EX.NO.1.

NURSERY MANAGEMENT, SEED TREATMENT SOWING SEEDS AND RAISING SEEDLINGS

Nursery : Nursery is a place where seedlings, cuttings and grafts are raised with care before transplanting.

Depending on the method of cultivation, vegetable crops can be grouped into three types

1.	**Direct sown vegetables**	:	Bhendi, raidish, peas, amaranthus, cucurbits, beans, annual moringa etc.
2.	**Transplanted vegetables**	:	Tomato, brinjal, chillies, Sweet potato, cabbage, cauliflower, bellary onion, seed propagated aggregatum onion.
3.	**Vegetatively propagated vegetables**	:	Potato, Tapioca, sweetpotato, coccinea, chekurmanis etc.

For transplanted vegetables, raising of nursery is an important operation.

Advantages of raising seedlings in nursery

1. It is very convenient to look after the tender seedlings.
2. It is easy to protect the seedlings from pests and diseases
3. Economy of land usage (duration in the mainfield is reduced)
4. Valuable and very small seeds can be raised effectively without any wastage.
5. Uniform crop stand in the mainfield can be maintained by selecting healthy, uniform and vigorous seedlings in the nursery itself.

Preparation of nursery beds

Selection of site

1. The nursery area should be nearer to the water source.
2. Generally, the location should be partially shaded ie. under the trees. If not, artificial shade to be provided.
3. It should be well protected from animals.
4. Proper drainage facilities should be provided.

Selection of soil

1. A medium textured, loam (or) sandy loam soil is preferred.
2. Soil should be rich in organic matter.
3. Soil depth should be preferably 15-25 cm.

Types of nursery bed

1. Flat bed
2. Raised nursery bed.

Preparation of raised nursery bed

Selected soil should be worked well to break the clods and weeds, stones and stubbles should be removed. Height of the raised bed should be 10-15 cm with a width of 1 m and length may be according to the requirement and convenience. Two parts of fine red earth, one part of sand and one part of FYM can be incorporated to each bed to improve aeration and fertility of the soil. Before preparing the bed, the soil should be drenched with 4% formaldehyde or 0.3% copper oxychloride to kill the pathogenic spores in the soil. Nowadays solarisation of nursery bed with white polythene sheet can check the nematode infection and weed growth.

Advantages of raised nursery bed

1. Water movement will be uniform and drainage of excess water is possible (In the case of flat bed, water moves from one end to the other and there is possibility of washing away of seeds).
2. Germination percentage of seeds is normally high.
3. Operations like weeding and plant protection measures are easy.

Seed treatment

The seeds should be treated with Captan or Thiram 2g or carbendazim one g or Trichoderma viride 4 g per kg of seed 24 hours before sowing to control the seed borne pathogens. Microorganism inoculants like *Azospirillum* and phosphobacteria can be mixed with rice gruel @ 250 ml per packet of *Azospirillum* or phosphobacteria and dried under shade before sowing. Normally two packets (400 g), are needed for treating the seeds required for one hectare. These inoculants are helpful in getting healthy vigorous seedlings in the nursery itself so that the correct population can be maintained in the mainfield.

Sowing of seeds

The surface of the bed should be prepared well mixed with well decomposed FYM or compost and leveled by using a wooden plank. Straight lines are drawn at a spacing of 10 cm to a depth of 1-2 cm. Seeds are sown in the lines and covered with sand or fine soil or powdered FYM. Line sowing of seeds facilitates easy weeding, and removal of disease infected seedlings. Depth of sowing determines the rate of emergence. If it is too shallow the seeds come up and dry out early. If it is two deep, the seedling emergence is much delayed. So, a thumb rule is followed. Sow the seeds approximately at a depth of 3-4 times the diameter of the seed.

Season of sowing

In general, vegetable seeds are sown in there district seasons.

Brinjal	-	Dec.-Jan and May-June
Tomato	-	May-June, Nov-Dec, and Feb.-Mar.
Chillies	-	Jan. – Fed., June-July, Sept. – Oct.
Bellary onion	-	May-June and Jan.-Feb.
Cabbage and cauliflower	-	Jan.-Feb and July-Aug., Sept.-Oct. for hills Aug.-Nov. for plains.

After sowing the seeds, the bed is covered with paddy straw and watered by using a rose can so as to avoid packing of the soil and washing away of seeds. Watering should be done twice daily till the seeds germinate. The straw cover should be removed after germination and watering once a day will be sufficient. A week before transplanting, the seedlings should be exposed to full sunlight and the number of waterings should be reduced so that the seedlings become hardy to bear the shock of transplanting in the mainfield.

Types of nursery

1. **Temporary nursery** : It consists of raised nursery beds. It can be changed from one place to another, depending on needs.
2. **Permanent nursery**: Side walls with drainage holes are constructed with concrete to a height of 75 cm. Seeds are sown in soil inside the concrete structure. After removal of each batch of seedlings, the soil is enriched with manures.

Seed rate: (Per hectare).

Cabbage	-	375-500 g	Tomato	-	400-500 g
Cauliflower	-	375-500 g	Chillies	-	1 kg
Bellary onion	-	8-12 kg	Brinjal	-	370-500 g
Seed propagated aggregatum onion	-	8 kg/ha.			

Pest and disease management

Pests

There are two types of pests, which normally attack the nursery plants.

1. Sucking pests – Aphids, white flies, thrips etc.
2. Biting (or) chewing pests – Beetles, grasshoppers, leaf eating caterpillars etc.

Apart from causing damage to the seedlings, the sucking pests also act as vectors for transmitting some of the viral diseases even in the nursery stage itself.

Eg. 1. Aphids spread mosaic disease in chillies

2. Thrips act as vector for leaf curl virus disease in chillies and spotted wilt virus disease in tomato.

Control

i. Application of systemic insecticides like Methyl demeton or Dimethoate @ one ml per litre of water by using a hand operated sprayer.

ii. Application of carbofuran @ 10g/sq.m 10 days before pulling of seedlings will also control the sucking pests in the nursery and at the early stages in the mainfield.

Diseases

Damping off (*Pythium* spp., *Phytophthora*, spp. *Rizoctonia* spp.)

Seedlings of tomato, chillies, brinjal, cabbage, and cauliflower are highly affected by this disease. Water logging with poor drainage leads to infection. The disease affects the seedlings in two ways.

(1) Affected seeds get decayed inside the soil resulting in failure of germination.

(2) After germination, the fungi attack the seedlings in the collar region. The tissues will become soft and succulent. In advanced stages, the seedlings become lodged and get decayed.

Control

1. Raising seedlings in raised beds with good drainage facility reduces the infection.
2. Addition of organic matter improve the soil texture and soil aeration.
3. Avoiding thick sowing of seeds in beds.
4. Periodical changing of nursery sites.
5. Treating the seeds with captan, thirm @ 2g or carbendazim @ one g/kg or Trichodama viride @ 4g of seeds before sowing can reduce the infection.
6. Drenching the nursery bed once or twice with bordeaux mixture 1% or copper oxychloride 0.3% can also reduce the infection.

Nematodes

Root knot and lesion nematodes commonly infect the seedlings. Before sowing the seeds, carbofuran @ 10 g/sq.m should be incorporated in the soil and watered regularly.

Ants: Application of Lindane 1.3% dust at the rate of 100 g/bed on all sides to protect the seeds from ants.

EX.NO.2

BRIEF DESCRIPTION OF THE VARIETIES OF VEGETABLE CROPS

CO.1 Tomato (1969)

It is a pureline selection from an exotic type. It is a semi determinate type. The crop duration is 135 days and yields 38 tonnes/ha. It bears in clusters of 6 to 8 fruits. The fruits are round pale green at unripe stage and turns to capsicum red on ripening. The plants are dwarf and semi round and need no staking. The fruits contain high TSS (4.2°Brix) and acidity (0.69%).

CO. 2 Tomato (1974)

It is a pureline selection from U.S.S.R. type. The plants are semi-dwarf, leaves broad and thick. Fruits are ovate, large, devoid of cracking and rich in ascorbic acid (18-21 mg/100g). 4.22°Brix TSS and 0.90% acidity. It yields 42 t/ha (18.2% increase over CO.1).

