfurl.

* **Tinting :** Colouring of white carnation.

* Perpetual type of carnation are grown at large scale.

* Pinching in carnation is normally done at 6-7 pair leaf stage.

* Calyx splitting of carnation is due to genetic nutritional and environmental factor.

* Kodi Kanal, Ooty, Coonor places are suitable for carnation cultivation.

CHRYSANTHEMUM

- * Botanical Name: *Dendranthema grandiflora*
- * Family: Compositae
- * Origin: China
- * Common Name : Guldaudi, Autumn Queen, Glory of East, Queen of East
- Symbol of Royalty in Japan, National Flower of Japan
- * Chrysanthemum is a perennial plant.
- * **Disc florets** : Centre, **Ray Florets** : Outer.
- * It is a short day plant.
- * **Blooming period** : September-October
- * **Propagation** : By root suckers or terminal cuttings.
- * **Pinching** : To encourage side branches for cut flowers
- * **Disbudding** : To encourage single crown branch for standard flower.
- * **Yellow, white varieties** are Preferred for cut flowers.
- * Urea is not applied as it causes phytotoxicity.
- * Use of Alar/Phosphon is very effective in producing better size blooms on dwarf plants.
- * Auxillary shoots produce buds called crown buds.

Types

- (A) **Large flowered varieties**: 1. Sonar Bangla 2. Redwest field 3. Cresta 4. City beauty 5. Day Dream 6. Peach blossom 7. Sweet heart 8. Regalia 9. Green Sensation 10. Rupasi Bangala 11. Mahatma Gandhi 12. Hommand Philip 13. J.H. Salisbury 14. Indra 15. Kirti 16. Chandarkant 17. Kasturba Gandhi
- (B) **Small flowered varieties** : 1. Gul-a-sahir 2. Birbal Sahni 3. King Fisher 4. Golden dust 5. Manbhavan 6. Anokha 7. Red star 8. Stella 9. Sharad Kumar– No staking, no pinching
- (C) **Off season blooming varieties**: 1. Haldi Ghati 2. Himanshu (April-July) 3. Jwala 4. Maghi (February-March) 5. Meghdoot (July-August).

Export varieties : (A) *Standard* : Dignity, wild fire, Detroit News,

(B) *Spray*– Parliament, Dazzler Florida Marble

(C) *Pot mums* : Fantasy, Albert, Mandarin, Alpine

- * **Harvesting** : July → August → September
- * International variety (i) Kokovarouri – Std type – Yellow
(ii) Nanako– Spray type – yellow
- * **Sen, Rin tsukisi** : Japanese style of chrysanthemum culture (growing 1000 blooms)
- * **Pinching** : Most important for cascade (Japanese) formation.
- * Pinching also known as stopping.
- * Optimum temperature for long holding of chrysanthemum is 2.5°C.
- * By use of plant biotechnology the colour of money maker cultivar has changed from pink to white.
- * Chrysanthemum is a perennial plant
- * Qxathin is used for disbudding in chrysanthemum
- * Gable type of green house is suitable in hilly areas
- * Petal bum in chrysanthemum is due to deficiency of boron

MARIGOLD

Common Name: Rose of Indies, Family: Compositae, Native: Mexico

* Botanical Name: (A) African— *Tagetes erecta* ; 2n = 24

(B) French — *Tagetes Patula* ; 2n = 48

* Optimum temperature 18-30 °C

(A) African varieties: 1. Cracker jack, 2. Climax 3. Golden Age 4. Crown of Gold 5. Chrysanthamum charm
6. Star gold 7. Pusa Narangi genda 8. Pusa Basanti Genda

(B) French varieties: 1. Rusty red 2. Butter scotch 3. Valencia

* Nugget-triploid variety of marigold.

* Seed rate : 1-1.5 kg/hac.

* S.P.S. Raghava is associated with Marigold.

* Pusa Basanti is a open pollinated variety of marigold.

* Pinching of rainy crop is beneficial to avoid water logging.

* Seedling become ready for planting- one month after sowing.

* Male sterility in African marigold is due to female character

* Genetic male sterility is very common in marigold

* Marigold is not used in Gajra

* Protandary type of self incompatibility is found in marigold

* Marigold is a herbaceous plant

ORCHIDS

* Family: Orchidaceae

* Origin : India

Group of orchids—

(A) Epiphytes : Dendrobium, Vanda, Bulbophyllum

(B) Lithophytes (Terrestrial) : Cymbidium

Plant morphology

(A) Monopodial : Vanda, Vanilla, Renanthera

(B) Sympodial : Cattleya, Cymbidium, Dendrobium, Epidendrum, Bulbophyllum

Propagation : (A) Division : Cattleya, Cymbidium, Dendrobium

(B) Cutting : Vanda

* Netherlands— largest producer of temperate orchids (cymbidium)

* Thailand— largest producer of tropical orchids (dendrobium)

* Flower have 3-sepals and 3 petals, hence called as – Tepals

* Seed – Endosperm absent (Exalbuminous)

* Bulbophyllum is largest genera of orchids

* Commercial propagation method : Tissue culture

- * In orchids light requirement is 2000-6000 °F
- * Repotting is done every year in orchids.
- * ~~Dr. Foya Singh, and Dr. Abraham are associated with orchids.~~
- * 'Jewel' orchid are valued for their beautiful leaves.
- * Gynoecium in orchid flower is called as column.
- * Malaysia is leading orchid exporting country.
- * Fruit types of orchid is capsule.
- * Coal and bark is important constituent of potting media in orchids
- * First tissue culture in orchid was discovered by 'Morel'
- * Cateleya orchid are used for hair decoration in Hawaii

JASMINE

It is grown in Tropical climate

Different spp. of Jasminum

1. **Jasminum sambac** : Arabian Jasmine, Tuscan Jasmine, Bela, Mogra, Mallige

Variety	1. Motia	2. Single mogra	3. Double mogra
	4. Khoya	5. Rai Japanese	6. Mohra
2. **Jasminum grandiflorum** : Royal or spanish Jasmine, Mallai, Pitchi

Variety	1. CO-1 Pitchi	2. CO-2 pitchi	3. Surabhi
---------	----------------	----------------	------------

 - * Flowering time : March-September
3. **Jasminum auriculatum** : Jui, Mullai

Variety	1. CO-1 mullai	2. CO-2 mullai	3. Large point
	4. Medium point	5. Short point	6. Long round

 - * Max. recovery of oil.
4. **Jasminum multiflorum** : Kakada, kund
 - * Not scented, resistant jasmine
5. **Jasminum arborescence** : Tree jasmine, Muta, bela
 - * Flowering : November-May
6. **Jasminum calophyllum** : Pandal malli
7. **Jasminum flexile** : Climbing Jasmine
8. **Jasminum humile** : Yellow jasmine
 - * Propagation : By semi hard wood cutting
 - * Pruning :
 1. J. sambac : October end (pruning every after 6 months)
 2. J. grandiflorum : Mid December
 3. J. auriculatum : December-January
 - * For extraction of Jasmine concentrate-fully open flowers are plucked.
 - * Jasmine occupy maximum area under floriculture in India.
 - * S.Muthu Swami is associated with Jasmine.
 - * Maximum refineries of Jasmine oil extraction are located in Tamil Nadu.

ANTHURIUM

- * Botanical Name: *Anthurium spp.*
- * Family: Araceae
- * Cutflower spp. : *Anthurium adreanum* Variegated foliage : *Anthurium grandi*
- * 75% shade is ideal for healthy growth.
- * Plant thrive well at day temp. of 25-28 °C.
- * 80% RH is ideal for anthurium. [RH : Relative Humidity]
- * Propagation by suckers
- * Application of BA at 750 PPM increases sucker production
- Varieties : (a) Red : 1. Mickey Mouse 2. Jacqueline 3. Mauritius Red. 4. Butterfly
 (b) Orange : 5. Nitta 6. Sunbrust 7. Diamond jubilee
 (c) White : 8. Hidden treasure
 (d) Pink : 9. Surprise 10. Agnihotri 11. Passion 12. Paradise pink
- * Yield : 8-12 flower/plant/year

MUSHROOM

An above ground fruiting body of a fungus having a shaft and cap.

Mushroom types :

1. *White button mushroom* : *Agaricus bisporus*, *A. bitorquis*
 2. *Oyster mushroom* : *Pleurotus spp.*
 3. *Paddy straw mushroom* : *Volvariella displasia*
- (A) **White button mushroom**
- * Contribute 90% of total India's production.
 - * Most viable mushroom over the world.
 - * Prepared on compost.
- (B) **Oyster mushroom** : *Pleurotus sajor caju* most popular.
- (C) **Paddy straw mushroom** : –Tropical mushroom, (temperature 35 °C)
- * Mostly – Cultivated in south India.
- (D) **Shittake mushroom** : *Lentinula edodes*.
- (E) **Black ear mushroom** : *Auricularia polytricha*
- (F) **Milky mushroom** : *Colocybe indica*
- (G) **Giant mushroom** : *Stropharia rugoso-annulata*.
- * **Uses :**
- * Many species of mushrooms are utilized as folk medicines.
 - * *Maitake*, *Shittake* and *Reishi* are prominent among them for their potential as anticancer, antiviral or immunity enhancement properties.
 - * Mushrooms can also be used for dyeing wool and other natural fibres.
 - * The chromophores of mushrooms are organic compounds and produce strong and vivid colours.

TUBEROSE

- * Botanical Name : *Polianthus tuberosa* * Family : Amaryllidaceae * Origin : Mexico
- * Common Name : Rainigandha, Gul-e-Shabu
- * The flowers are highly fragrant in 'Single' tuberoe compared to 'Double' cultivar where the fragrance is less.
- * The spikes generally last for 7-12 days in vases depending upon the room temperature.
- * The peak flowering season is between June and October.

CHINA ASTER

- * Botanical Name : *Callistephus chinensis* * Family : Asteraceae * Origin : China and Japan
- * The pure yellow colour is not found in Aster
- * China Aster is excellent as a cut flower
- * Classification:
 - (a) Chrysanthemum flowered: Flower, look like chrysanthinum
 - (b) Mammoth Peony flowered: The height of plants vary between 60 and 75 cm
 - (c) Giant californian Asters : Plants are 80 cm tall. Example Los Angeles, Elmonte
 - (d) Comet : They bear double feathery flowers. Example- Crego, Ostrich
 - (e) Victoria: They are dwarf to intermediate types.
 - (f) Pampon : These plants are 35 cm tall
 - (g) Branching Aster: Example- America Beauty, Queen of Market, Invincible.
- * Propagation is usually done by seeds.
- * They bloom in about 3½ to 4 months from date of sowing.

DAHLIA

- * Botanical Name : *Dahlia variabilis* * Family: Compositae * Origin : Mexico
- * The ray florets in Dahlia have all the flower colours, whereas the disc florets are generally yellow.
- * Stopping and thinning is practiced in Dahlia
- * Disbudding is done to obtain quality bloom.
- * Dahlia have 3 buds at end of each branch
- * The central or crown bud is retained for blooming while other two are removed at 'Pea' stage.
- * Disbudding also consist of Deshooting.

GERBERA

- * Botanical Name : *Gerbera jamesonii* * Family : Compositae * Origin : South Africa
- * Common Name- Africa Daisy, Barberton daisy, Transvaal daisy
- * Gerbera is a dwarf perennial herbaceous plant wick is named after Gerber, a German Naturalist.
- * Commercial flowering start, 3rd year onwards.

CHROMOSOME NUMBER OF FLOWERS

Sr.No.	Crop	Chromosome No.		Sr.No.	Crop	Chromosome No.	
		n	2n			n	2n
1.	Verbena	5	10	14.	Marigold	12	24-48
2.	Salvia	6	12	15.	Tulip	12	24-60
3.	Rose	7	14	16.	Zinnia	12	24
4.	Narcissus	7	14	17.	Cosmos	12	24
5.	Lotus	8	16	18.	Gladiolus	15	30-60
6.	Antirrhinum	8	16	19.	Carnation	15	30-60
7.	Aster	9	18	20.	Bougainvillea	17	34
8.	China Aster	9	18	21.	Gaillardia	18	36
9.	Chrysanthamum	9	18	22.	Barleria	20	40
10.	Canna	9	18	23.	Tuberose	30	60
12.	Dahlia	8	16	24.	Agave	30	58
13.	Amaryllis	11	22				

GROWTH AND PRECOOLING TEMPERATURE OF FLOWERS

Sr.No.	Crop	Growth temperature (°C)		Precooling temperature
		Day temperature	Night temperature	
1.	Rose	18	28	1-2
2.	Chrysanthamum	16	8-10	5-4-0
3.	Gerbera	16	12	2-0
4.	Carnation	18	13	1-0
5.	Anthurium	24	18	3-0
6.	Orchid-tropical	27	16	8-10
	temperature	18	13	5-4-0
6.	Lilium	25	10	—
7.	Gladiolus	—	—	4-5-0

IMPORTANT FLOWER BREEDERS IN INDIA

Rose Breeders

- | | |
|-------------|-----------------|
| 1. B.P. Pal | 2. J.P. Agarwal |
| 3. S.C. Dey | 4. A.P. Singh |

Bougainvillea Breeder

- | | | | |
|-----------------|---------------|------------|-----------------|
| 1. T.N. Khushoo | 2. S.N. Zadoo | 3. D. Ohri | 4. Vishnuswarup |
|-----------------|---------------|------------|-----------------|

Chrysanthamum Breeder

- | | | |
|--------------|---------------|---------------|
| 1. M.A. Kher | 2. S.K. Dutta | 3. M.N. Gupta |
|--------------|---------------|---------------|

Jasmine Breeder

- | | | | |
|--------------------|------------------|---------------|----------------|
| 1. H.C. Srivastava | 2. S. Muthuswamy | 3. Bhupal Rao | 4. Madhava Rao |
|--------------------|------------------|---------------|----------------|

Hisbiscus Breeder

- | | |
|---------------|------------------|
| 1. R.N. Bhatt | 2. M. Virupaksha |
|---------------|------------------|

Gladiolus Breeder

- | | | | |
|-----------------------------------|----------------|--------------|-----------------|
| 1. Bajrang Bahadur Singh Bhandari | 2. R.L. Mishra | 3. S.S. Negi | 4. D. Mukherjee |
|-----------------------------------|----------------|--------------|-----------------|

Dahlia Breeder

- | | | |
|----------------------|-------------|-------------|
| 1. Swami Vinayananda | 2. P.K. Das | 3. A.K. Dey |
|----------------------|-------------|-------------|

CULTIVARS OF ORNAMENTAL'S DEVELOPED IN INDIA

- (A) **Amaranthus** : Amar shola
- (B) **Bougainvillea** : 1. Dr. R.R. Pal 2. Sonnet 3. Spring Festival 4. Summer time 5. Stanza 6. Dr. B.P. Pal 7. Vishaka 8. Begam Sikander 9. Mary Palmer special 10. Sensation 11. Thimma (Varigated foliage) 12. Dr. Rao 13. Partha (Bicoloured variety) 14. H.C. buck
- (C) **Chrysanthamum** : 1. Indra 2. Kirti 3. Chandrakant 4. Baggi 5. Basanti
Sport : 6. Sonar bangla 7. Kasturba Gandhi 8. R. Venkatraman
Pompon : 9. Apsara 10. Birbal Sahni 11. Kundan
No pinch-No. staking : 12. Apurva 13. Arun Kumar 14. Haldi Ghati 15. Sharad Kumar
Offseason cultivars : 16. Himanshu 17. Jwala 18. Maghi 19. Meghdoot
- (D) **China Aster** : 1. Kamini 2. Poornima 3. Phule Ganesh Pink 4. Phule Ganesh Violet 5. Phule Ganesh Pink 6. Phule Ganesh Purple 7. Shashank 8. Violet Cushion
- (E) **Coreopsis** : Pusa Tara
- (F) **Dahlia** : 1. Kenya blue 2. Manali 3. Manjushri 4. Swami Vinayananda 5. Swamiji 6. White star 7. Lucky star
- (G) **Gladiolus** : 1. Agni Rekha 2. Pusa Suhagin 3. Sanjeevini 4. Swarnima 5. Mridula 6. Mukta 7. Priyadarshani 8. Pusa Suwasini

- (H) **Hibiscus** : 1. Bharat Sundari 2. Smt. Indra Ghandhi 3. Smt. Kamala Nehru 4. Queen of Hissarghatta
- (I) **Hippeastrum** : Suryakiran
- (J) **Hollyhock** : 1. Dulhan 2. Pusa Apricot supreme 3. Pusa krishna 4. Pusa lalima 5. Pusa Shweta
- (K) **Jasmine** : 1. Surbhi 2. Mohra
- (L) **Tuberose** : 1. Rajat Rekha 2. Swarna Rekha 3. Shringar 4. Surasini
- (M) **Rose** : Hybrid tea : 1. Arjun 2. Rajkumari 3. Raktagandha 4. Bhim
Floribunda : 5. Mohini 6. Sindhoor 7. Suchitra (thorneless)
Miniature : 8. Delhi scarlet
Polyantha : 9. Swati 10. Rashmi
Climber : 11. Delhi white pearl, 12. Delhi Pink Pearl
- (N) **Croton** : Shahid Bhagat Singh, Vikrant
- (O) **Portulaca** : Jhumka
- (P) **Anthurium** : Agnihotri
- (a) **Anthurium cut flower spp.** : *Anthurium adreanum*
- (b) **Anthurium for varigated foliage** : *Anthurium grandi*

PEST MANAGEMENT

Sr.No.	Crop	Common Name	Scientific Name	Remarks
1.	Rose	Red scale	<i>Anidellia auranti</i>	—
		Red spider mite	<i>Tetranychus spp.</i>	Most serious pest
2.	Carnation	Aphids	<i>Myzus persicae</i>	—
3.	Chrysanthamum	Aphids	<i>Myzus persicae</i>	—
4.	Gladiolus	Aphids	<i>Myzus persicae</i>	—
5.	Lilium	Aphids	<i>Myzus persicae</i>	—

DISEASE MANAGEMENT

Sr.No.	Crop	Common Name	Causal organism	Scientific Name
1.	Rose	1. Dieback	Fungus	<i>Diplodia rosarum</i>
		2. Powdery mildew	Fungus	<i>Sporotheca pannosa</i>
2.	Carnation	1. Wilt	Fungus	<i>Fusarium spp.</i>
		2. Foot rot	Fungus	<i>Rhizoctonia spp.</i>
3.	Chrysanthamum	1. Wilt	Fungus	<i>Fusarium spp.</i>
		2. Stem & Foot rot	Fungus	<i>Rhizoctonia spp.</i>
4.	Gladiolus	1. Wilt or collar rot	Fungus	<i>Fusarium spp.</i> <i>Resistant variety- Dheeraj</i>
		2. Corm rot	Fungus	<i>Fusarium spp.</i>
5.	Lilium	1. Grey mould	Fungus	<i>Botrytis elliptica</i>
		2. Soft bulb rot	Fungus	<i>Rhizopus stolonifer</i>

DISORDERS

Sr.No.	Crop	Name of disorder	Cause	Remark
1.	Rose	1. Bullhead	—	Common in double carnation
		2. Bent neck (limp neck)	Storage disorder	
		3. Sleepiness	Ethylene injury during transportation	
2.	Carnation	1. Calyx splitting	If night temperature fall below 10°C	
		2. Slabside	Cool periods	
3.	Chrysanthamum	1. Premature budding	—	
		2. Quilling of florets	—	
4.	Gladiolus	1. Topple	Calcium deficiency	
		2. Budrot	Calcium deficiency	
		3. Blindness	Unfavourable temperature	
		4. Negative geotropism	due to uneven distribution of auxin	
5.	Lilium	1. Leaf scorch	Manganese Aluminium deficiency	
		2. Bud Blast	—	

PULSING RATE AND STORAGE TEMPERATURE OF FLOWERS

Sr.No.	Crop	Pulsing	Storage temperature	Storage life
1.	Rose	2-5% sucrose	0.5-2 °C	7-10 days
2.	Chrysanthamum	2-5% sucrose	0.5-2 °C	12-15 days
3.	Gladiolus	20% sucrose	—	7-15 days
4.	Gerbera	20% sucrose	4 °C	—
5.	Orchid	—	5-7 °C	—
6.	Anthurium	—	13 °C	—
7.	Crossandra	—	15-20 °C	—
8.	Merigold	—	8-12 °C	—
9.	Tuberose	—	7-10 °C	—

MISCELLANEOUS

- * **Carnation** – Susceptible to ethylene injury (sleepiness)
- * **Anthurium** – Resistant to ethylene injury (sleepiness)
- * **Modified part of Anthurium** : Spathe
- * **Protandry** : Rose, Chrysanthemum
- * **Jasmine** is substitute for saffron.
- * **Marigold** are used to produce natural colour.
- * **For defoliation in Jasmine**, Penta chloro isophenol is used.
- * **China Aster** is true short day plant
- * **Dahalia** is known as king of flowers.
- * Model floriculture centre were established in Maharashtra and Karnataka.
- * Floriculture infrastructure park is being established in Hosur in Tamil Nadu which is known as TANFLORA and Talegaon, Pune.
- * The first international flower auction center has been setup in Bangalore.

POST HARVEST TECHNOLOGY (PHT)

HISTORY OF POST HARVEST TECHNOLOGY

1. Fruit and vegetable processing was 1st started in organised manner in 1857.
 2. Canning of fruits and vegetables. started in 1927.
 3. Father of canning → Nicolas Appert (France) 1804
 4. Needham (1749) 1st time explained-cause of spoilage of stored food.
 5. Nicholas Appert (1804) 1st preserved the food in Glass containers.
 6. Cooking of food by means of preservation started by Papin in 1861.
 7. In India, 1st fruit and vegetable processing industry was established in 1935 at Mumbai.
 8. In 1950, CFTRI Mysore was established.
 9. Pasteurization by Louis Pasteur in 1864.
 10. FPO (Food Product Order) was passed by Government of India in 1955.
 11. 1st Fruit preservation and canning institute was established in 1949 at Lucknow.
 12. FPO : Two preservative : Na Benzoate, KMS (Potassium Metabisulphite) are permitted
- * **Post harvest losses** in fruit and vegetables are very high (20-40%). These losses are categorized as
- (A) **Mechanical losses** : Bruising, cracking, cuts
- (B) **Microbial losses** : By Fungi & Bacteria
- (C) **Physiological losses** : Change in Respiration, transpiration, pigments, organic acid, flavour.
- * 36% of vegetable decay due to soft rot Bacteria (*Erwinia carotovera*)
 - * 30% of fruits decay due to *Penicillium* spp.
 - * Maximum post harvest losses (A) **Fruits** : (1) Papaya : 40-100% (2) Mandarin : 20-95%
 - (B) **Vegetable** : (1) Cauliflower 49% (2) Tomato 40-60%

PRE HARVEST FACTORS

1. Cultural operations

- * Pruning or thinning increases the fruit size and decreases TSS and acidity.
- * Quality of fruits improved by application of K, Mn and Zn, while higher N and P deteriorate the quality of fruits.
- * Insufficient irrigation enhances maturity of crop.
- * In onion and garlic, irrigation should be stopped 3 weeks before harvesting to ensure better quality.
- * *Mo deficiency in cabbage cause* : Heart rot
- * *Mn deficiency in Peas cause* : Marsh spot
- * *Excessive irrigation and Fertilization cause* : Hollow-Heart in Potato

2. Pre harvest treatment

- * Pre harvest treatment of MH (Malic Hydrazide) reduces sprouting of onion and potatoes during storage.
- * Pre harvest spray of 0.2% difolatan control post harvest diseases of Tomato and Onion.
- * Pre harvest spray of N-Benzyladenine (BA) 10-20 PPM prolong shelf life of vegetables.

3. Maturity Indices

1. Shape: (a) *Banana* : disappearance of angularity

(b) *Pineapple* : Flattening of eyes.

(c) *Litchi* : Flattening of tubercles.

2. Juciness : Sweet corn

3. Tapping : Water melon, Jack fruit

4. Solidity : Cabbage

5. Netting : Musk Melon

6. Aroma : Jack fruit

7. Specific Gravity : (a) Alphonso Mango : 1-1.02

(b) Dashehari Mango : 1.0

(c) Potato : 0.98-1.02

(d) Pineapple : 0.98-1.02

(e) Guava : 1.0

8. TSS

1. Grape	Anab-e-Shahi	14-16°
	Thompson seedless	18-22°
	Bangalore blue	12-14°
2. Mandarin		12-14°
3. Sweet orange		12°
4. Papaya		11.5°
5. Pineapple		12-14°

9. Acidity

1. Mandarin	0.4%
2. Sweet orange	0.3%
3. Mango	0.5-0.6%
4. Pineapple	0.5-0.6%

10. Days from Fruit set to harvest

1. Banana	90 days
2. Alphonso	110-125 days
3. Pairi	110-125 days
4. Sapota	300 days
5. Mandarin	

11. Juice content : Citrus (35-50%)

POST HARVEST FACTORS

1. **Curing** : It is favoured by high temperature and high humidity.

- * Potato, Sweet potato, Colocasia, Onion, Garlic are cured prior to marketing.
- * Curing reduces moisture content in Onion and Garlic.
- * Artificial curing of Onions is done at 40 °C temperature.

2. **Degreening** : It is applicable to Banana, Mango, Citrus, Tomato.

- * Low concentration of ethylene (20 PPM) is applied for degreening.
- * Best degreening temperature is 27 °C.
- * Relative Humidity (RH) should be 85-90%.
- * CO₂ level below 1% does not allow higher colouring.

3. **Pre cooling** : Means removing of field heat.

- * Peas and Okra which deteriorate fast, needs prompt cooling.
- * Water cooling (hydrocooling) is used for leafy vegetables.
- * Hydrocooling at 12-15 °C with 500 PPM Bavistin increase shelf life of mango.

4. **Disinfection**

- * Papaya, Mango, Melon are susceptible to fruit fly attacks.
- * Disinfection is done either by vapour heat treatment (VHT) at 43 °C temperature or by ethylene dibromide fumigation (18-22 g/m³)

5. **Waxing** :

- * 2 type of wax emulsions and [wax 'O' and 'W'], both contain 12% TSS.
- * Wax 'O'-Impart gloss to fruits vegetables, wax-'W'-does not impart gloss to fruits vegetable.

6. **Ripening** : Cycocel (500 ml/lit), Alar, GA, Menadione bisulphite retard ripening.

- * Use of purafil (KMnO₄) silicate carrier is effective in complete absorption of ethylene in Banana held in sealed polythene bags.
- * Concentration of CO₂ above 1% delay ripening.
- * Ethephon commercially known as etherel or CEPA is used for ripening.
- * CaC₂ can also be used for ripening.
- * Fruitox (Fungicide with Wax 'O' (0.3%) and Tal prolong (1-1.5%) retard ripening in Mango.

7. **Packaging** :

- * Apple : wooden box (45 × 30 × 27.5 cm³) Packaging capacity 16-18 kg
- * Mango : wooden box (45 × 30 × 30 cm³) Packaging capacity 16-18 kg
- * Cushioning material-Paddy straw, Banana leaves, dry grass, wheat straw

8. **Transportation** : For highly perishable commodity, there should be minimum temperature rise during transit.

9. **Storage** :

- * To store fruit and vegetables, low temperature and high humidity (90-95%) are required except in onion and Garlic which require low RH (70%).
- * 90% capacity of cold store is being utilized for storage of potato.including seed potato.
- Among fruits mainly Apple are kept in cool stores.

10. **Irradiation** :

- * Sprouting of onion can be checked by gamma irradiation at a dose of 0.06-0.1 KGY.
- * In potato, irradiation at 0.1 KGY can inhibit sprouting completely.

STORAGE LIFE OF FRESH FRUITS

Sl. No.	Category	Produce	Time at optimum temperature (weeks)		
			-1 to 4 °C	5-9 °C	10 °C
1.	Very perishable (0-4 weeks)	1. Apricot	2	—	—
		2. Banana (ripe)	—	—	1-2
		3. Fig.	2-3	—	—
		4. Mango	—	2-3	—
		5. Watermelon	—	2-3	—
2.	Perishable (4-8 weeks)	1. Avocado	—	3-5	—
		2. Grape	4-6	—	—
		3. Mandarin	—	4-6	—
		4. Peach	2-6	—	—
		5. Pineapple	—	4-5	—
3.	Semi perishable (6-12 weeks)	1. Coconut	8-12	—	—
		2. Sweet orange	—	6-12	—
4.	Non perishable (>12 weeks)	1. Apple	8-30	—	—
		2. Grape fruit	—	—	12-16
		3. Pear	8-30	—	—

STORAGE LIFE OF FRESH VEGETABLES

Sr. No.	Category	Produce	Time at optimum temperature (weeks)		
			-1 to 4 °C	5-9 °C	10 °C
1.	Very perishable (0-4 weeks)	1. Spinach	1-2	—	—
		2. Broccoli	1-2	—	—
		3. Ripe tomato	—	1-3	—
		4. Lettuce	1-3	—	—
		5. Cauliflower	2-4	—	—
2.	Perishable (4-8 weeks)	1. Cabbage	4-8	—	—
		2. Tomato green	—	—	3-6
3.	Semi-perishable (6-12 weeks)	1. Celery	6-10	—	—
		2. Leek	8-12	—	—
4.	Non perishable (>12 weeks)	1. Carrot	12-20	—	—
		2. Onion	12-28	—	—
		3. Potato	—	16-24	—
		4. Turnip	16-24	—	—

PROCESSING

(A) Canning (sterilization)

- * Syruping (for fruits), Brining (for vegetables)
- * All fruits being acidic in nature can be processed at a temperature of 100 °C.
- * Vegetables except Tomato and Rhubarb are non-acidic in nature can be processed at a temperature of 115-121 °C (Pressure 10-15 lb/inch²)

Operation : 1. Grading 2. Washing 3. Peeling 4. Blanching 5. Can filling 6. Syruping 7. Brining 8. Exhaustion 9. Sealing 10. Processing.

- * *Lye peeling* : Potato, Peach, Citrus
- * *Flame peeling* : Onion
- * *Canning-Fruits* : Fully mature ripe and firm
- Vegetables* : Tender, ripe and firm

(B) **Pasteurization** : Heating of fruit and vegetable juice at 85-90 °C for 30 minutes.

(C) **Freezing** : Freezing with cryogenic liquids (liquid N₂ at -196 °C or liquid CO₂ at -43 °C).

- * Fruit juices are frozen at -12° to -17 °C [Quick freezing : -18 to -25 °C]
- * Household refrigerators run at 4.4° to 7.2 °C.

(D) **Drying** : Removal of moisture by applying heat is called drying.

(E) **Preservation with Sugar** : High concentration of sugar facilitates preservation.

Candied fruits : They are prepared by dehydrating them by osmotic pressure of sugar solution (Osmotic dehydration)

Ex. pointed gourd, Bottle gourd, Ash gourd Citrus, karonda, cherry, Ginger, Petha

Crystalized fruits : Candy coated with thin transparent coating of sugar crystal.

Ex. Ginger, cherry.

- * **Sugar act as a preservative by osmosis.**
- * Marmalade is a fruit Jelly in which the shreds of peels of citrus fruits (Orange, lemon) are suspended.
- * In Jam, Sugar quantity should be atleast 68%.
- * Fruit syrup (sharbat) contain more than 66% sugar that generally doesn't ferment.
- * Fruit for preserve should be firm ripe rather than soft ripe and uniform in size.

(F) **Preservation by salt** : Concentration 10-25% is sufficient.

(G) **Food additives** :

1. *Antioxidants* : BHA (Butylated hydroxy anisole), BHT, propyl gallate, SnCl₂.
2. *Preservatives* : SO₂, Benzoic acid, sorbic acid.
3. *Surface active agent* : Monosodium phosphate.
4. *Stablizers* : CMC (Carboxy methyl cellulose), Pectin

5. *Sweetners* : Aspartane, Glycyrrhizic acid

6. *Flavouring agent* : Monosodium glutamate

7. *Colouring agent* : Titanium dioxide, carbonblack

8. *Bleaching agent* : Benzoyl Peroxide, H_2O_2

* NaCl is the only salt that has salty taste.

* Sourness of food due to presence of organic acid of which citric, tartaric, malic acid are most common.

* Ascorbic acid present abundantly in fruits and vegetables.

* *Naringin* : Bitter principle of Grape fruit.

* *Amygladin* : Bitter principle of Almond

* *Sinigrin* : Bitter principle of Mustard and Horse raddish

* *Caffeine* Bitter principle of Tea and Coffee

(H) Flavour compound

1. Flavonoides : Hesperidin in Oranges and Lemon

Naringenin in Grape fruit

2. Terpinoides Neral and geraniol in Lemon

Nootaketone in Grape fruit

3. Volatile compounds (i) *Banana* : Isopentyl acetate

(ii) *Almond* : Benzaldehyde

(iii) *Apple* : 2-methyl butyrate

4. Esters : (i) *Grape* : Methyl salicylate

(ii) *Apple* : Pentyl valerate

(iii) *Orange* : Octyl acetate

(iv) *Strawberry* : Ethyl butyrate

(I) Food colour

(a) *Chlorophyll* : a : b (3:1) in plants

(b) *Carotenoids* : Fat soluble, orange yellow pigment.

Tomato : Lycopene

Black pepper : Capcanthin

Annatto : Bixin

Extract of Carrot, Avocado, Palm oil contain β -carotene, which is precursor of vitamin-A.

(c) *Anthocyanin* : Water soluble, Red, Blue, Purple pigment.

e.g. Cherry, Apple, Jamun

(d) *Flavonoides* : Cream white colour

e.g., Potato, Cauliflower

(e) *Tannin* is responsible for astringency in Brinjal, Apple, Bottle gourd

Mangiferin : Mango

Betalins : Beet

(J) Preservation by chemicals

(a) **Sulphur dioxide** : Salt KMS (Potassium metabisulphite)

It has better preservative action against Bacteria & moulds (Fungus)

It is used to preserve most of the juices/pulp.

According to FPO, max. amount of KMS allowed in fruit juice is 700 PPM.

(b) **Benzoic acid** : Salt-sodium benzoate

It is most effective against yeast.

It is used for coloured juices/pulp along with citric acid (only in non acid fruits)

According to FPO, permitted levels in RTS and nectar is 100 PPM

(K) Preservation by fermentation

Decomposition of CHO_s (Carbohydrates) by micro-organisms or enzyme is called as fermentation.

(a) **Acetic acid** : Fruit juice \rightarrow Vinegar

(b) **Lactic acid** :

Raw material	Predominant micro-organism	Product
1. Cabbage	Leconostoc, Lactobacillus	Sauerkraut
2. Cucumber, Tomato Mango, Lemon	Leconostoc, Lactobacillus Streptococcus	Pickle
3. Black Carrot	—	Kanji (popular in North India)

NaCl is also used in lactic fermentation.

(c) **Alcoholic fermentation** : CHO_s (Carbohydrates) + yeast \rightarrow Alcohol.

(L) Fermented beverages : Grape wine is oldest example of fermented beverage.

1. Wine \rightarrow Alcohol (7-20%)

Sparkling wine contains CO_2

Grape variety suitable for wine making \rightarrow Beauty seedless, Arka shyam

2. Nira \rightarrow Prepared from the juice of Palm tree.

3. Feni \rightarrow Prepared from the juice of Cashew apple.

4. Cider \rightarrow Prepared from the juice of Apple.

(M) Cold sterilization : Irradiation - Food is preserved by ionizing radiation.

Temperature remains 4-5 °C, that is why it is called as cold sterilization.

* Canning is also known as appertizing.

* Jam is prepared from fruit pulp

* Jelly is prepared from juice/clear water extract of fruit

* Dehydration temperature is generally 60-66 °C in case of vegetables and 61-71 °C for fruits.

* Vinegar- oldest known product of fermentation.

* Jelmeter test is used for determination of pectin content.

* Mango pickle-ranks 1st in India while cucumber pickle rank 1st in world.

* In pickle \rightarrow Salt concentration should be 10%.

(N) Unfermented beverages :

Sr.No.	Product	Fruit Juice %	TSS%	Acidity %
1.	Natural juice	100	-	-
2.	Sweetened juice	85	10	-
3.	RTS	10	10	3
4.	Nectar (All fruits)	20	15	3
5.	Cordial	25	30	1.5
6.	Orange and pineapple Nectar	40	15	-
7.	Squash	25	40-50	1.0
8.	Crush	25	55	1.0
9.	Syrup	25	65	1.3-1.5
10.	Barley water	25	30	9.0
11.	Chutney	40	50	1.0
12.	Jam	45	68	5-7
13.	Jelly	45	65	5-7
14.	Ketchup	-	28	-
15.	Sauce	-	30	1.2%
16.	Preserve	55	68-70	-
17.	Glazed fruits (candid, crystalized)	Not less than 25	Not less than 70	-
18.	Sharbat	-	65	-

Product	TSS%
1. Tomato Juice	5
2. Tomato soup	7
3. Tomato puree	9
4. Tomato paste	25
5. Tomato Ketchup	28
6. Tomato Sauce	30
7. Sauce (other than tomato)	15

Acidity : 1.2%

*Raspberry, strawberry
Fruit pulp - 25% in Jam

(O) Food spoilage

Blue mould of Citrus : *Penicillium italicum*

Green mould of Citrus : *Penicillium digitatum*

Blue mould of Apple : *Penicillium exopsum*

Sr.No.	Food	Type of spoilage	Causal organism
1.	Fresh fruit & vegetables	1. Gray mould rot	<i>Botrytis cinerea</i>
		2. Rhizopus soft rot	<i>R. nigricans</i>
		3. Blue mould rot	<i>Penicillium italicum</i>
		4. Black mould rot	<i>Aspergillus niger, Alternaria spp.</i>
		5. Sliminess or souring	Saprophytic bacteria
2.	Pickles	1. Black pickle	<i>Bacillus nigricans</i>
		2. Soft pickle	<i>Bacillus</i>

* *Determination of TSS* : By Hand refractometer

* *Estimation of Sugar* : By shaffer micro-method.

* *PFA act* : Prevention of food Adultration act-1954

* Salometer used for measuring the salt concentration of any substance in terms of degree salometer.

* *Citric acid* : "Nature's acidulant".

POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS

1. Potato

- * Suberization is the process in which wounds are healed. A temperature of 25 °C with 95% RH are ideal for suberization.
- * Kufri Chandramukhi and kufri Bahar have short dormancy.
- * Kufri Lalima and Kufri Sindhuri have long dormancy.
- * MH (desprout) is commonly used sprout suppressent in India.
- * Tuber moth causes maximum damage during storage when stored under high temperature.
- * High humidity and condensation of water on tuber surface can lead to infection of soft rot causing bacteria, (Erwinia spp.)
- * Cold storage can accommodate only about 45% of the total potato production.
- * Heaps and pits are most common methods of potato storage in plains and plateau region.

2. Tuber crop

- * Tuber crops are third most important food crops after cereals and grain legumes.
- * Tuber crop are staple food of one-fifth of the world population.

3. Cassava

- * Starch is the major industrial product from cassava.
- * Thailand and Indonesia are the world's largest exporters of Cassava pellets.
- * Cassava tuber contain cyanoglucosides (linamarin and lotaustralin) which are converted to toxic compounds hydrocyanic by the endogenous enzyme linamarase.

4. Sweet potato

- * It contains tripsin inhibitor which inhibits the important digestive enzyme trypsin.
- * Corms of Elephant foot yam contain oxalic acid.
- * Starch of arrow root is used mainly as an infant food.

5. Cut flowers

- * Silver thiosulphate is the best preservative.
- * Sucrose-sugar
- * Citric acid - acidifying agent
- * Quinoline - Biocide
- * New promising fresh flower preservative
 1. AOA : Amino oxyacetic acid
 2. Phenidone-typoxygenase inhibitors

6. Coconut

- * In India, 55% coconut is consumed as raw.
- * Fresh coconut kernels contain 50-55% moisture content which is to be brought down to 5-6% by drying.
- * Coconut oil contains lauric acid content.
- * Lakshadeep micro is best for ball copra.
- * About 30% of the husk is fibre and 70% is coir dust. (Husk-Meso carp)

7. Spices

- * Black pepper is harvested from December to March in Kerala.
- * Recovery of white pepper varies from 22-27% of the green pepper.
- * Himachal, Maran, Mananthody and Kuruppampaddy are good varieties to prepare dry ginger.
- * Rio-de-Janero, China wynad and Varada are good for raw ginger.
- * Major Indian trade type are Cochin and calicut ginger.
- * Cinnamon bark oil has high cinnamaldehyde content whereas leaf oil has high Eugenol.
- * The proportion of dried shelled nutmeg to dried mace is approximately 20 : 3.

8. General

- * Vinegar concentration in preservative should be not more than 2%.
- * Salt concentration of 15% or above prevents microbial growth in pickles.
- * Mango variety suitable for slicing-Alphonso, Dashehari, Neelum.
- * Ascorbic acid (100 g) for retention of colour, flavour and carotene.
- * Mango puree is adjusted to 30 Brix.
- * *Mango variety suitable for wine* : Bombay green, Dashehari, Chausa, Langra, Mallika.
- * Coaltar dye or mixture of dye which added to any food product should not exceed 0.2 g/kg of the final product.
- * *Jam marmalade* : Prepared from pulp of citrus fruits.
Jelly marmalade : Prepared from extract of citrus fruits.
- * Crystal form at ion in jelly due to excess of sugar and less cooking.
- * Concentration of brine solution used in canning of fruits is : 1-3%
- * Sirka preservative is used in squash preparation.
- * *Fruit type selected for making Jelly* : Firm ripe
- * *Sugar, salt* : React on the principle of Osmosis.
Oil : Anaerobic condition creation
SO₂ : Bacteria + Fungi growth retardation.
BA : Yeast growth retardation.
- * Controlled modified storage best method of storage.
- * *In washing solution - Cl concentration* : 50 PPM
- * *CO₂ conc. in cold drinks* : 1-8 g/lit
- * Effectiveness of Benzoic acid increases in the presence of CO₂
- * *Jam* : Less than 30% sugar : crystal will form
More than 50% sugar : Honey like mass will form

- * Waxol (3%) is more efficient in retaining the freshness of fruit than tal prolong (1-1.5%)
- * Zero energy cool chamber : principle-evaporative cooling system
- * Maximum temperature inside the cool chamber is 28 °C, Humidity 90%
- * Zero energy cool chamber was developed by S.K. Roy.
- * All enzymes loose their activity if heated to 80 °C and above.
- * By application of heat both-microbial and enzyme spoilage can be well checked.
- * *Freezing* : Pressure food without major changes in its physiochemical composition.
- * *Quick freezing* : Maximum crystallization. temperature (-18 to -25 °C).
- * Frozen peaches are used as halves, quarters, slices, pieces (15 mm).
- * Peach prepared with syrup should have 15-30% TSS at 20 °C.
- * Freezing-exposing fruit to low temperature resulting in converting the water molecule into ice crystals.
- * **Permissible limits of preservatives in food products.**

Sr.No.	Food product	Preservative	PPM	Product	SO ₂	BA
1.	Fruit pulp or juice (not dried)	SO ₂	1000	Fruit Juice	700 PPM	—
	Cherry juice	SO ₂	5000	RTS	100 PPM	100 PPM
	Strawberry pulp	SO ₂	2000	Nectar	100 PPM	100 PPM
2.	Fruit juice concentrate	SO ₂	1500			
3.	Dried fruits	SO ₂	2000			
4.	Raisins	SO ₂	750			
5.	Squash-crushes, cordials, Fruit syrup, fruit juices	SO ₂ Benzoic acid	350 600			
6.	Jam, Jelly, Marmalade Preserve	SO ₂ Benzoic acid	40 200			
7.	Crystalized, candid, Glazed fruit	SO ₂	150			
8.	RTS	SO ₂ Benzoic acid	70 120			
9.	Pickle, chutney	SO ₂ Benzoic acid	100 250	→ Product should not be packed in the container		
10.	Tomato or other sauces	Benzoic acid	750			
11.	Dehydrated vegetables	SO ₂	2000			
12.	Tomato puree, paste	Benzoic acid	250			
13.	Syrup & sharbat	SO ₂ Benzoic acid	350 600			
14.	Cider	SO ₂	200			

- * For Jams and Jelly, any fruit of suitable variety can be used.
- * Acetic acid (Antiseptic property) concentration in pickle, sauce, ketchup : 0.5%
- * *Ultrafiltration* : is a Cold process

MISCELLANEOUS

- * Syruping temperature : 79-82 °C
- * Temperature at sealing : 74 °C
- * Caramelization : Sugar when heated beyond their melting point, decomposes and forms a brown mass known as caramel and this process is known as *caramelization*. It occurs at high temperature.
- * Hand refractometer : Total refraction principle.
- * In preservation of food : Quantity of colour permitted is 200 PPM.
- * Freezing principle : crystallization.
- * B.V.O : Brominated vegetable oil.
- * Measurement of fruit firmness : By pepeometer.
- * Cellar storage temperature 15 °C for tuber crops (underground storage).
- * Lye peeling : 1-2% NaOH, (Potato, Peach) for 30 sec. to 2 minutes.
- * Alcohol % in wine : 13-20%.
- * Enzymatic browning
 - 1. Polyphenol oxidase
 - 2. Phenolase
 - 3. Pectic methyl esterase.
- * All vegetables are alkaline in nature.
- * Vegetables ranking 1st in pickle making : 1. Cucumber 2. Cauliflower. 3. Mango
- * Central food laboratory : Kolkata
- * Complete inhibition of micro-organism : CO₂ (46 g/lit).
- * Fermentation is only process in which both donor and acceptor are organic.
- * D value : 90% micro-organism are killed.
F value : combination of time and temperature.
- * Exhausting temperature : 82-100 °C.
- * Cooling temperature : 39 °C.
- * R-enamal-Acid resistant cans (Fruits).
C-enamal-sulphur resistant cans (Vegetables).
- * Mallard reaction : Non enzymatic reaction.
- * H swell : chemical reaction.
- * In canning : Fruits and Vegetables mostly get damaged by Flat saur (*Bacillus spp*).
- * Sulphuring : Prevent discolouration.
Burning of sulphur for 60-70 minutes.

* **Honey** : It is the only product which can't be spoiled.

* **Selenium** : Antioxidant mineral.

* **Blanching** : Scalding, parboiling, pre-cooking
Inactivate plant enzymes.

<i>Sr.No.</i>	<i>Product</i>	<i>Specifications</i>
1.	Bottled or canned fruit	Head space- Not more than 1.6 cm drained weight of fruit not less than 50% No preservative shall be added. No artificial colour Can should not show any pressure at sea level Can should not show any sign of bacteria growth at 37 °C
2.	Bottled or canned vegetables	Head space - Not more than 1.6 cm drained weight - atleast 55% (50% in case of tomato). No preservative should be added. No artificial colour except Peas. Can should not show any pressure at sea level. Can should not show any sign of bacteria growth at 37 °C.

* Ethylene application to climacteric fruits is 0.1 to 1.0 ml/litre.

* India ranks first in productivity of Grapes, Banana, Cassava, Peas and Papaya

* Export growth of fresh fruits and vegetables in terms of value is 14% and of processed fruits and vegetables is 16.27%.

* About 750 µg of vitamin A (Retinol) is required per day for healthy vision.

STORAGE OF VEGETABLES AND FRUITS

Sr. No.	Crop	Storage temperature (°C)	RH%	Storage life (weeks)
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VEGETABLES

1.	Squash	13-15.5	70-75	24-36
2.	Sweet Potato	10-13	80-90	13-20
3.	Brinjal	10-11	92	2-3
4.	Cucumber	10-11	92	2
5.	Unripe Tomato	8-9-10	85-90	4-5
	Ripe Tomato	7-2	85-90	1
6.	Pumpkin	1-7-11-6	70-75	24-36
7.	Chilli green	7-2	—	—
	Chilli ripe	5-7	—	—
8.	Potato	3-4-4	85	34
9.	Cole crops	0-1-7	92-95	4-6
10.	Garlic	0	65	20-36
11.	Carrot Raddish	0	95	20-24
12.	Peas, Turnip	0	95	—

FRUITS

1.	Banana	12-13	80-85	1-2
2.	Pineapple	11-13	80-86	6
3.	Papaya, Guava	9-10	—	—
4.	Mango, Grape fruit	8-9	—	—
5.	Sweet Orange	7-8	—	—
6.	Mandarin	6-8	—	—
7.	Grape, Fig, litchi	0-2	—	—
8.	Sapota	3-4°C	3-4°C	—
9.	Pomegranate	0-2°C	0-2°C	—
10.	Apple	0-2°C	0-2°C	16-32 weeks
11.	Pear	0-1°C	0-1°C	12-26 weeks
12.	Jackfruit	11-13	—	—

GENERAL HORTICULTURE

WEEDICIDES

Sl. No.	Common Name	Trade Name	Manufacturing Company
A.	Pre emergent herbicides		
1.	Alachlor	Lasso	Monsento - USA
2.	Butachlor	Machet	Monsento - USA
3.	Triflurodine	Top-E-25	Rome & Hass, USA
4.	Fluchloraline	Basaline	BASH, Germany
5.	Oxyfluraline	Gole	Rome & Hass, USA
6.	Oxydiozone	Roanster	Poulance, Paris
B.	Post emergent herbicide		
1.	Gramoxone / Paraquat		ICI, England
2.	Glyphosate	-	-
3.	Atrazine	-	Shell, USA
4.	Diuron	-	Dupond, USA
5.	Bromacil	Hyver-X	Dupond, USA
6.	Chloroxeuron	Teneron	Ciba-Gegy

GROWTH REGULATORS

<i>Trade names</i>	<i>Active Ingredient</i>	<i>Common name</i>	<i>Commercial uses</i>
Ethepon, Ethrel, Cepha	6- Benzyl aminopurine 2-chloroethyl phosphonic acid	6-Benzyl adenine Ethylene	Senescence delayer, Tillering agent Fruit ripening, Sugarcane ripener, Color enhancer, Gameticide, Seed dormancy breaker in Sunflower and Groundnut, Sex changer, En- hancer of latex flow in rubber, Abseission agent.
Plantgard	2,4-D (at low con.)	2,4-D	Fruit drop controller, Root in- ducer, Fruit set enhancer.
Cycocel, Lihocin	(2-chloroethyl) trimethyl ammonium chloride	Chloromequat, CCC	Loading reducer, Pigment former, Senescence delayer, Branch inducer; Fruit set enhancer, Reduc- tion in plant size, Tillering and Branching.
MH-30, Sprout --- stop, Sucker out	1,2 dihydro-3,6 pyridazinedion	Maleic hydrazide (MH)	Sucker controller, Axillary bud controller, Growth retardant, Sprout controller.
GA3, Progibb, Gibrosol, Gibrel	Gibberellic acid	Gibberellin	Germination enhancer, Post harvest life enhancer in apple, to increase fruit size in grapes and apples, increase cane growth in sugarcane.
SARODEX, Rapid root, Quick root	30 indole butyric acid	IBA	Root inducer
Chamatkar, White gold, Marvel	Mepiquat chloride	MC	Tuber and bulb growth enhancer, Enhances pod set and fruit set groundnut, cotton and pigeon pea.
Round up	Phosphonomethyl glycine (low conc.)	Glyphosate	Sugarcane ripener, Desiccant.

(Contd....)

Trade names	Active Ingredient	Common name	Commercial uses
Alar, Kyalax, B-nine	Succinic acid-2, 2-dimethyl hydrazine	Daminozide	Germination inhibitor, Growth retardant, Flowering inducer, Senescence delayer, Branch inducer, Sex changer.
Combine, BR-120, BR-2000	(222r, 23r, 24s) – 2a-3a, 22, 23 tetra hydroxy 24-methyl, 6, 7-lactone	Brassinolide along with GA	Growth stimulant, Grapes berry growth inducer.
Regime-8	2, 3, 5-tri iodo benzoic acid	TIBA	Soybean pod set, Stimulant, Tillering agent, Sunflower seed set and seed growth enhancer
Miraculan, TRIA, TRICON, ATHIPAL, VIPUL, Paras, Mixatol	1-hydroxy triacontane	Tricontanol	Growth stimulant
Fruitone, Planofix	1-Napththalene acetic acid	NAA	Root inducer, Fruit set enhancer, Post harvest fruit droop preventer.

DAILY REQUIREMENT OF CALORIES FOR AN AVERAGE PERSON

Sr. No.	Particular	Amount	Sr. No.	Particular	Amount
1.	Calories	2800	7.	Riboflavin	1.5 mg
2.	Protein	55 g	8.	Niacin	19 mg
3.	Calcium	450 mg	9.	b-Carotene	3000 µg
4.	Iron	20 mg	10.	Folic acid	100 µg
5.	Vitamin-C	50 mg	11.	Vitamin-B 12	1.0 µg
6.	Thiamine	1.4 mg	12.	Vitamin-D	5 µg

Fruit productivity – 11.7 t/ha ; Vegetable productivity - 15 t/ha

STATISTICAL DATA

- | | |
|---|------------------------|
| 1. All India production of Organic manure in 2013. | Ans. 4115.78 Lac Tones |
| 2. All India production of Green manure in 2013. | Ans. 237.55 Lac Tones |
| 3. State having highest Area under green manure in 2013. | Ans. Karnataka |
| 4. Which country is World leader in Vegetables production- | Ans. China |
| 5. Which country is World leader in Fruit production- | Ans. China |
| 6. Which country is World leader in Potato production- | Ans. China |
| 7. Which country is World leader in Onion (Dry) production- | Ans. China |
| 8. India's Rank in world in Vegetables production- | Ans. Second |
| 9. India's Rank in world in Fruit production- | Ans. Second |
| 10. India's Rank in world in Potato production- | Ans. Second |
| 11. India's Rank in world in Onion (Dry) production- | Ans. Second |
| 12. India's Rank in world in Coconut production- | Ans. Third |
| 13. Largest producer of Olive in world- | Ans. Spain |
| 14. Percentage share of Agri sector in GDP 2014-15 | Ans. 17% |
| 15. Fresh fruits exports in 2013 | Ans. 3290.51 Crore |
| 16. Fresh Vegetable exports in 2013 | Ans. 1119.74 Crore |
| 17. India's percent share contribution in world production of Vegetables- | Ans. 9.87% |
| 18. India's percent share contribution in world production of fruits- | Ans. 11.17% |
| 19. India's percent share contribution in world production of Potato's | Ans. 11.35% |
| 20. India's percent share contribution in world production of Onion | Ans. 19.68% |
| 21. State having highest area under fruits 2013 | Ans. Maharashtra |
| 22. State having highest production of fruits-2013 | Ans. A.P. |
| 23. State having highest area under vegetables 2013 | Ans. West Bengal |
| 24. State having highest production of Vegetables 2013 | Ans. West Bengal |
| 25. Total area under fruits in India in 2013 | Ans. 6982 Thousand Ha. |

NUTRITIVE VALUE OF FRUITS AND VEGETABLES

Sr. No.	Item	Fruits		Vegetables	
		Name	Quantity	Name	Quantity
1.	Vitamin-A	Mango	4800 IU/100g	Bathua leaves	11,3000 IU/100 g
		Papaya	2020 IU/100g	Colocasia leaves	10278 IU/100 g
				Beet leaves	9770 IU/100
				Turnip green	15000 IU/100 g
2.	Vitamin-B ₁ (Thiamine)	Cashew nut	630 mg/100g	Chillies	0.55 mg/100 g
		Walnut	450 mg/100g	—	—
3.	Vitamin-B ₂ (Riboflavin)	Beal	1191 mg/100g	Fenugreek leaves	0.31 mg/100
		Papaya	250 mg/100g		
		Litchi	122.5 mg/100g		
4.	Vitamin-C (Ascorbic acid)	Barbados	1000-4000	Drumstick leaves	220 mg/100g
		Cherry	mg/100g		
		Aonla	600 mg/g	Coriander leaves	135 mg/100g
		Guava	299 mg/g	Chillies	111 mg/100g
				Broccoli	109 mg/100g
5.	Carbohydrates	Rasins	77.3%		
		Apricot (dry)	72.8%	Tapica	38.1%
		Karonda (dry)	67.1%	Sweet Potato	28.2%
		Date (Pind)	67.8%	Potato	22.6%
6.	Protein	Cashew nut	21.2%	Lima bean	7.9g/100g
				Peas	7.2g/100g
		Almond	20.88%	Cowpea	4.3g/100g

Sr. No.	Item	Fruits		Vegetables	
		Name	Quantity	Name	Quantity
7.	Fat	Walnut	64.5%	Potato	118g/100g
		Almond	58.9%		
8.	Fibre	Fig	—	Potato	752g/100g
		Guava	6.9%	Chilli	6.8g/100g
		Pomegranate	5.10%		
9.	Calcium	Litchi	0.21%	Agathi	1130mg/100g
		Karonda(dry)	0.16%	Curry leaves	813mg/100g
10.	Phosphorus	Almond	0.49%	Amaranthus	800mg/100g
		Cashew nut	0.45%	Garlic	187mg/100g
		Walnut	0.38%		
11.	Iron	Dry Karonda	39.1%	Amaranthus	22.9%
		Date (Pind)	10.6%		
12.	Calorific value	1. Walnut	687/100g	1. Tapioca	338
		2. Almond	655/100g	2. Garlic	142
		3. Cashew	596/100g	3. Limabean	105
		4. Date	283/100g		
13.	Potassium	—	—	1. Spinach	605mg/100g
				2. Amaranthus	230mg/100g

ICAR INSTITUTIONS IN INDIA

<i>Sr. No.</i>	<i>Abbreviation</i>	<i>Name of Institute</i>	<i>Place</i>	<i>State</i>	<i>Establishment year</i>
1.	CISTH	Central Institute for Subtropical Horticulture	Lucknow	UP	
2.	CITH	Central Institute for Temperate Horticulture	Srinagar	J&K	
3.	CIAH	Central Institute for Arid Horticulture	Bikaner	Rajasthan	2000
4.	CTCRI	Central Tuber Crops Research Institute	Tiruvananthapuram	Kerala	
5.	CPRI	Central Potato Research Institute	Shimla	HP	1949
6.	CRIC	Central Research Institute for Chikoo	Muzzaffarpur	Bihar	
7.	CIPHET	Central Research Institute for Post Harvest Engineering and Technology	Ludhiana	Punjab	
8.	IHR	Indian Institute of Horticulture Research	Bangalore	Karnataka	1968
9.	IISR	Indian Institute of Spice Research	Calicut	Kerala	
10.	IIVR	Indian Institute of Vegetable Research	Varanasi	UP	
11.	RRII	Rubber Research Institute of India	Kottayam	Kerala	
12.	CCRI	Central Coffee Research Institute	Chikmagalur	Karnataka	
13.	CPPTI	Central Plant Protection Training Institute	Hyderabad	Andhra Pradesh	
14.	NRCB	National Research Centre for Banana	Tiruchirapalli	Tamilnadu	
15.	NRCC	National Research Centre for Cashew	Puttur	Karnataka	
16.	NRCC	National Research Centre for Citrus	Nagpur	Maharashtra	
17.	NRCG	National Research Centre for Grapes	Pune	Maharashtra	
18.	NRCOP	National Research Centre for Oil Palm	Eluru	Andhra Pradesh	
19.	NRCM	National Research Centre for Mushroom	Solan	Himachal Pradesh	

20.	NRCM&P	National Research Centre for Medicinal and Aromatic Plants	Anand	Gujarat
21.	NRCO&G	National Research Centre for Onion and Garlic	Nasik	Maharashtra
22.	NRCO	National Research Centre for Orchids	Gangtok	Sikkim
23.	NRCL	National Research Centre for Litchi	Muzaffarpur	Bihar
24.	NRCSS	National Research Centre for Seed Spices	Ajmer	Rajasthan
25.	NRCIPM	National Research Centre for Integrated Pest Management	New Delhi	NCR
26.	NRCG	National Research Centre for Groundnut	Junagadh	Gujarat
27.	NRCS	National Research Centre for Sorghum	Hyderabad	Andhra Pradesh
28.	NRCS	National Research Centre for Soyabean	Indore	MP
29.	NRCA	National Research Centre for Agro Forestry	Jhansi	UP
30.	NRCW	National Research Centre for Weed Science	Jabalpur	Maharashtra
31.	NRCM	National Research Centre for Mustard	Bharatpur	Rajasthan
32.	NRCPB	National Research Centre for Plant Biotechnology	New Delhi	
33.	PDR	Project Directorates on Rice	Hyderabad	AP
34.	PDW	Project Directorates on Wheat	Karnal	Haryana
35.	PDOS	Project Directorates on Oil Seed	Hyderabad	AP
36.	PDP	Project Directorates on Pulses	Kanpur	UP
37.	PDBC	Project Directorates on Biological Control	Bangalore	KN
38.	PDWM	Project Directorates on Water Management	Rahuri	MH
39.	PDVR	Project Directorates on Vegetable Research	Varanasi	UP
40.	DHIHQ	Division of Horticulture at ICAR Head Quarter	New Delhi	1987

41.	NARS	National Agriculture Research System		
42.	NARP	National Agriculture Research Project		
43.	NATP	National Agriculture Research Centre		
44.	IARC	Internet Agriculture Research Centre		
45.	CSWCRTI	Central Soil and Water Conservation Research and Training Institute	Dehradun	Uttaranchal 1954
46.	NAIS	National Agriculture Insurance Scheme		
47.	CSSRI	Central Soil Salinity Research Institute	Karnal	Haryana
48.	CFQC&TI	Central Fertilizer Quality Control and Training Institute	Faridabad	UP
49.	NIAM	National Institute of Agriculture Marketing	Jaipur	Rajasthan 1988
50.	NPOP	National Programme for Organic Production		
51.	NPPTI	National Plant Protection Training Institute	Hyderabad	AP

MINERAL NUTRITION

Total essential elements-17

Sr. No.	Name of Nutrients	Examples	Characteristics
1.	Basic nutrient	C, H, O	Constitute 96% of total dry matter of plant
2.	Macro-nutrient	N, P, K, Ca, Mg, S	>100 µg/g dry matter
	(a) Primary	N, P, K	
	(b) Secondary	Ca, Mg, S	
3.	Micro-nutrient	Fe, Zn, Cu, Mo, Cl	
4.	Beneficial nutrient	Na, Co, Va, Ni, Si	

Sr. No.	Base of Classification	Nature of nutrient	Examples
1.	Mobility in soil	1. Mobile 2. Less mobile 3. Immobile	NO_3^- , SO_4^{2-} , BO_3^{2-} , Cl^- , Mn^{2+} NH_4^+ , Ca^{2+} , Mg^{2+} , K^+ , Cu^{2+} H_2PO_4^- , HPO_4^{2-} , Zn^{2+}
2.	Mobility in plant	1. Highly mobile 2. Moderately mobile 3. Immobile	N, P, K Zn Ca, B
3.	Function in plants	1. Elements useful in energy storage, bonding 2. Elements act as Regulators and Carriers 3. Elements are Catalysers and Activators	N, S, P K, Ca, Mg Fe, Mn, Zn, Cu, B, Mo, Cl

Sr. No.	Essential element	Mineral source
1.	C	Carbonate, Air
2.	N	Organic matter
3.	Ca	Dolomite, Calcite, Apatite
4.	Zn	Sphalerite, Horn-blend, Augite
5.	K	Micas, feldspar
6.	Cu	Chalcopyrite, Biotite
7.	B	Tourmaline
8.	Mo	Olivine
9.	Cl	Apatite

Minerals, their role and deficiency symptoms in plants

Sr. No.	Nutrient	Role	Deficiency symptoms
1.	N	Vigorous vegetative growth, delay maturity	Chlorosis 1st observed on older leaves.
2.	P	Found in flowers, seeds, maturing fruits, root growth and development.	
3.	K	Osmotic regulation, Improves colour, flavour and size of fruits, sugar translocation	
4.	Ca	Occurs in leaves as calcium pectate, maintenance of membrane integrity	1st appears on shoot tips
5.	Mg	Constituent of chlorophyll, protoplasm and chromosome	1st appears on older leaves, yellowing of leaf margins
6.	S	Constituent of cystine, methionine, Stabilization of protein structure	Chlorosis- 1st observed on younger leaves.
7.	Fe	Key element of respiration, Photosynthesis, reduction of nitrate and sulphates	Interveinal chlorosis 1st observed on younger leaves
8.	Mn	Key element in Respiration, photolysis of water	
9.	Cu	Oxidation-reduction reaction, activity of ethylene in fruit ripening	
10.	Zn	Required for synthesis of Tryptophan, Essential for CO ₂ evolution and utilization	Short internodes, Rosettes or little leaf symptoms
11.	Bo	Salt traslocation, Pollen tube growth, active salt absorption	Corky area develops in cortex and browning in core region.
12.	Mo	Plays important role in N ₂ metabolism, constituent of enzyme-Nitrogenous and nitrate reductase, Helps in fixation of atmospheric N ₂ in legume crop	Yellow spots on leaves
13.	Cl	Involved in O ₂ evolution in primary reactions of Photosynthesis, turgor production in guard cells.	

Defeciency symptoms

1. Old leaves- N, P, K, Mg, Mo
2. New leaves- S, Fe, Mn, Cu
3. Old and New leaves- Zn
4. Terminal bud- Cu, B

FERTILIZERS

(a) Inorganic fertilizers

Sr. No.	Fertilizer	N(%)	P ₂ O ₅ (%)	K ₂ O(%)
1.	Anhydrous Ammonia	82	—	—
2.	Ammonia sulphate	20.5	—	—
3.	Ammonia nitrate (Hazardous)	33.5	—	—
4.	SSP (S : 12.5%)	—	16	—
5.	MAP (Mono Ammonium, Phosphate)	11	48	—
6.	Rock phosphate	—	20-40	—
7.	Basic slag	—	14-18	—
8.	Calcium Ammonium Nitrate (CAN)	25	—	—
9.	MOP (KCl) Murate of potash	—	—	60
10.	Sulphate of potash (Potassium sulphate), K ₂ SO ₄	—	—	50

(B) Organic Fertilizers

1.	FYM	0.75	0.20	0.50
2.	Rural compost	0.75	0.20	0.50
3.	Urban compost	1.75	1.0	1.5
4.	Vermi compost	3	1.0	1.5
5.	Groundnut cakes	7.3	1.5	1.3
6.	Urea (Organic fertilizer)	46	—	—

* Organic manure are low in plant food. They supply all ingredients of plant food.

* Inorganic manures are rich in plant food. They supply one or two elements of plant food only.

* Best time of application of fertilizers is : February-March

Bio-Fertilizers

1. Saprophytes– Aspergillus, Penicillium, Trichoderma
2. Legume inoculant– Rizobium
3. In association with plants– Azospirillum
4. Free living organism– Azatobactor
5. Blue Green Algae– Anabaena, Nostoc (Heterocyst)
6. Free Water Fern– Azolla
7. Phosphorus solubilizers– Pseudomonas, Aspergillus Bacillus, Penicillium
8. Ectotrophic mycorrhizae– Basidiomycetes
9. Endotrophic mycorrhizae– Glomus, Gigaspore

DORMANCY

Unability of viable seed to germinate.

1. Hard seed coat dormancy— Ber, Guava, Walnut
2. Dormancy due to presence of ABA— temperate fruits

Methods to break dormancy

(A) **Scarification** : Process of breaking or softening the seed covering to make it permeable to water and gases.

- (i) Mechanically : Ber, Walnut, Peach
- (ii) By Hot water : Guava, Strawberry
- (iii) By Acid : KNO_3

(B) **Stratification** : Seeds are subjected to low temperature (Chilling temp) to break dormancy— Apple, Pear, Peach, Apricot

- ❖ Seeds of tropical and subtropical fruits are sown during monsoon.
- ❖ In Walnut, Pecanut, Jackfruit, Ber-sowing of seeds in insitu is recommended.
- ❖ *Orthodox seeds* : Seeds remain viable for long time at low temperature.
- ❖ *Recalcitrant seed* : Seeds don't remain viable for long time at low temperature. So they should be sown immediately after extraction.

Example : 1. Mango 2. Citrus 3. Litchi 4. Loquat 5. Mangosteen 6. Avocado 7. Jack fruit 8. Rambutan
9. Barbados Cherry

(C) **Chemical treatment** : Seeds are treated with 0-2% KNO_3 (Potassium nitrate)

(D) **Use of hormones** : 1. 100-500 ppm GA_3 2. Etheral (500 ppm) 3. BA (10-20 ppm)

(E) **Cryopreservation** : Storage in liquid N_2 at -96°C temperature or liquid CO_2 at 43°C temperature.

(F) **Cryoprotactants** : 1. Glycerol 2. DMSO (Dimethyl-sulphoxide)

PROPAGATION

Most of the fruit crops are propagated by vegetative means

Methods

1. **Runners** : Strawberry (typical example)
2. **Offsets** : Date palm
3. **Suckers** : Banana
4. **Layering** : *Ideal time* : February-March and June-July
Rooting hormone : IBA, IAA
 1. *Tip layering* : Black berries
 2. *Serpentine layering* : Muscadine Grape
 3. *Trench* : Walnut
 4. *Air layering* (Gottee, Marcotting) Litchi
5. **Cutting** :
 - (A) *Hard wood cutting* : Time November-February, length of cutting-10 to 45 cm, at least contain 2 buds.
 Grape, Fig, Pomegranate
 - (B) *Semi hardwood cutting* : Mostly used in evergreen fruit plants.
 Time : June-July
 ❖ Bottom heat technique is used for rooting of semi hardwood cuttings.
 - (C) *Root cutting* : Black berries, Rasp berries
6. **Grafting** :
 - (A) **Attached method/Approach Grafting** :
 - (i) Inarching/Embracing/Adjuvant grafting-Mango
 - (ii) Tongue grafting : Apple, Pear, Walnut
 - (B) **Detached method** :
 - (i) Whip or Splice
 - (ii) Side
 - (iii) Notch
 - (iv) Veneer : March-September-ideal time : Mango
 Most ideal for establishing insitu orchard and top working of old unproductive orchard.
 - (v) Cleft or wedge
 - (vi) Saddle
 - (vii) Bark
 - (viii) Bridge

7. Budding :

- i) T-budding or shield budding-Roses, Citrus fruits and Aonla
- ii) Patch budding-
- iii) Chip budding-
- iv) Ring budding-
- v) Flute budding
- vi) I-budding
- vii) Forket budding (Modification of patch budding) Rubber

8. Micro propagation:

- i) Callus culture
 - ii) Cell culture
 - iii) Meristem culture
 - iv) Organ culture
 - v) Protoplast culture
- ❖ Virus free plants are obtained through meristem culture.
 - ❖ Tissue culture technique has been preferred in Banana.
 - ❖ Shoot tip culture technique produce female plant in Banana.
 - ❖ *Micro Grafting* : Citrus
 - ❖ Shoot tips and Micro-cuttings are highly suitable ex-plant for faster and disease free grape production.
 - ❖ India's rank : 8th in seed trade in the world.
 - ❖ Seed quality is considered best if pure seed % is above 98%,
Moisture content : 6-8% Germination % : 60-70%.
 - ❖ Horticulture sector contribute 24.5% to GDP from 8.5% area under horticulture.
 - ❖ 1987 : Full fledged division of horticulture was created at ICAR head quarter.
 - ❖ Arid zone fruits : 1. Ber 2. Aonla 3. Pomegranate 4. Annona 5. Fig 6. Phalsa

PROPAGATION STRUCTURES

i) Green houses-type of greenhouse

- | | |
|----------------------------|--------------------------|
| a) Tunnel type | b) Ground to ground type |
| c) Even span or Gable type | d) Quonset type |
| e) Ridge and furrow type | |

ii) Plastic green houses

- | | |
|-------------------|----------------|
| a) Polythene film | b) PVC film |
| c) Polyester film | d) Fibre glass |

iii) Hot beds

iv) Lath houses

v) Mist beds

vi) Mist chamber

vii) Nursery bed

viii) Fluorescent light boxes.

SYSTEMS OF PLANTING

1. *Square system* : Simplest and ubiquitous system of planting.
2. *Triangular* : It is mostly used in HDP (High density planting).
3. *Hexagonal* : Equilateral triangle system accommodate 15% more plants than square system.
4. *Quincunx* : Diagonal system. Most suitable in highly fertile soil.