CO. 3 Tomato (1980)

It is an induced mutant from CO. 1 having 100 days duration with very dwarf, compact and determinate plants. Fruits are globular attractive red, borne in cluster of 4-5 fruits, rich in vit C (25 mg/100g), TSS (3.2° Brix) and acidity (0.8%) with a flesh to seed ratio of 17%. It yields 50 t/ha and is suitable for summer season also.

PKM 1 Tomato (1978)

It is an induced mutant from Annanji giving 32.0 t/ha in a duration of 135 days. The plants are determinate with fruits of attractive capsicum red in colour with green shoulders and uniform ripening. The fruits are best suited for long distance transport. The fruits contain 3.6°Brix of TSS 23.7 mg/100 g of vitamin C and 0.99% acidity.

Paiyur 1 Tomato (1988)

This variety is a hybrid derivative evolved by crossing Pusa Ruby x CO 3. It is suitable for rainfed cultivation. It yields about 30 t/ha.

COTH.1 Tomato (1999)

This was developed at the Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore by crossing IHR 709 and LE 812. It is a determinate F_1 hybrid requiring minimum staking. The fruits are round to slightly oblong

each weighing 50 g with deep red skin and thick flesh and borne in clusters of 4-5. The juice is acidic rendering the fruits for use in culinary preparation unlike the most of the hybrids developed by a number of private firms which lack acidity and hence used mostly for salad. The plants can be planted at a spacing of 60 x 45 cm. The estiamted yield is 96 tonnes / ha in a crop duration of 110-115 days after transplanting.

CO. 1 Brinjal (1978)

It is a selection. The crop duration is 160 days. The plants are erect, medium, bushy with greenstem and leaves and greenish purple petiole. Fruits are light green with white base, medium sized (50-60 g/fruit) with good keeping quality. It is moderately resistant to root-knot and reniform nematodes. It yields 24.0 t/ha.

CO. 2 Brinjal (1988)

It is a selection from the local cultivar called Coimbatore Varikkathiri. The plants are medium in height and spread and capable of yielding as high as 38 t/ha. The fruit are oblong in shape having eminent deep purple colour with inter mittent pale green streaks. The crop duration is 150 days. The quality is very good and this variety is suitable for growing in Coimbatore and Periyar districts.

MDU 1 Brinjal (1979)

It is a selection from a local type and yields 34.0 t/ha in a crop duration of 135 days. The plants are compact and medium spreading. The fruits are round, bright, purple coloured and each weights 280g. The leaves are broad with light green pigments. The fruits contain 0.38% acidity and 11.36 mg/100 g of ascorbic acid.

PKM 1 Brinjal (1984)

It is an induced mutant of a local type. It is high yielding (34.75 t/ha) with a duration of 150-155 days. The fruits measure 6 to 8 cm and 10-14 cm in length and girth respectively with a mean weight of 45 to 65 g. It is drought tolerant and can withstand long distance transport. It stores well under normal room temperature. The fruits contain 0.29% acidity and 14 mg/100 g of ascorbic acid.

PLR 1 Brinjal (1990)

This is a selection. The fruits are small to medium in size. Sometimes borne in clusters. Egg shaped and with bright glossy purple colour. It fetches premium price in the

markets of Cuddalore, Chenglepet and Chennai. It has got a self life of 8-10 days under ambient temperature. It yields an average of 15 t/ha.

KKM 1 Brinjal (Killikulam-1) (1995)

It is a pureline selection from Kulathur local. It is suitable for cultivation both under rainfed and irrigated conditions in Tirunelveli district. Fruits medium sized, egg shaped, milky white in colour and bears in clusters of 2-4 per cluster. It yields 37 t/ha in a duration of 135 days.

CO. 1 Chilli (1979)

It is a selection from Sathur Samba. The crop duration is 210 days and yields 2110 kg of dry pods per hectare. The plants are erect, medium tall and compact with medium branching. The fruits are green when unripe and bright shiny red on ripening. The fruits are 6-6.5 cm long with sharp tip and bulged shoulders. The seed content is 55% with high capsaicin (0.72 mg/g).

CO. 2 Chilli (1982)

It is a selection from a local Gundu type. The crop duration is 210 days and yields 2200 kg of dry pods per hectare. The stem is angular semidwarf and less spreading. The pods are oblong and bright red in colour. Seed content is high (60%) Capasicin content of dry pod is 0.56%. It is suitable for harvest as green pods and red ripe pods.

PKM 1 Chilli (1990)

This is a hybrid derivative of the cross between Ac.No. 1797 x CO. 1 selected in F_1 generation and fixed by selfing. It has very bold pods which are dark red in colour. It has got a very high yield potential of 3000-3200 kg of dry pods per hectare in a crop duration of 180 days.

CO. 3 Chilli (1991)

This is a dwarf and compact growing samba culture suitable for very close planting of 30 cm x 15 cm. The potential yield at this spacing is 3000-3500 kg of dried chilli per hectare. It is also suitable to be used as green chilli. It has a very low stalk weight in comparison with pod weight unlike other cultivars and high oleoresin and capsaicin content and hence suitable for export purpose.

CO.4 Vegetable Chilli (2000)

It is a pureline selection made from an open pollinated type introduced from Sri Lanka with a crop duration of 165 days after transplanting. It is suited for *kharif* and *rabi* seasons. This variety recorded 96.58% increased yield over PKM-1. The fruits are dark green, stout, less pungent and turns to capsicum red colour after ripening. It has the potential to yield 23 t/ha of green chilli.

K 1 Chilli (1964)

It is a selection from local Sathur Samba. The crop duration is 210 days and yields 1.8 t/ha. The fruits are long and contain high capsaicin. The variety is suitable for rainfed cultivation in southern districts of Tamil Nadu.

K 2 Chilli (1975)

It is hybrid derivative of the cross B 70-A and Sathur Samba. The crop duration is 210 days and yields 1980 kg of dry pods/ha. The plants are tall and compact. The pods are long and bright red in colour with high seed content. The increased yield is 29% over K1 chilli.

MDU 1 Chilli (1978)

It is a mutant from K 1 chilli. The fruits are longer and bears in clusters of 6 to 8. The crop duration is 210 days with an yield of 1.9 tonnes of dry pods per ha. It is more suitable for southern districts of Tamil Nadu. The fruits contain 0.70 mg/g of capsaicin.

PLR 1 Chilli (1994)

It is a pureline selection from Kandengadu local. It is more suited for green chillies and yields per hectare. The crop duration is 210 days.

PMK 1 Chilli (1993)

Plants are medium tall. Duration is 200 days and suitable for semi-dry cultivation in Ramanathapuram district. It yields about 2.4 tonnes of dry pods/ha.

CO. 1 Bhendi (1976)

It is a selection from 'Red Wonder' of Hyderabad. The crop duration is 90 days with an yield of 14.25 t/ha. The plants are medium tall, moderately vigorous and deeply lobed leaves. Pods are slender, smooth and fleshy.

CO.2 Bhendi (1987)

It is a F_1 hybrid bhendi involving two parents AE 180 and Pusa Sawani. First harvest can be done 45 days after sowing and the crop duration is 90 days. It yields 16.5 t/ha accounting for 26 to 64% increase over CO. 1, MDU 1 and Pusa Sawani. It can be grown throughout the year.

MDU 1 Bhendi (1978)

It is an induced mutant from Pusa Sawani. The fruits are long and light green in colour. It yields 12 to 14 t/ha in a crop duration of 100 days. The pods contain 12.3% crude fibre.

CO.3 Hybrid Bhendi (1991)

It is a high yielding hybrid evolved from the cross between Parbhani Kranti x MDU 1 and suitable for fresh Market with dark green colour of medium sized fruits. This hybrid has high degree of field tolerance to Yellow Vein Mosaic Disease. The yield is 18.75 t/ha.

CO.1 Amaranthus (1968)

It is a selection from a local type. The crop duration is 25 days for mulakkeerai and 50 days for thandukeerai. The yield is 8 t/ha. The leaves are dark and seeds are black and small sized. The greens contain 4.8% calcium and 3.85% iron.