Accomodate : 1.5 times more plants than square system adopted only when tree spacing exceeds 8m or fruit crop which are very slow growing in habit.

5. *Terrace (contour)* : Suitable for hills and undulated lands.

Bench terrace : Popular in hills.

♣ Every IIIrd tree in every IIIrd row should be a pollinizer in self incompatible varieties

TRAINING AND PRUNING

Pruning : It is done to make tree more productive and bear quality fruits.

Types : (A) *Heading Back* : Terminal part of shoot is removed.

(B) *Thinning out* : Entire branch is cut from base.

❖ *Pruning time in North India is* : April-May

❖ *Citrus* : Fruit bud differentiation is just little before flowering

❖ Citrus is rarely pruned except lemon.

❖ **Training** : It is done to maintain proper canopy of the tree.

Type: (A) *Centre leader system*

(B) *Open centre system*

(C) *Modified leader system* : Most widely adopted method for fruit crops.

TYPES OF NURSERIES

* Nursery is place where young crop plants are raised under intensive care for later transplanting to the field.

* Nursery may be classified as follows :

A) On the basis of irrigation facilities-

i) Dry nursery

ii) Wet nursery - a) Temporary nursery -Flying nursery b) Permanent nursery

B) On the basis of size of production

(i) Commercial nursery (ii) Small scale nursery

C) On the basis of kind of plant material raised

i) Fruit nursery

ii) Vegetable nursery

iii) Flowering plant nursery

iv) Forest nursery

* **Irrigation methods in nursery**

i) Flow or flood irrigation,

ii) Furrow irrigation,

iii) Overhead irrigation- (a) Rose cans, (b) Automizer, c) Sprinkler system

* The water for nursery should have pH between 5.5 to 7.5 and contain salt less than 400 ppm.

* Amount of water required for raising one lakh plants in dry areas during summer is 20-30 cc/plant/day and during winter is 10 c.c./plant/day.

MISCELLANEOUS

- ❖ Defoliation causes maleness.
- ❖ Defloration causes Femaleness.
- ❖ Female flowers contain more amino acid CAA than male flowers.
- ❖ ICAR recognised : 8 agro climatic zones for effective land use Planning
- ❖ Planning commission recognised : 15 agro climatic zones for effective land use planning.
- ❖ NBBS and LUP, Nagpur recognized : 21 agro ecological regions.
- ❖ Growing period of Arid zone : 90 days. Growing period of Semi arid zone : 90-150 days.
- ❖ Growing period of Sub arid zone : 150-210 days.
- ❖ Growing period of humid zone : 210-270 days.
- ❖ Growing period of pre humid zone : 270 days.
- ❖ Growth of Banana is influenced by temperature. It grows well at temperature of 26.5 °C.
- ❖ In subtropical region flowering reaches its peak in March.
- ❖ Mango matures first in South India, followed by Central and North West India.
- ❖ Broad leaved fruit trees suffer if temperature goes below 5 °C.
- ❖ High temperature is favourable for Melons.
- ❖ High temperature-Bolting and seed formation (Spinach and Lettuce).
- ❖ Optimum temperature needed for most fruits and vegetables : 22-27 °C
- ❖ Maximum Temperature limit for most fruits and vegetables : 40-52 °C
- ❖ High humidity : 1. Apple scab 2. Brown rot of peaches 3. Black rot and downy mildew of Grapes 4. Reduces photosynthetic activities.
- ❖ pH of saline soil : 7-8.5
- ❖ pH of alkaline soil : 8.6-10
- ❖ Brinjal variety suitable for Bharta making : BH-2
- ❖ Cereal with maximum minerals and energy : Jowar
- ❖ Spores of Lycopodium are commercially known as : Vegetable sulphur as they are used to cure stomach disorders.
- ❖ Fruit which does not exhibit flowers : Jack fruit
- ❖ Fastening of vine of Grapes to a upright support of a tree (Panagra) is known as : Single stake system
- ❖ Amingola Behuta, Summer Behuta is variety of Mango
- ❖ Root cuttings are used in propagation of Wild Pear
- ❖ Spontaneous mutation is used mostly for Ornamentals
- ❖ A separate ministry of food processing was established in year 1999.
- ❖ Mashobra is a apple research station.
- ❖ The word pomology is derived from Greek word.
Pome- type of fruit development from inferior ovary.
Logy- study.
- ❖ Yellow coloured fruits are rich source of vitamin A.
- ❖ Almond is rich source of minerals, Ca, P, Nicotinic acid.

- ❖ Tomato trap crop Merigold (16 : 1).
- ❖ TIBA is exogenously applied in Watermelon. It is applied at 2-4 leaf stage.
- ❖ CCC is used in hardening treatment of Tomato seedlings.
- ❖ Cross pollination by honeybees is one of the most effective and cheapest method of enhancing crop yield.
- ❖ Honey bee spp. used for cross pollination. *Apis cerana*
- ❖ Citrus : World leading tree fruit crop.
- ❖ Orange and Mandarins – TSS : Acid ratio = 8 : 1
- ❖ Grape fruit – TSS : Acid ratio = 6 : 1
- ❖ In orchard, area under roads and buildings should not exceed 10% of the total orchard area.
- ❖ Onion, Okra, Asparagus, Summer Squash supply : Iodine
- ❖ Blue berries contain highest antioxidants, improve memory and concentration.
- ❖ India rank – 7th in world in use of micro-irrigation system.
- ❖ In the world scenario-almost 54% of drip irrigation is applied to the orchard of citrus.
- ❖ Bleeding of grapes due to excess moisture during rest period of summer.
- ❖ June drop – Endoxerosis
- ❖ 30-40% of total cost of a fruit grower goes in packaging and transportation.
- ❖ Most popular method of breeding in India is Pedigree method.

ISOLATION DISTANCE KEPT IN SEED PRODUCTION

Sr. N.	Crop	Isolation distance (M)	
		Foundation seed	Certified seed
1.	Tomato	50	25
2.	Brinjal	200	100
3.	Chilli	400	200
4.	Sweet pepper	400	200
5.	Okra	400	200
6.	Pea	20	40
7.	Other beans	50	25
8.	Cole crops	1600	1000
9.	Raddish	1600	1000
10.	Turnip	1600	1000
11.	Carrot	1000	800
12.	Potato	5	5
13.	Onion	1600	1000
14.	Beet	1600	1000
15.	Cucurbits	800	400
16.	Chrysanthemum	400	—
17.	Marigold	400	—

SOILS IN INDIA

1. *Red soil (Alfisols)* – Rich in Fe and Mn.

Universally poor in N and K due to excessive leaching, high phosphorus fixation capacity due to presence of Kaolinite clay.

2. *Laterite soil (Ultisols)* – Same as red soil.

3. *Acidic soil (Oxisols)* – Rich in Al, Mn, Sesquioxides. Fixation of P is major problem.

4. *Black soil (Vertisols)* – Presence of Montmorillonite clay, cracking problem. Rich in Mn, Ca. Best suitable for dry land agriculture, deficiency of Zn.

5. *Alluvial soil (Entisols)* – Rich in fertility, found predominantly in India in newly formed soil.

6. In low PH soil (Acidic soil) leaf Bronzing leading to decline, is commonly observed due to Al toxicity.

7. Rock phosphate should be applied as a source of P and Ca in Acidic soil.

8. Chloride containing fertilizers are toxic to grapes and mangoes.

9. Sulphate of Potash (K_2SO_4) is used instead of Murate of potash (KCl) in Mango and Grapes.

PROBLEMATIC SOILS

1. **Acid soil :** 30% of cultivated soil of India are acidic in nature.

Deficiency of Ca, Mg, K

Toxicity of Al, Mn

Control measures – lime application.

2. **Alkali soil :** ESP > 15%, EC < 4 ds/m pH: 8.6–10

Deficiency of Fe, Zn, P, Mn

Toxicity of Na, B

Control measures : Application of Gypsum, Calcium, Chloride, Phosphogypsum

3. **Saline soil :** ESP < 15%, pH: 7–8.5, EC > 4 ds/m

Deficiency of Ca, K

Toxicity of Na, Cl

Control measures : Application of Gypsum

4. **Saline-Alkaline soil :** ESP > 15%, EC > 4, pH–8.5

PART-IV

MULTIPLE CHOICE QUESTIONA

&

MATCH THE PAIRS

PART - I

(A)

1. Which variety of grape is commercially cultivated in North India

(a) Thompson seedless	(b) Anab-a-Shahi
(c) Perlette	(d) Black Champa
2. State having highest productivity in Guava

(a) UP	(b) Maharashtra
(c) AP	(d) Gujarat
3. % area covered by plantation crop to the total cropped area in India

(a) 1.2%	(b) 1.4%
(c) 1.6%	(d) 1.8%
4. Leading country in coffee production is

(a) Brazil	(b) China
(c) South Africa	(d) India
5. Type of inflorescence in Grape

(a) Solitary	(b) Spadix
(c) Panicle	(d) Catkins
6. Self sterile variety of Pear is

(a) China Pear	(b) Patharnakh
(c) Leconte	(d) Magness
7. Type of self incompatibility in loquat

(a) Sporophytic	(b) Gametophytic
(c) Both	(d) None
8. Protogyny is found in which fruit crop

(a) Sapota	(b) Passion fruit
(c) Walnut	(d) Plum
9. Which fruit is hexaploid (Auto) in nature

(a) European Plum	(b) Phalsa
(c) Kiwi Fruit	(d) Litchi
10. Origin of custard Apple is

(a) South-east Asia	(b) Tropical America
(c) China	(d) India
11. Highly shade tolerant fruit crop is

(a) Kiwi fruit	(b) Rambutan
(c) Carambola	(d) Durian

12. Which system of planting is used in High density planting in Amrapali

(a) Diagonal	(b) Quincunx
(c) Hexagonal	(d) Triangular
13. Type of Apomixis present in citrus

(a) Non recurrent	(b) Recurrent
(c) Parthenocarpy	(d) All of the above
14. Commercial method of propagation of Bael is

(a) Grafting	(b) Budding
(c) Cutting	(d) Seed
15. Dwarf cultivar of peach is

(a) Flordarsum	(b) Early Grande
(c) Redhaven	(d) J.H. Hale
16. Nugget is the dwarf cultivar of

(a) Apple	(b) Pear
(c) Peach	(d) Plum
17. Mulching is the most important cultural practice in cultivation of

(a) Apple	(b) Pear
(c) Peach	(d) Strawberry
18. Training method followed in Peach

(a) Central leader	(b) Open centre
(c) Modified central leader	(d) Multiple System
19. In Phalsa, training is done in which month

(a) September	(b) October
(c) November	(d) December
20. Which fruit crop is resistant to Mn deficiency

(a) Walnut	(b) Peach
(c) Pecanut	(d) Strawberry
21. Which growth regulator is used to reduce period of chilling requirement

(a) NAA	(b) IBA
(c) Cytokinin	(d) GA3
22. Which chemical serves as an alternative to caprification in Fig

(a) SADH	(b) CPA
(c) BOA	(d) CCC
23. Witches broom is the major disorder of which crop

(a) Coffee	(b) Cocoa
(c) Tea	(d) Betelvine
24. Sunset is the variety of

(a) Apple	(b) Papaya
(c) Pineapple	(d) Pear

25. **Mango hybridization work was started in year**
 (a) 1901 (b) 1911
 (c) 1921 (d) 1931
26. **Genetic classification of Banana was given by**
 (a) Burn and prayag (b) Simmond and Shepherd
 (c) De candole (d) Vavilob
27. **Mudkhed seedless is the variety of**
 (a) Sweet orange (b) Mandarin
 (c) Grape fruit (d) Lemon
28. **Grape variety suitable for double cropping in South India**
 (a) Arka vati (b) Arka Hans
 (c) Arka kanchan (d) Arka shyam
29. **Dwarf variety of Guava is**
 (a) Sardar (b) Arka Mridula
 (c) Allahabad safeda (d) Arka shyam
30. **Boshop is the variety of**
 (a) Mango (b) Apple
 (c) Coconut (d) Citrus
31. **Which variety of Pear has highest TSS**
 (a) Punjab Gold (b) Punjab Nectar
 (c) Redblush (d) Jorgonella
32. **Double century is the variety of**
 (a) Cocount (b) Arecanut
 (c) Coffee (d) Cocoa
33. **Vengurla-6 is a cross between**
 (a) Vengurla-1 × Vetore-56 (b) Ansur early × Mysore Kotekar
 (c) Midnapore Red × Vetore-56 (d) Vetore-56 × Vengurla-1
34. **Triploid cultivar of Tea is**
 (a) Sundaram (b) Jayaram
 (c) Athrey (d) Golconda
35. **Indigenous cultivar of Arecanut is**
 (a) Mangla (b) Sumangla
 (c) Sreemangla (d) Mohitnagar
36. **Coffee leaf rust is introduced from**
 (a) Japan (b) Srilanka
 (c) France (d) Thiland
37. **Single seeded berry is**
 (a) Coconut (b) Arecanut
 (c) Cashew (d) Coffee

38. Rubber research institute of India is situated at
 (a) Balanagar (b) Kottayam
 (c) Calicut (d) Kassargod
39. Triploid growth curve is found in
 (a) Kiwi fruit (b) Pecanut
 (c) Tea (d) Coffee
40. Chandlar is the variety of
 (a) Strawberry (b) Plum
 (c) Peach (d) Apple
41. Fruit cracking in Pear is due to defeciency of
 (a) Ca (b) Mg
 (c) Boron (d) N₂
42. Largest producer of Almond in the world is
 (a) USA (b) Japan
 (c) China (d) Afganistan
43. National yield of Rubber is
 (a) 2.6 t/hac (b) 2.0 t/hac
 (c) 1.6 t/hac (d) 1.0 t/hac
44. Vertical continuous stem of cocoa is called as
 (a) Fan (b) Jorquette
 (c) Chupan (d) All the above
45. Dried ripe nuts of Arecanut is called as
 (a) Chali (b) Kottapak
 (c) Both (d) None of above
46. Coffee variety suitable for higher elevation
 (a) Arabica (b) Robusta
 (c) Both (d) None of above
47. Harvesting time of cashew nut is
 (a) January-March (b) February-May
 (c) February-April (d) March-June
48. Which state gives highest productivity of coconuts
 (a) Kerala (b) Tamil Nadu
 (c) Maharashtra (d) Karnataka
49. Which plantation crop is heliotropic in nature
 (a) Coffee (b) Cocoa
 (c) Coconut (d) Arecanut
50. Which is climacteric fruit
 (a) Pomegranate (b) Litchi
 (c) Jamun (d) Fig

MATCH THE PAIRS

A**B**

- | | |
|-------------------|-----------------------|
| 51. Coffee | (a) Long day plant |
| 52. Banana | (b) Climacteric |
| 53. Passion fruit | (c) Nonclimacteric |
| 54. Peach | (d) Day neutral plant |
| 55. Cashew | (e) Short day plant |

A**B**

- | | |
|---------------|------------------------|
| 56. Pineapple | (a) Isopentanol |
| 57. Banana | (b) Octaploid Variety |
| 58. Apple | (c) Tetraploid Variety |
| 59. Gola | (d) Mallic acid |
| 60. Umran | (e) Citric acid |

A**B (Storage Temp)**

- | | |
|------------------|-------------|
| 61. Guava | (a) 8-9°C |
| 62. Litchi | (b) 7-8°C |
| 63. Banana | (c) 9-10°C |
| 64. Mango | (d) 11-13°C |
| 65. Sweet Orange | (e) 0-2°C |

(B)

1. **Aonla is**
 (a) Deciduous (b) Evergreen
 (c) Semideciduous (d) None
2. **Origin of Apple is**
 (a) N. America (b) S. America
 (c) S.E. Asia (d) S.W. Asia
3. **Ultra dwarf roots stock of Apple is**
 (a) M-9 (b) M-27
 (c) MM-106 (d) MM-111
4. **Type of fruit in Avocado**
 (a) Nut (b) Berry
 (c) Drupe (d) None of these
5. **Spacing followed in Almond is**
 (a) $5.4 \times 7.5 \text{ m}^2$ (b) $2.5 \times 3 \text{ m}^2$
 (c) $8 \times 8 \text{ m}^2$ (d) $9 \times 9 \text{ m}^2$
6. **Mirzapuri, Kagzi Etawah, Kagzi gonda, Kagzi Banarasi are varieties of**
 (a) Ber (b) Bael
 (c) Fig (d) Loquat
7. **In India Banana contributes to what % of fruit production**
 (a) 31.72% (b) 32.3%
 (c) 40% (d) 50%
8. **Banana variety showing highest production in India**
 (a) Nendran (b) Poovan
 (c) Dwarf cavendish (d) Grand Naine
9. **Genomic constitution of FHIA-1 (gold Finger) is**
 (a) AAAA (b) AAAB
 (c) ABBB (d) AAA
10. **Fruit having feet in running water and head in the fire of sky is**
 (a) Fig (b) Water chesnut
 (c) Datepalm (d) Walnut
11. **First fruit crop known to mankind**
 (a) Apple (b) Mango
 (c) Datepalm (d) Karonda
12. **Fig is**
 (a) dioecious (b) monoceious
 (c) gynodiaecious (d) Andromoneicous
13. **Coloured seeded variety of grape is**
 (a) Muscat (b) Thompson seedless
 (c) Anabeshahi (d) Perlette

14. **Variety of grape with pink flesh and pink skin colour**
 (a) Allahabad Safeda (b) Harijha
 (c) Allahabad Surkha (d) Arka Mridula
-
15. **Polyembryony is seen in**
 (a) Ber (b) Jamun and citrus
 (c) Grape and guava (d) All
-
16. **Kiwi fruit is a**
 (a) Evergreen vine (b) Evergreen shrub
 (c) Deciduous tree (d) Deciduous vine
-
17. **Most commonly followed propagation method in kiwi fruit**
 (a) Seeds (b) layering
 (c) Cuttings (d) Stooling
-
18. **Rangpur lime and Acid lime is propagated by**
 (a) seeds (b) layering
 (c) hard wood cutting (d) Grafting
-
19. **Harvesting of litchi is done in**
 (a) August-September (b) May-June
 (c) January-February (d) November-December
-
20. **Thames pride is a variety of**
 (a) Litchi (b) Loquat
 (c) Bread fruit (d) Walnut
-
21. **Australian nut or Queens land nut is**
 (a) Walnut (b) Pecanut
 (c) Macadamia nut (d) Hazel nut
-
22. **Fruit type in Mahua (Bassia latifolia)**
 (a) Pome (b) Berry
 (c) Drupe (d) Syconus
-
23. **Most important commercial mandarin of South India**
 (a) Khasi (b) Nagpur
 (c) Kinnow (d) Coorg
-
24. **Kakea, I kaika, Keass, Purvis, Makai are variety of**
 (a) B. latifolia (b) Macadamia nut
 (c) Mandarin (d) None of these
-
25. **Granulation in mandarin can be controlled by**
 (a) Spraying of lime (b) Reduction in irrigation
 (c) Zn Application (d) Copper application
-
26. **State leading in production of mango**
 (a) U.P. (b) M.P.
 (c) A.P. (d) Maharashtra
-
27. **Kinnow was introduced in India in the year**
 (a) 1958 (b) 1957
 (c) 1959 (d) 1956

28. **Early maturing mango variety of South India**
 (a) Neelum (b) Dashehari
 (c) Alphonso (d) Banganpalli
29. **Average yield of mango is**
 (a) 5 t/ha (b) 6 t/ha
 (c) 7 t/ha (d) 8 t/ha
30. **Reason for clustering or Jhumka in Mango**
 (a) Water imbalance (b) Low temperature
 (c) High temperature (d) None of these
31. **Finest fruit of the world**
 (a) Apple (b) mango
 (c) Mangosteen (d) None of these
32. **Frontoio, coralina, Pendolina, Canino, Picholine are varieties of**
 (a) Apple (b) Cherry
 (c) Kiwifruit (d) Olive
33. **Gyno dioecious varieties of Papaya are**
 (a) Thaiwan (b) Sunrise solo
 (c) Both (d) None of the above
34. **Origin of Passion fruit**
 (a) China (b) Japan
 (c) Brazil (d) Mexico
35. **Annona atemoya bears fruit in**
 (a) January-February (b) February-March
 (c) December-January (d) September-October
36. **Largest Annona fruit in terms of weight and size is**
 (a) A. Squamosa (b) A. reticulata
 (c) A. glabra (d) A. muricata
37. **Productivity of Aonla is**
 (a) 9-10 t/hac (b) 15-20 t/hac
 (c) 18-20 t/hac (d) 20-25 t/hac
38. **For better root development of Apple temperature required is**
 (a) 1.8°C (b) 15-20°C
 (c) 3°C (d) 7°C
39. **Modified leader system of training in Apple is practiced in**
 (a) North India (b) South India
 (c) East India (d) West India
40. **Rootstock used in Apricot propagation**
 (a) Zardalu (b) Crab
 (c) Chuli (d) All of above
41. **Training system followed in cherry is**
 (a) Open centre (b) Central leader system
 (c) Modified leader system (d) None

42. Chromosome number of Bael is
 (a) 18 (b) 36
 (c) 26 (d) 24
-
43. Datepalm variety which can be eaten as raw
 (a) Barhee (b) Halawy
 (c) Khalas (d) All of these
-
44. Water requirement of Grape is very high during
 (a) Flower formation (b) Vegetative growth
 (c) Pollination (d) Berry growth
-
45. Muttam Varika is the variety of
 (a) Guava (b) Jamun
 (c) Kiwifruit (d) Jackfruit
-
46. Chromosome no. and origin of Jamun are
 (a) 30, Indoburma (b) 40, Indo-malaya
 (c) 36, China (d) 42, Japan
-
47. Yellow heart is the variety of
 (a) Loquat (b) Litchi
 (c) Bread fruit (d) Almond
-
48. Best quality Apples are produced in
 (a) Kullu vally (b) Kumon hills
 (c) Both (d) None
-
49. Which fruit is the rich source of calcium
 (a) Apple (b) Cashew
 (c) Guava (d) Pineapple
-
50. Daily requirement of fruit per capita per day is
 (a) 100 g (b) 150 g
 (c) 120 g (d) 200 g

MATCH THE PAIRS

- | <i>A</i> | <i>B</i> |
|--------------------------------------|--|
| 51. Kaveri | (a) Peach |
| 52. Japanese Medlar | (b) Novel's Special |
| 53. Paja. (<i>Prunus cerasids</i>) | (c) High chilling requirement-1500 hrs |
| 54. Flordasun, Dawn rose | (d) High water requirement than other nuts |
| 55. Passion fruit | (e) Plum |
| 56. Bartlett | (f) Sweet cherry |
| 57. Pecanut | (g) National fruit of Japan |
| 58. Persimmon | (h) Peach |
| 59. Perishable fruit | (i) Loquat |
| 60. Satlej purple | (j) Purple yellow |

(C)

1. **Polyembryony in coconut was reported into**
 (a) Arasikere Tall (b) Lacadive
 (c) Gang-abondam (d) TXD
2. **Some consider _____ as queen of fruit**
 (a) Mango (b) Tamarind
 (c) Mango steen (d) Papaya
3. **Papaya cultivar suitable for high density planting**
 (a) Pusa giant (b) CO₄
 (c) Pusa nanha (d) Pusa giant
4. **Betel nut spaced at distance of**
 (a) 2.7 × 2.7 m (b) 3.5 × 3.5 m
 (c) 1.25 × 1.25 m (d) 7 × 7 m
5. **Iylon is processed product of which crop consumed in Tamil Nadu**
 (a) Peach (b) Papaya
 (c) Areca nut (d) Mango
6. **Average yield of cashew is around**
 (a) 8-10 kg/tree (b) 10-15 kg/tree
 (c) 40 ton/hac (d) 75 ton/hac
7. **Most popular method of cashew propagation is by**
 (a) Soft wood grafting (b) T-budding
 (c) Hard wood cutting (d) Seed
8. **Highest production of cocoa is in state of**
 (a) Karnataka (b) Tamil nadu
 (c) Kerala (d) A.P.
9. **'Escalna' is vanety of**
 (a) Almond (b) Olive
 (c) Peach (d) Pineapple
10. **Aonla is**
 (a) Evergreen (b) Deciduous
 (c) None (d) Both A and B
11. **Forestero is variety of**
 (a) Coffee (b) Rubber
 (c) Tea (d) Cocoa
12. **Cherelle is a name of young fruit of**
 (a) Cherry (b) Ber
 (c) Cocoa (d) Mango steen
13. **'Gudanjali dwarf' is variety of**
 (a) Banana (b) Arecanut
 (c) Coconut (d) None

14. Chinese date is common name of
 (a) Phalsa (b) Litchi
 (c) Aonla (d) Ber.
-
15. Native of coffee is
 (a) Indonesia (b) China
 (c) Ethiopia (d) Australia
-
16. Oil palm is mainly propagated by
 (a) Grafting (b) Off shoots
 (c) Seeds (d) Suckers
-
17. Palmyrah is a crop of region
 (a) Temperate (b) Humid
 (c) Tropical (d) Sub-tropical
 (e) Dry
-
18. Highest tea producing state of India is
 (a) Kerala (b) Kanataka
 (c) Assam (d) Meghalaya
-
19. ICMR recommends use of how much fruits/day/head
 (a) 120 g (b) 280 g
 (c) 370 g (d) 300 g
-
20. Edible part of pear is
 (a) Seed (b) Mesocarp
 (c) Endosperm (d) Thalamus
-
21. Among following which is not a monocot
 (a) Guava (b) Banana
 (c) Pineapple (d) None
-
22. Among following which is low chilling variety of peach
 (a) Shane-punjab (b) Florda-red
 (c) Flordasun (d) All
-
23. Which is famous root promotor
 (a) IAA (b) IBA
 (c) NAA (d) All
-
24. Which is modification of whip grafting
 (a) Veneer (b) Tongue
 (c) Bridge (d) All
-
25. A fruit called Indian goose berry is
 (a) Ber (b) Aonla
 (c) Guava (d) Date
-
26. 'Butter Fruit' is nick name of
 (a) Avocado (b) Apricot
 (c) Cashew (d) Guava
-
27. Bael is type of fruit in climatic requirement
 (a) Evergreen shrub (b) Evergreen tree
 (c) Deciduous tree (d) Deciduous shrub

28. Indian jujube is propagated by
 (a) Veneer grafting (b) T-budding
 (c) Seed (d) None
29. Paja commonly used roots stock for
 (a) Cherry (b) Apricot
 (c) Almond (d) Peach
30. 1 kg ripe date palm equals to
 (a) 3090 calories (b) 3150 calories
 (c) 3240 calories (d) 3740 calories
31. Among following which is non climatic
 (a) Apple (b) Fig
 (c) Banana (d) Pineapple
32. Which Fig is able to produce pollen
 (a) San pedro (b) Smyrna
 (c) Capri (d) Dauldabad
33. Girdling is most common in
 (a) Litchi (b) Mango
 (c) Grape (d) Citrus
34. Tea is commonly propagated by
 (a) Soft wood cutting (b) Layering
 (c) T-budding (d) Seed
35. Sundaram is a very high yielding clone of
 (a) Coffee (b) Tea
 (c) Rubber (d) Coconut
36. Coffee fruit is called as
 (a) Drupe (b) Pea berry
 (c) Nut (d) Pome
37. Chromosome no. of cocoa is
 (a) 20 (b) 18
 (c) 36 (d) 22
38. Native of cashew is
 (a) Brazil (b) Afganistan
 (c) U.K. (d) India
39. Among following which is dioecious
 (a) Date palm (b) Palmyrah
 (c) Both (d) None
40. Carambola is native of
 (a) Indonesia (b) India
 (c) Afganistan (d) None

41. Major importer of cashew from India is
 (a) Russia (b) USA
 (c) UK (d) UAE
42. Inflorescence type of cashew is
 (a) Pistillate (b) Poly gamomonoecious
 (c) Andromonoecious (d) None
43. Banganpalli, a variety of mango is also known as _____ in South India
 (a) Baneshan (b) Safeda
 (c) Bahaduran (d) Banglora
44. 'Chintamani-1' is the variety of
 (a) Cashew (b) Coconut
 (c) Mango (d) Aonla
45. Who is known as 'Father of Pomology'
 (a) M.S. Swaminathan (b) Williams
 (c) De candole (d) B.P. Pal

MATCH THE PAIRS

- | <i>A</i> | <i>B</i> |
|-----------------------------|----------------------------------|
| 46. Native of tea | (a) Ethiopia |
| 47. Native of coffee | (b) Tropical America |
| 48. Dwarf variety of coffee | (c) Sanroman |
| 49. Oil palm origin | (d) China |
| 50. Home of rubber | (e) Coastal area of South Africa |

HQ OF IMPORTANT INSTITUTES

- | <i>A</i> | <i>B</i> |
|-------------------|------------------------|
| 51. NRC, Grape | (a) Eluru (A.P.) |
| 52. NRC, Oil palm | (b) Puttur (Karnataka) |
| 53. NRC, Banana | (c) Pune (Maharashtra) |
| 54. NRC, Cashew | (d) Trichy (Tamilnadu) |

PARENTS OF CLONE

- | <i>A</i> | <i>B</i> |
|---------------|----------------------|
| 55. CO1 | (a) Ganesh |
| 56. CO6 | (b) Gross michel |
| 57. G-137 | (c) Bassein seedless |
| 58. Krishna | (d) Ranchi |
| 59. Jyothi | (e) Banarasi |
| 60. High gate | (f) Pusa majesty |

GENERAL

- | A | B |
|--------------------|-----------------------|
| 61. Pond apple | (a) Ganoderma lucidem |
| 62. Pusa delicious | (b) H.B. Frost |
| 63. Kinnow | (c) Annona glabra |
| 64. Anab-e-roga | (d) Gynodioecious |
| 65. Paradox | (e) Walnut |

(D)

1. Highest producer of grape in the world

- (a) China (b) USA
(c) Italy (d) India

2. Pistachionut (*pistacia vera*) belongs to family

- (a) Myrtaceae (b) Anacardiaceae
(c) Rosaceae (d) Rhamnaceae

3. Velliacolamban a dwarfing rootstock is

- (a) Diploid (b) Tetraploid
(c) Hexaploid (d) Octaploid

4. Granulation is serious problem in

- (a) Citrus (b) Mango
(c) Grape (d) Strawberry

5. Jhoomka in mango is caused due to

- (a) Improper pollination and fertilization (b) High temperature
(c) Water scarcity (d) None of the above

6. Most widely used variety for preparation of Anar Dana a processed product of pomegranate

- (a) Daru (b) Basein seedless
(c) Dholka (d) Ganesh

7. Most North Indian cultivars of Mango are

- (a) Alternate bearer (b) Polyembryonic
(c) Both (d) None of above

8. Seedlessness in Banana due to

- (a) Stenospermocarpy (b) Vegetative parthenocarpy
(c) Stimulative parthenocarpy (d) None of above

9. Citrumelo, hybrid used as ultra resistant root stock is derived from

- (a) Trifoliolate orange × Grape fruit (b) Trifoliolate orange × sweet orange
(c) Trifoliolate orange × mandarin (d) Trifoliolate orange × Pummelo

10. Kanchan a chance seedling of Aonla derived from

- (a) Foster (b) Krishna
(c) Banarasi (d) Chakaiya

11. Largest Guava producing state in India

- (a) M.P. (b) U.P.
(c) Maharashtra (d) Karnataka

12. Dwarfing rootstock used in high density planting of ber

- (a) *Z. jujuba* (b) *Z. nummularia*
(c) *Z. lotus* (d) *Z. rotundifolia*

13. Tahiti lime is

- (a) Sterile triploid (b) Fertile triploid
(c) Fertile tetraploid (d) Sterile tetraploid

14. **Family of Litchi is**
 (a) Myrtaceae (b) Rosaceae
 (c) Sapindaceae (d) Apocynaceae
15. **Indicator plant for triestiza disease is**
 (a) *C. paradisi* (b) *C. aurantifolia*
 (c) *C. limonia* (d) *C. sinensis*
16. **Fruit type of litchi**
 (a) Berry (b) Single seeded nut
 (c) Etaerio of achens (d) None
17. **Type of inflorescence in pomegranate**
 (a) Catkin (b) Panicle
 (c) Hypanthodium (d) Balusta
18. **Major problem is breeding of pineapple is**
 (a) Self sterility (b) Self incompatibility
 (c) Heterostyly (d) All of above
19. **Loquat is propogated by**
 (a) Seed (b) Patch-budding
 (c) Sucker (d) T-budding
20. **Kaveri is an improved hybrid of**
 (a) Avocado (b) Passion fruit
 (c) Tea (d) Coconut
21. **Gamboge a disorder of fruit is common in**
 (a) Mango (b) Mangosteen
 (c) Grape (d) Apricot
22. **San jose scale got entry in to India from**
 (a) England (b) France
 (c) Srilanka (d) USA
23. **Cultivated strawberry is**
 (a) Diploid (b) Triploid
 (c) Tetraploid (d) Octaploid
24. **Male sterile cultivar of peach**
 (a) Florda red (b) Sharbati
 (c) J.H. Hale (d) Paja
25. **Botanically kiwi fruit is**
 (a) Drupe (b) Pome
 (c) Berry (d) Nut
26. **Popular clone used as male in coffee breeding**
 (a) Cauvery (b) Singara
 (c) Taferikela (d) Athrey

27. Mohitnagar is improved cultivar of
 (a) Coconut (b) Arecanut
 (c) Date palm (d) Perisimmon
28. Calyptra observed in
 (a) Grape (b) Coffee
 (c) Annona (d) None
29. Sib mating is popularly done in
 (a) Papaya (b) Mango
 (c) Citrus (d) Coconut
30. Swarn roopa is an important cultivar of
 (a) Litchi (b) Pear
 (c) Persimmon (d) Citrus
31. Botanically type of filbert fruit is
 (a) Nut (b) Pome
 (c) Berry (d) Balusta
32. Colt and charger are related with
 (a) Cherry (b) Citrus
 (c) Pear (d) Peach
33. Type of incompatibility in Mango
 (a) Sporophytic (b) Gametophytic
 (c) None (d) Both (a) and (b)
34. Family of carambola is
 (a) Rutaceae (b) Oxalidaceae
 (c) Rosaceae (d) Moraceae
35. Notching is commonly practiced in
 (a) Fig (b) Grape
 (c) Mango (d) Date palm
36. Variety of grape occupies 55% area is
 (a) Basein seedless (b) Thompson seedle
 (c) Ana-b-shahi (d) Dilkhush
37. Sugar loaf is variety of
 (a) Sweet orange (b) Grape
 (c) Papaya (d) Pineapple
38. Exanthema in citrus due to deficiency of
 (a) Cu (b) Mo
 (c) Ca (d) K
39. Native of Date palm
 (a) Iran (b) USA
 (c) Indonesia (d) Iraq
40. Edible portion of Grape is
 (a) Pericarp and placenta (b) Mesocarp
 (c) Endocarp (d) Bract

41. Hen and chicken disorder is found commonly in
 (a) Grape (b) Citrus
 (c) Mango (d) All of above
42. Rosica variety of mango developed through
 (a) Introduction (b) Selection
 (c) Hybridization (d) Mutation
43. Parents of Arkavati are
 (a) Black champa × Queen of vineyard (b) Black champa × Thompson seedless
 (c) Bangalore blue × Anab-e-shahi (d) Angoor kalan × Anab-e-shahi
44. Ambri is variety of
 (a) Apple (b) Pear
 (c) Olive (d) Grape
45. Baldwin is cultivar of apple which is
 (a) Diploid (b) Triploid
 (c) Tetraploid (d) Octaploid
46. Kinnow a hybrid is evolved by
 (a) H.P. Olmo (b) H.B. Frost
 (c) N.E. Lee. (d) G.S. Cheema
47. Which of following is non-climacteric fruit
 (a) Apple (b) Mango
 (c) Pineapple (d) Banana
48. Origin of oil palm is
 (a) USA (b) Indonesia
 (c) Iraq (d) West Africa
49. Jackfruit is commercially propogated by
 (a) T-budding (b) Seed
 (c) Stooling (d) Inarching
50. Alternate bearing habit is observed in
 (a) Mango (b) Date palm
 (c) Persimon (d) All
51. Chromosome no. of grape and mango respectively are
 (a) 40, 38 (b) 38, 42
 (c) 38, 40 (d) 86, 42
52. Banana variety resistant to panama wilt is
 (a) Basari (b) Nendran
 (c) High gate (d) Poovan
53. Result of cross of Ontario X Sultania is
 (a) Hur (b) Foster
 (c) Sloh (d) Himrod

54. Variety of Papaya producing only Female plants

(a) Pusa dwarf

(b) Pusa delicious

(c) Pusa giant

(d) Sunrise solo

55. Breba is parthenocarpically produced crop of

(a) Almond

(b) Grape

(c) Fig

(d) Mangosteen.

MATCH THE PAIRS

<i>A</i>	<i>B</i>
56. Polyembryonic Rootstock of Mango	(a) Furete
57. Temple root stock	(b) Kurrukan
58. Pomegranate	(c) Protogynous
59. Avocado	(d) Skiffing
60. Tamarind	(e) PKM-1
61. Tea	(f) Bassein seedless
62. Jyoti	(g) Hard wood cutting
63. Sapota	(h) Ca deficiency
64. Bitter pit	(i) Pierce Disease Resistance
65. Cocoa	(j) Forestro

(E)

1. **India's share in global production of fruits is**
 (a) 5% (b) 10%
 (c) 15% (d) 20%
2. **How much % area under fruit crops is covered by Apple**
 (a) 12% (b) 3%
 (c) 6.2% (d) 20%
3. **Which state has highest productivity under fruit crops**
 (a) Maharashtra (b) UP
 (c) Karnataka (d) Kerala
4. **India's share in world production of Banana is**
 (a) 21.3% (b) 31.3%
 (c) 41.3% (d) 51.3%
5. **Which fruit crop is the richest source of fat**
 (a) Walnut (b) Almoud
 (c) Apricot (d) Pecanut
6. **Sweetest variety of Mango is**
 (a) Langra (b) Deshehari
 (c) Chausa (d) Alphonso
7. **Pusa Arunima is the variety of**
 (a) Banana (b) Mandarin
 (c) Papaya (d) Mango
8. **Which variety of mango has characteristic terpentine flavour**
 (a) Chausa (b) Langra
 (c) Deshehari (d) Totapuri
9. **June flowering in citrus is known as**
 (a) Mrig Bahar (b) Ambe Bahar
 (c) Haste Bahar (d) None of the above
10. **Degreening of citrus fruits is done by**
 (a) Ethepon (b) Ethylene
 (c) Calcium carbide (d) Methyl Bromide
11. **Which citrus spp act as a indicator plant for tristiza virus**
 (a) Mandarin (b) Pummelo
 (c) Acid lime (d) Sweet lime
12. **Which variety of Banana is used for making baby food**
 (a) Nendran (b) Kunnan
 (c) Monthan (d) Hill Banana
13. **Which disease mostly occurs in high density planting of Banana**
 (a) Sigatoka leaf spot (b) Bunchy top
 (c) Panama wilt (d) Finger tip

14. **Diploid variety of Banana is**
 (a) Lal velchi (b) Safed velchi
 (c) Hill banana (d) Poovan
-
15. **Spotted variety of Guava is**
 (a) Chittidar (b) Allahabad safeda
 (c) Banarasi (d) L-49
-
16. **Bronzing in Guava is caused due to defeciency of**
 (a) Mn (b) Mo
 (c) Zn (d) P
-
17. **Grape was introduced in India in the year**
 (a) 1200 AD (b) 1300 AD
 (c) 1400 AD (d) 1500 AD
-
18. **Sharad seedless is the clonal selection from which variety of Grape**
 (a) Thompson seedless (b) Anab-a-Shai
 (c) Cheema Shahebi (d) Kishmish Chorni
-
19. **Which var of Grape is suitable for preparation of red wine**
 (a) Arkavati (b) Arka Neelmani
 (c) Arka Champa (d) Arka Hans
-
20. **Pierce's disease resistant rootstock of Grape is**
 (a) Salt creek (b) Dogridge
 (c) Temple (d) 1613
-
21. **Type of parthenocarpy found in Black corianth variety of Grape**
 (a) Sternospermocarpy (b) Vegetative
 (c) Stimulative (d) None of the above
-
22. **CAM cycle is found in which fruit crop**
 (a) Papaya (b) Sapota
 (c) Strawberry (d) Pineapple
-
23. **Pineapple wilt is transmitted by**
 (a) Lace wing bug (b) White fly
 (c) Mealy Bug (d) Aphids
-
24. **Gynodioecious variety of Papaya is**
 (a) Pusa Majesty (b) Pusa Nanha
 (c) Pusa dwarf (d) All the above
-
25. **Recommended spacing for pusa Nanha**
 (a) $1 \times 1 \text{ m}^2$ (b) $1.25 \times 1.25 \text{ m}^2$
 (c) $1.5 \times 1.5 \text{ m}^2$ (d) $2 \times 2 \text{ m}^2$
-
26. **Nutrient loving plant is**
 (a) Apple (b) Banana
 (c) Citrus (d) Papaya
-
27. **Which state is the leading producer of litchi**
 (a) UP (b) MP
 (c) Bihar (d) Uttarnchal

28. Which fruit crop is climacteric in nature
 (a) Sapota (b) Strawberry
 (c) Both (d) None of these
29. Mridula is the variety of
 (a) Guava (b) Pomegranate
 (c) Fig (d) Sapota
30. Most popular cultivar of Fig in India is
 (a) Dualatbad (b) Poona Fig
 (c) Kabul (d) Brown Turkey
31. Edible portion of Date Palm
 (a) Mesocarp (b) Pericarp
 (c) Endocarp (d) Aril
32. Date fruits for fresh eating are harvested at which stage
 (a) Doka (b) Pind
 (c) Gandora (d) Dang
33. Chinese date is common name of which fruit crop
 (a) Aonla (b) Ber
 (c) Phalsa (d) Litchi
34. Which crop has energy value twice as much as banana fruit
 (a) Apricot (b) Avocado
 (c) Apple (d) Almond
35. Marmelosin is present in which fruit crop
 (a) Bael (b) Jack fruit
 (c) Mangosteen (d) Karonda
36. Which fruit crop is the National symbol of Newzealand
 (a) Persimon (b) Rambutan
 (c) Kiwi fruit (d) Mangosteen
37. Family of Phalsa is
 (a) Rutaceae (b) Moraceae
 (c) Leguminoceae (d) Tiliaceae
38. Largest or leading Apple producing state
 (a) J and K (b) Himachal Pradesh
 (c) Uttranchal (d) Punjab
39. Most popular variety of Apple in India
 (a) Golden delicious (b) Red delicious
 (c) Ambri (d) Red Gold
40. Ultra dwarf root stock of mango is
 (a) M-9 (b) M-13
 (c) M-27 (d) MM-104
41. Apple scab is caused due to
 (a) Bacteria (b) Fungus
 (c) MLO (d) None of these
42. Leconte is low chilling variety of
 (a) Apple (b) Pear
 (c) Peach (d) Plum

43. Which country is leading producer of pear in the world
 (a) India (b) USA
 (c) China (d) Italy
-
44. Pear decline is caused due to
 (a) Bacteria (b) Fungus
 (c) MLO's (d) Other factors
-
45. Which temperate fruit has lowest chilling requirement
 (a) Pear (b) Peach
 (c) Plum (d) Apricot
-
46. Propagation method of cherry
 (a) Tongue grafting (b) T-budding
 (c) Hard wood cutting (d) Air layering
-
47. St. Ambrose is the variety of
 (a) Plum (b) Almond
 (c) Walnut (d) Apricot
-
48. How much % of edible portion exists in strawberry
 (a) 88% (b) 98%
 (c) 78% (d) 68%
-
49. Santa Rosa is the variety of
 (a) Peach (b) Plum
 (c) Pear (d) Apple
-
50. Sporophytic incompatibility is present in
 (a) Mango (b) Aonla
 (c) Both (d) None of these

MATCH THE PAIRS

CHROMOSOME NUMBER

- | <i>A</i> | <i>B</i> |
|-----------------|----------|
| 51. Mango | (a) 30 |
| 52. Sapota | (b) 48 |
| 53. Litchi | (c) 40 |
| 54. Ber | (d) 18 |
| 55. Pomegranate | (e) 26 |

FIND OUT CENTRE OF ORIGIN

- | | |
|---------------|---------------------|
| 56. Pineapple | (a) Hindustan |
| 57. Persimon | (b) China |
| 58. Papaya | (c) Brazil |
| 59. Ber | (d) China |
| 60. Peach | (e) Central America |

PHYSIOLOGICAL DISORDERS

- | | |
|---------------------------------------|--------|
| 61. Water core in Apple | (a) Ca |
| 62. Dieback in litchi | (b) K |
| 63. Leaf Bronzing in litchi | (c) B |
| 64. Calyx end rot of Grape | (d) Cu |
| 65. Improper finger Filling in Banana | (e) Zn |

(F)

1. **Chilgozanut is grown in**

(a) Hot desert	(b) Semi arid
(c) Cold sandy desert	(d) Temperate region
2. **In papaya, cool climate results into**

(a) Fruits attain small size	(b) Flower and fruits drop
(c) Reduction in T.S.S.	(d) Green colour appearance
3. **Elaidobius kamaranicus, a pollinating weevil, act as pollinator in**

(a) Date palm	(b) Rubber
(c) Oil Palm	(d) Chilgoza nut
4. **Coffee board was established in the year**

(a) 1974	(b) 1987
(c) 1942	(d) 1992
5. **Recurrent apomixis is found in**

(a) Pear	(b) Peach
(c) Plum	(d) Apple
6. **Cape gooseberry is propagated by**

(a) Cutting	(b) Layering
(c) Seeds	(d) Grafting
7. **Duodichogamy is observed in which crop**

(a) Pistachionut	(b) Walnut
(c) Chestnut	(d) Coconut
8. **In arid zones mango is grafted by**

(a) Soft wood grafting	(b) Epicotyl grafting
(c) Veneer Grafting	(d) None
9. **Drought resistant apple root stock are**
 (i) M-9 (ii) M-27 (iii) MM-111 (iv) MM-104

(a) All	(b) (i) and (ii)
(c) (iii) and (iv)	(d) (ii) and (iii)
10. **T.S.S. of most of mango varieties is**

(a) 15%	(b) 20%
(c) 10%	(d) 30%
11. **Flying dragon is a rootstock of**

(a) Cherry	(b) Bael
(c) Citrus	(d) Apple
12. **Amrapalli variety of mango is generally planted by**

(a) Hedge row system	(b) Square system
(c) Triangular system	(d) Hexagonal system
13. **Open centre system of training is followed in**

(a) Apple	(b) Pear
(c) Plum	(d) Peach

14. **Iron deficiency occurs in**
 - (a) Older leaves
 - (b) Younger leaves
 - (c) Nodes
 - (d) Buds
15. **Bitter principle present in citrus is**
 - (a) Lycopene
 - (b) Isocoumarin
 - (c) Eugenol
 - (d) Limonin
16. **Mango malformation was first observed in**
 - (a) 1992, UP
 - (b) 1891, Bihar
 - (c) 1992, MH
 - (d) 1880, MP
17. **Acidic nature of star fruit is due to**
 - (a) Oxalic acid
 - (b) Mallic acid
 - (c) Propanoic acid
 - (d) Linolic acid
18. **Cauliflory is observed in**
 - (a) Carambola
 - (b) Jackfruit
 - (c) Both
 - (d) None
19. **Which of the following can be used as substitute for tamarind**
 - (a) Aonla
 - (b) Cherry
 - (c) Avocado
 - (d) Carambola
20. **Which of the following is popularly known as 'Poor man's food'**
 - (a) Banana
 - (b) Guava
 - (c) Mango
 - (d) Jackfruit
21. **Early fruit drop in apple is caused because of**
 - (a) Lack of pollination
 - (b) Moisture stress
 - (c) Severe frost
 - (d) High temp with high humidity
22. **Forward pruning in Grape is done in month of**
 - (a) April
 - (b) October
 - (c) September
 - (d) November
23. **An element which is important to cure anaemia is found in**
 - (a) Karonda
 - (b) Date
 - (c) Apricot
 - (d) None
24. **Which of the following is self pollinated crop**
 - (a) Apricot
 - (b) Citrus
 - (c) Peach
 - (d) All
25. **Bahar treatment is followed in**
 - (a) Guava
 - (b) Pomegranate
 - (c) Citrus
 - (d) All
26. **Seedless strain of Acidlime is**
 - (a) Pramalini
 - (b) Vikram
 - (c) Chakadhar
 - (d) PKM-1
27. **Eriobotrya japonica is a**
 - (a) Tropical fruit
 - (b) Sub tropical fruit
 - (c) Arid fruit
 - (d) Temperate fruit

28. 'Early Bedana' is the variety of
 (a) Grape (b) Pomegranate
 (c) Litchi (d) Annona
29. The February flowering in citrus is known as
 (a) Ambe bahar (b) Mrig Bahar
 (c) Hasta bahar (d) None
30. Parents of the mango variety Arka Puneet are
 (a) Banganapalli × Alphonso (b) Neelum × Alphonso
 (c) Alphonso × Banganapalli (d) Neelum × Banganapalli
31. China pear is the variety of
 (a) Plum (b) Pear
 (c) Peach (d) Apple
32. *Cariyo illinoensis* is the Botanical name of
 (a) Persimon (b) Avocado
 (c) Pecanut (d) Phalsa
33. Starking delicious is the variety of
 (a) Pear (b) Apple
 (c) Plum (d) Peach
34. Basic chromosome no. of peach is
 (a) 9 (b) 7
 (c) 8 (d) 6
35. Red sitaphal a variety of *Annona* is evolved by
 (a) Mutation (b) Introduction
 (c) Hybridization (d) Chance seedling
36. Genomic constitution of gold finger variety of Banana is
 (a) AABB (b) AAAB
 (c) ABBB (d) AABA
37. Governer's wood is the variety of
 (a) Peach (b) Cherry
 (c) Pecanut (d) Plum
38. Short styled pistillate flower are found in
 (a) Edible fig (b) Smyrna fig
 (c) Wild fig (d) San padro fig
39. Grape is a
 (a) Deep feeder (b) Shallow feeder
 (c) Moderate feeder (d) Top feeder
40. Max. concentration of feeding roots in Guava is available upto depth of
 (a) 15 cm (b) 35 cm
 (c) 25 cm (d) 45 cm
41. The most common type of Jamun grown in North India is
 (a) Kath Jamun (b) Paras
 (c) Rajjamun (d) Gulabi
42. The temperate fruit require max. chilling in
 (a) Apple (b) Pear
 (c) Peach (d) Cherry

43. T-bar system of training is followed in
 (a) Cherry (b) Almond
 (c) Kiwi fruit (d) Pecanut
44. Which of the following has max. water requirement
 (a) Mandarin (b) Orange
 (c) Lime and lemon (d) Grape fruit
45. 'Combodiana' is the poly embryonic exotic variety of
 (a) Citrus (b) Jamun
 (c) Mango (d) Pineapple
46. Damsun plum is the variety of
 (a) Pear (b) Peach
 (c) Cherry (d) Plum
47. Type of incompatibility found in almond is
 (a) Sporophytic (b) Gametophytic
 (c) Both (d) None
48. Triploid growth curve is observed in
 (a) Cherry (b) Pecanut
 (c) Kiwi (d) Carambola
49. Vivipary is observed in
 (a) Cocoa (b) Jackfruit
 (c) Avocado (d) None
50. 'Prunacin' compound is present in which of the following
 (a) Quince (b) Apple
 (c) Plum (d) Pear

MATCH THE PAIRS

- | A | B |
|----------------|------------------|
| 1. Peach | (a) Bitter pit |
| 2. Almond | (b) J.H. Hale |
| 3. Plum | (c) Colt |
| 4. Apple | (d) Pearless |
| 5. Cherry | (e) President |
| 6. Coconut | (a) Vengurla-1 |
| 7. Arecanut | (b) Criollo |
| 8. Cashewnut | (c) S-795 |
| 9. Cocoa | (d) Mangla |
| 10. Coffee | (e) Kalpavriksha |
| 11. Betel vine | (a) M-4 |

- | | | |
|-----|-------------------------------|--------------------------|
| 12. | Oil palm | (b) Euphorbiaceae |
| 13. | Rubber | (c) Assam |
| 14. | Tea | (d) Tenora |
| 15. | Tapioca | (e) Maghi |
| 16. | Pomegranate | (a) Grape |
| 17. | Kallipatti | (b) Coconut |
| 18. | Nucellar Mosami | (c) Ganesh |
| 19. | TXD | (d) Sapota |
| 20. | Sharad seedless | (e) Sweet Orange |
| 21. | Pear | (a) Prunes |
| 22. | Plum | (b) Prunus armenica |
| 23. | Walnut | (c) Live fencing |
| 24. | Karonda | (d) Placentia |
| 25. | Apricot | (e) Quince-Gado |
| 26. | Rootstock of pear | (a) Boussock |
| 27. | Virus Free rootstock of Apple | (b) Stone fruit |
| 28. | Triploid variety of pear | (c) Queen of nut |
| 29. | Apricot | (d) Quince |
| 30. | Pecanut | (e) M-2A |
| 31. | Litchi | (a) Rosaceae |
| 32. | Passion fruit | (b) Sapindaceae |
| 33. | Phalsa | (c) Placentia |
| 34. | Apricot | (d) Grewia |
| 35. | Walnut | (e) Trellising |
| 36. | Dogridge | (a) Thompson seedless |
| 37. | Khirani | (b) Basarai |
| 38. | Rangpurlime | (c) Rootstock for sapota |
| 39. | Banana | (d) Rootstock for Grape |
| 40. | Grape | (e) Rootstock for citrus |
| 41. | Sai Sarbati | (a) Sapota |
| 42. | San Pedro | (b) Pineapple |
| 43. | Cricket ball | (c) Kagzilime |
| 44. | Shahi | (d) Fig |
| 45. | Mauritious | (e) Litchi |

- | | |
|--------------------------------------|----------------------------------|
| 46. Sapota | (a) Lycopene |
| 47. Mango | (b) Anthocyanin |
| 48. Tomato | (c) Carotene |
| 49. Ethylene | (d) Yellow streak below skin |
| 50. Strawberry | (e) Methionine |
| 51. IBA 500 PPM | (a) Sapota |
| 52. Rayan | (b) Improve berry shape and size |
| 53. Adriatic | (c) Rooting of air layers |
| 54. Sardar | (d) Fig |
| 55. GA3 | (e) Guava |
| 56. Creeper | (a) Rambutan |
| 57. Arka chitra | (b) Bael |
| 58. Janum picking | (c) Pineapple |
| 59. Anti Pallegra fruit | (d) Dwarf variety of mango |
| 60. Pride of tropical Southeast Asia | (e) Tea |
| 61. Corebreakdown | (a) Banana |
| 62. Gumming | (b) Mango |
| 63. Jelly seed | (c) Persimmon |
| 64. Neer Vazahi | (d) Peach |
| 65. Sun scald | (e) Apple |
| 66. Vineyard of India | (a) Nasik |
| 67. Zygodormany | (b) Litchi |
| 68. Insulin | (c) Pineapple |
| 69. Red rot | (d) Jamun |
| 70. Yellow disease | (e) Aonla |
| 71. Rancidity | (a) Acid lime |
| 72. Brown rot | (b) Pear |
| 73. Cross protection | (c) Apricot |
| 74. Dioecious | (d) Walnut |
| 75. Pink colour | (e) Mulberry |

RESPIRATION RATE

- | | |
|---------------|----------------|
| 76. Very low | (a) Strawberry |
| 77. Low | (b) Mango |
| 78. Moderate | (c) Snap Melon |
| 79. High | (d) Apple |
| 80. Very high | (e) Apricot |

ETHYLENE PRODUCTION

81.	Very low	(a) Passion fruit
82.	Low	(b) Apple
83.	Medium	(c) Pineapple
84.	High	(d) Mango
85.	Very high	(e) Citrus

ANSWERSHEET

MULTIPLE CHOICE QUESTIONS

(A)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (d) | 3. (d) | 4. (a) | 5. (c) | 6. (d) | 7. (b) | 8. (d) |
| 9. (c) | 10. (b) | 11. (c) | 12. (d) | 13. (a) | 14. (b) | 15. (c) | 16. (a) |
| 17. (d) | 18. (b) | 19. (d) | 20. (d) | 21. (d) | 22. (b) | 23. (b) | 24. (b) |
| 25. (b) | 26. (b) | 27. (b) | 28. (d) | 29. (b) | 30. (b) | 31. (a) | 32. (a) |
| 33. (d) | 34. (a) | 35. (d) | 36. (b) | 37. (b) | 38. (b) | 39. (a) | 40. (a) |
| 41. (c) | 42. (a) | 43. (c) | 44. (c) | 45. (c) | 46. (a) | 47. (b) | 48. (c) |
| 49. (c) | 50. (d) | | | | | | |

MATCH THE PAIRS

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 51. (e) | 52. (d) | 53. (a) | 54. (b) | 55. (c) | 56. (e) | 57. (a) | 58. (d) |
| 59. (c) | 60. (b) | 61. (c) | 62. (e) | 63. (d) | 64. (a) | 65. (b) | |

(B)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (d) | 3. (b) | 4. (b) | 5. (a) | 6. (b) | 7. (b) | 8. (d) |
| 9. (b) | 10. (c) | 11. (c) | 12. (c) | 13. (a) | 14. (c) | 15. (b) | 16. (a) |
| 17. (c) | 18. (a) | 19. (b) | 20. (b) | 21. (c) | 22. (b) | 23. (d) | 24. (b) |
| 25. (a) | 26. (c) | 27. (c) | 28. (d) | 29. (d) | 30. (b) | 31. (c) | 32. (d) |
| 33. (c) | 34. (c) | 35. (c) | 36. (c) | 37. (b) | 38. (d) | 39. (b) | 40. (d) |
| 41. (c) | 42. (b) | 43. (d) | 44. (d) | 45. (d) | 46. (b) | 47. (c) | 48. (c) |
| 49. (e) | 50. (c) | | | | | | |

MATCH THE PAIRS

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 51. (j) | 52. (i) | 53. (f) | 54. (e) | 55. (a) | 56. (b) | 57. (d) | 58. (g) |
| 59. (k) | 60. (h) | | | | | | |

(C)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (c) | 3. (c) | 4. (c) | 5. (c) | 6. (a) | 7. (a) | 8. (c) |
| 9. (b) | 10. (b) | 11. (d) | 12. (c) | 13. (c) | 14. (d) | 15. (c) | 16. (c) |
| 17. (c) | 18. (c) | 19. (a) | 20. (d) | 21. (a) | 22. (d) | 23. (a) | 24. (b) |
| 25. (b) | 26. (a) | 27. (b) | 28. (b) | 29. (a) | 30. (b) | 31. (d) | 32. (c) |
| 33. (c) | 34. (a) | 35. (b) | 36. (b) | 37. (a) | 38. (a) | 39. (c) | 40. (a) |
| 41. (b) | 42. (b) | 43. (a) | 44. (a) | 45. (c) | | | |

MATCH THE PAIRS

46. (d)	47. (a)	48. (c)	49. (e)	50. (b)	51. (c)	52. (a)	53. (d)
54. (b)	55. (d)	56. (f)	57. (a)	58. (e)	59. (c)	60. (b)	61. (c)
62. (d)	63. (b)	64. (a)	65. (e)				

(D)

1. (c)	2. (b)	3. (d)	4. (a)	5. (a)	6. (a)	7. (a)	8. (b)
9. (d)	10. (d)	11. (b)	12. (b)	13. (a)	14. (c)	15. (b)	16. (b)
17. (c)	18. (b)	19. (a)	20. (b)	21. (b)	22. (b)	23. (d)	24. (c)
25. (c)	26. (c)	27. (b)	28. (a)	29. (a)	30. (a)	31. (a)	32. (a)
33. (a)	34. (b)	35. (a)	36. (b)	37. (d)	38. (a)	39. (d)	40. (a)
41. (a)	42. (d)	43. (b)	44. (a)	45. (b)	46. (b)	47. (c)	48. (b)
49. (b)	50. (d)	51. (c)	52. (d)	53. (d)	54. (d)	55. (c)	

MATCH THE PAIRS

56. (b)	57. (i)	58. (c)	59. (a)	60. (e)	61. (d)	62. (f)	63. (g)
64. (h)	65. (i)						

(E)

1. (b)	2. (c)	3. (c)	4. (b)	5. (a)	6. (c)	7. (d)	8. (b)
9. (a)	10. (c)	11. (c)	12. (b)	13. (d)	14. (b)	15. (a)	16. (c)
17. (b)	18. (d)	19. (b)	20. (c)	21. (c)	22. (d)	23. (c)	24. (a)
25. (b)	26. (c)	27. (c)	28. (a)	29. (b)	30. (b)	31. (b)	32. (d)
33. (b)	34. (b)	35. (a)	36. (c)	37. (d)	38. (a)	39. (b)	40. (c)
41. (b)	42. (b)	43. (d)	44. (c)	45. (b)	46. (a)	47. (d)	48. (b)
49. (b)	50. (c)						

MATCH THE PAIRS

51. (c)	52. (e)	53. (a)	54. (b)	55. (d)	56. (c)	57. (d)	58. (e)
59. (a)	60. (b)	61. (c)	62. (d)	63. (e)	64. (a)	65. (b)	

(F)

1. (c)	2. (c)	3. (c)	4. (c)	5. (d)	6. (c)	7. (c)	8. (a)
9. (d)	10. (b)	11. (c)	12. (c)	13. (c)	14. (c)	15. (d)	16. (b)
17. (a)	18. (c)	19. (d)	20. (d)	21. (a)	22. (b)	23. (d)	24. (d)
25. (d)	26. (c)	27. (b)	28. (c)	29. (a)	30. (c)	31. (b)	32. (c)
33. (a)	34. (c)	35. (d)	36. (b)	37. (b)	38. (c)	39. (b)	40. (c)
41. (c)	42. (d)	43. (c)	44. (a)	45. (c)	46. (d)	47. (b)	48. (c)
49. (b)	50. (c)						

MATCH THE PAIRS

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (d) | 3. (e) | 4. (a) | 5. (c) | 6. (e) | 7. (d) | 8. (a) |
| 9. (c) | 10. (b) | 11. (e) | 12. (d) | 13. (b) | 14. (c) | 15. (a) | 16. (c) |
| 17. (d) | 18. (e) | 19. (b) | 20. (a) | 21. (a) | 22. (e) | 23. (d) | 24. (c) |
| 25. (b) | 26. (d) | 27. (e) | 28. (a) | 29. (b) | 30. (c) | 31. (b) | 32. (e) |
| 33. (d) | 34. (a) | 35. (c) | 36. (d) | 37. (c) | 38. (e) | 39. (b) | 40. (a) |
| 41. (c) | 42. (d) | 43. (a) | 44. (e) | 45. (b) | 46. (d) | 47. (c) | 48. (a) |
| 49. (e) | 50. (b) | 51. (c) | 52. (a) | 53. (d) | 54. (e) | 55. (b) | 56. (d) |
| 57. (e) | 58. (e) | 59. (b) | 60. (a) | 61. (d) | 62. (c) | 63. (b) | 64. (a) |
| 65. (e) | 66. (a) | 67. (e) | 68. (d) | 69. (b) | 70. (c) | 71. (d) | 72. (c) |
| 73. (a) | 74. (e) | 75. (b) | 76. (e) | 77. (d) | 78. (b) | 79. (a) | 80. (c) |
| 81. (e) | 82. (c) | 83. (d) | 84. (b) | 85. (a) | | | |

MULTIPLE CHOICE QUESTIONS AND MATCH THE PAIRS

PART - II

(A)

1. **Tendrometer is used to measure maturity of which vegetable crop**
 (a) French Bean (b) Cowpea
 (c) Dolichos Bean (d) Garden Pea
2. **Pusa Parvati is the mutant variety of**
 (a) Cowpea (b) French Bean
 (c) Cluster Bean (d) Garden Pea
3. **Vigna unguiculata is the BN of**
 (a) Cluster Bean (b) French Bean
 (c) Cowpea (d) Garden pea
4. **Butter Bean is the common name of**
 (a) Dolichos Bean (b) Lima Bean
 (c) Broad Bean (d) Winged Bean
5. **Which vegetable require more amount of N₂ as compared to others**
 (a) Potato (b) Tomato
 (c) Brinjal (d) Palak
6. **Mulching is recommended in cultivation of which vegetable crop**
 (a) Lettuce (b) Potato
 (c) Chilli (d) Tomato
7. **Family of sweet potato is**
 (a) Euphorbiaceae (b) Convolvulaceae
 (c) Cucurbitaceae (d) Leguminosae
8. **On the basis of photoperiod requirement sweet potato is classified as**
 (a) Short day plant (b) Day neutral plant
 (c) Long day plant (d) None of above
9. **Sago is the important food product which is derived from**
 (a) Sweet potato (b) Cassava
 (c) Yams (d) All of above
10. **B.N. of lesser yam is**
 (a) Dioscorea alata (b) Dioscorea esculanta
 (c) Dioscorea rotundata (d) Dioscorea floribunda
11. **Sree keerthi is the variety of**
 (a) Greater yam (b) Lesser yam
 (c) White yam (d) Medicinal yam

12. Which vegetable crop is commercial source of levulose
 (a) Queensland Arrowroot (b) Jerusalem Artichoke
 (c) West Indian Arrowroot (d) Colocasia
13. Horse Raddish tree is the common name of which vegetable crop
 (a) Bread fruit (b) Drumstick
 (c) Asparagus (d) Rhubarb
14. Edible part of Asparagus is
 (a) Root (b) Tender shoots
 (c) Fruit (d) Flower
15. Fruit of which vegetable crop contain single seed
 (a) Chekurmanis (b) Ceylon spinach
 (c) Chow-chow (d) Rhubarb
16. Which vegetable crop is commonly called as — “Multivitamin Greens”
 (a) Chekurmanis (b) Chow-chow
 (c) Asparagus (d) Rhubarb
17. Botanical name of Indian spinach is
 (a) Basella spp (b) Spinacea oleracea
 (c) Beta vulgaris var-bangalensis (d) All of the above
18. Which vegetable crop belong to monocotyledoneae family
 (a) Asparagus (b) White yam
 (c) Garlic (d) All of the above
19. Which vegetable crop is dioecious in nature
 (a) Spine gourd (b) Pointed gourd
 (c) Ivy gourd (d) All the above
20. Edible part of Agathi is
 (a) Leaves (b) Flowers
 (c) Pods (d) Shoots
21. Green leafy vegetables are rich source of
 (a) Citric acid (b) Malic acid
 (c) Folic acid (d) All the above
22. Aroma containing compound present in onion is
 (a) Diallyldisulphide (b) Allyl propyl disulphide
 (c) Dimethyl disulphide (d) Isothiocyanate
23. Which of vegetable crop is non-climacteric in nature
 (a) Musk melon (b) Water melon
 (c) Tomato (d) Cucumber
24. ICMR recommendation for consumption of veg/capita/day is around
 (a) 200 g (b) 300 g
 (c) 250 g (d) 400 g

25. **Bioflavonoids (Quercetin) present in which vegetable crop**
 (a) Onion (b) Garlic
 (c) Both (d) None of above
-
26. **In India vegetable crop occupies how much % area to total cultivated area**
 (a) 1.8% (b) 2.8%
 (c) 3.8% (d) 4.8%
-
27. **India's contribution in world production of vegetables**
 (a) 3.38% (b) 13.38%
 (c) 23.38% (d) 33.38%
-
28. **Which of the vegetable crop is C₄ plant**
 (a) Carrot (b) Potato
 (c) Bean (d) Amaranthus
-
29. **Which vegetable crop contribute maximum to earn foreign exchange from export of fresh vegetables**
 (a) Potato (b) Tomato
 (c) Onion (d) Garlic
-
30. **Storage temperature of Brinjal is**
 (a) 5-6°C (b) 7-8°C
 (c) 10-11°C (d) 13-14°C
-
31. **Which of the vegetable is often cross pollinated**
 (a) Cowpea (b) Winged Bean
 (c) Broad Bean (d) Lima Bean
-
32. **Origin of Potato is**
 (a) North America (b) South America
 (c) China (d) India
-
33. **Wart disease of Potato is caused due to**
 (a) Fungus (b) Bacteria
 (c) Virus (d) Mycoplasma
-
34. **Tomato leaf curl is transmitted by**
 (a) Thrips (b) Aphids
 (c) White fly (d) All the above
-
35. **Little leaf in Brinjal is caused due to**
 (a) Fungus (b) Bacteria
 (c) Virus (d) Mycoplasma
-
36. **Aulacophora foveicollis is the S.N. of which pest**
 (a) Tuber moth (b) Mustard saw fly
 (c) Stem fly (d) Red pumpkin beetle
-
37. **Leucinodis or banalis is the major pest of**
 (a) Tomato (b) Brinjal
 (c) Potato (d) Chilli

38. **Hollow heart in Potato is due to**
 (a) Moisture deficiency (b) Excessive N₂
 (c) Poor ventilation (d) Low temperature
39. **Pusa Mukta is the variety of**
 (a) Cabbage (b) Cauliflower
 (c) Knol-khol (d) None
40. **India's rank in cauliflower production in the world**
 (a) I (b) II
 (c) III (d) IV
41. **Wolf Apple is the C.N. of**
 (a) Potato (b) Tomato
 (c) Chilli (d) Brinjal
42. **In which state potato is generally not grown**
 (a) Andhra Pradesh (b) UP
 (c) Kerala (d) Tamil Nadu
43. **Central Potato research institute is situated at**
 (a) Lucknow (b) Shimla
 (c) Dehradun (d) Nanital
44. **In which vegetable crop, max. no of hybrids varieties are cultivated**
 (a) Tomato (b) Brinjal
 (c) Cabbage (d) Cauliflower
45. **In which type of flower maximum no. of fruit setting takes place in Brinjal**
 (a) Long styled (b) Medium styled
 (c) Short styled (d) All the above
46. **Water melon is harvested at the time of**
 (a) When metallic sound appear while tapping (b) When dull sound appear while tapping
 (c) Both (d) None
47. **TSS of the Ripe musk melon fruits lies between**
 (a) 11-17% (b) 17-20%
 (c) 10-12% (d) 20-25%
48. **Average yield of turnip varies between**
 (a) 10-20 t/ha (b) 20-30 t/ha
 (c) 30-40 t/hac (d) 40-50 t/hac
49. **Krishna is the hybrid variety of**
 (a) Tomato (b) Brinjal
 (c) Chilli (d) Potato
50. **Khara Palak, Katui palak is the variety of**
 (a) Palak (b) Spinach
 (c) Lettuce (d) Parsley

MATCH THE PAIRS

<i>A</i>	<i>B</i>
51. Turnip	(a) 18
52. Pumpkin	(b) 20
53. Cabbage	(c) 48
54. Chilli	(d) 40
55. Potato	(e) 24

<i>A</i>	<i>B</i>
56. Pant Rituraj	(a) Tomato
57. Pusa Rituraj	(b) Water melon
58. Hissar Garlic	(c) Cowpea
59. Pusa Red Plum	(d) Brinjal
60. Pusa Bedana	(e) Carrot

<i>A</i>	<i>B</i>
61. Potato	(a) Brazil
62. Tapioca	(b) Africa
63. Spinach	(c) India
64. Muskmelon	(d) South America
65. Water melon	(e) Afganistan

(B)