CO.2 Amaranthus (1979)

It is a selection from a germplasm type with a duration of 25 days for mulakeerai and 35-50 days for thandukeerai. It yields 10.75 tonnes of greens/ha. The plants are erect, with moderate branching. The seeds are bolder with early germination and early vigorous growth. The crude fibre content is less (1.3%) with 19.0 mg of iron, 20.0 mg of calcium per 100 g.

CO.3 Amaranthus (1988)

It is a selection from the local type and yields 30.72 tonnes of greens per hectare. It lends itself for 10 clippings, commencing from 20 days after sowing and provide a

continuous supply of luscious tender green for three months. It has high leaf to stem ratio (2.0). The plants are erect with green nutritious leaves containing 25.2 mg per 100 g of vitamin C, 1.75% crude fibre, 0.8% iron and 2.48% Ca. The seeds are black in colour.

CO.4. Amaranthus (1989)

It is a selection from *A. hypochondriacus* which is suitable for growing in plains and hills throughout Tamil Nadu. It is a high yielding grain amaranthus with an yield of 2,555 kg/ha in addition to 8,200 kg/ha of leaf on 25 the day. The crop duration is 90 days/ The seeds are rich in protein (15.95%) and amino acids like lysine (7.5 mg/100g), phenylalanine (5 mg/100g), leycine (1.2 mg/ 100 g) and isoleucine (1.8 mg;/100 g). The grain can be substituted for minor millets like ragi and tenai. It is amendable for various food preparations just like any other grains.

CO.5 Amaranthus

It is a single plant selection (A 166-I) from an OP plant introduction. The variety has double coloured leaves (green and pink). It gives a rosette growth in early stages. The stem is also free of fibres. The first harvest starts 25 days after sowing and in a crop duration of 55 days it produces on an average of 40 tonnes of green leaves per hectare.

CO. 1 Onion (1963)

It is a selection. The crop duration is 90 days and yields 10 t/ha. Bulbs are medium sized, pink in colour with 8 bulbs per plant weighing 55 to 60 g. The bulbs are fairly pungent.

CO.2 Onion (1975)

It is a selection from a germplasm type, CS 911. The crop duration is 65 days yielding 12 t/ha. It is a photo insensitive type. This variety is pungent with high total soluble solids (12.0°Brix).

CO.3 Onion (1979)

It is a clonal selection from open pollinated progenies of CS 450. The crop duration is 65 days and yields 15.8 t/ha. The bulbs store well over 120 days. The variety contains 17.5% dry matter, 0.53 per cent sulphur and 13.0°Brix TSS.

CO.4 Onion (1982)

It is a hybrid derivative of the cross AC 863 x CO3. The crop duration is 65 days and yields 19.0 t/ha.. The bulbs store well over 150 days devoid of sprouting in well ventilated store rooms.

MDU 1 Onion (1984)

This is a selection from a local type, Sempatti. Bulbs are big sized with attractive red colour. It yields 52.7% higher than CO 2. It keeps well for a long time with less reduction during storage in bulb weight (45%) for 5 months compared to 65% in CO 2 onion.

CO. 1 Snake gourd (1976)

It is a selection from a local germplasm type. The crop duration is 135 days and yields 18.0 t/ha. The fruits are dark green with white stripes, long fruits (160-180 cm) each weighing 500 to 750 g with good cooking quality. It is moderately resistant to powdery mildew.

CO.2 Snake gourd (1986)

It is a selection from a local type. The fruits are short and stout. It yields on an average 36 t/ha. The fruit is light greenish white and each weighs 400-600 g. The crop duration is 105 days. The variety does not require pandal.

MDU 1 Snake gourd (1981)

It is a hybrid between Panri Pudal and selection 1. It is an early flowering type (84 days) with an average yield of 31.74 t/ha. The fruits are medium long (66.94 cm) and short with an average weight of 551 g. The fruits are fairly rich in Vit. C (44.4 mg/100g) and very low in fibre content (0.6%).

PKM 1 Snake gourd (1979)

It is an induced mutant from H 375 type and yields 25.5 t/ha in a duration of 145 days. The vines are vigorous giving fruits of dark green colour with white strips outside and light green inside. Each fruit weighs 700 g.

CO.1 Bitter gourd (1978)

It is a selection from a local type. The crop duration is 115 days and yields 14.0 t/ha. The fruits are green, long (30-35 cm) and contain 1.8 mg/100 g of iron, 20 mg/100g of calcium and 1.1g/100 g of minerals.

MDU 1 Bitter gourd (1984)

It is an induced mutant, developed by gamma irradiation of local cultivar (MC 103). It is early in flowering (60 days) and yields 16.66 fruits/plant. The fruits are long with mean length of 40.34 cm and a girth of 17.54 cm and each fruit weighs 410.0 g on an average. It yields 32.19 t/ha.

CO.1 Ribbed gourd (1976)

It is a selection from a local type. The crop duration is 125 days and yield of 14.0 t/ha. Fruits are long (60-75 cm), light green, attractive in appearance each weighing 300 g on an average. Moderately tolerant to pest and disease.

CO.2 Ribbed gourd (1984)

It is a selection from a germplasm type. The fruits are green, long (1 m) and fleshy. The crop duration is 120 days with an yield of 25 t/ha.

PKM 1 Ribbed gourd (1980)

It is an induced mutant from the type H 160 and gives 28.0 t/ha of fruits in a duration of 160 days/ The fruits are dark green with shallow grooves. The plants are tolerant to pumpkin beetle, fruit fly and leaf spot.

CO.1 Bottle gourd (1981)

It is a selection from a germplasm type. The crop duration is 135 days and yield of 36.0 t/ha. Fruits are round at the base with a prominent bottle neck at the top., medium sized, attractive light green in colour with mean weight of 2.025 kg.

CO.1 Pumpkin (1971)

It is a selection from a local type and yields 30 t/ha. The vines are vigorous and spreading. The fruits are bigger and globular, each weighing 7.00 kg. One vine yields 6 to 7 fruits. First harvest can be had 115 days after sowing and the total crop duration is 180 days.

CO.2 Pumpkin (1974)

It is a selection from a local type. The duration is 135 days and yields 23.0 t/ha. The vines are moderately vigorous and less spreading. Individual fruit weighs 1.5 to 2.0 kg with 5 to 6 fruits per vine. It is a small fruited variety suitable for kitchen garden. The fruits contain 9.2% starch, 10.8 brix TSS, 10 mg/100 g of ascorbic acid and 0.14% acidity.

CO.1 Ash gourd (1971)

It is a selection from a local type with a crop duration of 150 days. The fruits are globular, light green with ash coating with less seeds. The yield is 25 t/ha.

CO.2 Ash gourd (1982)

It is a selection from a local type. The duration is 120 days and yields 34.0 t/ha. The fruits are light green with waxy bloom, small sized with a mean weight of 2.5 to 3.0 kg. The fruits contain 200-300 seeds. It takes 85-90 days from sowing to harvest.

PKM.1 Annual Moringa (1989)

It is a pure line selection from the population generated by continuous selfing of the seed moringa types for six generations. The plants grow to a height of 4-6m and come to flowering 90-100 days after planting. The first harvest starts 160-170 days after planting. Each tree bears on an average 200-225 fruits/year (3 kg). The pods are 65-70 cm long with 6.3 cm girth and 150 g weight. Ratoon crops can be taken for 3 years. Every year after the harvest is completed, the trees have to be cut back to about one metre from ground level.

PKM.2 Annual Moringa

It is a high yielding type with an increase of 9.18% in number of pods over PKM-1 Annual Moringa. The pods are long, less seeded, more fleshy and delicious. It comes to bearing in six months after sowing. It yields 98 tonnes/ha/year.

CO.1 Tapioca (1977)

It is a clonal selection with a crop duration of 8½ -9 months. The tuber is whitish brown with white flesh, and is suitable for industrial uses and consumption purpose. The starch content of tubers is 35.0 per cent with an out turn of 10.35 tonnes of starch per hectare. The HCN content is less (10g/g) in the flesh. It yields 30 t/ha. The plants are tolerant to mosaic virus.

CO.2 Tapioca (1984)

It is also a clonal selection. The tubers are medium sized with whitish grey skin, creamy white rind and white flesh. The crop duration is 8 ½ to 9 months . The starch content is 34.50 per cent. It yields 38.6 t/ha of tubers. The incidence of mosaic virus is low. The tubers contain low HCN of 10 g/g in the flesh.

CO.3 Tapiaco (1993)

It is also a clonal selection from open pollinated seeds obtained from Ibadan, Nigeria. It yields 43 t/ha in a crop duration is 8 months. The tubers contain high starch 35.6% and low

HCN of 77.89µg/g. The plants exhibit field tolerance to mosaic virus disease. It is a branching type. Tuber flesh is white with brown skin and creamy white rind.

CO.1 Sweetpotato (1976)

It is a clonal selection. The crop duration is 135 days and yields 28 t/ha. The tubers have light pink skin and white flesh. The number of tubers per plant is 3.2 with a starch content of 24% and a TSS of 10.6° brix.

CO.2 Sweetpotato (1980)

It is a clonal selection. The crop duration is 110 to 115 days and yields 32 t/ha. Tubers have pink skin and white flesh and have a starch content of 29.5 per cent and TSS of 10.8°Brix.

CO.3 Sweetpotato (1982)

It is also a clonal selection. The crop duration is 105-110 days and yields 42 t/ha. It is suitable for cultivation in both seasons and tolerant to root weevil. The tubers have light pink skin and orange flesh and contain a carotene of 13.28 mg/100 g and starch of 30.72 per cent.

CO.CIP.1 Sweetpotato

It is a clonal progeny of IB 19.10.20 developed through half-sib evaluation of open pollinated seedlings. Duration is 95-110 days September-October, February-March and June-July are best suitable seasons. It yields 31.76 t/ha. Tolerant to weevil incidence (14.85%).

CO.1 Coleus (1991)

It is a clonal selection. It yields 32 t/ha in a crop duration of 180-190 days. The tubers have 21.5 per cent starch. The cooked tubers are tasty and have lesser soil odour.

CO.1 Dioscorea (1991)

It is a clonal selection. It gives 44.8 tonnes of tubers/ha in a crop duration of 8 to 8½ months. The tubers are big in size with white flesh. Tubers are rich in carbohydrate (28%) and protein (2.5%).

CO.1 Colocasia (1991)

It is a high yielding selection. It has an yield potential of 24 t/ha. Tubers have high starch content (22.5%) and higher protein content (2.4%) than cassava and sweet potato. Tubers have less acidity and good cooking quality.

CO.1 Radish (1971)

It is a selection from a germplasm type. Roots are milky white, less pungent, long (22 cm) cylindrical and tapering and thick (12.5 cm girth) and medium sized (226 g). Roots contain 10.9 mg/vit. C per 100 g and 1.28% crude fibre, suitable for intercropping and other systems of cropping. Roots have better consumer's preference. Top to root ratio is 0.99.

Ooty-1 Beetroot (1992)

It is a selection and yields 31.4 t/ha in the hills. The crop duration is 120-130 days if direct sown and 135-150 days if transplanted. It is suitable for growing in all seasons. The roots are blood red in colour with thin skin.

KKL-1 Moringa bean (1996)

It is a selection from a local type. The selection yields 7 tonnes of green pods/ha with 31 per cent increase over local. Pods are green, fleshy and thick.

YCD.1 French bean (1994)

It is a pureline selection from a local type and suitable for rainfed cultivation in the hills upto an elevation of 1500 m above M.S.L. It yields 9 tonnes of green pods or 6 tonnes of grain per hectare in a duration of 105 days. The pods are flat, green with dark purple bold seeds. It exhibits field tolerance to yellow vein mosaic and anthranose disease.

KKL-1 Butter beans (1991)

KKL-1 butter beans (*Phaseolus lunatus*) is a selection from a type collected from Vilpatti. It is a pole type and bears pods in clusters. The pods are 11.6 cm long, beans are 5-6 in number per pod. The crop will be ready for harvest from 100 days. The harvest will continue upto 140 days. It yields 3.47 t/ha in 3 to 4 pickings.

CO.1 Dolichos bean (1993)

It is a selection. Pods are dark green flat and slightly curved, tender and fleshy. Pods contain 4.69% protein, 12 mg vit. C, Fe 2 mg, P.14 mg, Ca 39 mg. 100 g or edible portion with 1.33% crude fibre. Matured seed is black in colour. Yield 18 t/ha, duration 165 days.

CO. Simla potato (1970)

It is a selection from the hybrids obtained from CPRI, Simla. It is suitable for cultivation in the plains during monsoon seasons. The yield is 12 t/ha in a crop duration of 110 days.

Ooty 1 Palak (1995)

It is a selection and can be grown all through the year. It is tasty green leafy vegetable in which first picking can be had 45 days after sowing and continued at 15 days interval for a period of 2 years. It yields 15 t/ha/harvest. The leaves contain higher carotene.

PKM.1 Watermelon (1993)

Fruits are oblong, green in colour with light green stripes. Each fruit weighs about 3-4 kg. Duration is 120-135 days and yield is 38 t/ha.

CO.1 Cucumber (1989)

It is a selection from Kanyakumari local type. It is a high yielding selection (25-28 t/ha). The fruits are long (60 to 65 cm), slightly curved, tapering towards stalk end.

Ooty.1 Garlic (1991)

It is a high yielder and gives on an average 17.1 t/ha. Comes to harvest in 120-130 days. The bulb is dull white in colour.

EX.NO.3

PREPARATION OF MAIN FIELD AND PLANTING OF SEEDLINGS

Selection of site for vegetable cultivation

The points to be considered while selecting a particular site for vegetable cultivation are,

i) Marketing facility to sell the produce.

ii) Transport facilities and cost of transportation from production site to market place (more than one mode of transport is essential)

iii) Suitable climate for vegetable cultivation.

iv) Extent and suitability of land

v) Nature of available soil conditions

vi) Availability of labour force.

vii) Assurance of water supply.

A good soil for vegetable cultivation should have the following characters.

i) Soil should have ample plant nutrients for good yield.

ii) It should have a reasonable water storage capacity and ability to maintain sufficient moisture.

iii) Soil should have a good physical properties (which enables proper root development and anchorage of the plant)

iv) Soil should be free from adverse chemical reactions. Highly acidic or alkaline soil should be avoided.

Soil reaction influences the availability of plant nutrients N, P & K are highly available at a pH range of 6.5 to 7.0. The bacteria which fix nitrogen and decompose organic matter are very active in the pH of 7.0.

Each vegetable crop requires on optimum pH range for better performance. Cauliflower and spinach come up well in a pH range of 6.0 to 6.7, while peas and cabbage can tolerate a soil pH of 5.5.

Soil should be selected depending on the crop to be grown.

(1) Crops like celery, onion and lettuce have shallow root system. Plenty of organic matter and moisture should be available in the top soil for these crops. So soils which are high in fertility and moisture in top layer should be selected.

(2) Cucurbits have tap root system which grows to a depth of 45 to 75 cm. But the lateral roots spread as much as the spread of the top of the plant. Fertile, well drained loamy soils should be selected.

While transplanting, roots are injured and the capacity of the plant to absorb water to compensate transpiration loss is reduced. Hence it is better to transplant in the late evenings or on a cloudy day. During summer, it is desirable to provide some artificial shade to newly planted seedlings by inserting twigs with leaves near the seedlings. Life irrigation should be given on the third day. Gap filing may be done during the life irrigation or during the subsequent irrigation.

Age of seedlings suitable for transplanting

	Crops	Age (days)
1.	Brinjal	30-35
2.	Tomato	25-30
3.	Chillies	40-45
4.	Bellary onion	40-45
5.	Cabbage	30-35
6.	Cauliflower	30-35

Seedlings in polybags

7	Cucurbits	25-30
8	Annual Moringa	30-40

EX.NO.4

METHODS OF FERTILIZER APPLICATION AND IRRIGATION IN VEGETABLE CROPS

Fertilization refers to the addition of nutrients to the plant. The primary objective of crop fertilization is to achieve an optimum plant response. Fertilization beyond this level must be considered a wasteful practice. Not only it is subjected to an excess loss by leaching and volatilization, but also it becomes toxic to crops.