1. **Pusa Deepti is F₁ hybrid of which vegetable**
 (a) Capsicum (b) Tomato
 (c) Brinjal (d) None
2. **Brinjal is a plant**
 (a) Day-neutral (b) Short day
 (c) Long day (d) Mid day
3. **Root-knot nematode resistant variety of tomato**
 (a) Sel-120 (b) Pusa uphar
 (c) Pusa sheetal (d) Pusa ruby
4. **Raigira leaves are richest source of**
 (a) Vitamin 'A' (b) Vitamin 'B'
 (c) Minerals (d) Iron
5. **In brinjal cross pollination occurs due to**
 (a) Heterostyly (b) Dioecy
 (c) Self incompatibility (d) None
6. **Aphid resistant cultivar of brinjal**
 (a) Annamalai (b) Pusa Purple long
 (c) Vaishali (d) Arka shrish
7. **Self incompatibility found in**
 (a) Cabbage (b) Knol-khol
 (c) Cauli flower (d) All
 (e) A and B
8. **Resistant variety for black rot of cabbage is**
 (a) Pusa sambandh (b) Pusa Mukta
 (c) Pusk ageti (d) None
9. **'Palam samridhi' is a known variety of**
 (a) Knol-khol (b) Sprouting broccoli
 (c) brusels sprout (d) None
10. **Excellent variety of carrot for canning is**
 (a) Pusa keser (b) Pusa lal
 (c) Pusa maghali (d) Chantaney
11. **Chromosome no. of carrot**
 (a) 24 (b) 22
 (c) 18 (d) 16
12. **'Pragati' is a cross beta brinjal variety**
 (a) Arka kusumakar × manjiri gola (b) Vaishali × Manjiri Gola
 (c) PPC × manjiri gola (d) Manjirigola × Arka kusumakar
13. **Shallot is propagated by**
 (a) Seed (b) Bulb
 (c) Stem cutting (d) Rhizome

14. Among following which is sexually sterile diploid
 (a) Garlic (b) Onion
 (c) Leek (d) Beet
15. _____ is a single seeded cucurbitaceous vegetable
 (a) Chayote (b) Kakrol
 (c) Kartoli (d) Ivy gourd
16. Arka Abhay is variety of
 (a) Brinjal (b) Chilli
 (c) Tomato (d) Bhindi
17. F₁ hybrid of cucumber recommended by IARI is
 (a) Pusa sanyog (b) Poinsette
 (c) Straight Eight (d) None
18. Arka suryamukhi is improved variety of
 (a) Summer squash (b) Winter squash
 (c) Pumpkin (d) Musk melon
19. AVRDC is situated at
 (a) Tokyo (b) Taiwan
 (c) Tasmania (d) Turkmenistan
20. Black leg disease of cabbage is caused by
 (a) Bacterium (b) Virus
 (c) Fungus (d) Mycoplasma
21. Carrot is _____ pollinated
 (a) Self (b) Cross
 (c) Often-cross (d) All
22. Celery belong to family
 (a) Compositae (b) Umbelliferae
 (c) Cruciferae (d) None
23. Challenger is a variety of
 (a) Indian bean (b) Lima bean
 (c) Cluster bean (d) Hyacinth bean
24. Delayed harvesting in radish may cause
 (a) Forking (b) Pithiness
 (c) Deformed root (d) All
25. Earthing up of potato is done at
 (a) 20 DAS (b) 40 DAS
 (c) 50 DAS (d) None
26. Globe artichoke is propagated by
 (a) Suckers (b) Root cutting
 (c) Seeds (d) None
27. Golden nematode is a serious pest of
 (a) Tomato (b) Potato
 (c) Brinjal (d) Cabbage
28. Hermaphrodite cultivar of ridge gourd is
 (a) Pusa nasdar (b) Satputia
 (c) CO 1 (d) Jhingalrai

29. Potato seed rate (TPS) ha is
 (a) 1 g (b) 5 g
 (c) 10 g (d) 15 g
30. Kakrol is _____
 (a) Monoecious (b) Dioecious
 (c) Andromonoecious (d) Gynodioecios
31. Ivy gourd is propagated by
 (a) Seed (b) Root cutting
 (c) Tuberous root (d) Stem cutting
32. Globe artichoke is cultivated for its
 (a) Succulent leaves (b) Flower buds
 (c) Tuber (d) None
33. Lettuce is a _____ pollinated crop
 (a) Self (b) Often-cross
 (c) Cross (d) None
34. Leek is grown for its
 (a) Bulb (b) Tuber
 (c) Clove (d) Branched stem and leaves
35. Pusa chetki is variety of
 (a) Radish (b) Beet root
 (c) Sweet potato (d) None
36. Pusa chikni is variety of
 (a) Spong gourd (b) Ridge gourd
 (c) Bottle gourd (d) Bitter gourd
37. Pusa Rasraj is variety of
 (a) Pureline variety of muskmelon (b) Hybrid of muskmelon
 (c) Hybrid of watermelon (d) Seedless variety watermelon
38. Rhubarb is grown for its
 (a) Thick leaf stalks (b) Tuber
 (c) Tender stem (d) None
39. Rat-tail Radish excessively grown for its
 (a) Long thin pod (b) Tender root
 (c) Succulent leaf (d) None
40. Squash melon origin is
 (a) China (b) Malaysia
 (c) India (d) None
41. Sweet potato contain _____ % starch
 (a) 10 (b) 12
 (c) 14 (d) 16

42. The part of celery used as salad
 (a) Fruit (b) Flower
 (c) Shoot (d) Petioles
43. Largest area of chillies is in
 (a) Maharashtra (b) Tamil Nadu
 (c) Andhra Pradesh (d) Andaman
44. In tomato 'Bo' deficiency leads to
 (a) Puffiness (b) Cracking
 (c) Blossom end rot (d) Silvering
45. Origin of watermelon is
 (a) India (b) Iran
 (c) Africa (d) None
46. Turnip belong to family
 (a) Umbelliferae (b) Chenopodiaceae
 (c) Cruciferae (d) Convolvulaceae
47. Triploid watermelon variety is
 (a) New Hampshire midget (b) Pusa bedana
 (c) Charleston green (d) All
48. Photo insensitive variety of cowpea is
 (a) Arka Garima (b) Pusa phalguni
 (c) Pusa rituraj (d) None
49. TSS of Arka jeet is
 (a) 4-5% (b) 5-6%
 (c) 14-15% (d) 15-17%
50. Lincoln - a exotic variety of which crop
 (a) Cowpea (b) Pea
 (c) Dolichos bean (d) None
51. For control of whip-tail is done
 (a) Application of Bo in soil (b) Liming in soil
 (c) Gypsum addition (d) Late sowing
52. Nidhi a clonal selection of
 (a) Cassava (b) Arrow root
 (c) Beet (d) Spinach beet
53. 'Eddoe' and 'dahsheen' related with
 (a) colocasia (b) Suran
 (c) Coleus (d) Cassava
54. Which state occupies 1st position in India under sweet potato cultivation
 (a) Bihar (b) Orissa
 (c) Meghalaya (d) Assam
55. Largest vegetable growing state in India
 (a) West Bengal (b) Orissa
 (c) U.P. (d) Maharashtra

MATCH THE PAIRS

PROPAGATION

- | <i>A</i> | <i>B</i> |
|---------------------|------------------|
| 56. Chow-chow | (a) Vine cutting |
| 57. Arrowroot | (b) Sucker |
| 58. Globe artichoke | (c) Rhizome |
| 59. Tannia | (d) Corm |
| 60. Asparagus | (e) Crown |
| | (f) Whole fruit |

PHYSIOLOGICAL DISORDER

- | | |
|-------------------------------|-----------------------------------|
| 61. Pencil strip of celery | (a) Effect of ethylene |
| 62. Buttoning in cauliflower | (b) Excess of 'P' |
| 63. Bitterness in carrot | (c) 'Ca' deficiency |
| 64. Blossom end rot of tomato | (d) Over sized tuber |
| 65. Hollow heart of potato | (e) Deficiency of N |
| 66. Cat face of tomato | (f) Deficiency of Ca |
| 67. Metsbure of Taro | (g) Distortion of blossom end rot |
| 68. Internal brown spot | (h) 'Bo' deficiency |
| 69. Splitting of carrot | (i) Insect damage |
| 70. Blindness in cauliflower | (j) Craigs deficiency |

CHROMOSOME NO.

- | | |
|------------------|------------------|
| 71. Okra | (a) 24 |
| 72. Muskmelon | (b) 72, 108, 144 |
| 73. Carrot | (c) 14 |
| 74. Onion | (d) 18 |
| 75. Garden pea | (e) 16 |
| 76. Turnip | (f) 36 |
| 77. Tapioca | (g) 20 |
| 78. Sweet potato | (h) 90 |

(C)

1. **Anti nutritional factor present in sweet potato is**
 - (a) Cynoglucoside
 - (b) Coumarin
 - (c) Tripsin inhibitors
 - (d) All
2. **Cassava tubers are harvested after _____ of planting**
 - (a) 3-4 months
 - (b) 9-12 months
 - (c) 2-3 months
 - (d) None
3. **Soft rot of potato is a**
 - (a) Bacterial disease
 - (b) Fungal disease
 - (c) Viral disease
 - (d) All
4. **The leading vegetable producing state in India is**
 - (a) UP
 - (b) Orissa
 - (c) West Bengal
 - (d) Bihar
5. **The vegetable crop that tops in the share of total vegetable production**
 - (a) Brinjal
 - (b) Tomato
 - (c) Potato
 - (d) Cauliflower
6. **The cloves required for planting Garlic/hac is**
 - (a) 100 kg
 - (b) 500 kg
 - (c) 250 kg
 - (d) 750 kg
7. **Pusa kirti is the variety of**
 - (a) Amaranthus
 - (b) Spinach
 - (c) Palak
 - (d) Fenugreek
8. **The edible part of globe artichoke is**
 - (a) Leaves
 - (b) Immature flower heads
 - (c) Roots
 - (d) Stems
9. **Amaranthus is a**
 - (a) C₃ plant
 - (b) C₄ plant
 - (c) CAM plant
 - (d) None
10. **Great lakes variety of lettuce belong to following type**
 - (a) Butterhead type
 - (b) Cos types
 - (c) Cuphead type
 - (d) None
11. **Phytic acid, a toxic substance is present in**
 - (a) Leafy vegetables
 - (b) Peas and beans
 - (c) Root vegetables
 - (d) Cucurbits
12. **Propagation of annual drumstick is usually done by**
 - (a) Limb cutting
 - (b) Root cutting
 - (c) Root suckers
 - (d) Seeds
13. **Sree sahya is the variety of**
 - (a) Greater yam
 - (b) Elephant phoot yam
 - (c) Lesser yam
 - (d) Tapioca

14. The propagation of curry leaves is usually done by
 (a) Suckers (b) Seed
 (c) Both (d) None
15. Coleus is commonly known as
 (a) Indian Potato (b) White Potato
 (c) Chinese Potato (d) Irish Potato
16. The following vegetable is known as multivitamin greens
 (a) Amaranthus (b) Spinach
 (c) Asparagus (d) Chekurmanis
17. The propagation of yams is done by
 (a) Tuber pieces (b) Seeds
 (c) Vine cuttings (d) Whole tuber
18. Sree shilpa is a first hybrid of
 (a) Greater yam (b) Elephant phoot yam
 (c) Lesser yam (d) White yam
19. The origin of sweet potato is
 (a) Asia (b) Mexico
 (c) South America (d) Africa
20. The chemical used to prevent sprouting during storage of onion is
 (a) NAA (b) GA₃
 (c) MH (d) Thiourea
21. Exposure of potato tuber to sunlight causes
 (a) Black heart (b) Hollow heart
 (c) Browning (d) Greening
22. The ETL (economic threshold level) of aphid population in case of potato is
 (a) 20/100 leaves (b) 3/100 leaves
 (c) 10/100 leaves (d) 40/100 leaves
23. The optimum size of potato tuber for planting is
 (a) 225 g (b) 30-40 g
 (c) 750 g (d) 100 g
24. Pusa sneha is the variety of
 (a) Ridge gourd (b) Sponge gourd
 (c) Bitter gourd (d) Snake gourd
25. Satputia has following sex form
 (a) Monoecious (b) Dioecious
 (c) Hermaphrodite (d) Gynoeious
26. The growth regulators in case of cucurbits is applied at
 (a) 2-4 leaf stage (b) 4-6 leaf stage
 (c) Flowering stage (d) Fruiting stage

27. TIBA, a chemical is exogenously applied in case of
 (a) Cucumber (b) Watermelon
 (c) Musk melon (d) Bitter Gourd
28. The recommended seedrate of bottle gourd/hac is
 (a) 2.5 - 3 kg (b) 3-6 kg
 (c) 8 kg (d) 10-12 kg
29. Aska suryamukhi is a cultivar of
 (a) C. maxima (b) C. pepo
 (c) C. Moschata (d) Cucumis melo
30. The ornamental type in case of cucurbit is
 (a) Summer squash (b) Winter squash
 (c) Pumpkin (d) Ash Gourd
31. The origin of water melon is
 (a) India (b) America
 (c) Tropical Africa (d) Central Asia
32. The chemical used to induce maleness in gynococious lines of cucumber is
 (a) Silver nitrate (b) NAA
 (c) IAA (d) ABA
33. The F₁ hybrid in case of musk melon is
 (a) Pusa madhurus (b) Pusa Rasraj
 (c) Arka Rajhans (d) Arka Jeet
34. Florida butter is a variety of
 (a) Broad bean (b) Lima bean
 (c) Indian bean (d) Winged bean
35. The vegetable in which all parts of plant are to be used as edible part
 (a) Lima bean (b) Winged bean
 (c) Raddish (d) Broad bean
36. The vegetable which is richest source of vitamin 'A' is
 (a) Turnip leaves (b) Carrot
 (c) Pumpkin yellow (d) Drumstick leaves
37. The vegetable which is the important source of iodine to human diet is
 (a) Tapioca (b) Tomato
 (c) Okra (d) Spinach
38. The fruit of okra botanically known as
 (a) Pod (b) Berry
 (c) Capsule (d) Siliqua
39. The inflorescence of onion is called as
 (a) Umbell (b) Spadix
 (c) Panicle (d) Raceme

40. The chilli hybrid CH-1 is bred by using the mechanism of
 (a) Self incompatibility (b) GMS
 (c) CGMS (d) Stigma
41. The mechanism of protogyny is observed in following vegetable type
 (a) Onion (b) Cabbage
 (c) Carrot (d) Raddish
42. The origin place of Dolichos/Indian Bean is
 (a) India (b) China
 (c) Mediteranean region (d) Mexico
43. The diploid chromosome no. of cluster bean is
 (a) $2n = 22$ (b) $2n = 24$
 (c) $2n = 14$ (d) $2n = 16$
44. Arka suman is the variety of
 (a) French Bean (b) Cowpea
 (c) Garden pea (d) Dolichos bean
45. Optimum temperature for seed germination in case of pea is
 (a) 5°C (b) 10°C
 (c) 20°C (d) 22°C
46. Arkel is an introduction from
 (a) Germany (b) UK
 (c) USA (d) Netherlands
47. In Garden Pea, the flower colour is
 (a) White (b) Purple
 (c) Yellow (d) Pink
48. IIVR is located at
 (a) New Delhi (b) Lucknow
 (c) Varanasi (d) Karnal
49. The per capita availability of vegetables in India is
 (a) 300 g (b) 288 g
 (c) 175 g (d) 225 g
50. The variety of resistant to phomopsis blight in brinjal is
 (a) Pusa Bhairav (b) Pusa ankur
 (c) Arka saurabh (d) Arka sheel

(D)

1. **White Brinjal is a good remedy for**
 (a) Diabetes (b) Cancer
 (c) Heart disease (d) Skin problem
2. **Blotchy ripening in case of tomato is due to deficiency of**
 (a) Nitrogen (b) Potassium
 (c) Phosphorus (d) Calcium
3. **Per capita consumption of potato in India/year is**
 (a) 15 kg (b) 20 kg
 (c) 30 kg (d) 50 kg
4. **The perennial variety in case of chilli is**
 (a) Pusa sadabahar (b) Pusa Jwala
 (c) Arkalohit (d) Arka Abir
5. **The crop in which anthesis takes place during evening hours is**
 (a) Bottle gourd (b) Bitter gourd
 (c) Musk melon (d) Water melon
6. **The variety resistant to pithiness in turnip is**
 (a) Pusa swati (b) Pusa swarnima
 (c) Pusa chandrima (d) Pusa kanchan
7. **'Multigerminant seed' is found in case of**
 (a) Carrot (b) Raddish
 (c) Turnip (d) Beetroot
8. **'Akashin' a disorder in raddish is due to deficiency of**
 (a) Mn (b) B
 (c) Ca (d) Mg
9. **The vegetable producing maximum amount of nutrient/unit area/unit time is**
 (a) Potato (b) Carrot
 (c) Tomato (d) Onion
10. **The optimum temperature requirement for snowball group for curd initiation and development in cauliflower is**
 (a) 20-27°C (b) 12-16°C
 (c) 20-25°C (d) 10-16°C
11. **The first tropical variety which can set seed in plains in cabbage is**
 (a) Pusa sambandh (b) Pusa Ageti
 (c) Pusa drum head (d) Golden acre
12. **Pusa Rohini is the variety of**
 (a) Chilli (b) Capsicum
 (c) Tomato (d) Cauliflower
13. **The variety most suitable for export of onion is**
 (a) Arka Bindu (b) Pusa Red
 (c) Arka Kalyan (d) N-53

14. The diploid chromosome no. of leek is
 (a) 16 (b) 32
 (c) 18 (d) 24
15. The source for YVMV resistance transfer in Arka anamika and arka abhay is
 (a) *A. tetraphyllum* (b) *A. esculanthus*
 (c) *A. manihot* (d) *A. manihot* sub spp manihot
16. Absence of axillary bud is the typical character of
 (a) Cabbage (b) Cauliflower
 (c) Sprouting broccoli (d) Brussel's sprout
17. 'Jadecross' is a F_1 hybrid of
 (a) Brussel's sprout (b) Sprouting Broccoli
 (c) Knol-khol (d) Cabbage
18. 'Chieftain' is a variety of
 (a) Capsicum (b) Brussel's sprout
 (c) Broccoli (d) Savoy cabbage
19. Maximum area and production of cauliflower is in
 (a) West Bengal (b) Bihar
 (c) UP (d) Tamil Nadu
20. 'King of North' is a variety of
 (a) Cabbage (b) Knol-khol
 (c) Cauliflower (d) Brussel's is sprout
21. Bitterness in carrot is due to
 (a) Isopentanol (b) Carotene
 (c) Isocoumarin (d) Sulphoraphane
22. Origin of cucumbr is
 (a) Africa (b) Mexico
 (c) India (d) Mediteranean region
23. Cucumber green mottle virus is transmitted through
 (a) Insect (b) Soil
 (c) Water (d) Air
24. 'Balsam Pear' is the common name of
 (a) Bottle gourd (b) Cucumber
 (c) Bitter gourd (d) Pointed gourd
25. B.N. of scarlet gourd is a
 (a) *Momordica charantia* (b) *Trichosanthus dioica*
 (c) *Coccinia indica* (d) None
26. Country leading in okra production is
 (a) Africa (b) China
 (c) India (d) Netherlands

27. **Amaranthus** is a
 (a) Cool season crop
 (b) Warm season crop
 (c) Intermediate
 (d) None
-
28. **Sweet potato** is a
 (a) Short day plant
 (b) Long day plant
 (c) Intermediate
 (d) None
-
29. **Diploid chromosome no. of yam** is
 (a) 24
 (b) 20
 (c) 26
 (d) 28
-
30. **Seed rate of water melon** is kg/hac
 (a) 5-6
 (b) 3.5-5
 (c) 4-5
 (d) 8-10
-
31. **Long day type variety of Garlic** is
 (a) Agrifound white
 (b) Agrifound Parvati
 (c) Yamuna Safed
 (d) G-282
-
32. **White spine colour is important indice of edible maturity of**
 (a) Cucumber
 (b) Cabbage
 (c) Cauliflower
 (d) Ash gourd
-
33. **Which variety of okra is recommended for cultivation in disease prone area**
 (a) Pusa sawami
 (b) Pusa mukhmali
 (c) Punjab Padmani
 (d) Varsha upkar
-
34. **Onion variety suitable for dehydration is**
 (a) Pusa Red
 (b) Pusa Ratnar
 (c) Pusa white flat
 (d) Pusa white round
-
35. **Earliest maturing type of cabbage is**
 (a) Round head
 (b) Flat head
 (c) Conical head
 (d) All
-
36. **Optimum temperature for tomato cultivation**
 (a) 10-15°C
 (b) 15-27°C
 (c) 20-30°C
 (d) 25-35°C
-
37. **Colletotrichum capsici causes which disease in chilli**
 (a) Anthracnose
 (b) Fruit Rot
 (c) Dieback
 (d) All
-
38. **Which country is the largest producer of sprouting Broccoli in the world**
 (a) China
 (b) India
 (c) USA
 (d) Japan
-
39. **Potato is _____ plant for its tuber**
 (a) Short day
 (b) Long day
 (c) Day neutral
 (d) None
-
40. **Pollination in Raddish is done by**
 (a) Bees
 (b) Honey bee
 (c) Wind
 (d) Water

41. **Biggest onion market in India is in which state**
(a) UP (b) MP
(c) Maharashtra (d) Karnataka
42. **'Yerusseri' product is prepared from which vegetable**
(a) Cucumber (b) Pumpkin
(c) Raddish (d) Carrot
43. **Which vegetable is recommended during convelescence**
(a) Bitter gourd (b) Ash gourd
(c) Pointed gourd (d) Ridge gourd
44. **Ridge gourd is commercially trained for**
(a) Bower system (b) Angular system
(c) Kniffin system (d) None
45. **Money maker is the variety of**
(a) Tomato (b) Brinjal
(c) Chilli (d) Potato
46. **Seed plot technique in potato is developed by**
(a) G. Kallo (b) Harbhajan singh
(c) Puskarnath (d) None
47. **Dry chilli contain how much % of pericarp**
(a) 10% (b) 25%
(c) 30% (d) 40%
48. **Which is the vegetable cum spice crop**
(a) Fenugreek (b) Cumin
(c) Coriander (d) Curry leaf
49. **Vascular streaking is present in which crop**
(a) Cassava (b) Sweet potato
(c) Yams (d) None
50. **Winged bean is also known as**
(a) Four angled bean (b) Goa bean
(c) Both (d) None

(E)

1. Propagation of cardamom is done by

- (a) Seeds (b) Rhizome
(c) Cuttings (d) Air layering

2. Seed rate of turmeric is kg/hac

- (a) 1200-1500 (b) 2500
(c) 3000 (d) 1500

3. Chromosome no. of Ginger is - (2n)

- (a) 32 (b) 22
(c) 14 (d) 16

4. Konkan Tej is the variety of

- (a) Cardamom (b) Clove
(c) Cinnamon (d) Nutmeg

5. Oil of Black pepper consist mainly of

- (a) Phenol (b) Alkaloid
(c) Terpenes (d) Tetracycline

6. Alleppy and Duggirala are the trade name of

- (a) Ginger (b) Garlic
(c) Tamarind (d) Turmeric

7. Trachyspermum ammi is the botanical name of

- (a) Hing (b) Ajowain
(c) Zeera (d) Parsley

8. Cinnamon belong to family

- (a) Lauraceae (b) Fabaceae
(c) Iridaceae (d) Araceae

9. Important ingradient in Bishops weeds is

- (a) Cineol (b) Phenol
(c) Thymol (d) Limone

10. Linalool, important ingradient present in

- (a) Fennel (b) Coriander
(c) Cumin (d) Aniseed

11. Origin of Ginger is

- (a) Mediteranean region (b) Tropical America
(c) South-East Asia (d) North-West Asia

12. Terbinen is the important constituent present in

- (a) Sweet flag (b) Cinnamon
(c) Nutmeg (d) Cury leaf

13. Origin of small cardamom is

- (a) Srilanka (b) Indonasia
(c) India (d) China

14. 'Saffaron' belong to family
 (a) Fabaceae (b) Lauraceae
 (c) Iridaceae (d) Myrtaceae
15. Per capita consumption of spice in USA is (approximately)
 (a) 2 times of Indian consumption (b) 3 times of Indian consumption
 (c) ½ times of Indian consumption (d) 4 times of Indian consumption
16. 'Ajowan ka Phool' is
 (a) Crystal form of Thymol (b) Liquid form of Thymol
 (c) Crystal form of cineol (d) Crystal form of linalool
17. 'Bareja system' is the term associated with
 (a) Nutmeg (b) All spice
 (c) Betelvine (d) Black Pepper
18. Leading producer of large cardomom is
 (a) Indonesia (b) China
 (c) Srilanka (d) India
19. Average yield of Betelvine is
 (a) 40-50 lakhs leaves/hac (b) 60-80 lakhs leaves/hac
 (c) 30-40 lakhs leaves/hac (d) 90-100 lakhs leaves/hac
20. Which of the following is oldest known spice.
 (a) All spice (b) Nutmeg
 (c) Black pepper (d) Cassia
21. Feathering and scrapped chipps are important grades of
 (a) Black pepper (b) Nutmeg
 (c) Clove (d) Cinnamon
22. The biting taste of Black pepper is because of
 (a) Terpenine (b) Piperine
 (c) Pipermenthene (d) Pentanol
23. The leading state in production of Fenugreek is
 (a) Rajasthan (b) Gujrat
 (c) MP (d) UP
24. The leading Ginger producing country in the world is
 (a) China (b) Srilanka
 (c) Italy (d) India
25. Highest production of spices is in which state
 (a) Himachal Pradesh (b) Andhra Pradesh
 (c) MP (d) UP
26. Essential oil % in Dill is
 (a) 0.1-2.6% (b) 0.1-1.0%
 (c) 1.5-4% (d) None

27. Large cardamom is a
 (a) Sun loving plant (b) Shade loving plant
 (c) Both (d) None
-
28. India accounts for what % of area under Black pepper
 (a) 56% (b) 55%
 (c) 54% (d) 50%
-
29. India accounts to – % of turmeric production in the world
 (a) 80% (b) 70%
 (c) 76% (d) 90%
-
30. Cinnamomum tamala is the botanical name of
 (a) Cinammon (b) Tejpat
 (c) All spice (d) None
31. Major all spice producing country in the world is
 (a) India (b) Srilanka
 (c) Jamica (d) America
32. Curry leaf is a
 (a) Self pollinated crop (b) Cross pollinated crop
 (c) Often cross pollinated crop (d) None
33. Among following which is seed spice
 (i) Dill (ii) Aniseed (iii) Caraway (iv) Cumin
 (a) (i) & (ii) (b) (ii) & (iii)
 (c) None (d) All
34. Sex form present in Betelvine is
 (a) Monoecious (b) Dioecious
 (c) Andromonecious (d) None
35. For bleaching of Betelvine temperature required is
 (a) 60–70°C (b) 30–35°C
 (c) 40–45°C (d) 80–90°C
36. In cardamom, mainly pollination occurs due to
 (a) Honey bee (b) House fly
 (c) Air (d) Water
-
37. 'Katte disease' mainly problematic in
 (a) Cinnamon (b) Cumin
 (c) Cardamom (d) Pepper
38. To retain green colour of capsule of cardamon what is used
 (a) Washing soda 2% (b) Calcium carbide
 (c) Ethylene (d) All
39. Family of clove is
 (a) Myrtaceae (b) Apiaceae
 (c) Alliaceae (d) None

40. World most expensive spice crop is
 (a) Saffron (b) Coriander
 (c) Turmeric (d) Celery
41. Part used for consumption of clove is
 (a) Seed (b) Bark
 (c) Flower (d) Unopened bud
42. Plant part of saffron used as spice
 (a) Seed (b) Bark
 (c) Flouur (d) Rhizome
43. Commercial part of all spice is
 (a) Whole tree (b) Leaves
 (c) Bark only (d) Fruits only
44. Origin of clove is
 (a) Indonesia (b) Africa
 (c) India (d) None
45. Navashree and Nithyashree are variety of
 (a) Caradamom (b) Cinnamom
 (c) Black pepper (d) None
46. Fenugreek seed contain _____ alkaloid
 (a) Allicin (b) diosgenin
 (c) Ajmacline (d) All
47. Commercial part of mace used is
 (a) Dried kernel (b) Seed
 (c) Flower (d) Dried Aril
48. Male musk deer smell resembles to
 (a) Ambrette seed (b) Basil
 (c) Celery (d) Davana
49. India's share in world trade of spice is
 (a) 8% (b) 18%
 (c) 28% (d) 38%
50. Chemical present in turmeric is
 (a) Cineol (b) Zingiberene
 (c) Cucurmine (d) Linalool

(F)

1. India holds monopoly in the production of

(i) Davana (ii) Isabgol (iii) Senna (iv) Opium

(a) Only (i)

(b) Both (i) and (ii)

(c) All the above

(d) None

2. Plant part used in fox glove is

(a) Flowers

(b) Leaves

(c) Roots

(d) Stem

3. 'God of Sleep' is common name of

(a) Isabgol

(b) Opium

(c) Sarpagandha

(d) Vitever

4. Family of sarpagandha and its property are

(a) Apocynaceae, laxative

(b) Solanaceae, laxative

(c) Apocynaceae, sedative

(d) None of above

5. *Cassia angustifolia* is the botanical name of

(a) Isabgol

(b) Medicinal yam

(c) Sweet flag

(d) Senna

6. Which one of following possess cooling and demulcent effect

(a) Senna

(b) Isabgol

(c) Sarpagandha

(d) Fox glove

7. Arka sanjeevani is the variety of

(a) Isabgol

(b) Senna

(c) Medicinal solanum

(d) Digitalis

8. Which one of following is used in obstetrics

(a) Medicinal solanum

(b) Rye ergot

(c) Isabgol

(d) Senna

9. Economic part of sweet flag is

(a) Leaves

(b) Pod

(c) Rhizome

(d) Bark

10. Family of mint is

(a) Lauraceae

(b) Labiatae

(c) Papavaraceae

(d) None of above

11. Patchouli has which type property

(a) Sedative

(b) Laxative

(c) Stomachic

(d) Fixative

12. Eucalyptus is a

(a) Medicinal plant

(b) Aromatic plant

(c) Both

(d) None

13. Which part of Ambrette plant is used

(a) Flowers

(b) Fruits

(c) Seeds

(d) Roots

14. **Atropine drug is extracted from**
 (a) Opium (b) Datura
 (c) Belladonna (d) None
15. **Largest producer of Jasmine concrete is**
 (a) India (b) Holland
 (c) Egypt (d) Indonesia
16. ***Plantago ovata* is the Botanical name of**
 (a) Isabgol (b) Ambrette seed
 (c) Cassia (d) Davana
17. **Guggal is mainly used in**
 (a) Reduce cholesterol content of blood (b) Treatment of Asthama
 (c) Constipation, dysantry and diarrhoea (d) All
18. **Mucilage is present in which medicinal plant**
 (a) Belladonna (b) Isabgol
 (c) Yams (d) Datura
19. **Which medicinal crop is used to cure heart disease**
 (a) Belladonna (b) Isabgol
 (c) Foxglove (d) Henbane
20. **'Hyoscyamine' chemical is present in which medicinal plant**
 (a) Henbane (b) Belladonna
 (c) Sarpagandha (d) Periwinkle
21. **Chetak, kirtiman are variety of**
 (a) Aloe (b) Isabgol
 (c) Opium (d) Medicinal yam
22. ***Cymbopogon winterianus* is the B.N. of**
 (a) Palmrosa grass (b) Java citronella grass
 (c) Lemon grass (d) None
23. **Skin tonic is prepared from which medicinal crop**
 (a) Aloe (b) Yams
 (c) Neem (d) Medicinal solanum
24. **Chemical 'Farnesol' is obtained from which aromatic plant**
 (a) Hops (b) Oil bearing rose
 (c) Muskdana (d) Vitever grass
25. **Which country is the chief exporter of sarpagandha leaves**
 (a) India (b) China
 (c) Indonesia (d) Brazil
26. **Commonly used part of liquorice is**
 (a) Leaves (b) Roots
 (c) Fruits (d) Flower

27. Family of Hops is
 (a) Solanaceae (b) Malvaceae
 (c) Scrophulariaceae (d) None
-
28. Family of Ambrette seed is
 (a) Solanaceae (b) Malvaceae
 (c) Rosaceae (d) Umbelliferae
-
29. Arka upkar is the variety of
 (a) Medicinal solanum (b) Sarpagandha
 (c) Periwinkle (d) Medicinal yam
-
30. Chemical content of Henbane is
 (a) Reserpine (b) Nicotine
 (c) Saponins (d) Hyocyamine
-
31. Chemical content of safed Musali is
 (a) Saponins (b) Morphine
 (c) Nicotine (d) Reserpine
-
32. Which medicinal crop have sedative property
 (a) Ashwagandha (b) Sarpagandha
 (c) Isabgol (d) Periwinkle
-
33. Which part of Belladonna is used as medicine
 (a) Fruits (b) Flowers
 (c) Leaves (d) Roots
-
34. Origin of Belladonna is
 (a) China (b) India
 (c) Japan (d) Europe
-
35. Nirmal is the variety of
 (a) Isabgol (b) Opium
 (c) Mentha (d) Periwinkle
-
36. Shivalik is the variety of
 (a) Opium (b) Mentha
 (c) Isabgol (d) Datura
-
37. Following plant have great medicinal value
 (a) Benincasa hipsida (b) Cryptostegia grandiflora
 (c) Rauwolfia serpentina (d) Coffea robusta
-
38. Plant part useful for extraction of opium from papaver somniferum are
 (a) Young seedlings (b) Old leaves
 (c) Unripe fruits (d) Ripend seeds
-
39. Rauwolfia serpentina belong to family
 (a) Rubiaceae (b) Solanaceae
 (c) Malvaceae (d) Apocynaeae

40. **Medicine to check high blood pressure is obtained from**
 (a) Digitalis purpurea (b) Cinchona spp
 (c) Rauwolfia serpentina (d) None
41. **Vinblastine drug is obtained from**
 (a) Viola (b) Viccia
 (c) Catharanthus (d) None
42. **Central drug research institute is situated at**
 (a) Lucknow (b) Bombay
 (c) Delhi (d) Madras
43. **Which of the following is medicinal plant**
 (a) Delbergia (b) Linum
 (c) Aconitum (d) Tectona
44. **Which medicinal plant is used as remedy to reduce cholesterol content in blood**
 (a) Neem (b) Dill
 (c) Guggal (d) Isabgol
45. **Commercial cultivation of Rauwolfia is done mainly through**
 (a) Cutting (b) Seed
 (c) Grafting (d) Layering
46. **Which aromatic plant have anti phlogistic properties**
 (a) Celery (b) Muskdana
 (c) Chamomil (d) Davana
47. **Methyl chavicol ingredient present in which aromatic crop**
 (a) Citronella (b) Basil
 (c) French Jasmine (d) Celery
48. **'Screwpine' is the common name of which aromatic plant**
 (a) Lemon grass (b) Citronella
 (c) Kewada (d) None
49. **Which part of lemon grass is used to extract oil**
 (a) Root (b) Fruit
 (c) Flower (d) Leaves
50. **Mentha contains how much % of oil**
 (a) 0.5 - 0.6% (b) 1-2%
 (c) 2-4% (d) 6-8%

MATCH THE PAIRS	
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A	B
1. Clove	(a) Rhizome
2. Chilli	(b) Fruit
3. Black Pepper	(c) Unopened flower bud
4. Cumin	(d) Berries
5. Ginger	(e) Seed
6. Cinnamon	(a) Pod and sticks
7. Nutmeg	(b) Aril
8. Curryleaf	(c) Kernel
9. Vanilla	(d) Bark
10. Mace	(e) Leaves
11. Celery	(a) <i>Anethum graveolens</i>
12. Kewara	(b) <i>Cassia angustifolia</i>
13. Liquorice	(c) <i>Pandanus odorastissi</i>
14. Senna	(d) <i>Apium graveolens</i>
15. Sowa	(e) <i>Glycyrrhiza glabra</i>
16. NAA	(a) Bamboo Basket
17. Lettuce	(b) Black heart
18. Turnip	(c) Growth regulator
19. Packaging Material	(d) <i>Brassica rapa</i>
20. Potato	(e) Salad crop
21. Drumstick	(a) Konkan Ruchira
22. Cluster Bean	(b) Pusa Sanyog
23. Ivy gourd	(c) Pusa Navbahar
24. Cucumber	(d) Konkan Ashwani
25. Sweet Potato	(e) Local Green striped
26. Amorphophalus	(a) Samrat
27. Bottle gourd	(b) DWD-1
28. Curry leaf	(c) Gajendra
29. Water Melon	(d) Pusa kiran
30. Amaranthus	(e) Arka Jyoti
31. Turmeric	(a) Riode-generio
32. Curryleaf	(b) Unopened flower bud