Fertilizers may be classified as natural organics and chemicals. Natural organics (eg. manure, blood, fish scraps and cotton seed meal) are compounds derived from living organisms. Chemical fertilizers, such as ammonium nitrate and superphosphate are synthesized from inorganic minerals.

In addition to soil application, nutrients may be applied directly through the foliage. N can be efficiently applied through the leaves by spraying them with urea. The application to the foliage of such trace elements as manganese, boron, Iron, Zn, etc. has also proved practical.

Important organic manures

1. **Cattle manure or farmyard manure:** The manures produced by horse, cattle or other animals are included in this category. It takes a long time to decompose nearly a year before it becomes usable. It is more suited to light than heavy soils. This contains 0.6% N, 0.35% phosphorus and 0.6% potassium. However, the percentage of these nutrients may vary depending upon the substances the animal feed, age of the animals, condition of animals and storage and handling including the kind of litter used. The manure is applied as a basal dressing by broadcast and immediately incorporated into the soil by ploughing.
2. **Bone meal**: This is rich in phsophoric acid and lime. Steamed bone meal contains not less than 3.5% N and 23% Phosphoric acid. Bone meal is especially beneficial to soil deficient in lime.

3. **Oil cakes**: They are residues left after the oil is extracted from the seeds of groundnut, castor, gingelly, pongamia, Neem, etc. and they contain 3 to 5% N and 1.5-2% P. They are best applied to potted plants in the form of liquid manure.
4. **Leaf mould**: Withered and dried leaves and garden sweepings are thrown into a pit in a shady corner in the garden and covered over with earth and watered copiously once or twice in summer to assist decomposition. Decomposition will be completed within a year. Leaf mould is rich in humus and is hence applied to both sandy and clayey soils. It is usually mixed with soil in the preparation of pot mixtures.
5. **Wood ash:** It is rich in potassium. Vegetables generally require liberal manuring with wood ash.
6. **Compost**: The soil organic matter can be increased by the addition of Compost. It may be defined as the material resulting from the decomposition of plant residues under the action of bacteria and fungi. A well prepared compost contains 0.75-1% N, 0.60-0.75% P_2O_5 and 1-1.5% K_2O.

Sometimes, green manure or green leaf manures are ploughed into the soil for the purpose of incorporating organic matter, thus applying humus as well as nutrients contained in them. The following are the commonly grown green manure legumes in India.

1. Sunnhemp (*Crotolaria juncea*)
3. Pillipesara (*Phaseolus trilobus*)
3. Daincha (*Sesania aculeata*)
4. Sesbania (*Sesbania speciosa*)

Green leaf manuring refers to the incorporation of the green leaves and other tender parts of the plants collected from the shurbs and trees grown outside the field and also collected from the waste lands and nearby forests into the soil. The popular plants are

1. Gliricidia (*Gliricidia maculata*)
3. Pungam (*Pungamia pinnata*)
2. Daincha (*Sesbania aculeata*)
4. Sesbania (*Sesbania speciosa*)

Type of fertilizers			Nutrient content
	Nitrogenous fertilizers	-	**%**
a)	Ammonium sulphate	-	20.6
b)	Urea	-	46.0
c)	Sodium Nitrate	-	16.0
d)	Potassium Nitrate	-	12.5-13.5
	Phosphatic fertilizers		
a)	Superphosphate	-	16.0
b)	Rock phosphate	-	30.0-40.0
	Potassic fertilizers		
a)	Muriate of potash	-	60.0
b)	Potassium Sulphate	-	48.0

Mixed fertilizers: It is a mixture of straight fertilizers which can supply more than one plant nutrient elements.

Advantages:

1. Saving in time and labour for application.

Disadvantages

1. Specific needs of crops for individual nutrient element cannot be met.
2. Unit cost of various nutrients contained in the mixed fertilizers will always be higher than the unit cost of nutrients in the straight fertilizers.

Biofertilizers

Fixation of atmospheric nitrogen is carried out by specific group of microroganisms either in free living condition (Eg) *Azotobacter* or in symbiotic association with leguminous crops (eg.) *Rhizobium* and non-leguminous crops. (eg.) *Azospirillum*.

Application of phosphobacteria solubilizes the insoluble phosphorus thereby it increases the availability of phosphorus.

They are applied in the following methods.

a) Seed treatment or seed inoculation (400 g/ha)

b) Seedling dip or root bacterization (1 kg/ha for 10 minutes)

c) Soil application or broadcasting (2kg/ha)

Depending upon the nature of soil and the crop, there are different methods of fertilizer application.

Organic manures are mostly spread uniformly in the field and incorporated at the last ploughing.

Methods

1) Broadcast

The fertilizer is applied uniformly over the field before planting the crop. It is incorporated by using a tiller or cultivator. One of the main disadvantages in this method is that more amounts of fertilizers are leached out. It has the advantage that there is less chance of injury to roots.

2) Side band

Fertilizer is applied in bands to one or both sides of the seed or plant.

3) With seed

The fertilizers are applied along with the seed at the time of sowing. The emergence of seedlings is affected if seedlings get scorched.

Starter solution

Solution of fertilizers consisting of NPK is applied to young plants at the time of transplanting. Such type of solution is known as starter solution which has the following advantages.

1. Nutrients reach the plant roots immediately.
2. Solution is sufficiently directed so that it does not inhibit growth (Eg) tomato.

Seed Treatment

Seed treatment with nutrient solution is also one of the ways to fulfill the nutrient needs of the crop at the early stages of growth. (Eg) Potato-soaking of seed tubers in 0.5% solution of micronutrients *viz*., Zinc sulphate, Ferrous sulphate, Manganese sulphate and copper sulphate for 4 hours has been found effective.

Foliar application

The water soluble fertilizers may be applied directly to the aerial portion of the plants. The nutrients can penetrate the cuticle of the leaf and stomata and then enter the cells. This method provides, more rapid utilization of nutrients and permits the correction of observed deficiencies in shorter time than the soil treatments. Micronutrients are highly effective when given as foliar spray. Urea is highly suitable for foliar application

because of its high solubility, easy and quick absorption by plant tissues and it contains more nitrogen. It can also be mixed with pesticides and fungicides while spraying. Urea injury could be corrected by sucrose or by the addition of Magnesium sulphate. Micronurients are highly effective if given as foliar spray because of their requirements in small amounts by the plants. Moreover, micronutrients like Zn, Cu and Fe are not highly soluble in soil.

Disadvantages

1. Skill is required in preparation of the solution for sprays as the foliage of the vegetable crops is damaged by high concentration of fertilizers.
2. Time of application is equally important. If the solution is sprayed in the hot sun, the foliage may get scorched due to rapid drying of sprayed solution over the foliage and thus increase in the concentration.

To avoid scorching effect, foliar application of micronutrients should be neutralized with 0.25% lime or 3.0% urea. (Eg) Foliar application of 2% urea at weekly intervals in bhendi for 6 times from 20 DAS.

Nutrient requirement of Vegetable Crops

Vegetable crops are fertilized in order to supply the nutrient elements which are not present in sufficient quantities in the soil.

Nitrogen

Nitrogen fertilizer is readily soluble in water and more loss is found to occur. This nutrient is required throughout the crop growth and all plants are found to absorb the nitrogen continuously through out the entire growth phase. So it is advisable to supply nitrogenous fertilizers in split doses instead of applying the entire quantity at one time.

Phosphorus

This nutrient is required in large amounts in the early stages of plant growth. Phosphorus fertilizers are found to be slow acting and the available phosphorus become unavailable due to fixation.

Soil amendments like Lime, Dolomite or Magnesium sulphate are easily decomposable organic matter in acid soils. Iron pyrites may be incorporated in alkaline soils to change the pH before application of fertilizers to reduce the fixation.

Surface application or broadcasting is preferred for shallow rooted crops, whereas placement in the root zone is advantageous for deep rooted crops.