- | | |
|--------------------------|---------------------------|
| 33. Vanilla | (c) Murrya koengini |
| 34. Clove | (d) Curcumin |
| 35. Ginger | (e) Orchidaceae |
| 36. Black pepper | (a) Burliar-1 |
| 37. Cardamom | (b) Konkan Tej |
| 38. Cinnamon | (c) Rajapuri |
| 39. Clove | (d) Balancotta |
| 40. Turmeric | (e) Mudigree-1 |
| 41. Coriander | (a) Myristica fragrans |
| 42. Clove | (b) Limalool |
| 43. Fennel | (c) Leaves |
| 44. Curry leaf | (d) Unopened bud |
| 45. Nutmeg | (e) Umbellifearae |
| 46. Davana | (a) Lawsonia inermis |
| 47. Rosha grass | (b) Pandanus fascicularis |
| 48. Ashwagandha | (c) Withania somnifera |
| 49. Kewada | (d) Cymbapagon martinii |
| 50. Mehendi | (e) Artemisia pallens |
| 51. Frog eye leaf spot | (a) Tomato |
| 52. Redical cracking | (b) Cauliflower |
| 53. Root Bulging | (c) Chilli |
| 54. Potato scurf disease | (d) Raddish |
| 55. Brown rot | (e) Acidic soil |
| 56. Napiform root | (a) Raddish |
| 57. Conical root | (b) Sweet potato |
| 58. Fusiform root | (c) Tomato |
| 59. Adventious root | (d) Sugerbeet |
| 60. Simple root | (e) Carrot |
| 61. Blown | (a) Tomato |
| 62. Zoning | (b) Garlic |
| 63. Vegetative apomixis | (c) Cauliflower |
| 64. Scooping | (d) Sugerbeet |
| 65. Staking | (e) Brussel's sprout |
| 66. Garlic | (a) Calcium oxalate |
| 67. Bitter Gourd | (b) 3n-butyl pthalide |

68. Celery (c) Diosgenin
 69. Colocasia (d) Cheratin
 70. Yams (e) Diallyl disulphide

71. Summer Squash (a) Arka Jyoti
 72. Cucumber (b) Arka Bahar
 73. Pumpkin (c) Pusa Sanyog
 74. Bottle gourd (d) Arka chanect
 75. Water melon (e) Pusa Alankar

76. Tapioca (a) Tubers
 77. Leek (b) Knob
 78. Asparagus (c) Blanched stem
 79. Knol-khol (d) Spears
 80. Colocasia (e) Fleshy roots

81. Ridge Gourd (a) $2n=48$
 82. Peas (b) $2n=130$
 83. French Bean (c) $2n=22$
 84. Okra (d) $2n=26$
 85. Potato (e) $2n=14$

86. Sweet Potato (a) $2n=20$
 87. Winter squash (b) $2n=12$
 88. Fenugreek (c) $2n=90$
 89. Spinach (d) $2n=40$
 90. Turnip (e) $2n=16$

91. Shallot (a) Onion
 92. Wholesome fruit (b) Carrot
 93. 5 sex form (c) Bitter gourd
 94. Blunt tubercels (d) Spinach
 95. Shizocarp (e) Musk Melon

96. Senna (a) God of sleep
 97. Opium (b) Laxative
 98. Glycyrrhizin (c) Carminative property
 99. Dill fruits (d) Sedative property
 100. Ashwagandha (e) Liquorice

101. Horse raddish tree (a) Lima Bean

- | | |
|-------------------------|--------------------------|
| 102. Balsam pear | (b) Dolichos bean |
| 103. Butter bean | (c) Bitter gourd |
| 104. French bean | (d) Drumstick |
| 105. Indian bean | (e) Navy bean |
| 106. Seed spice | (a) Crocus sativa |
| 107. Harbal spice | (b) Turmeric |
| 108. Saffron | (c) Dill |
| 109. Plagiotropes | (d) Rosemary |
| 110. Rhizome | (e) Black pepper |
| 111. Nutmeg | (a) Linalool |
| 112. All spice | (b) Eugenol |
| 113. Fenugreek | (c) Menthol |
| 114. Black pepper | (d) Terbimen |
| 115. Coriander | (e) Phenol |
| 116. Coriander | (a) Wind and insect |
| 117. Fenugreek | (b) Polinator (Honeybee) |
| 118. Cumin | (c) Long thin pods |
| 119. Nutmeg | (d) Apiaceae |
| 120. Rat's tail raddish | (e) Fabaceae |

ANSWERSHEET

MULTIPLE CHOICE QUESTIONS

(A)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (d) | 2. (b) | 3. (c) | 4. (b) | 5. (d) | 6. (a) | 7. (b) | 8. (a) |
| 9. (b) | 10. (c) | 11. (a) | 12. (c) | 13. (b) | 14. (b) | 15. (c) | 16. (a) |
| 17. (a) | 18. (d) | 19. (d) | 20. (b) | 21. (c) | 22. (c) | 23. (d) | 24. (b) |
| 25. (c) | 26. (b) | 27. (b) | 28. (d) | 29. (c) | 30. (c) | 31. (d) | 32. (b) |
| 33. (a) | 34. (c) | 35. (d) | 36. (d) | 37. (b) | 38. (c) | 39. (a) | 40. (a) |
| 41. (b) | 42. (c) | 43. (b) | 44. (c) | 45. (a) | 46. (b) | 47. (a) | 48. (b) |
| 49. (a) | 50. (b) | 51. (b) | 52. (d) | 53. (a) | 54. (e) | 55. (c) | 56. (d) |
| 57. (c) | 58. (e) | 59. (a) | 60. (b) | 61. (d) | 62. (a) | 63. (e) | 64. (c) |
| 65. (b) | | | | | | | |

(B)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (a) | 3. (a) | 4. (a) | 5. (a) | 6. (a) | 7. (d) | 8. (b) |
| 9. (b) | 10. (d) | 11. (c) | 12. (a) | 13. (b) | 14. (a) | 15. (a) | 16. (d) |
| 17. (a) | 18. (a) | 19. (b) | 20. (a) | 21. (b) | 22. (b) | 23. (b) | 24. (b) |
| 25. (b) | 26. (a) | 27. (b) | 28. (b) | 29. (b) | 30. (b) | 31. (b) | 32. (b) |
| 33. (a) | 34. (d) | 35. (a) | 36. (a) | 37. (b) | 38. (a) | 39. (a) | 40. (c) |
| 41. (d) | 42. (a) | 43. (c) | 44. (b) | 45. (c) | 46. (c) | 47. (b) | 48. (c) |
| 49. (c) | 50. (b) | 51. (b) | 52. (a) | 53. (a) | 54. (b) | 55. (a) | 56. (f) |
| 57. (c) | 58. (b) | 59. (d) | 60. (e) | 61. (b) | 62. (e) | 63. (a) | 64. (c) |
| 65. (d) | 66. (g) | 67. (f) | 68. (j) | 69. (h) | 70. (i) | 71. (b) | 72. (a) |
| 73. (d) | 74. (e) | 75. (c) | 76. (g) | 77. (f) | 78. (h) | | |

(C)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (b) | 3. (a) | 4. (c) | 5. (c) | 6. (b) | 7. (c) | 8. (b) |
| 9. (b) | 10. (a) | 11. (b) | 12. (d) | 13. (d) | 14. (b) | 15. (c) | 16. (d) |
| 17. (a) | 18. (a) | 19. (d) | 20. (c) | 21. (d) | 22. (a) | 23. (b) | 24. (b) |
| 25. (c) | 26. (a) | 27. (b) | 28. (b) | 29. (a) | 30. (a) | 31. (c) | 32. (a) |
| 33. (b) | 34. (b) | 35. (b) | 36. (a) | 37. (c) | 38. (c) | 39. (a) | 40. (b) |
| 41. (b) | 42. (a) | 43. (c) | 44. (b) | 45. (d) | 46. (b) | 47. (a) | 48. (c) |
| 49. (b) | 50. (a) | | | | | | |

(D)

- | | | | | | | | |
|--------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (a) | 4. (a) | 5. (a) | 6. (d) | 7. (d) | 8. (b) |
| 9. (b) | 10. (a) | 11. (b) | 12. (c) | 13. (a) | 14. (b) | 15. (a) | 16. (b) |

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|---------|----------|---------|---------|---------|---------|---------|---------|
| 17. (a) | 18. (d) | 19. (b) | 20. (b) | 21. (c) | 22. (c) | 23. (c) | 24. (c) |
| 25. (b) | 26. (c) | 27. (b) | 28. (a) | 29. (b) | 30. (b) | 31. (b) | 32. (a) |
| 33. (d) | 34. (c) | 35. (b) | 36. (b) | 37. (d) | 38. (c) | 39. (a) | 40. (b) |
| 41. (c) | 42. (b) | 43. (c) | 44. (c) | 45. (d) | 46. (c) | 47. (d) | 48. (d) |
| 49. (a) | 50. (c). | | | | | | |

(E)

- | | | | | | | | |
|---------|----------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (b) | 4. (c) | 5. (c) | 6. (a) | 7. (b) | 8. (a) |
| 9. (c) | 10. (b) | 11. (c) | 12. (c) | 13. (c) | 14. (c) | 15. (c) | 16. (a) |
| 17. (c) | 18. (d) | 19. (b) | 20. (d) | 21. (d) | 22. (b) | 23. (a) | 24. (d) |
| 25. (b) | 26. (c) | 27. (a) | 28. (c) | 29. (c) | 30. (b) | 31. (c) | 32. (a) |
| 33. (d) | 34. (b) | 35. (a) | 36. (a) | 37. (c) | 38. (a) | 39. (a) | 40. (a) |
| 41. (d) | 42. (c) | 43. (d) | 44. (a) | 45. (b) | 46. (b) | 47. (d) | 48. (a) |
| 49. (b) | 50. (c). | | | | | | |

(F)

- | | | | | | | | |
|---------|----------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (b) | 3. (b) | 4. (c) | 5. (d) | 6. (b) | 7. (c) | 8. (b) |
| 9. (a) | 10. (b) | 11. (b) | 12. (b) | 13. (c) | 14. (c) | 15. (c) | 16. (a) |
| 17. (a) | 18. (b) | 19. (c) | 20. (a) | 21. (c) | 22. (b) | 23. (a) | 24. (c) |
| 25. (c) | 26. (c) | 27. (c) | 28. (b) | 29. (d) | 30. (d) | 31. (a) | 32. (b) |
| 33. (c) | 34. (d) | 35. (d) | 36. (b) | 37. (c) | 38. (c) | 39. (d) | 40. (c) |
| 41. (c) | 42. (a) | 43. (c) | 44. (c) | 45. (b) | 46. (c) | 47. (b) | 48. (c) |
| 49. (d) | 50. (a). | | | | | | |

MATCH THE PAIRS

- | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 1. (c) | 2. (b) | 3. (d) | 4. (e) | 5. (a) | 6. (d) | 7. (c) | 8. (e) |
| 9. (a) | 10. (b) | 11. (d) | 12. (c) | 13. (e) | 14. (b) | 15. (a) | 16. (c) |
| 17. (e) | 18. (d) | 19. (a) | 20. (b) | 21. (a) | 22. (c) | 23. (e) | 24. (b) |
| 25. (d) | 26. (c) | 27. (a) | 28. (b) | 29. (e) | 30. (d) | 31. (d) | 32. (c) |
| 33. (e) | 34. (b) | 35. (a) | 36. (d) | 37. (e) | 38. (b) | 39. (a) | 40. (c) |
| 41. (b) | 42. (d) | 43. (e) | 44. (c) | 45. (a) | 46. (e) | 47. (d) | 48. (c) |
| 49. (b) | 50. (a) | 51. (c) | 52. (a) | 53. (d) | 54. (e) | 55. (b) | 56. (d) |
| 57. (e) | 58. (a) | 59. (b) | 60. (c) | 61. (d) | 62. (e) | 63. (b) | 64. (c) |
| 65. (a) | 66. (e) | 67. (d) | 68. (b) | 69. (a) | 70. (c) | 71. (e) | 72. (c) |
| 73. (d) | 74. (b) | 75. (a) | 76. (e) | 77. (c) | 78. (d) | 79. (b) | 80. (a) |
| 81. (d) | 82. (e) | 83. (c) | 84. (b) | 85. (a) | 86. (c) | 87. (d) | 88. (e) |
| 89. (b) | 90. (a) | 91. (a) | 92. (e) | 93. (d) | 94. (c) | 95. (b) | 96. (b) |
| 97. (a) | 98. (e) | 99. (c) | 100. (d) | 101. (d) | 102. (c) | 103. (a) | 104. (e) |
| 105. (b) | 106. (c) | 107. (d) | 108. (a) | 109. (e) | 110. (b) | 111. (d) | 112. (e) |
| 113. (c) | 114. (b) | 115. (a) | 116. (b) | 117. (e) | 118. (d) | 119. (a) | 120. (c) |

MULTIPLE CHOICE QUESTIONS AND MATCH THE PAIRS

PART- III

(A)

1. Calyx splitting is the major disorder of
 (a) Rose (b) Carnation
 (c) Chrysanthamum (d) All
2. Glory of east is the C.N. of
 (a) Rose (b) Gerbera
 (c) Chrysanthamum (d) Carnation
3. Haldighati is off season cultivar of
 (a) Chrysanthamum (b) Carnation
 (c) Gladiolus (d) Gerbera
4. Chrysanthamum charm is the variety of
 (a) Orchids (b) Merigold
 (c) Gladiolus (d) Gerbera
5. 2n no. of french merigold is
 (a) 12 (b) 24
 (c) 36 (d) 48
6. Among following spp. of orchid, which is temperate one
 (a) Dendrobium (b) Vanda
 (c) Cymbidium (d) All
7. Dendrobium is propagated by means of
 (a) Division (b) Cutting
 (c) Seed (d) All of above
8. Zinnia comes under which category
 (a) Summer Annual (b) Winter Annual
 (c) Rainy Annual (d) All
9. Rose is the national flower of
 (a) Japan (b) Spain
 (c) China (d) England
10. Raja Ram Mohan Roy variety of Rose is classified under which group
 (a) HT group (b) Floribunda
 (c) Polyantha (d) Grandiflora
11. Desert charm is the variety of
 (a) Gladiolus (b) Gerbera
 (c) Carnation (d) Rose

12. **Most serious disease of Rose is – ICAR-2002**
 (a) Powdery midew (b) Dieback
 (c) Leaf spot (d) Wilt
13. **Carnation is the national flower of – ICAR-2002**
 (a) Japan (b) China
 (c) Spain (d) Holland
14. **Tissue culture is common in – ICAR-2002**
 (a) Rose (b) Orchid
 (c) Gladiolus (d) Palms
15. **Annual flower of Indian origin is – ICAR-2002**
 (a) Antirrhinum (b) Gaillardia
 (c) Gomphrena (d) Statice
16. **Popular climber of Indian Origin is – ICAR-2002**
 (a) Tecoma (b) Bigonia
 (c) Clerodendrum (d) Gloriosa superba
17. **Ficus elastica is a popular – ICAR-2002**
 (a) Flowering tree (b) Indoor plant
 (c) Cacti (d) Climber
18. **Annual flower suited for planting in shade – ICAR-2002**
 (a) Antirrhinum (b) Stock
 (c) Cineraria (d) Nasturtium
19. **'Palash' is the common name for – ICAR-2002**
 (a) Plumeria alba (b) Cassia fistula
 (c) Butea monosperma (d) Bauhimia purpurea
20. **Disbudding is commonly practiced for obtaining better bloom in – ICAR-2002**
 (a) Rose (b) Chrysanthmum
 (c) Gerbera (d) Jasmine
21. **Largest Genera of orchid is – ICAR-2002**
 (a) Dendrobium (b) Bulbophyllum
 (c) Catteleya (d) Vanda
22. **B.N. of 'Amaltas' is – ICAR-2002**
 (a) Delonix regia (b) Cassia fistula
 (c) Butea monosperma (d) None
23. **National flower of Japan is – ICAR-2003**
 (a) Rose (b) Carnation
 (c) Gerbera (d) Chrysanthamum
24. **Which of flower crop have South African Origin – ICAR-2003**
 (a) Carnation (b) Gladiolus
 (c) Rose (d) Merigold

25. **Duranta is mainly used as a – ICAR -2003**
 (a) Edge plant (b) Hedge plant
 (c) Shrub (d) Climber
-
26. **Which of the flowering annual do not produce flower**
 (a) Amaranathus (b) Balsam
 (c) Kochia (d) Ageratum
-
27. **Snap dragon is the common name of**
 (a) Acroclinum (b) Ageratum
 (c) Anchusa (d) Antirrhinum
-
28. **Pusa tara is the variety of**
 (a) Coreopsis (b) Cornflower
 (c) Cosmos (d) Dahlia
-
29. **Dimorphotheca is commonly known as**
 (a) Cape marigold (b) Pot marigold
 (c) Fig marigold (d) None of these
-
30. **Trimming of hedges is done when it attain a height of**
 (a) 10 cm (b) 15 cm
 (c) 20 cm (d) 25 cm
-
31. **Which plant comes under - Edge category:**
 (a) Euphorbia (b) Opuntia
 (c) Justicia (d) Agave
-
32. **Barleria comes under which category**
 (a) Edge (b) Hedge
 (c) Shrub (d) Tree
-
33. **Family of *Lantana camera* is**
 (a) Malvaceae (b) Solanaceae
 (c) Verbanaceae (d) Rubiaceae
-
34. **Phyllanthus nivosus is the botanical name of**
 (a) Anar (b) Lollypop plant
 (c) Snow bush (d) Duranta
-
35. **Which climber is of Indian origin**
 (a) Chameli (b) Railway creeper
 (c) Madhulata (d) All
-
36. **Which bulb plant prefer cool climate**
 (a) Tuberose (b) Dahlia
 (c) Narcissus (d) Zephyranthus
-
37. **Tuberose is propagated by**
 (a) Tuber (b) Corm
 (c) Bulb (d) Rhizome

38. 1st ranking foliage plant in the world is
 (a) Coleus (b) Diffenbachia
 (c) Dracena (d) Ferns
39. Century plant is the common name of
 (a) Agave (b) Aloe
 (c) Euphorbia (d) Lithops
40. Delonix regia is the B.N. of
 (a) Palas (b) Pangara
 (c) Gulmohar (d) Bottle Brush
41. Which tree is preferred in draught prone areas
 (a) Banyan (b) Jangal Jalebi
 (c) Silver Oak (d) Karanj
42. Which flower represent purity
 (a) Amaryllis (b) Iris
 (c) Lily (d) Stock
43. The Byrant park is situated in which state
 (a) Andhra Pradesh (b) Karnataka
 (c) Tamil Nadu (d) Kerala
44. Dr. B.P. Pal is the variety of
 (a) Amaranthus (b) Bouganvillia
 (c) Chrysanthamum (d) Gladiolus
45. International registration authority for rose is situated at
 (a) New Delhi (b) USA
 (c) Denmark (d) Belgium
46. Leading flower product exporting country in the world is
 (a) Netherland (b) Colombia
 (c) Israel (d) Germany
47. State having maximum area under floriculture
 (a) Kerala (b) Karnataka
 (c) Tamil Nadu (d) Andhra Pradesh
48. Bharat Sundari is the variety of
 (a) Gladiolus (b) Coreopsis
 (c) Hibiscus (d) Hollyhock
49. Pinjoore Garden was made by
 (a) Ranjit Singh (b) Fadai Khan
 (c) Bhupinder Singh (d) Jhangir
50. Leading flower seed producing state in India is
 (a) Haryana (b) Himachal Pradesh
 (c) Punjab (d) Delhi

MATCH THE PAIRS

A	B
51. Merigold	(a) Terminal cutting
52. Tuberose	(b) Corm
53. Carnation	(c) Bulb
54. Canna	(d) Seed
55. Gladiolus	(e) Rhizome
56. Diffen-backia	(a) Fern
57. Mamarillaria	(b) Climber
58. Nephroleis	(c) Cactus
59. Clitoria	(d) Succulent
60. Euphorbia	(e) House plant
61. India	(a) Lily
62. Japan	(b) Tulip
63. Italy	(c) Lotus
64. Germany	(d) Chrysanthamum
65. Netherland	(e) Corn flower
66. Agni Rekha	(a) Chrysanthamum
67. Rajat Rekha	(b) Merigold
68. Birbal Sahani	(c) Rose
69. Pusa Sonia	(d) Gladiolus
70. Cracker Jack	(e) Tuberose

(B)

1. **Chrysanthamum is a**
 (a) Self pollinated crop
 (b) Often cross pollinated
 (c) Cross pollinated crop
 (d) None
2. **Area under loose flowers in India is**
 (a) 2/3rd
 (b) 1/4th
 (c) 1/3rd
 (d) 1/2 of total area under flower
3. **India's rank in area under Jasmine in the world**
 (a) I
 (b) II
 (c) III
 (d) IV
4. **Amaltas is a**
 (a) Tree
 (b) Climber
 (c) Shrub
 (d) Annual
5. **First person to start gardening in India**
 (a) Akbar
 (b) Birbal
 (c) Shahjahan
 (d) Babar
6. **Lalbagh Garden is situated at**
 (a) Lucknow
 (b) Bangalore
 (c) Orissa
 (d) Mumbai
7. **National flower of China is**
 (a) Rose
 (b) Lotus
 (c) Cornflower
 (d) Narcissus
8. **Division of floriculture and landscaping started at IARI in year**
 (a) 1969
 (b) 1980
 (c) 1983
 (d) 1990
9. **Swami Vinayananda is associated with which flower**
 (a) Gladiolus
 (b) Rose
 (c) Carnation
 (d) Dahalia
10. **Total area under floriculture in the world is (lakh hac)**
 (a) 10
 (b) 20
 (c) 25
 (d) 5
11. **Begam Sikander is the variety of**
 (a) Carnation
 (b) Bouganvillia
 (c) Gladiolus
 (d) Cock's comb
12. **Bharat Sundari is the variety of**
 (a) Hibiscus
 (b) Coreopsis
 (c) Amaranthus
 (d) Bongavillia
13. **Arjun Raktagandha belong to which class of rose**
 (a) Floribunda
 (b) Hybrid Tea
 (c) Polyantha
 (d) Climber

14. Mohini is the variety of Rose, which is
 (a) Triploid (b) Diploid
 (c) Tetraploid (d) Octaploid
15. Carnation is a
 (a) Short day plant (b) Long day plant
 (c) Day neutral plant (d) None
16. Non-fragrant spp. of Jasmine is
 (a) J. auriculatum (b) J. Primulinum
 (c) J. Sambac (d) J. Multiflorum
17. Resistant spp. of Rose to cold is
 (a) R. multiflora (b) R. indica
 (c) R. rugosa (d) R. Pendulina
18. In chrysanthamum singleness is due to
 (a) Dominance over doubleness (b) Recessive over doubleness
 (c) Both (d) None
19. Petunia show which type of self in-compatability
 (a) Gametophytic (b) Sporophytic
 (c) Both (d) None
20. Largest producer of loose flower in the world is
 (a) China (b) Japan
 (c) India (d) USA
21. Bahunia vahli is a
 (a) Climber (b) Rambler
 (c) Shrub (d) Tree
22. National research centre for orchid is located at
 (a) Orissa (b) Sikkim
 (c) Haryana (d) Punjab
23. Acasia belong to family
 (a) Amaryrillidaceae (b) Solonaceae
 (c) Leguminoceae (d) None
24. Auocaria cooki is also known as
 (a) Sapt Parni (b) Monkey Jack
 (c) Monkey Puzzle (d) None
25. Parrot flower is common name of
 (a) Pagoda (b) Pangara
 (c) Eucalyptus (d) Siris
26. Family of Ficus is
 (a) Proteaceae (b) Moraceae
 (c) Leguminoceae (d) Solanaceae

27. 'Pride of India' is the common name of
 (a) Queen's flower (b) Balam Khira
 (c) Bara Champa (d) None
28. 'La france' cultivar of Rose belong to
 (a) Hybrid Tea (b) Floribunda
 (c) Polyantha (d) Miniatures
29. 'Peach blossom' is the variety of
 (a) Rose (b) Carnation
 (c) Chrysanthamum (d) Gerbera
30. Chromosome no. of carnation is
 (a) 18 (b) 20
 (c) 30 (d) 14
31. Topple disease of Gladiolus is caused due to defeciency of
 (a) B (b) Ca
 (c) Mn (d) Cu
32. Calyx splitting disorder is found in
 (a) Gladiolus (b) Carnation
 (c) Dahalia (d) Rose
33. 'Queen of east' is the common name of
 (a) Carnation (b) Chrysanthamum
 (c) Gerbera (d) Jasmine
34. 'Feroz Masani' is related to which flower crop
 (a) Carnation (b) Gladiolus
 (c) Rose (d) Gerbera
35. Cymbidium orchid is
 (a) Epiphyte (b) Lithophyte
 (c) Halophyte (d) None
36. Sonar Bangla is the variety of
 (a) Bouganvillia (b) Chrysanthamum
 (c) Carnation (d) Gerbera
37. Favourable temperature for growth of Gladiolus is
 (a) 20-30°C (b) 16-30°C
 (c) 15-20°C (d) 25-30°C
38. Hilling is an important operation in
 (a) Carnation (b) Rose
 (c) Gladiolus (d) Gerbera
39. Shobha is the mutant variety of
 (a) Rose (b) Gladiolus
 (c) Carnation (d) Gerbera

40. Which garden is regarded as genesis of gardening
(a) Hampshire (b) Osaka
(c) Eden (d) Brindavan
41. Dilkush Garden of Lahore was built by
(a) Shah Jahan (b) Jahangir
(c) Fadaikhan (d) Akbar
42. *Hybaena thebaica* a branching palm is located at
(a) Bombay (b) Baroda
(c) Bangalore (d) Coimbatore
43. 'Baradari' is important feature of which garden
(a) Mughal (b) French
(c) Chinese (d) English
44. Sand Garden is known as
(a) Rayangi (b) Roji-niwa
(c) Rathai-Seki (d) Hira-niwa
45. India's share in Global flower market is about
(a) 0.6% (b) 8.8%
(c) 10% (d) 2%
46. Leading state in flower acreage in India
(a) Tamil Nadu (b) Karnataka
(c) Andhra Pradesh (d) Maharashtra
47. Where is international flower market situated
(a) Alsmeer (b) UK
(c) Genava (d) Florida
48. Largest producer of perfumery product in the world is
(a) Switzerland (b) Bulgaria
(c) Netherland (d) None
49. No. one cut green at Global level is
(a) Ribbon grass (b) Asparagus
(c) Coleus (d) None
50. Basic chromosome no. of Jasmine is
(a) 11 (b) 12
(c) 13 (d) 15

(C)

1. **IIHR was established in year**
 (a) 1958 (b) 1968
 (c) 1978 (d) 1988
2. **State having largest area under fruit cultivation**
 (a) Utter Pradesh (b) Maharashtra
 (c) Andhra Pradesh (d) Karnataka
3. **Which is 4th major fruit crop in India**
 (a) Apple (b) Guava
 (c) Citrus (d) Banana
4. **Leading mushroom growing state is**
 (a) Andhra Pradesh (b) Maharashtra
 (c) Himachal Pradesh (d) Taminl Nadu
5. **India's share in cashew export**
 (a) 45% (b) 55%
 (c) 65% (d) 75%
6. **Major or leading coffee growing state is**
 (a) Andhra Pradesh (b) Karnataka
 (c) Tamil Nadu (d) Kerala
7. **India has highest productivity in which crop in the world**
 (a) Rubber (b) Grape
 (c) Both (d) None
8. **Humid zone have a growing period of**
 (a) 90-150 days (b) 150-210 days
 (c) 210-270 days (d) 270 days
9. **Optimum temperature for banana cultivation is**
 (a) 16.5°C (b) 26.5°C
 (c) 35.5°C (d) 46.5°C
10. **Which type of soil has high P fixation capacity**
 (a) Arid soil (b) Black soil
 (c) Alluvial (d) Laterite
11. **At time of maturity Brix/acid ratio in grape should be**
 (a) 20-25 (b) 25-30
 (c) 30-35 (d) 35-40
12. **At time of maturity pineapple have _____ % TSS**
 (a) 8-10 (b) 12-24
 (c) 16-18 (d) 20-22
13. **Chloride containing fertilizers are toxic to which fruit crop**
 (a) Banana (b) Citrus
 (c) Mango (d) Cashew

14. Among following spp. which is used as wind break in orchard
 (a) Opuntia (b) Ingadulus
 (c) Carissa caroudus (d) All

15. Diagonal system is also known as

- (a) Hexagonal (b) Triangular
 (c) Quincunx (d) Contour

16. In North India, pruning is done in month of

- (a) Jan-Feb (b) Feb-March
 (c) March-April (d) April-May

17. Which are the basic element

- (a) NPK. (b) CHO
 (c) Mg, Ca, P (d) Fe, Zn, Cu

18. Which are immobile element in plant

- (a) NP (b) KS
 (c) Ca, B (d) None of above

19. Chlorosis due to N_2 deficiency is Ist observed in

- (a) Younger leaves (b) Older leaves
 (c) Both (d) None

20. Which element is required for synthesis of tryptophan

- (a) Cu (b) Zn
 (c) Fe (d) Sulphur

21. Yellow spots on leaves shows deficiency of

- (a) Cu (b) Mo
 (c) Zn (d) Mg

22. Highest Samples are taken in which fruit crop for sampling

- (a) Banana (b) Mango
 (c) Grape (d) Coconut

23. Mangosteen is propagated by means of

- (a) Cutting (b) Grafting
 (c) Layering (d) Seed

24. Which are the cryoprotectants

- (a) Glycerol (b) DMSO
 (c) Both (d) None

25. Stooling is commercial method of propagation of

- (a) Apple (b) Guava
 (c) Citrus (d) Litchi

26. KMS is effective against

- (a) Bacteria (b) Yeasts
 (c) Both (d) None

27. Sterilization is practiced at temperature of

- (a) Above 100 (b) Below 100
 (c) Both (d) None

28. Concentration of salt used in preservation is
 (a) 10-15% (b) 15-20%
 (c) 20-25% (d) 25-30%
29. TSS of Jam should be
 (a) 68% (b) 65%
 (c) 50% (d) 40%
30. TSS of Tomato sauces should be
 (a) 25% (b) 28%
 (c) 30% (d) 35%
31. In Lye peeling, which chemical is used
 (a) K_2SO_4 (b) NaOH
 (c) KOH (d) All
32. Solution of salt in water is called as
 (a) Vinegar (b) Cider
 (c) Brine (d) Juice
33. Solution of sugar in water is called as
 (a) Jam (b) Jelly
 (c) Syrup (d) All
34. Removal of outer covering of fruits is known as
 (a) Lying (b) Peeling
 (c) Cutting (d) All
35. Father of canning is
 (a) Nicholus Appert (b) Needham
 (c) Frunk (d) Bergilius
36. Commonly used sprout suppressant in India is
 (a) Alar (b) Cycocal
 (c) MH (d) All
37. During storage diseases of Poato is caused by the bacteria
 (a) Pink rot (b) Dry rot
 (c) Soft rot (d) Late blight
38. Which is the acidifying agent used in vase solution
 (a) Sucrose (b) Citric acid
 (c) Quinoline (d) All
39. Bent neck disorder is found in
 (a) Rose (b) Carnation
 (c) Gerbera (d) Gladiolus
40. The Coconut variety suitable for making Ball copra
 (a) Pratap (b) West coast tall
 (c) Laccadweep Micro (d) Laccadweep Ordinary

41. Palm oil is obtained from which part of oil palm
 (a) Endocarp (b) Mesocarp
 (c) Epicarp (d) Endosperm
42. The term Alleppy is related to which crop
 (a) Ginger (b) Turmeric
 (c) Asafoetida (d) Garlic
43. Trymyristicin is major constituent of
 (a) Clove (b) Cinnamon
 (c) Nutmeg (d) Ginger
44. India's rank in seed trade in the world is
 (a) IInd (b) IVth
 (c) VIth (d) VIIIth
45. Among following varieties of tomato which is indeterminate type
 (a) Pusa gaurav (b) Pusa sheetal
 (c) Pusa ruby (d) Pusa early dwarf
46. Among following varieties of Brinjal which one is round type
 (a) Arka keshav (b) Arka Nidhi
 (c) Arka Navneet (d) Arka Kusumkar
47. Pusa Katki is the variety of
 (a) Cabbage (b) Cauliflower
 (c) Raddish (d) Carrot
48. Interstock used in Apple between scion and rootstock
 (a) M-IX (b) M-27
 (c) M-16 (d) M-23
49. Which chemical is used in Acid scarification
 (a) HSO_4 (b) HNO_3
 (c) H_2O_2 (d) All
50. Which is the recalcitrant seed
 (a) Guava (b) Fig
 (c) Datepalm (d) Mango
51. Evergreen fruit plants are propagated by means of
 (a) Hardwood cutting (b) Semihardwood cutting
 (c) Softwood cutting (d) All
52. Aonla is propagated by means of
 (a) T budding (b) Shield budding
 (c) Patch budding (d) Ring budding
53. Which is the beneficial nutrient
 (a) Na (b) Co
 (c) Both (d) None

54. Yellowing of leaf margins is typical symptom of deficiency of
 (a) Ca (b) Mg
 (c) N₂ (d) Sulphur
55. Rosette or little leaf symptoms occur due to the deficiency of
 (a) Cu (b) Zn
 (c) Bo (d) Mo

MATCH THE PAIRS

- A*
56. Acid soil
 57. Alkaline soil
 58. Saline soil
 59. Red soil
 60. Black soil

- B*
- (a) Smectite
 (b) Cl toxicity
 (c) Na toxicity
 (d) Al toxicity
 (e) Kaolinite

- Crop*
61. Tea
 62. Cocoa
 63. Mango
 64. Grape
 65. Guava

- Leading State*
- (a) Andhra Pradesh
 (b) UP
 (c) Assam
 (d) Kerala
 (e) Maharashtra

- Crop*
66. Brinjal
 67. French bean
 68. Cauliflower
 69. Raddish
 70. Carrot

- Variety*
- (a) Pusa himlata
 (b) Pusa Meghali
 (c) Pusa Chetki
 (d) Pusa Deepali
 (e) Pusa kranti

(D)

1. Which fruit contain maximum amount of vitamin B₂
 - (a) Mango
 - (b) Cashew
 - (c) Pineapple
 - (d) Ber

2. In tomato, flower fail to set fruit when the temperature in shade rises above _____ °C
 - (a) 10-20
 - (b) 42-50
 - (c) 5-10
 - (d) 20-30

3. Central coffee research institute is located at
 - (a) Lucknow
 - (b) Balahanur
 - (c) Kotayyam
 - (d) Mysore

4. Cole crop seedling should be transplanted at the age of _____ week
 - (a) 1-2
 - (b) 2-3
 - (c) 3-4
 - (d) 4-8

5. Which of the following variety of okra is suitable for hill region
 - (a) Annamallai
 - (b) Perkinlong
 - (c) Parbhani kranti
 - (d) Pusa purple cluster

6. Girdling is done in Grapes for the purpose of
 - (a) Increasing size of Berry
 - (b) Increasing TSS
 - (c) Early maturity
 - (d) All

7. For how many years raddish seed remain viable under favourable storage condition
 - (a) 1-2
 - (b) 10-15
 - (c) 7-8
 - (d) 4-5

8. Bending operation is not required for the natural horizontal growing variety of Guava
 - (a) L-49
 - (b) Kothrud
 - (c) Allahabad safeda
 - (d) All

9. In Ber crop _____ method is followed for seed treatment before seed propagation
 - (a) Mechanical scarification
 - (b) GA 400 PPM
 - (c) H₂SO₄
 - (d) All

10. Application of _____ PGR is effective in Grape for increasing berry size
 - (a) NAA
 - (b) GA-50
 - (c) GA-200 PPM
 - (d) IBA

11. In _____ method of propagation of mango pits are dug along the contour on hill slopes
 - (a) Veneer Grafting
 - (b) Insitu planting
 - (c) Inarch Grafting
 - (d) Coppice Grafting

12. During harvesting of mango fruit TSS should be at least
 - (a) 20°
 - (b) 12°
 - (c) 5°
 - (d) 25°

13. In _____ type of fig flowers are pistillate and fruits developed without pollination and fertilization
 - (a) Sanpedro fig
 - (b) Smyrna fig
 - (c) Capri fig
 - (d) Common fig

14. _____ is intermediate type of fig in which the 1st crop is known as 'Breha crop'
 (a) Sanpadro fig (b) Capri fig
 (c) Poona fig (d) All
15. Pineapple contains _____ which are responsible for pineapple flowering
 (a) Methyl propionate esters (b) Ethyle propionate esters
 (c) Vitamin-C (d) All
16. Papain extracted from immature papaya fruit contains digestive enzyme known as
 (a) Papainaze (b) Acetate
 (c) Both (d) None
17. Papaya fruit which is about _____ days old is selected for tapping
 (a) 75-80 (b) 100-110
 (c) 90-100 (d) None
18. According to CFTRI papain extraction is highest during _____ season
 (a) Winter (b) Summer
 (c) Rainy (d) All
19. Latex collected every time from immature papaya fruit should be dried at _____ °C temperature
 (a) 30-35 (b) 50-55
 (c) 10-25 (d) None
20. Spongy tissue in mango is one of the varietal character of Alphonso recorded _____ %
 (a) 10 (b) 15
 (c) 46 (d) 60
21. _____ variety of Banana is highly resistant to Panama disease but susceptible to bunchy top
 (a) Rajapuri (b) Harichal
 (c) Rajeli (d) Basari
22. For seed production programme onion seeds are sown 8-10 kg/hac in the month of
 (a) Jan-Feb (b) Oct-Nov
 (c) June-July (d) Feb-March
23. Vitamin which shorten blood clotting time and are rich source of leafy vegetables is
 (a) Vit-A (b) B
 (c) D (d) K
24. When seedling of tomato attain _____ cm height, irrigation should be withhold for 4-5 days
 (a) 5-10 (b) 3-5
 (c) 25-30 (d) 10-15
25. Variety of Potato suitable for hill area of H.P. and Punjab introduced from UK in the year 1953
 (a) Phulwa (b) Craigs Defiance
 (c) President (d) Kutri kuber
26. _____ variety of potato very early, photo insensitive suitable for plains of Northern India
 (a) Kufri chatmatkar (b) Kufri Naveen
 (c) Kufri Jyoti (d) Kufri Alankar

27. The fruits of Arecanut contains alkaloid
 (a) Arachine (b) Arecoline
 (c) Ardicme (d) None
-
28. _____ fruit drop known as IIIrd drop is attributed to some factor like lack of pollination in Apple
 (a) October (b) June
 (c) Summer (d) Monsoon
-
29. The vegetable prepared from white Brinjal fruit is said to be beneficial for person suffering from _____ disease
 (a) Diabetes (b) Paralysis
 (c) Pellagra (d) Cancer
-
30. Langra variety of mango bears _____ % perfect flower
 (a) 16 (b) 10
 (c) 5 (d) 66
-
31. In chrysantham the bud which appear Ist and singly in the centre is called as
 (a) Terminal bud (b) Prominent bud
 (c) Auxillary bud (d) Crown bud
-
32. _____ defeciency increase the tendency of Bolting in onion
 (a) Boron (b) P
 (c) N₂ (d) K
-
33. Which of the following growth regulator can be used for improving fruit set in tomato
 (a) GA-3 (b) 2-4-D
 (c) MH-40 (d) Ethophon
-
34. In cauliflower black rot disease is caused by
 (a) Fungi (b) Bacteria
 (c) Virus (d) Nematodes
-
35. In onion crop the insect which cause purple blotch disease is
 (a) White fly (b) Mosquito
 (c) Aphids (d) Thrips
-
36. Which of following is the primary centre of origin of water melon
 (a) India (b) America
 (c) Africa (d) Iran
-
37. Onion variety suitable for export and having yellow colour
 (a) Phule suwarna (b) N-53
 (c) Baswant-780 (d) All
-
38. Mucilaginous material present in okra fruit is used for preparation of icecream is
 (a) Glycolipid (b) Glycogene
 (c) Glycoprotein (d) Galactogene
-
39. The optimum mean temperature for best growth and development and max yield is about _____ °C
 (a) 10°C (b) 20°C
 (c) 35°C (d) 27°C

40. The total requirement of water in Banana crop is _____ hectare cm
 (a) 50 (b) 100
 (c) 200 (d) 250
41. For controlling Preharvest fruit drop of sweet orange spraying of _____ is effective
 (a) GA-3 (b) IAA
 (c) 2-4D (d) NAA
42. Bitterness in grape fruit Juice is due to presence of
 (a) Naringin (b) Biteracine
 (c) Streptocine (d) None
43. Which of following variety of tuberose is more widely cultivated than other types
 (a) Double flower (b) Single flower
 (c) Semi double (d) Multiple
44. Queen of Bulbous plant is
 (a) Tuberose (b) Gladiolus
 (c) Narcissus (d) Dafodill
45. The bark and juice of promogranate fruit is valued for the treatment of _____ disease
 (a) Cancer (b) Diarrhoa
 (c) Dysentry (d) Leprosy
46. During preparation of raisin, processed grape are dried till the water reduces to _____ %
 (a) 5-6 (b) 6-8
 (c) 10-12 (d) 13-15
47. Standing water in the form of lake is main feature of _____ garden
 (a) Mughal (b) Japanese
 (c) English (d) Italy
48. Development of shrivelled loose textured acidic berries in a bunch of Thomson seedless is called as
 (a) Mummification (b) Sumdgeing
 (c) Both (d) None
49. The average percentage of hermaphrodite flower in mango is
 (a) 20 (b) 10
 (c) 50 (d) 5
50. Which of the following variety of Banana is developed by tissue culture technique
 (a) Basrai (b) Harichal
 (c) Lalvelchi (d) Srimanti
51. Which of the following variety of chilli are used for pickle purpose
 (a) Jyoti (b) Sindur
 (c) CO-2 (d) All
52. Desuckering operation is followed in
 (a) Papaya (b) Banana
 (c) Potato (d) Cashew

MATCH THE PAIRS	
------------------------	--

<i>A</i>	<i>B</i>
53. RTS	(a) 68
54. Nector	(b) 40-50
55. Cordial	(c) 65
56. Squash	(d) 68
57. Syrup	(e) 10
58. Jam	(f) 15
59. Ketchup	(g) 30
60. Preserve	(h) 28
61. Agni Rekha	(a) Rose
62. Rajat Rekha	(b) Chrysanthamum
63. Happiness	(c) Gladiolus
64. Blue Moon	(d) Tuberose
65. Peach Blossom	(e) Rose
66. Mango	(a) 48
67. Coconut	(b) 24
68. Tomato	(c) 40
69. Potato	(d) 32
70. Chilli	(e) 24

(E)

1. The coconut development board is located
 (a) Gurgoan (b) Tripura
 (c) Cochin (d) Calicut
2. India shows the highest productivity of
 (a) Grapes (b) Guava
 (c) Mango (d) Banana
3. State of India leading in fruit production is
 (a) Karnataka (b) West Bengal
 (c) Maharashtra (d) Gujarat
4. Highest productivity of fruits is in
 (a) Karnataka (b) Maharashtra
 (c) Rajasthan (d) West Bengal
5. Mango covers an area of
 (a) 36% (b) 36.60%
 (c) 37.60% (d) 35%
6. Dashehari mango is obtained
 (a) 2 months late in South India (b) 2 months late in West India
 (c) 2 months early in South India (d) 2 months early in West India
7. India's rank in potato production is
 (a) 1st (b) 2nd
 (c) 3rd (d) 4th
 (e) 5th
8. Loose flowers in India cover an area of
 (a) > 2/3rd (b) > 3/4th
 (c) 1/4th (d) 1/2
9. Major arecanaut producing state is
 (a) Kerala (b) Karnataka
 (c) Maharashtra (d) Andhra Pradesh
10. Commercial plantation crop was the status given at National botanical garden Kolkata to
 (a) Arecanut (b) Coconut
 (c) Oil palm (d) Palmry palm
11. How much % of global share of cashewnut comes from India
 (a) 40% (b) 42.7%
 (c) 44.7% (d) 45.7%
12. Highest cocoa producer is _____
 (a) Karnataka 80% (b) Kerala, 80%
 (c) Maharashtra (d) A.P., 80%
13. India is _____ largest tea producer
 (a) 1st (b) IInd
 (c) IIIrd (d) IVth

14. Share of chilli in total production of spice is
 (a) 40% (b) 42%
 (c) 30% (d) 32%
-
15. Banana grows well in a mean monthly temperature of
 (a) 27°C (b) 26.5°C
 (c) 25.5°C (d) 27.5°C
-
16. Agroeco region-2 comprises of
 (a) Western part of Rajasthan (b) Western part of Maharashtra
 (c) Western Himalayas (d) None
-
17. Red soils occupy an area of
 (a) 109 million ha (b) 100 mha
 (c) 107 mha (d) 60 mha
-
18. Al toxicity is observed in
 (a) Alfisols (b) Ultisols
 (c) Oxisols (d) Histosols
-
19. Deficiency of B and Mo is observed in
 (a) Alfisols (b) Ultisols
 (c) Oxisols (d) Histosol
-
20. Vertisols show the deficiency of
 (a) Al. (b) Zn.
 (c) Bo (d) Mo
-
21. Leaf bronzing in guava is due to
 (a) Fe toxicity (b) Al toxicity
 (c) Zn toxicity (d) None
-
22. Highest pineapple producer is
 (a) Assam (b) Gujrat
 (c) West Bengal (d) Maharashtra
-
23. In India _____ land in acidic state is
 (a) 60 mha (b) 50 mha
 (c) 10 mha (d) 40 mha
-
24. Spacing followed in custard apple is
 (a) 4 × 4 mts. (b) 4.5 × 45 mts.
 (c) 5.5 × 5.5 m (d) 6.5 × 6.5 mts.
-
25. Early summer pruning is referred to
 (a) Pruning after flowering period when shoot is succulent
 (b) Pruning before flowering period when shoot is succulent
 (c) Pruning done at resting period
 (d) None

26. Zn is element in the soil
 (a) Mobile (b) Immobile
 (c) Both (d) None
27. Structural and mobile elements in plants are
 (a) Mo, B, Zn (b) N, S, P.
 (c) k, Ca, Mg (d) None
28. Mineral source of 'k' is
 (a) Mica (b) Feldspar
 (c) Apatite (d) Both and and b
29. Content of chlorophyll is
 (a) Zn (b) Mg
 (c) Fe (d) C
30. In sulphur defecient plants shlorosis is 1st observed in
 (a) Old leaves (b) Young leaves
 (c) Both (d) None
31. Fe deficient plants show chlorosis first in
 (a) Young leaves (b) Old leaves
 (c) Short tips (d) All
32. Activity of Ethylene in fruit ripening is maintained by
 (a) Fe (b) Cu
 (c) Mo (d) Ca
33. _____ helps in nitrogen metabolism
 (a) Fe (b) Mn
 (c) Mo (d) Ca
34. Oldest propagation method of mango is
 (a) Stone grafting (b) Inarching
 (c) Veneer Grafting (d) Bridge Grafting
35. St. george is a rootstock of _____ resistant to _____
 (a) Grape, wilt (b) Grape, Powdery mildew
 (c) Guava, anthracnose (d) Grape, phy lloxera pest
36. Guava, Ber, aonla seeds are sown in
 (a) June-July (b) Feb-March
 (c) May-June (d) Sept-Oct
37. Cryopreservation by liquid N₂ is 196°C and that by carbon is
 (a) -23°C (b) -33°C
 (c) -43°C (d) -53°C
38. Tongue grafting is a modified form of
 (a) Whip grafting (b) Saddle grafting
 (c) Inarching (d) None

39. is a form of repair grafting.
 (a) Bridge Grafting (b) Top working
 (c) Both (d) None
-
40. Spring budding is commonly done in
 (a) Mango (b) Guava
 (c) Citrus (d) Mangosteen
-
41. Punjab kesri is a variety of
 (a) Brinjal (b) Onion
 (c) Tomato (d) None
-
42. Arka Nidhi, Azad kranti, Pusa kranti are
 (a) Round type of Brinjal (b) Long type of Brinjal
 (c) Short type of Brinjal (d) None
-
43. Bonneville is a variety of
 (a) Peas (b) Beans
 (c) Tomato (d) Potato
-
44. Premier is a variety of
 (a) Peas (b) Beans
 (c) Tomato (d) Chilli
-
45. Pusa Early Rajni is a variety of
 (a) French bean (b) Cluster Bean
 (c) Dolichos Bean (d) None
-
46. Pusa Aghani is a variety of
 (a) Knolkhol (b) Cabbage
 (c) Cauliflower (d) None
-
47. Large green is a variety of
 (a) Knolkhol (b) Cabbage
 (c) Cauliflower (d) Broccoli
-
48. For production of seed _____ spp. of marigold is beneficial
 (a) T. erecta (b) T. pahela
 (c) T. patula (d) None
-
49. Major biting taste of Black pepper is due to
 (a) Eugenol (b) Piperine
 (c) Flavonoids
-
50. Curing of cardamona is
 (a) Drying at hot temperature (b) Drying at low temperature
 (c) Drying at medium temperature (d) None

MATCH THE PAIRS

- A*
51. Cardamom
 52. Riode-Janeiro
 53. Himacha
 54. Clove
 55. Nutmeg
 56. Black pepper

- B*
- (a) Raw ginger
 - (b) Teepinyl acetate
 - (c) Eugenol 85%
 - (d) Trymyristicin
 - (e) Subhakara, Balankotta
 - (f) Dry ginger

- A*
57. Gladiolus
 58. Cassava
 59. Sweet potato
 60. Lanamarin, linaustralin
 61. Tripsin inhibitor
 62. Sodium Benzoate

- B*
- (a) 9-12 months
 - (b) Grey mould in storage
 - (c) 4 months
 - (d) Sweet potato
 - (e) Coloured products
 - (f) Cassava

(F)

1. **Bajrang Bahadur Singh Bhadri is related with**
 (a) Chrysanthamum (b) Tulip
 (c) Orchid (d) Gladiolus
2. **Most of the chrysanthamum cultivars are**
 (a) Short day types (b) Long day types
 (c) Day neutral types (d) None
3. **Bouganvillia belong to family**
 (a) Nyctaginaceae (b) Combertaceae
 (c) Rosaceae (d) None
4. **Pelargonium anthocyanidin present in which colour**
 (a) Blue (b) Yellow
 (c) Orange-red (d) White
5. **Genetic male sterility is very common in**
 (a) China Aster (b) Marigold
 (c) Gaillardia (d) Dahlia
6. **Origin of chrysanthamum is**
 (a) China (b) Japan
 (c) South Africa (d) Mexico
7. **The word Gladiolus is derived from**
 (a) Latin (b) Arabian
 (c) French (d) English
8. **Optimum temperature for storing spikes of Gladiolus is**
 (a) 1.7–4.4°C (b) 4.5–7.2°C
 (c) 0–1°C (d) –1 to 0°C
9. **Transval daisy is another name of**
 (a) Chrysanthamum (b) Dahlia
 (c) Gerbera (d) Marigold
10. **Sleepiness is associated with**
 (a) Gladiolus (b) Tulip
 (c) Carnation (d) Chrysanthamum
11. **Popular thornless rootstock of Rose is**
 (a) Grandgala (b) Mercedes
 (c) Motrea (d) All
12. **In cut roses, minimum vase life should be**
 (a) 10 days (b) 20 days
 (c) 8 days (d) 12 days
13. **In Rosa damascene oil percentage is**
 (a) 0.03% (b) 0.2%
 (c) 0.1% (d) 0.5%

14. Which is known as peruvian lily
 (a) Gladiolus (b) Kaiferlily
 (c) Nargis (d) Alstromeria
15. Which city is regarded as foliage capital of world
 (a) Washington (b) Sydney
 (c) Florida (d) Tokyo
16. Leading Rose producing state in India is
 (a) TN (b) Maharashtra
 (c) Karnataka (d) West Bengal
17. Which loose flower cant be stored in cold storage below 15°C
 (a) Rose (b) Chrysanthamum
 (c) Crossandra (d) All
18. What is pot porries
 (a) Flower arrangement (b) Style of Gardening
 (c) Item in landscape (d) None
19. _____ has beautiful natural dried seeds
 (a) Indian liquorice (b) Hedra
 (c) Marigold (d) Woodrose
20. CO₂ concentration in Green House for Rose Growing is
 (a) Upto 500 ppm (b) 500-1000 ppm
 (c) 1000-3000 ppm (d) 4000 ppm
21. Treatment of cut flower after harvesting with high concentration of sugar is
 (a) Pulsing (b) Hardening
 (c) Loading (d) None
22. One kg rose oil is extracted from _____ Flowers
 (a) 10 g (b) 3.5 tonnes
 (c) 1.5 tonnes (d) 50 kg
23. Bonsai is originated from
 (a) China (b) Japan
 (c) Australia (d) India
24. In which flower arrangement fruit, flower and foliage are used
 (a) Ikebana (b) Morimona
 (c) Nagerii (d) All
25. Bottom heating technique is useful in propagation of
 (a) Coleus (b) Bouganvillia
 (c) Aracaria (d) Rose
26. Offesets are mainly used to propagate
 (a) Agave (b) Pandanus
 (c) Aloe (d) All

27. **Delonix regia is commonly known as**
 (a) Red Gulmohar (b) Yellow Gulmohar
 (c) Pink Gulmohar (d) Any one
-
28. **Which is foliage annual**
 (a) Kochia (b) Aster
 (c) Salvia (d) Cosmos
-
29. **Seed of which annual germinate only in dark**
 (a) Zinnia (b) Nigella
 (c) Marigold (d) Aster
-
30. **Carissa carandus is used for**
 (a) Ornamental (b) Hedge
 (c) Fruit (d) Fence
-
31. **KMS used for the preservation of**
 (a) Coloured product (b) Colourless product
 (c) Both (d) None
-
32. **Chutney should have how much % of acidity**
 (a) 2% (b) 0.2%
 (c) 1% (d) 1.5%
-
33. **TSS of thompson seedless grape is**
 (a) 12-14% (b) 18-22%
 (c) 14-16% (d) 10-12%
-
34. **N and P in excess amount**
 (a) Improve quality of fruits (b) Deteriorate quality of fruits
 (c) Not effect quality (d) None
-
35. **The book entitled 'Beautiful Gardens' is written by**
 (a) V. Swarup (b) T.K. Bose
 (c) M.S. Randhawa (d) K.L. Chadda
-
36. **Summer annuals are transplanted in the month of**
 (a) Oct-Nov (b) Dec-Jan
 (c) July-Aug (d) Feb-March
-
37. **In fruit canning and pickling salt act as an**
 (a) Oxidant (b) Antioxidant
 (c) Reductant (d) Enzyme
-
38. **Acidic fruits can easily be sterilized at**
 (a) 88°C temp. (b) 100°C temp.
 (c) 112°C temp. (d) 116°C temp.
-
39. **Which shows alkaline reaction**
 (a) Auxins (b) Gibberellic acid
 (c) Cytokinin (d) Ethylene

40. Central leader system is common method of training in
 (a) Vines (b) Shrubs
 (c) Annuals (d) Trees
41. During sealing of cans temperature should not fall below
 (a) 60°C (b) 74°C
 (c) 100°C (d) 116°C
42. The residual moisture in dehydrated vegetables should be
 (a) More than 9% (b) Less than 6-8%
 (c) More than 10-11% (d) Less than 9-10%
43. Which is the scented variety of Gladiolus
 (a) Eurovision (b) Friendship
 (c) Oscar (d) Lucky star
44. Which is known as "9 O'clock" plant
 (a) Balsam (b) Portulaca
 (c) Nastursium (d) Rose
45. Mango pieces are dipped before pickling in the solution of
 (a) 2% salt (b) 15% salt
 (c) 2% sugar (d) 10% sugar
46. National research centre for spices is recorganised as IISR in
 (a) 1988 (b) 1990
 (c) 1992 (d) 1995
47. For preservation of fruit juices, concentration of 'Sodium benzoate' should be
 (a) 0.1-0.5% (b) 0.06-0.10%
 (c) 0.5-1.0% (d) 1.1-2.0%
48. Cassia alata is a flowering
 (a) Tree (b) Bush
 (c) Climber (d) Annuals
49. The removal of dried flowered shoots in canna is known as
 (a) Training (b) Deshooting
 (c) Mattocking (d) Dehorning
50. During transportation 'cut flowers' are affected by
 (a) Hydrotropism (b) Phototropism
 (c) Geotropism (d) Chemotropism

MATCH THE PAIRS

A	B
1. Chrysanthamum	(a) 12
2. Dahlia	(b) 7
3. Marigold	(c) 9
4. Gladiolus	(d) 8
5. Rose	(e) 15
<i>Place</i>	
6. Roshanara park	(a) Mysore
7. Brindavan Garden	(b) Lahore
8. Bryant Park	(c) New Delhi
9. Chasma-a-shahi	(d) Kodaikanal
10. Shalimar Garden	(e) Srinagar
<i>Variety</i>	
11. Chrysanthamum	(a) Pusa Tara
12. Tuberose	(b) Shaheed Bhagat Singh
13. Coreopsis	(c) Sonlar bangla
14. Croton	(d) Suvashini
15. Hibiscus	(e) Bharat Sundari
<i>C.N.</i>	
16. Amaranthus	(a) Blanket Flower
17. Gaillardia	(b) Crown daisy
18. Annual chrysanthamum	(c) Hyacinth flower
19. Brachycome	(d) Love lies bleeding
20. Candytuft	(e) Swan river daisy
<i>Flower colour</i>	
21. Barlaria	(a) White
22. Thunbergia	(b) Violet
23. Kamini	(c) Purple
24. Railway creeper	(d) Viloet blue
25. Passion flower	(e) Purple
26. Clerodendron	(a) Aristolochiaceae
27. Bouganvilla	(b) Apocynaceae
28. Duck flower	(c) Nyctan-ginaceae
29. Indian Ivy creeper	(d) Verbanaceae
30. Thevattia	(e) Moraceae

- | | |
|----------------------------|----------------------------------|
| 31. Rose | (a) Butter scotch |
| 32. Chrysanthamum | (b) Pico |
| 33. Gladiolus | (c) Pusa sonia |
| 34. Carnation | (d) Pusa suvasini |
| 35. Marigold | (e) Nanako |
| 36. Anthurium | (a) 0-4°C |
| 37. Orchid | (b) 0.5-2°C |
| 38. Carnation | (c) 13°C |
| 39. Chrysanthamum | (d) 5-7°C |
| 40. Rose | (e) 0-1°C |
| 41. Sunkun Garden | (a) English Garden |
| 42. Wells | (b) Italian Garden |
| 43. Baradari | (c) Rastrapati Bhawan |
| 44. Char Bag | (d) Japanese Garden |
| 45. Roshanhara Park | (e) Moughal Garden |
| 46. Perlite | (a) Preservative |
| 47. Ethylene | (b) Sea lavender |
| 48. Orchid | (c) Flemming flower |
| 49. Statice | (d) Substitute for sand |
| 50. Anthurium | (e) Angiosperm |
| 51. Compound fertilizer | (a) Improvement over grannules |
| 52. Ca defeciency | (b) Sulphur defeciency |
| 53. Zn defeciency | (c) Common in citrus |
| 54. Tea yellow disease | (d) Gypsum application |
| 55. Prilled fertilizers | (e) Supply two or more elements |
| 56. Pansy | (a) Thoughts |
| 57. Narcissus | (b) Regard |
| 58. Iris | (c) Luxary |
| 59. Stock | (d) Message |
| 60. Daffodil | (e) Self esteem |
| 61. Guava | (a) Aonla |
| 62. Vitamin-A | (b) Bael |
| 63. Vitamin-B ₁ | (c) Fibre |
| 64. Vitamin C | (d) Cashewnut |
| 65. Vitamin B ₂ | (e) Mango |
| 66. Chilling temperature | (a) Glycerol |
| 67. Softening process | (b) -196°C liquid N ₂ |

68. KNO_3 (c) Stratification
(d) Chemical treatment
69. Cryopreservation (e) Scarification
-
70. Cryoprotactants (a) Iron
-
71. Basic nutrient (b) Calcium
72. Macro nutrient primary (c) Carbon
73. Micro nutrient (d) Nitrogen
74. Beneficial element (e) Sodium
75. Secondary element
-
76. Axile Placentation (a) Cocoa
77. Marginal Placentation (b) Ber
78. Perietal Placentation (c) Papaya
79. Basal placentation (d) Litchi
80. Vivipary (e) Banana
-
81. Cloudy Jelly (a) Due to moulds
82. Crystalization Jelly (b) 0.5–0.6%
83. Pectin in Jelly (c) Due to excess sugar
84. Acidity in Jam (d) Due to over cooking
85. Browning of Marmalade (e) 0.5–1%
-
86. Gardening in India (a) B.P. Pal
87. Flowering shrubs in India (b) S.L. Jindal
88. Beautiful climbers of India (c) M.S. Randhawa
89. Fruit growing in India (d) W.B. Hayes
90. Vegetable crops of India (e) K.S. Yawalkar
-
91. Shitake (a) *Auricularia polytricha*
92. Wood ear mushroom (b) *Volvariella volvacea*
93. White button mushroom (c) *Pleurotus florida*
94. Oyster mushroom (d) *Lentinula edodes*
95. Paddy straw mushroom (e) *Agaricus bisporus*
-
96. D.G. (ICAR) (a) Dr. G. Kalloo
97. D.D.G Horti (ICAR) (b) Dr. Mathura Rai
98. Director (CISH) (c) Dr. B.S. Dhillon
99. Director (NBPGR) (d) Dr. Mangla Rai
100. Director (IIVR) (e) Dr. R.K. Pathak

ANSWERSHEET I

MULTIPLE CHOICE QUESTIONS

(A)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (c) | 3. (a) | 4. (b) | 5. (d) | 6. (c) | 7. (a) | 8. (a) |
| 9. (d) | 10. (a) | 11. (d) | 12. (b) | 13. (c) | 14. (b) | 15. (c) | 16. (d) |
| 17. (b) | 18. (c) | 19. (b) | 20. (b) | 21. (b) | 22. (b) | 23. (d) | 24. (b) |
| 25. (b) | 26. (c) | 27. (d) | 28. (a) | 29. (a) | 30. (b) | 31. (c) | 32. (c) |
| 33. (c) | 34. (c) | 35. (d) | 36. (c) | 37. (c) | 38. (b) | 39. (a) | 40. (c) |
| 41. (b) | 42. (c) | 43. (c) | 44. (b) | 45. (b) | 46. (a) | 47. (b) | 48. (c) |
| 49. (b) | 50. (c) | | | | | | |

MATCH THE PAIRS

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 51. (d) | 52. (c) | 53. (a) | 54. (e) | 55. (b) | 56. (e) | 57. (c) | 58. (a) |
| 59. (b) | 60. (d) | 61. (c) | 62. (d) | 63. (a) | 64. (e) | 65. (b) | 66. (e) |
| 67. (d) | 68. (a) | 69. (c) | 70. (b) | | | | |

(B)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (a) | 3. (a) | 4. (a) | 5. (d) | 6. (b) | 7. (d) | 8. (c) |
| 9. (d) | 10. (c) | 11. (b) | 12. (a) | 13. (b) | 14. (a) | 15. (b) | 16. (b) |
| 17. (c) | 18. (a) | 19. (a) | 20. (c) | 21. (b) | 22. (b) | 23. (c) | 24. (c) |
| 25. (b) | 26. (b) | 27. (a) | 28. (a) | 29. (c) | 30. (c) | 31. (b) | 32. (b) |
| 33. (b) | 34. (a) | 35. (b) | 36. (b) | 37. (b) | 38. (c) | 39. (b) | 40. (c) |
| 41. (b) | 42. (b) | 43. (a) | 44. (a) | 45. (a) | 46. (b) | 47. (a) | 48. (b) |
| 49. (b) | 50. (c) | | | | | | |

(C)

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (a) | 4. (c) | 5. (c) | 6. (b) | 7. (c) | 8. (c) |
| 9. (b) | 10. (d) | 11. (c) | 12. (b) | 13. (c) | 14. (c) | 15. (c) | 16. (d) |
| 17. (b) | 18. (c) | 19. (b) | 20. (b) | 21. (b) | 22. (c) | 23. (d) | 24. (c) |
| 25. (b) | 26. (b) | 27. (a) | 28. (b) | 29. (a) | 30. (c) | 31. (b) | 32. (c) |
| 33. (c) | 34. (b) | 35. (a) | 36. (c) | 37. (c) | 38. (b) | 39. (a) | 40. (c) |
| 41. (b) | 42. (b) | 43. (c) | 44. (d) | 45. (c) | 46. (c) | 47. (b) | 48. (a) |
| 49. (d) | 50. (d) | 51. (b) | 52. (c) | 53. (c) | 54. (b) | 55. (b) | |

MATCH THE PAIRS

- | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 56. (d) | 57. (c) | 58. (b) | 59. (e) | 60. (a) | 61. (c) | 62. (d) | 63. (a) |
| 64. (e) | 65. (b) | 66. (e) | 67. (a) | 68. (d) | 69. (c) | 70. (b) | |

(D)							
1. (b)	2. (b)	3. (b)	4. (c)	5. (b)	6. (d)	7. (d)	8. (a)
9. (d)	10. (b)	11. (b)	12. (a)	13. (d)	14. (a)	15. (a)	16. (a)
17. (c)	18. (c)	19. (b)	20. (c)	21. (d)	22. (b)	23. (d)	24. (d)
25. (b)	26. (d)	27. (b)	28. (b)	29. (a)	30. (d)	31. (d)	32. (c)
33. (b)	34. (b)	35. (d)	36. (c)	37. (a)	38. (c)	39. (d)	40. (d)
41. (c)	42. (a)	43. (b)	44. (b)	45. (d)	46. (d)	47. (b)	48. (a)
49. (b)	50. (d)	51. (d)	52. (b)				

MATCH THE PAIRS

53. (e)	54. (f)	55. (g)	56. (b)	57. (c)	58. (a)	59. (h)	60. (d)
61. (c)	62. (d)	63. (a)	64. (e)	65. (b)	66. (c)	67. (d)	68. (e)
69. (a)	70. (b)						

(E)							
1. (c)	2. (a)	3. (c)	4. (a)	5. (c)	6. (c)	7. (e)	8. (a)
9. (b)	10. (c)	11. (c)	12. (b)	13. (a)	14. (d)	15. (b)	16. (a)
17. (c)	18. (a)	19. (h)	20. (b)	21. (b)	22. (a)	23. (b)	24. (b)
25. (a)	26. (b)	27. (b)	28. (d)	29. (b)	30. (b)	31. (a)	32. (b)
33. (c)	34. (b)	35. (d)	36. (b)	37. (c)	38. (a)	39. (a)	40. (c)
41. (c)	42. (b)	43. (a)	44. (b)	45. (c)	46. (c)	47. (c)	48. (b)
49. (b)	50. (b)						

MATCH THE PAIRS

51. (b)	52. (a)	53. (f)	54. (c)	55. (d)	56. (e)	57. (b)	58. (a)
59. (c)	60. (f)	61. (d)	62. (e)				

(F)							
1. (d)	2. (a)	3. (a)	4. (c)	5. (b)	6. (a)	7. (a)	8. (a)
9. (c)	10. (c)	11. (a)	12. (d)	13. (a)	14. (c)	15. (c)	16. (b)
17. (c)	18. (a)	19. (a)	20. (b)	21. (a)	22. (b)	23. (a)	24. (b)
25. (b)	26. (d)	27. (a)	28. (a)	29. (b)	30. (b)	31. (b)	32. (c)
33. (b)	34. (b)	35. (c)	36. (d)	37. (b)	38. (b)	39. (c)	40. (d)
41. (b)	42. (b)	43. (d)	44. (b)	45. (a)	46. (d)	47. (b)	48. (b)
49. (c)	50. (c)						

MATCH THE PAIRS

1. (c)	2. (d)	3. (a)	4. (e)	5. (b)	6. (c)	7. (a)	8. (d)
9. (e)	10. (b)	11. (c)	12. (b)	13. (a)	14. (d)	15. (e)	16. (d)
17. (a)	18. (b)	19. (c)	20. (e)	21. (c)	22. (b)	23. (a)	24. (e)
25. (d)	26. (d)	27. (c)	28. (a)	29. (b)	30. (e)	31. (c)	32. (e)
33. (d)	34. (b)	35. (a)	36. (c)	37. (d)	38. (e)	39. (b)	40. (a)
41. (c)	42. (d)	43. (e)	44. (b)	45. (a)	46. (d)	47. (a)	48. (e)
49. (b)	50. (c)	51. (e)	52. (d)	53. (c)	54. (b)	55. (a)	56. (a)
57. (e)	58. (d)	59. (c)	60. (b)	61. (c)	62. (e)	63. (d)	64. (a)
65. (b)	66. (c)	67. (e)	68. (d)	69. (b)	70. (a)	71. (c)	72. (d)
73. (a)	74. (e)	75. (b)	76. (e)	77. (d)	78. (c)	79. (b)	80. (a)
81. (d)	82. (c)	83. (e)	84. (b)	85. (a)	86. (c)	87. (b)	88. (a)
89. (d)	90. (e)	91. (d)	92. (a)	93. (e)	94. (c)	95. (b)	96. (d)
97. (a)	98. (e)	99. (c)	100. (b)				

PART-V
TABLES

TABLES

1. MAJOR INDIAN STATES CULTIVATING SPECIFIC FRUITS

<i>Sr. No.</i>	<i>Name of the fruits</i>	<i>States</i>
1.	Mango	Uttar Pradesh, Maharashtra, Gujarat, Bihar, Andhra Pradesh, West Bengal
2.	Banana	Maharashtra, Tamil Nadu, Karnataka, Bihar, West Bengal, Gujarat
3.	Citrus	Maharashtra, Tamil Nadu, Punjab, Karnataka, Assam
4.	Apple	Himachal Pradesh, Jammu-Kashmir, Uttar Pradesh
5.	Litchi	Bihar, West Bengal, Uttar Pradesh
6.	Sapota	Maharashtra, Gujarat, Karnataka
7.	Guava	Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra
8.	Pineapple	Karnataka, Kerala, Orissa, Bihar, North-East State
9.	Papaya	Kerala, Bihar, Karnataka, Uttar Pradesh, Tamil Nadu, Maharashtra
10.	Pomegranate	Maharashtra, Karnataka, Andhra Pradesh

2. FRUITS AND PROCESSED PRODUCTS

<i>Fruits</i>	<i>Processed products</i>
Mango	Juice, Jam, Squash, Syrup, Pickle, Mango, Powder, Toffee, Canned Mango.
Guava	Jam, Jelly, Pickle, Powder, Puree, Peru Khand.
Orange	Juice, Jam, Squash, Syrup.
Custard Apple	Jam, Puree, Powder.
Grapes	Bedana (Kishmish), Jam, Juice, Syrup, Squash and Wine.
Jamun	Juice, Squash, Syrup, Jam, Jelly, Toffee, Seed Powder.
Ber	Ber candy, Ber powder, Ber dates, Ber squash, Syrup, Jam and Dried ber.
Papaya	Jam, Marmalade, Tutti-frutti (candy), Pickle, Wafers (Papad), Chocolate, Cannel papaya, Fridge dried papaya.
Pomegranate	Pomegranate Juice, Jelly, Syrup, Squash, Nectar, Anar rub, Anar crush, Dried pomegranate (Anar Dana), Powder, Pomegranate wine.
Chikku (Sapota)	Chikku Juice (RTS), Squash, Syrup, Jam, Toffee, Candy, Dried Fruit Scrap and Powder, Milk Shake, Ice cream.
Banana	Banana Powder, Banana Flour, Banana Puree, Banana Chips, Banana Jam and Banana Jelly, Banana vinegar, Sweet coat banana.
Anola (Amla)	Juice, Syrup, Squash, Sweet Syruped Anola, Pickle, Dried Anola and in Ayurvedic Medicine.