Potassium

Potassium is required throughout the crop growth. But the release of this nutrient in the soil is very slow. Therefore, it is desirable to apply the entire quantity of K before sowing or planting of crop.

Time of application

Nitrogen: It should be applied through more number of splits for long duration as well as perennial crops. A major part of nitrogen from urea broadcast on soil surface is lost easily.

Powdered neem cake and urea at 1:5 ratio (Neem coated urea) reduce quick mineralisation of ammoniacal nitrogen thus increasing the period of nitrogen availability for the crop and reduces losses by leaching and run-off from upland soils (slow release fertilizer).

Phosphorus: It is generally recommended that the entire quantity of phosphatic fertilizers should be applied before planting or sowing of crop.

Potassium: In acid soils, potassic fertilizers should be applied after Lime application, otherwise potassium may be lost by leaching.

METHODS OF IRRIGATION IN VEGETABLE CROPS

Vegetables are composed largely of water. Adequate water supply ensures maximum yield,. earliness in maturity, good market and table quality. Except a few crops, like tapioca and sweetpotato, all other vegetables require regular irrigation. Uniform availability of water and plant nutrients in the root zone are essential for the growth, development and yield of vegetable crops.

Factors governing water supply to vegetable crops

i) Nature of crops

Some crops like tapioca, sweetpotato are drought tolerant and require less irrigation. Crops like cauliflower and other root crops are drought sensitive, and require more frequent irrigation. A shallow rooted crop requires more frequent watering than a deep rooted crop.

ii) Nature of soil

Fine textured soils hold moisture for longer time than soils of coarse texture. Deep soils hold large quantities of water than shallow soils. Incorporation of organic matter improves water holding capacity. When water holding capacity of soil is increased, the interval between irrigations can be extended.

Systems of irrigation

I. Surface irrigation : Water is directly applied to the soil surface. This system generally requires more quantity of water.

1. **Flooding**: This method of irrigation is followed widely in wetland banana cultivation. It is a wasteful method which leads to the stagnation of water.
2. **Check**: This is a more economical method than flooding. Here, check bunds are formed enclosing the large area of trees which are provided with channels between two rows.
3. **Basins**: This method of irrigation is widely practiced for perennial tree crops like coconut, mango and sapota. For vegetables, this can be followed for agathi and moringa.
4. **Ring**: Here a single irrigation channel connecting all the trees is formed and around each tree, the channel is widened to form a basin. This method is followed in cucurbitaceous vegetables.

5. **Beds:** Bed system of irrigation is followed for direct sown vegetables like amaranths, coriander, fenugreek etc. Hence, there is possibility of washing of seeds from one end of the bed to the other end.
6. **Furrows:** For crops like, tomato, brinjal, onion etc, this is the most common system of irrigation.

Drip irrigation

This type of surface irrigation ensures uniform supply of water to all plants. Here, water is supplied near to the root zone gradually. The water leaks from small holes in the hose and seeps into the soil at a slow and uniform rate. This method of irrigation can be followed for line planted vegetable crops like tomato, brinjal, chillies, beet root etc. In general, the water consumption is about half to one fifth in the drip irrigation method as compared to other methods of surface irrigation.

I. Sub soil irrigation

This method supplies water through underground pipes or pitcher pots on one side. This is useful for green houses. Pipes are laid 45-60 cm deep and 6m apart. The pipes have holes at regular intervals. This method is too costly and deep cultivation is not possible. But, evaporation of moisture is prevented to a great extent.

Pitcher method

This method is highly useful, particularly for drought prone areas where fruit crops and widely spaced vegetables are grown. An earthen pot of 20 litres capacity having 4 small holes of about 1 mm at a height of 5 cm from the bottom is buried in pits of 50 cm diameter and 50 cm depth. The soil around each pitcher is pressed firmly. The pot has to be filled with water once in 4-5 days which helps in the economy of water use and at the same time, the root zone is supplied with enough moisture.

II. Overhead system of irrigation

Sprinkler irrigation

Sprinkler irrigation is a versatile means of applying adequate amount of water to any crop, in general.

Advantages

1. Saving in labour and water.
2. More uniform wetting of soil

3. Soil erosion can be minimised
4. Best suited for steep and terraced lands
5. Most suited for plantation crops and vegetables like cabbage, cauliflower etc.

Disadvantages

a) Due to the influence of wind, there may be ununiformity in coverage.

b) In hot sunny days, water droplets on leaves and fruits may cause sunburn.

c) Certain disease may spread easily.

Based on water requirement of the rooting depth, vegetables are classified as,

I. Shallow rooted crops: (Root depth upto 60 cm)

1. Broccoli, 2. Brussels sprout, 3. Cabbage, 4. Cauliflower, 5. Celery, 6. Lettuce, 7. Onion, 8. Radish, 9. Potato, 10. Spinach.

II. Moderately deep rooted crops : (Root depth 61-120 cm)

1. Beans, 2, Beets, 3. Carrots, 4. Brinjal, 5. peas, 6. Sweet pepper, 7. Turnip, 8. Squash

III Deep rooted crops : (Root depth 121-180 cm)

1. Artichoke, 2. Asparagus, 3. Lima beans, 4. Sweetpotato, 5. Tomato, 6. Watermelon

EX.NO. 5

KITCHEN/NUTRITION GARDEN

A kitchen garden is a vegetable garden where the vegetable crops are grown in the backyard of a house or any available space in the home compound to meet the daily requirement of the family.

1. Growing vegetables by the family members serves as a good hobby and helps save money in purchase of fresh vegetables.

   For a balanced diet, 300 g of vegetables are to be included in our daily food. But on an average, Indians take only 160 g per day. Hence to fill up the gap, vegetable cultivation not only in farmers' holdings but also in home gardens is encouraged.
2. It helps to grow selected vegetables of our choice in fresh form.
3. Waste water and land available within our house compound are best utilized for growing vegetables.
4. It creates a healthy, beautiful atmosphere to the house.

Due to increased cost and non-availability of fresh vegetables, every home should lay out a small kitchen garden with available area. Arrangements may also be made to grow vegetables in containers, if the land availability is very low or nil.

Features of a Kitchen Garden

Perennial plot

This area should be located at the rear end of the garden so that the perennial plants can be grown effectively as its shade does not affect the growth of other crops. Crops like moringa, curry leaf, tapioca, yams, agathi and fruits like lime, banana, West Indian Cherry can be grown in this area.

Fence

It is very important to fence the garden to protect it from animals and trespass. If no compound wall is provided, live fence can be grown. Bamboo thatties, barbed wire or plain wire can be erected for fencing. On this fence line, coccinia, bitter gourd, lab lab and basella can be grown.

Manure Pits

Manure pits are dug at two corners of the garden at the rear end near the perennial plot. In this pit, garden and kitchen wastes including ash and household sweepings are dumped in and composted. This can be used for manuring kitchen garden.

Gourds like snake gourd, ribbed gourd can be grown near the manure pit and trained on pandal erected above the manure pit.

Paths and irrigation channels

A main path dividing the entire garden into two halves with side paths and walks are to be made. The area for main and side paths should be the minimum. The width of the path should be 45 to 60 cm. The number of irrigation channels should also be at the minimum. Along the main path, pandal may be provided and above that grapes can be trained. Along the side paths, greens like ponnanganni, palak, Mint and small onions can be grown.

Beds

After allocating areas for the above features, the rest of the area can be divided into beds of equal size and rectangular shape. According to the area available, 6-8 beds may be formed. Ridges that are seperating the beds may be grown with radish or small onion for effective utilization of the land area under cultivation.

The following vegetables can be grown in different beds depending upon the location, climate and choice of the family members.

				Duration
1)	Fruit vegetables	-	Tomato, Brinjal, Chillies	4-5 months
2)	Root vegetables	-	Raddish, Carrot, Beet root, turnip	3 months
3)	Bulb crops	-	Small onions, bellary onion, garlic	3-4 months
4)	Legumes	-	Lab lab, Cowpea, French beans, peas, cluster beans	3-4 months
5)	Curcurbits	-	Pumpkin, bitter gourd, ribbed gourd, snake gourd, coccinia	4-5 months
6)	Tuber crops	-	Sweetpotato, Tapioca, yams	8-9 months
7)	Cole crops	-	Cabbage, cauliflower, knol-khol	3-4 months
8)	Leafy vegetables	-	Amaranthus, coriander, fenugreek, palak, Alternenthra, mint etc.	2 months

In each bed, crop rotation, has to be followed. Shallow rooted vegetable (onion) may be rotated with deep rooted one (lab lab and Brinjal) or a leguminous vegetable (cow pea) may be rotated with a non-leguminous vegetable (brinjal and tomato) or tuber forming vegetable (sweetpotato) may be rotated with non tuber forming vegetable (Bhendi) etc. By crop rotation the soil characters are maintained without any crop loss.

For continuous supply of vegetables almost throughout the year, green leafy vegetables may be sown or planted at different dates preferably short duration crops first and later the long duration crop, so as to ensure regular supply of vegetables. Growing more than one crop in a bed in a year enables judicious utilization of the soil nutrients and the air space above.

In general, vegetables could be grown throughout the year with a few exceptions. Cropping intensity should be the maximum in kitchen garden. A cropping programme for a kitchen garden is furnished below for guidance.

Bed No.	**Vegetables**	**Season of growing**
1.	Brinjal + radish	June-September
	Cabbage	October-January
	Bhendi	Feb-May
2.	Tomato + cluster beans	June-September
	Beet root	October-December
	Greens	Jan-Feb
	Cowpea	March-May
3.	Avarai	June-September
	Brinjal and Turnip	October-January
	Cluster beans	Feb-May
4.	Bhendi	June-Sep.
	Cauliflower	Oct-Jan
	Radish	Feb-March
	Greens	April-May

Bed No.	Vegetables	Season of growing
5.	Chillies + onion (small)	June- November
	Greens	Dec.-January
	Brinjal + Radish	Feb.-May
6.	Onion (Bellary)	June-September
	Chillies	Oct.-Feb.
	French beans	March-May

Sl. No.	Crop	Duration	Sl. No.	Crop	Duration (months)
1.	Tomato	3 ½ - 4 months	8.	Curry leaf	Perennial
2.	Brinjal	4 months	9.	Chekurmanis	Perennial
3.	Chillies	5 months	10.	Tapioca	Perennial
4.	Moringa	Perennial	11.	Amorphophallus	Perennial
5.	Banana	Perennial	12.	Dioscorea	Perennial
6.	W.I. Cherry	Perennial	13.	Colocasia	Perennial
7.	Lime	Perennial	14.	Spinach	Perennial

EX.NO.6

USE OF PLANT GROWTH REGULATORS IN VEGETABLE CROPS

Vegetables occupy the vital place in our balanced diet. It is equally important that the area and production of vegetable crops should be increased. Use of high yielding varieties and improved technologies can increase the production to meet our growing demand for vegetables. Application of plant growth regulators, has become essential for increasing the productivity of vegetable crops.

Plant growth hormones are chemical substances other than nutrients produced by plants in small quantities at one place and transported to the place of action. These growth hormones may promote or inhibit or otherwise modify growth and development.

Plant growth regulators are also chemical substances applied exogenously to promote or inhibit or otherwise modify growth and development (Eg) Spraying of 2,4 D enhances fruit set in short styled flowers of brinjal.

Growth Promoters

(i) Auxins: The auxin like substances are produced in buds, tips of stem, root etc. Some of the synthetic substances having auxin activity are IAA, NAA etc.

Main action of these auxin like substances are (i) cell elongation (ii) cell enlargement (iii) cell differentiation.

Gibberellins: This kind of substances stimulate growth in tissues of young internodes (e.g.) GA_3.

It acts by (i) modifying RNA produced in nuclei i.e. it has control over cell elongation.

(ii) Cell elongation by hydrolysis of starch leads to increased concentration of sugar in cell sap, intrun make entry of water finally it stretches the cell size.

Cytokinins

This type of chemicals interact with auxins. It acts on cell initiation/cell division. When cytokinin Auxin ratio is more, shoot development will be more. The prevalence of equal ratio leads to undifferentiated callus production.

II. Plant Inhibitors

Plant inhibitors have the actions like (i) induction of senescence, (ii) inhibition of growth, (iii) prolongation of rest period in seeds (Eg):ABA in seeds.

III. Plant growth retardants:

Main action of these chemicals is retardation of stem elongation by preventing cell division in subapical meristem. (E.g.) SADH, phosphon-D, CCC etc.

Some of the growth regulators widely used are (1) NAA (Naphthalene acetic acid) (2) GA (Gibberellic acid), (3) Ethrel (4) CCC (Cycocel), (5) MH (Maleic hydrazide), (6) 2-4-D (7) Triacontanol, (8) 2,4,5-T, etc.

1. Growth regulators are generally applied in the evening hours.
2. High volume hand operated sprayers are recommended for spraying.

List of growth regulators

	Name of growth regulator		**Make**
1)	P-Chlorophenoxy Acetic Acid (CPA)	-	SIGMA
2)	α-NAA	-	SIGMA
3)	2,4-Dichlorophenoxy Acetic Acid (2,4-D)	-	SIGMA
4)	6-Benzyl Amino Purine (BAP) (or) Benzyladenine (BA)	-	SIGMA
5)	Indole-3-Butyric Acid	-	SIGMA
6)	Kinetin (6-Furfuryl aminopurine)	-	SIGMA
7)	1-Phenyl-3-urea (Thidiazron) Thiourea	-	SIGMA
8)	Gibberellic Acid (GA)	-	SIGMA
9)	Paclobutrazol (cultar)	-	SIGMA

Tomato: Temperature requirement is a very essential factor for fruit set in tomato. Application of GA 50 ppm or 2-4-D 2 ppm or Triacontanol 1 ppm at 15DAP and at flowering will increase the fruit set and yield when the night and day temperatures are below 15°Cand above 35°C respectively. It has been found that spraying of cycocel 250 ppm can check the spread of leaf curl virus disease.

Brinjal;: In brinjal, there are four types of flowers depending upon their style length *viz*. Long styled, medium styled, pseudo -short styled and true-short styled. Fruit set occurs mostly in long and medium styled flowers and to a certain extent in pseudo short styled flowers. By spraying 2,4-D 2 ppm or Triacontanol 2 ppm at the time of flowering, the fruit set was found to be increased to a considerable amount in true short styled flowers also. 2,4-D 5 ppm can also be used for seed treatment for the above purpose. Brinjal responds well to application of micronutrients when combined with triacontanol 4 ppm at 15 DAP and at flowering for increasing production.

Chillies: In chillies, though the flowers are produced profusely, the fruit set percentage is very low. To increase the fruit set and check the flower and fruit drop, spraying of NAA 10 to 25 ppm (Planofix 1-2.5 ml per 4.5 litres of water) on 60 and 90 days after planting is recommended. This practice is widely followed by chilli growers. It has also been found that by spraying of 'Biozyme Crop' @ 180 ml in 180 litres of water on 35, 55 and 75 days after planting, the yield of chillies could be increased.

Gourds: In gourds, the number of male flowers is generally more than the female flowers (high sex ratio) which leads to less yield. To increase the number of female flowers and fruit set, ethrel spray is recommended. For Ash gourd, pumpkin and ribbed gourd, ethrel can be sprayed at 250 ppm and for snake gourd and bitter gourd it can be sprayed at 100 ppm. The spray should be taken up four times at weekly intervals starting from 15 days after sowing. For bitter gourd, spraying of Triacontanol 5 ppm at four leaf stage and at vining stage was found to improve the yield.

Onion: Long storage of onion bulbs is a difficult task. The bulbs would start sprouting during storage, if moisture content is increased. To arrest the sprouting of onion bulbs during storage onion crop can be sprayed with MH 2500 ppm as a pre harvest spray 15 days prior to harvest.

Tapioca: Spraying of ethrel 250 ppm five times at monthly intervals starting from 3rd month after planting can improve the tuber yield of tapioca.