3. NUTRIENT-WISE RICHNESS OF IMPORTANT FRUITS

Vitamin 'A' richness		Protein richness	
Fruits (F)		Cashewnut	21.20%
Mango	4800 IU/100 g	Almond	20.8%
Papaya	2020 IU/100 g	Walnut	15.60%
Vitamin 'B₁' (Thiamine) richness		Fat richness	
Cashewnut	630 mg/100g	Walnut	64.50%
Walnut	450 mg/100g	Almond	58.9%
Apricot (dry)mg/100g		Cashewnut	46.90%
		Avocado	22.80%
Vitamin 'B₂' (Riboflavin) richness		Fibre richness	
Beal	1191 mg/100g	Guava	6.90%
Papaya	250 mg/100g	Kaintha	5.20%
Litchi	122.5 mg/100g	Pomegranate	5.10%
		Aonla	3.40%
Vitamin 'C' richness		Grape	3.00%
Barbados cherry	1000-4000.mg/100g	Walnut	2.60%
Aonla	600 mg/100g	Calcium richness	
Guava	299 mg/100g	Litchi	0.21%
Lime	63 mg/100g	Karonda	0.16%
Sweet orange	5017 mg/100g	Kaintha	0.13%
Lemon	39 mg/100g	Phosphorus richness	
Carbohydrate richness		Cashewnut	0.45%
Apricot (dry)	72.81%	Walnut	0.38%
Date (pind)	67.30%	Litchi	0.30%
Karonda (dry)	67.10%	Kaintha	0.11%
Banana	36.40%	Iron richness	
Bael	30.6%	Dry Karonda	39.1%
Custard apple	23.90%	Date (pind)	10.6%
Cashewnut	22.37%	Cashewnut	5.0%
Jamun	19.7%	Walnut	4.80%
Jackfruit	18.9%		
Tapioca	38.1%		

4. AREA AND PRODUCTION OF HORTICULTURE CROPS IN INDIA (2013-14)

S.No.	Crop	Area	Production
		93.96	1628.97
1.	Vegetables	72.16	889.77
2.	Fruits	36.75	163.01
3.	Plantation crops	31.63	59.08
4.	Spices	2.55	22.97
5.	Flowers	4.93	8.95
6.	Aromatics & medicinal plants	NA	0.76
7.	Mushroom		

Area: Lakh Hectare, Production : Lakh MT, Productivity : MT/Hectare

5. AREA AND PRODUCTION OF MAJOR FRUITS CROPS IN INDIA (2013-14)

S.No.	Crop	Area	Production	Productivity
1.	Banana	8.03	297.25	37.0
2.	Mango	25.16	184.31	7.3
3.	Citrus	10.78	111.47	10.3
4.	Papaya	1.33	56.39	42.3
5.	Apple	1.19	25.85	21.8
6.	Grapes	1.10	17.37	15.8
7.	Sapota	1.77	17.44	9.9
8.	Pineapple	3.13	24.98	8.0
9.	Pomegranate	1.31	13.46	10.3
10.	Guava	2.68	36.68	13.70

Area: Lakh hectare, Production : Lakh MT, Productivity: MT/ hectare

6. AREA AND PRODUCTION OF MAJOR VEGETABLES IN INDIA (2013-14)

S.No.	Crop	Area	Production	Productivity
1.	Potato	19.73	415.55	21.1
2.	Onion	8.82	187.36	21.2
3.	Tomato	12.04	194.02	16.1
4.	Brinjal	7.11	135.58	19.1
5.	Tapioca	2.28	81.39	35.7
6.	Cabbage	4.00	90.39	22.6
7.	Cauliflower	4.34	85.73	19.8
8.	Okra	5.33	63.46	11.9
9.	Peas	4.34	38.39	8.9
10.	Sweet potato	1.06	10.88	10.3

Area: Lakh hectare, Production : Lakh MT, Productivity: MT/ hectare

7. AREA AND PRODUCTION OF MAJOR PLANTATION CROPS IN INDIA (2013-14)

<i>S.No.</i>	<i>Crop</i>	<i>Area</i>	<i>Production</i>	<i>Productivity</i>
1.	Coconut	21.40	149.11	7
2.	Cashew nut	10.11	7.53	0.7
3.	Areca nut	4.52	6.22	1.4
4.	Cocoa	0.71	0.15	0.2

Area: Lakh hectare, Production : Lakh MT, Productivity: MT/ hectare

8. AREA AND PRODUCTION OF MAJOR SPICES IN INDIA (2013-14)

<i>S.No.</i>	<i>Crop</i>	<i>Area</i>	<i>Production</i>	<i>Productivity</i>
1.	Chillies	7.75	14.92	1.9
2.	Turmeric	2.33	11.90	5.1
3.	Garlic	2.31	12.52	5.4
4.	Ginger	1.33	6.55	4.9
5.	Coriander	4.47	3.14	0.7
6.	Tamarind	0.59	1.88	3.2
7.	Cumin	8.59	5.14	0.6
8.	Pepper	1.24	0.51	0.4
9.	Fennel	0.54	0.70	1.3

Area: Lakh hectare, Production : Lakh MT, Productivity: MT/ hectare

9. EXPORT OF HORTICULTURE PRODUCE BY INDIA

<i>S.No.</i>	<i>Product</i>	<i>Quantity (MT)</i>	<i>Value (lakhs)</i>
1.	Fresh Onions	1378373.17	1166330.57
2.	Fresh Mangoes	79060.88	14153.55
3.	Fresh Grapes	85897.79	30192.45
4.	Walnuts	6062.06	61803.06
5.	Floriculture	42016.6	64983.50
6.	Dried and Preserved vegetables	118787.46	42406.20
7.	Mango pulp	166835.52	50582.79
8.	Pickel and Chutneys	14527.06	29350.48

10. MAJOR FRUIT PRODUCING COUNTRIES IN THE WORLD (2013-14)

S.No	Country	Area	Production	Productivity
1.	China	118.34	1370.66	11.6
2.	India	72.16	889.77	12.3
3.	Brazil	23.25	383.68	16.5
4.	USA	11.37	265.48	23.3
5.	Indonesia	7.96	177.44	22.3
6.	Philippines	12.40	163.70	13.2
7.	Mexico	12.56	159.17	12.7
8.	Turkey	11.02	149.74	13.6
9.	Spain	15.39	139.96	9.1
10.	Italy	11.25	138.89	12.3
11.	Others	279.24	2705.94	9.7
	World Total	5749.94	6544.49	11.4

11. MAJOR VEGETABLES PRODUCING COUNTRIES IN THE WORLD (2013-14)

S.No.	Country	Area	Production	Productivity
1.	China	245.60	5739.35	23.4
2.	India	93.96	1628.96	17.3
3.	USA	11.04	359.47	32.5
4.	Turkey	11.11	278.18	25.0
5.	Iran	8.76	234.85	26.8
6.	Egypt	7.72	198.25	25.7
7.	Russia	7.90	160.84	20.3
8.	Others	205.47	2998.7	
	World Total	591.61	11598.8	19.6

Area: Lakh hectare, Production : Lakh MT, Productivity: MT/ hectare

12. STATES WITH HIGHEST BANANA PRODUCTION IN INDIA (2013-14)

S. No.	State	In '000 MT (2013-14)
1.	Tamil Nadu	5650.00
2.	Maharashtra	4830.60
3.	Gujarat	4225.49
4.	Andhra Pradesh	3166.90
5.	Karnataka	2675.63
6.	Madhya Pradesh	1735.00
7.	Bihar	1435.78
8.	West Bengal	1097.50
9.	Assam	857.72
10.	Odisha	476.60
	Others	3573.33
	Total India	29724.80

13. STATES WITH HIGHEST GRAPES PRODUCTION IN INDIA

<i>S. No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	Maharashtra	160.0
2.	Karnataka	302.4
3.	Tamil Nadu	47.7
4.	Andhra Pradesh	25.8
5.	Mizoram	23.9
	Others	25.5
	Total India	2585.3

14. STATES WITH HIGHEST MANGO PRODUCTION IN INDIA

<i>S. No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	Uttar Pradesh	4300.98
2.	Andhra Pradesh	2737.01
3.	Bihar	1367.57
4.	Karnataka	1755.56
5.	Tamil Nadu	785.50
6.	Maharashtra	1212.50
7.	West Bengal	430.71
8.	Odisha	751.02
9.	Kerala	441.03
10.	Gujarat	1125.61
	Total India	18431.33

15. STATES WITH HIGHEST SAPOTA PRODUCTION IN INDIA

<i>S. No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	Maharashtra	474.5
2.	Karnataka	365.7
3.	Gujarat	297.0
4.	Tamil Nadu	264.4
5.	Andhra Pradesh	247.2
6.	West Bengal	45.4
7.	Odisha	15.6
8.	Others	34.5
	Total India	1744.3

16. STATES WITH HIGHEST GUAVA PRODUCTION IN INDIA

S.No.	State	In '000 MT (2013-14)
1.	Uttar Pradesh	605.0
2.	Maharashtra	324.1
3.	Punjab	180.8
4.	West Bengal	186.0
5.	Andhra Pradesh	104.1
6.	Gujarat	140.8
7.	Karnataka	143.4
8.	Bihar	373.7
9.	Madhya Pradesh	841.1
	Total India	3667.9

17. STATES WITH HIGHEST PAPAYA PRODUCTION IN INDIA

S.No.	State	In '000 MT (2013-14)
1.	Andhra Pradesh	1544.77
2.	Gujarat	1185.47
3.	Karnataka	475.71
4.	West Bengal	335.00
5.	Chhattisgarh	286.84
6.	Assam	149.14
7.	Kerala	89.91
8.	Tamil Nadu	202.67
9.	Madhya Pradesh	433.69
10.	Others	435.60
	Total India	5639.30

18. STATES WITH HIGHEST CITRUS PRODUCTION IN INDIA

S.No.	State	In '000 MT (2013-14)
1.	Andhra Pradesh	1913.4
2.	Maharashtra	1761.0
3.	Punjab	1044.2
4.	Madhya Pradesh	1240.8
5.	Gujarat	449.2
6.	Karnataka	379.3
7.	Rajasthan	433.2
8.	Odisha	268.0
9.	Assam	294.1
10.	Haryana	235.4
11.	Others	3128.6
	Total India	11147.1

19. STATES WITH HIGHEST POMEGRANATE PRODUCTION IN INDIA

<i>S.No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	Maharashtra	945.0
2.	Karnataka	134.2
3.	Gujarat	99.3
4.	Andhra Pradesh	90.0
5.	Telangana	26.0
6.	Madhya Pradesh	25.3
7.	Tamilnadu	13.1
8.	Rajasthan	5.6
9.	Others	7.2
	Total India	1345.7

20. STATE WITH HIGHEST APPLE PRODUCTION IN INDIA

<i>S.No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	Jammu & Kashmir	1647.7
2.	Himachal Pradesh	738.7
3.	Uttarakhand	77.5
4.	Arunachal Pradesh	31.9
5.	Others	2.0
	Total India	2497.7

21. STATE WITH HIGHEST BRINJAL PRODUCTION IN INDIA

<i>S.No.</i>	<i>State</i>	<i>In '000 MT (2013-14)</i>
1.	West Bengal	2977.0
2.	Odisha	2158.3
3.	Gujarat	1477.0
4.	Bihar	1240.5
5.	Andhra Pradesh	1160.5
6.	Madhya Pradesh	1066.7
7.	Maharashtra	690.0
8.	Chhattisgarh	586.0
9.	Karnataka	402.5
10.	Others	1799.4
	Total India	13557.8

22. STATES WITH HIGHEST CABBAGE PRODUCTION IN INDIA

S.No.	State	In '000 MT (2013-14)
1.	West Bengal	2197.4
2.	Odisha	1150.9
3.	Bihar	735.0
4.	Gujarat	661.4
5.	Maharashtra	640.9
6.	Jharkhand	471.3
7.	Chhattisgarh	338.6
8.	Haryana	241.1
9.	Karnataka	212.8
10.	Assam	656.7
11.	Others	1154.8
	Total India	9039.20

23. STATES WITH HIGHEST PINEAPPLE PRODUCTION IN INDIA

S.No.	State	In '000 MT (2013-14)
1.	West Bengal	316.00
2.	Assam	288.60
3.	Karnataka	160.31
4.	Bihar	113.91
5.	Meghalaya	117.77
6.	Kerala	72.86
7.	Tripura	162.26
8.	Manipur	136.31
9.	Nagaland	142.50
10.	Arunachal Pradesh	69.61
11.	Others	156.61
	Total India	1736.74

24. STATES WITH HIGHEST CAULIFLOWER PRODUCTION IN INDIA

S. No.	State	In '000 MT (2013-14)
1.	West Bengal	1879.0
2.	Bihar	1147.8
3.	Maharashtra	813.2
4.	Madhya Pradesh	703.8
5.	Odisha	667.7
6.	Others	3361.6
	Total India	8573.3

25. SOURCES OF B-COMPLEX VITAMINS

<i>Vitamin</i>	<i>Metabolic function</i>	<i>Importance</i>	<i>Daily requirement</i>	<i>Source</i>
Vitamin B ₁ Thiamine	Utilization of sugar and starch	Deficiency leads to beriberi	0.5 to 2.0 mg	Green leafy vegetables
Vitamin B ₂ Riboflavin	Protein metabolism	Deficiency leads to sore tongue cracking in mouth angles, redness and burning of eyes, scaliness of the skin	0.7 to 2.2 mg	Green leafy vegetables
Niacin	Component of co-enzymes	Deficiency leads to pellagra	8 to 26 mg	Nuts are good sources of niacin
Vitamin B ₆ Pyridoxine	Protein and fat metabolism	Deficiency leads to convulsions in infants	0.6 to 2.5 mg	Vegetables
Folic acid	Multiplication and maturation of red blood cells	Deficiency causes anaemia in children and pregnant women	50 to 100 mg	Fresh green vegetables
Vitamin B ₁₂	Important for DNA synthesis	Deficiency causes anaemia in children and pregnant women	1 g	Present only in animal foods

26. SOURCES OF MINERALS

<i>Mineral</i>	<i>Metabolic function</i>	<i>Importance</i>	<i>Daily requirement</i>	<i>Source</i>
Calcium	Maintenance of skeleton and teeth	Deficiency leads to weak bones and teeth	0.4 to 0.6 g	Amaranth, drumstick leaves, fenugreek, guava, tapioca turnip etc.
Iron	Formation of haemoglobin	Deficiency leads to anaemia	1 to 3 mg	Amaranth, fenugreek, guava, tapioca etc.
Electrolytes (sodium, potassium and magnesium)	Maintenance of cellular osmotic balance	Deficiency leads to cellular turgidity and muscular cramps	—	drumstick leaves, Amaranth, drumstick leaves, fenugreek, guava, tapioca etc.
Phosphorous	Component of nucleic acids, ATP	Deficiency leads to weak bones and teeth	1 g	Nuts, leafy vegetables, beans bitter gourd, bottle gourd, ginger and onion

27. PROCESSABLE VARIETIES OF HORTICULTURAL CROPS

<i>Crop</i>	<i>Name of variety</i>	<i>Brief description (Key character only)</i>	<i>State and recommendation zone</i>
Citrus	Satgudi and Malta	High acidity (> 0.6%), free from bitterness, good for canned juice	Citrus growing area in country
Grapes	Thompson Seedless and its clones like Tas-A Ganesh and Sonaka, Sharad Seedless, Flame Seedless and Red Globe	Suitable for raisin, wine and juice	Maharashtra and other grape growing areas
Litchi	Shahi	High TSS (20°Brix) and inherent rosy aroma & flavour. Best for all type of alcoholic & nonalcoholic beverages products.	Bihar, Uttarakhand
Banana	Udhayam	Suitable for making fig, sweet chutney, jam, bar, ready to serve beverages and wine	TN, A.P., Karnataka, Bihar, West Bengal, Tripura
Guava	Arka Mridula	Few soft seeds. Pulp is white with TSS >12.0°B, good keeping quality.	Guava growing zones of the country
	Lalit	Good for processing	Guava growing zones of the country
Mango	Totapuri	Good for processing	Mango growing areas
	Alphanso, Kesar	For mango pulp processing	Mango growing areas
	Ramkela	Pickling	Mango growing areas
Custard Apple (Annona)	Arka Sahan	Very sweet, (TSS 30°B), few seeds (9-10 seeds/100g fruit weight), slow ripening (6-7 days), firm when ripe,	Semi-arid, arid tropic
Apricot	CITH Apricot-1	low acidity, high T.S.S (14°Brix), suitable for table use and also for processing.	J & K
Apricot	CITH Apricot-2	low acidity, high T.S.S. (14°Brix) and high yielding (16 kg/tree in 6 year age), Suitable for table use and also for processing.	J & K
Apricot	CITH Apricot-3	low acidity, high T.S.S. (16°Brix) and good yielder (13 kg/tree in 6 year age), suitable for use in desserts.	J & K

Walnut	CITH walnut-1	Large kernel size (12.76g), good kernel recovery (47%), light shell colour,	J & K
Walnut	CITH walnut-2	Nuts are large, complete shell integrity, well filled kernel, plummy, easy to remove kernel halves	J & K
Walnut	CITH walnut-5	High yielder, having extra light kernel color, suitable for export market, good kernel recovery (48.9%),	J & K
Tomato	Arka Ashish	Firm and crack resistant. Locules-2. Fruit colour-deep red. Lycoperne content – 10mg/100mg. TSS-4.8%, concentrated fruit maturity, suitable for processing.	Eastern Dry zone of Karnataka
	Arka Ahuti	Locules-2-3, Fruit colour-Deep red. TSS 5.2%. Concentrated fruit maturity suitable for processing,	Eastern Dry zone of Karnataka
	Kashi Sharad	Thick pericarp, longer shelf life	J & K, H.P. Uttarakhand
Chilli	Kashi Anmol, Kashi Vishwanath	Dry processing	Punjab, UP, Bihar, Jharkhand, West Bengal, Odisha
Paprika	Arka Abhir	Better colour (colour value maximum 1,65,541 cu) and low pungency (0.05% capsaicin), suitable for oleoresin extraction	Released at Institute Level
Tuberose	Prajwal	Single type with large flowers and pinkish flower buds. The variety yields 0.102% of concrete which is used in processing industry	Karnataka
Tuberose	Shringar	Single type with large flowers. The variety yields 0.106% of concrete which is used in processing industry	Karnataka
Coconut	Kalpa Mitra Kalpa Chandra Chandrakalpa	66.50% oil, 47.88% lauric acid 72% oil	West Coast, W. Bengal Kerala, Karnataka, TN, AP, Maharashtra
	Kalpraksha	Good quality of sweet tender nut water (290ml)	Kerala, TN, AP, Karnataka, Maharashtra

Arecanut	Sumangala	High yield of chali (3.28kg/palm /year)	Coastal Karnataka and Kerala
	Swarnmangala	High yield of chali (3.88kg/palm /year)	Coastal Karnataka, Kerala and Maharashtra
	Kahilkuchi	High yield of chali (3.70kg/palm /year)	Assam and NE Region
	VTLAH 1 and 2 Hybrids	Chali, (2.54 kg/palm /year)	Coastal Karnataka and Kerala
Cocoa	VTLCC 1	1.33 kg dry bean/tree/year	Kerala, Karnataka, TN, AP, Maharashtra, and NE
	VTLCH 1 hybrid	1.48 kg dry bean/tree/year	Kerala, Karnataka
Fennel	NRCSS AF 1	1.6% essential oil, suitable for processing for green saunf	Rajasthan, Gujarat
Cumin	GC4	3.5% essential oil	Rajasthan, Gujarat
Ajowain	NRCSS AA 1	3.2% essential oil	Rajasthan, Gujarat
Cassava	Sree Athulaya	Starch 30.2% and cyanogens 80-90%	TN
	Sree Apoorva	Starch 30%, cyanogens 85-93%	TN
Sweet potato	H-42	Sweet taste, fibreless	Kerala
Potato	Kufri Chipsona 1, 2, 3 Himsona, Frysona	22% dry matter, suitable for chips making	Indogangaetic plains
Black Pepper	Sreekara	Dry recovery 35.0% and piperine is 5.3% essential oil 7%	Kerala, Karnataka, NE
	IISR Shakti	Dry recovery 43.0% and piperine is 3.3% essential oil 3.7%	Kerala, Karnataka, NE
Cardamom	IISR Kodagu Suvasini	Essential oil 8.7%, dry recovery 22%	Kerala, Karnataka, NE
Ginger	IISR Rejatha	Essential oil 2.36% dry recovery 19%	Kerala, NE
Turmeric	Sudarsana	Curcumin-high 7.9%, essential oil 7%, high recovery 20%	Kerala, NE

28. AREA AND PRODUCTION OF HORTICULTURE CROPS IN INDIA

(Area in '000 HA, Production in '000 MT and Productivity = MT/HA)

Crops	2011-12		2012-13		2013-14	
	Area	Production	Area	Production	Area	Production
Fruits						
Banana	797	28455	776	26509	803	29725
Mango	2378	16196	2500	18002	2516	18431
Citrus	915	7922	1042	10090	1078	11147
Papaya	117	4457	132	5382	133	56394
Guava	220	2510	236	3198	268	3668
Apple	322	2203	312	1915	119	25852
Pineapple	102	1500	105	1571	313	2498
Sapota	163	1426	164	1495	177	1744
Grapes	116	2221	118	2483	110	1737
Pomegranate	112	772	113	745	131	1346
Litchi	80	538	83	580	84	585
Others	1383	8224	1402	9315	1484	9872
Fruits-Total	6705	76424	6982	81285	7216	88977
Vegetables						
Potato	1907	41483	1992	45344	1973	41555
Tomato	907	18653	880	18227	1204	19402
Onion	1087	17511	1052	16813	882	18736
Brinjal	692	12634	722	13444	711	13558
Tapioca	227	8747	207	7237	228	8139
Cabbage	390	8412	372	8534	400	9039
Cauliflower	391	7349	402	7887	434	8573
Okra	518	6259	231	6350	533	6346
Peas	408	3745	421	4006	434	3869
Sweet Potato	110	1073	112	1132	106	1088
Others	2352	30459	2815	33213	2492	32591
Veg.-Total	8989	156325	9205	162187	9396	162897

INSTANT HORTICULTURE

	2011-12		2012-13		2013-14	
	Area	Production	Area	Production	Area	Production
	506	566	557	918	493	895
Orange	254	1652	233	1729	255	1754
Citrus*		75066		76732		543
Other Crops	3577	16359	3641	16985	3675	16301
	3212	5951	3076	5744	3163	5908
						76
Total	23243	257277	23695	268847	24198	277352

% Growth of Horticultural Crops

	11-12 over 10-11		12-13 over 11-12		13-14 over 12-13	
	Area	Production	Area	Production	Area	Production
Orange	6.5	7.0	1.9	4.5	2.1	
	5.0	2.1	4.1	6.4	3.3	9.5
	5.8	6.7	2.4	3.7	2.1	0.4

29. HORTICULTURE CROP VARIETIES RELEASED BY IIHR

Crops	Varieties
Acid lime	Rasraj
Ber	Goma kirti
Mustard Apple	Arka sahan
Grape	Arka chitra, Arka soma, Arka majestic, Arka shyam, Arka neelmani, Arka trishna, Shweta seedless,
Guava	Arka amulya, Arka kiran, Arka mridula
Litchi	Swarn roopa
Mango	Arka anmol, Arka puneet, Arka neelkiran
Papaya	Arka prabhat, Surja, Coorg, Honeydew
Passion Fruit	Kaveri

Contd...

<i>Sr. No.</i>	<i>Crops</i>	<i>Varieties</i>
10.	Pomegranate	Ruby
11.	Amaranth	Arka sanraksha, Arka sugna, Arka veruna,
12.	Bitter Gourd	Arka harit, Arka anupama
13.	Bottle Gourd	Arka bahar
14.	Brinjal	Arka anand, Arka navneeta, Arka keshav, Arka neelkanth, Arka nidhi, Arka shirish
15.	Capsicum	Arka basant, Arka gaurav, Arka mohini
16.	Cauliflower	Arka kanti
17.	Chilli	Arka harita, Arka lohit, Arka meghna, Arka shweta, Arka suphal
18.	Cluster Bean	Goma manjari
19.	Coriander	Arka isha
20.	Cowpea	Arka garima
21.	Dolichos Bean	Arka amogh, Arka jay, Arka sambharam, Arka soumya, Arka vijay
22.	French Bean	Arka anoop, Arka bold, Arka komal, Arka sharath, Arka suman, Arka suvidha,
23.	Garden Pea	Arka ajit
24.	Long Melon	Arka sheetal
25.	Musk Melon	Arka jeet
26.	Water Melon	Arka madhu, Arka akash, Arka madhuri, Arka manik, Arka rajhans, Arka aishwarya
27.	Tomato	Arka abha, Arka abhijeet, Arka ahuti, Arka alok, Arka ananya, Arka meghali, Arka rakshak, Arka samrat, Arka saurabhi, Arka shreshtha, Arka vardani, Arka vikas, Arka vishal
28.	Round Melon	Arka tinda
29.	Ridge Gourd	Arka sujath, Arka sumeet,
30.	Pumpkin	Arka chandan
31.	Carnation	Arka flame, Arka tejas,
32.	China Aster	Kamini, Violet, Cushion
33.	Chrysanthemum	Arka pink star, Indira, Nilima
34.	Crossandra	Arka ambare, Arka kanaka
35.	Gerbera	Arka krishika
36.	Gladiolus	Arka amar, Arka gold, Arka naveen, Arka kumkum
37.	Rose	Arka parimala
38.	Tube Rose	Arka Nirantara, Arka shringar, Arka suvasini, Arka vaibhav
39.	Paprika	Arka abhir
40.	Mushroom	Arka om-1

30. HORTICULTURE JOURNALS/MAGAZINES PUBLISHED IN INDIA/WORLD

Sl No.	Title of the Journal	Annual Subscription	Periodicity	Publisher Address
1.	Floriculture today	Rs. 50/issue Rs. 550/year Rs. 975/2 years	Monthly	Media Today Pvt. Ltd., T-30, 1st Floor Khirki Extension, Malviya Nagar, New Delhi-110017 Ph.: No. 91-11-26680153/26680683 Fax: 91-1126680153/26682045 Email: mediatoday@vsnl.com
2.	Indian Journal of Horticulture	Rs. 4000	Quarterly	The Horticultural Society of India, Division of Fruits & Horticultural, Technology, IARI, New Delhi-110012
3.	Journal of Asia Horticulture	Rs. 1500	Quarterly	The Karnataka Horticultural Society, Kittur Rani Channamma College of Horticulture, Arabhavi-591310, Karnataka.
4.	The Orissa Journal of Horticulture	Rs. 400.00	Half-yearly	The Orissa Horticultural Society, C/o. Department of Horticulture, College of Agriculture, OUAT, Bhubaneswar-751003
5.	The Asian Journal of Horticulture	Rs. 500	Half-yearly	Hind Agri-Horticultural Society, Ashram, 418/4-South Civil Lines, Muzaffarnagar-251001.
6.	South Indian Horticulture	Annual Subscription: Individuals- Rs. 250.00 Institutions- Rs. 750.00 Foreign Institutions- US \$350 Life Membership: Individuals- Rs. 1500.00	Annual	The Secretary South Indian Horticulture Tamil Nadu Agricultural University Coimbatore-641003
7.	Journal of Plantation Crops	Rs. 750	Monthly	Indian Society for Plantation Crops, Central Plantation Crops Research Institute, Kasaragod-671124
8.	Journal of spices and aromatic crops	Rs. 2000/Life member Rs. 400/ Ordinary Member	Monthly	Indian Institute of Spices Research Post Box No. 1701 Marikunna Post Calicut-673012, Kerala Ph. No. 0495-2731410 Fax: 0091-495-2731187 Email: josac@spices.res.in iss@spices.res.in web: www.spicesociety.org.

<i>Sl. No.</i>	<i>Title of the Journal</i>	<i>Annual Subscription</i>	<i>Periodicity</i>	<i>Publisher Address</i>
9.	Spice India	50.00	Monthly	Spices Board, P.B. No. 2277 Sugandha Vahaban, Palarivattom, Cochin-682025
10.	Potato Journal	120.00	Quarterly	Indian Potato Association, Central Potato Research Institute, Shimla-171001, Himachal Pradesh
11.	Journal of Ornamental Horticulture	2500.00	Quarterly	Indian Society of Ornamental Horticulture, Division of Floriculture and Landscaping, I.A.R.I., New Delhi-110012
12.	Journal of Spices and Aromatic Crops	1000.00	—	Indian Society for Spices, P.O. Bag 1701 Marikunna (P.O), Calicut-673012 Kerala State.
13.	Indian Coffee	150.00	Monthly	Coffee Board, 1, Dr. B.R. Ambedkar Veedhi, Post Box. 5366, Bengaluru-560001
14.	Indian Horticulture	—	—	Indian Council of Agriculture Research, Directorate of Information and Publication of Agriculture, New Delhi.
15.	Indian JI. of Arecanut, Spices and Medicinal Plants	150.00	Quarterly	Directorate of Arecanut and Spices Development Ministry of Agri. Dept. of Agri. and Cooperation, Government of India, Calicut-673005.
16.	Hort. Science *Foreign Journal	—	Bi-Monthly	American Society for Horticultural Science 10/8 Duke Street, Alexandria, VA22314-3512
17.	Hort. Technology *Foreign Journal	—	Quarterly	American Society for Horticultural Science 10/8 Duke Street, Alexandria, VA22314-3512
18.	Plant Hort. Tech.	400.00	Bio-Monthly	Institute of Plantation and Horticulture Management, P.O. Bengaluru-560068. Ph.: 080 25743109 Fax: 080 25743110 Mob. 09663867741 Email: info@inphom.com

<i>Sl. No.</i>	<i>Title of the Journal</i>	<i>Annual Subscription</i>	<i>Periodicity</i>	<i>Publisher Address</i>
19.	Haryana Journal of Horticultural Science	—	—	Horticultural Society of Haryana, Department of Vegetable Crops, HAU, HISAR, 125004 (Haryana)
20.	Journal of Applied Horticulture	—	—	Society for the Advancement of Horticulture, A-859, Indira Nagar, Lucknow-226016
21.	Progressive Horticulture The Horticultural Journal	— —	— —	Horticultural Experiments and Training Centre, Chaubattia-263651, Ranikhet, Almora (Uttarakhand) Society of the Advancement of Horticulture, Faculty of Horticulture, BCKV, Mohanpur, (WB).
22.	Vegetable Science	—	—	Indian Institute of Vegetable Research (IIVR), P.O. Jakhani (Shanshahpur), Varanasi 221305 (Uttar Pradesh)
23.	The Horticulture Journal	—	—	Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, 741252, Nadia, West Bengal
24.	Hi-Tech Horticulture	—	—	Horticulture Society of India Div. of Fruit and Horticulture Technology, IARI, New Delhi-110012
25.	Scientia Horticulture	—	—	Elsevier Journal Netherlands
26.	ACTA Horticulture	—	—	International Society of Horticulture Sciences, Belgium

31. LIST OF IMPORTANT BOOKS ON HORTICULTURE

<i>Titles</i>	<i>Authors</i>	<i>Publishers</i>
1. Advances in Horticulture	: <i>K.L. Chadha</i>	Malhotra Pub. House, New Delhi
2. Basic concepts of Vegetable science	: <i>N.P. Singh</i>	CBS Pub. Dist. New Delhi
3. Basic Horticulture	: <i>Singh</i>	Kalyani Pub. New Delhi
4. Beautiful Climbers of India	: <i>B. P. Pal</i>	ICAR, New Delhi
5. Biotechnology in Horticultural and Plantation Crops	: <i>K.L.Chadha, Ravindran, Leela Sahijram</i>	International Book Dis. Co. Lucknow
6. Biotechnology of Horticultural Crops	: <i>V.A. Parthasarathy, T.K. Bose, P.C. Deka and P. Das</i>	Naya Prokash , Kolkata
7. Cultivation of Spice Crops	: <i>A.A. Farooqi, B.S. Sreeramu and Srinivasappa</i>	Universities Press, Hyderabad
8. Diseases of Vegetable Crops, 3rd Ed.,	: <i>Singh, RS</i>	Oxf & IBH Pub Co., New Delhi.
9. Diseases of Fruit Crops,	: <i>Pathak</i>	Oxf & IBH Pub. Co., New Delhi
10. Floriculture in India	: <i>M. S. Randhawa</i>	Allied Pub. New Delhi
11. Flowering Shrubs in India	: <i>S. L. Jindal</i>	
12. Flowers and Vegetables of India	: <i>Romesh Kumar Sud and Sudhir Kumar</i>	Scientific Book Pub., Jodhpur
13. Fruit Growing in India	: <i>W. B. Hayes</i>	CBS Publisher Dist. New Delhi
14. Fruit Growing	: <i>Bal</i>	Kalayani Pub. New Delhi
15. Gardening In India 2nd Ed.	: <i>Lancaster's</i>	Oxford and IBH Pub. Co. New Delhi
16. Genetics and Breeding of Vegetables	: <i>K.V. Peter</i>	ICAR, New Delhi
17. Heterosis Breeding in Vegetable Crops	: <i>N. Rai & Mathura Rai</i>	New India Publishing Agency, New Delhi
18. Horticulture Science	: <i>Janick</i>	Surjeet Pub Co., New Delhi
19. Horticulture Principles and Practices	: <i>Acquaah</i>	Pearson Education India
20. Handbook of Horticulture	: <i>Dr. K.L. Chaddha</i>	ICAR, New Delhi
21. Handbook of Horticulture	: <i>C.H. Preston</i>	Reprint Pub., Dehradun.
22. Horticulture at A Glance (Vol. I, II & III)	: <i>Salaria & Salaria</i>	Jain Brothers, New Delhi
23. Major Spices of India-Crop Management and Post Harvest Technology	: <i>J.S. Pruthi</i>	ICAR, New Delhi

24. Minor Spices and Condiments Crop Management and Post Harvest Tech. : Pruthi JS ICAR, New Delhi
25. Pest and Soil Management of Horticultural Crops : S.K. Singh and D.K. Singh Agrotech Pub., Udaipur
26. Preservation of Fruits and Vegetables : Girdhari Lal, G.S. Siddappaa and G.L. ICAR, New Delhi
27. Principles of Horticulture and Fruit growing : K. S. Yawalkar Agri Hort. Pub. Co., Nagpur
28. Principles of Horticulture 4th Ed. : Adams, CR and Early MP Elsevier, India.
29. Text book of Pomology Vol. I-IV : Chattopadhaya Kalyani Pub. New Delhi
30. Tomato : G. Kallou Allied Publishers Pvt. Ltd., New Delhi
31. Tropical Horticulture (Vol. I & II) : T.K. Bose, S.K. Mitru, A.A. Farooqi and M.K. Sadhu Naya Prokash, Kolkata
32. Vegetable Crop Vol. I, II, and III : T.K. Bose, J. Kabir, T.K. Maity, V.A. Parthasarathy and M.G. Som Naya Prokash, Kolkata
33. Vegetable Growing in India : S. L. Katyal Oxford and IBH Publishing Co.Pvt. New Delhi
34. Vegetable Growing : S.C Day Agrobios, Jodhpur
35. Vegetable Crops : Homer C. Thomson McGraw Hill Book Co.
36. Vegetable Crops of India : K. S. Yawalkar Agri Hort. Pub. Co., Nagpur
37. Handbook of Fruit Crops : S.K. Tyagi Jain Brothers, New Delhi
38. Flowering Shrubs and Seasonal Ornaments : S.K. Bhattacharjee Pointer Publishers
39. Orchids : (RHS Simple Steps to Success) Royal Horticultural Society D.K. Pub. Co. USA.
40. Introduction to Horticulture : N. Kumar OXFORD & IBH-Pub. Company-New Delhi.
41. Insect Pests of Fruit Crops : N. Kumar Daya Publishing Co. New Delhi