SweetPotato: Ethrel spray @ 250 ppm five times at 15 days interval starting from 15 days after planting can be practised to increase the tuber yield in sweetpotato.

Method of application

Growth regulators are generally applied at very low concentrations i.e. in ppm (parts per million) i.e. one mg in 1 litre of water gives 1 ppm solution. The growth regulators may be applied in powder form or paste (lanolin paste) or spray solution. Good water should be used for dissolving chemicals. If the growth regulator is insoluble in cold water, hot water or alcohol can be used to dissolve the chemicals.

It is essential to prepare the solution of correct concentration for a particular crop to get the expected results. Higher or lower concentration of chemical may some times give negative effect. It is a general rule that spraying of growth regulators should be taken up in early morning and late evening hours for better utilization of the chemical.

EX.NO.7

SEED PRODUCTION TECHNIQUES IN VEGETABLE CROPS

Solanaceous Vegetables

Tomato, brinjal and Chillies

The method of cultivation for seed production is more or less the same as for vegetable production. Individual plants with good fruiting quality should be marked and ripe fruits harvested for seed extraction.

Isolation distance: To maintain genetic purity of seeds, proper isolation distance should be given. This may vary according to the nature of pollination. Tomato-50 m, Brinjal 200m, Chillies-400 m.

Extraction of seeds from ripe fruits:

1. Tomato

a. Fermentation method: The ripe fruits are crushed and allowed to ferment for 1-2 days. The pulp and skin floats and the seeds settle down at the bottom. The seeds should be washed thoroughly and dried.

b. Acid method: The fruits are cut into halves and the slimy mass is removed 100 ml of (10-15 ml per kg) commercial HCl is mixed with 10 kg of slimy mass. Seeds separate out from the mass within one hour. Then it is washed free of acid and dried. The flesh can be used after seed extraction. Average seed yield is 16-20 kg/ha. For bacterial canker – 0.8% acetic acid treatment for 24 hrs.

c. Alkali method: In this method, 300 g of washing soda is dissolved in 4 litres of boiling water. This solution is mixed with equal volume (4 kg) of slimy mass of seeds. Then it is allowed to cool down overnight. The next day morning it is washed with fresh water repeatedly until all the chemicals are washed away. In this method also, flesh can be used.

d. Mechanical Extraction - Tomato seed extractor is used. Moisture content of seed is 6-8% and viability is 2 years.

II. Brinjal

Fully ripe yellow coloured fruits are crushed and allowed to stand overnight. It is washed with water, dried and sieved. Average seed yield is 590-880 kg/ha.

III. Chillies

Red ripe dried pods are broken and the seeds are collected. Average seed yield is 105-225 kg/ha depending on varieties.

IV. Gourds and Melons

All melons and gourds are highly cross pollinated. Except watermelon and roundmelon all the other melons are cross compatible with each other. No two melons should be grown in the same field for seed production. Isolation distance of 800 m is recommended. Proper roguing is essential. Seeds are collected from ripe fruits and dried under sun or using mechanical driers. Seeds are collected from fully matured fruits in bottle gourd, bitter gourd , ash gourd , pumpkin and cucumber.

Leguminous vegetables

Peas and beans

These are self pollinated crops and hence no appreciable contamination is expected. Isolation distance of 50 m and 20 m is followed for beans and peas respectively. Agronomic practices for crop to be raised for seed production are more or less the same as for vegetable production. Dry pods are collected and threshed carefully without injuring the seed.

Average seed yield : French beans – 1000-1500 kg/ha

Peas – 2000-2500 kg/ha

Root crops

Radish: It is a cross pollinated crop and requires an isolation distance of 1600 m. Roots are harvested at marketable stage. Good quality roots are selected. One half or one fourth of the root is cut and planted in well prepared field. Some growers leave the plants *in situ* and allow it to produce the seeds. This practice is not recommended as the removal of off types (which are not true to variety) is not possible.

Carrot: European varieties do not set seed in plains, hence seed production is limited to the hills only., whereas the Asiatic varieties produce seeds in the plains. Isolation distance of 1000 m is recommended for foundation seed production. Roots are harvested at marketable stage, after removing the off types, the stecklings are given one third shoot cut and one fourth to one half root cut to obtain better quality and higher seed yield. The stecklings are again planted in the field at 75 x 20 cm spacing. Some times only root cut is given without any shoot cut.

Cole crops

Cabbage

(i) Head to seed method

The time of planting of seedlings is adjusted so that full maturity of the heads occurs just prior to winter. When they mature earlier, they tend to split. At maturity, off types are rogued based on the shape and size of head and appearance of basel leaves. Heads which are less compact and with large number of non-wrapper leaves are also eliminated. The selected plants are uprooted and stored for over wintering.

Storing or over wintering

(a) Cellular method (or) Cold storage : 32°F (0°C) and 90-95%R.H.

(b) Trench method of storage:

A trench of 1m width, 3m length and 1m depth is dug. After maturity, the plants are removed from field during November. The non-wrapper leaves are removed. The plants are kept in a slanting manner inside the trench. The roots and stem are covered with soil. Trenches are covered with wooden plank. Soil is spread over it to a depth of 15 cm. On both the ends of trench, small holes are provided for ventilation which keeps the head in good condition.

During first week of April, (melting of snow), the heads are taken out of the trench, again selection for true shape and size of head is done and replanted in a well prepared field at a spacing of 90-180 x 45-90 cm depending on varieties. Before planting, a crosscut of 2.5 cm deep is given to the head without causing injury to the growing point. This ensures better emergence of flowering stalk. This method of seed production is usually followed in Kulu valley of H.P. During spring, there will be mild temperature and bright weather, which facilitate cross pollination. When pod colour changes from green to yellow, they are harvested, dried, threshed and seeds are sieved.

(ii) Seed to seed method

This is an easy method to adopt. The heads are left *in situ* in the mainfield. Off types are rogued and in late autumn, small furrows are dug in between two rows and the soil is used to cover the plant. The top is left exposed and partially buried plants withstand low temperature.

(iii) Stump method

After full maturity of the crop, heads are cut off just below the base by means of a sharp knife retaining the stem with outer leaves. Heads are marked and the deheaded portion of the plant, known as stump is either left *in situ* or replanted during autumn. Through this method, the yield of seeds is increased and the crop matures 12-15 days earlier than the head intact method. But flowering shoots are spreading and may break down easily during inter cultural operation or spraying. Hence, staking and tying the flowering shoots is essential.

Stump with central core-intact method

Heads are not removed but chopped on all sides with a downward perpendicular cut. Pods are borne in racemes and harvested in two to three lots. Early plants are harvested first and the remaining crop is cut when about 75% of the pods turn yellowish brown. Harvested crop is piled, covered with tarpaulin and kept for 4-5 days. After curing, seed is thrashed and separated from dust. Seed is dried in sun and then graded. Average seed yield is 500-600 kg/ha.

CAULIFLOWER

Seed to seed method

(i) Transplanting of seedlings and leaving *in situ*:

Scooping the curd at 2/3 rd maturity result in higher seed production. After curd formation, roguing is done for curd size, colour, compactness and free from riceyness/fuzziness etc. Under South Indian conditions for seed production, the time of sowing and transplanting is same as that of market crop. Seeds are sown during July-August, transplanted in Aug.-Sept. and curds are left *in situ* for seed production. Average seed yield is 500-600 kg/ha.

BULBS

Onion

Onion seed is usually produced in the temperate and subtropical conditions. Onion is a biennial crop for the purpose of seed production. In one season, bulbs are produced from seed and in the second season, bulbs are replanted to produce seeds.

It is a highly cross pollinated crop. Isolation distance is 1000m. There are two methods of seed production (1) Bulb to seed method (2) Seed to seed.

Bulb to seed method

Seeds are sown and seedlings are transplanted to produce the bulbs

Roguing

Late maturing plants are discarded before harvesting the bulbs. After harvest, bulbs are rogued carefully for off types like thick necks, doubles, bottle necks, under and over sized bulbs. Normally bulb size is 50-60 g. Bulbs harvested during warm weather is carefully stored at a temperature of 4.5 to 12°C till October. The growing portion of the selected bulb is cut to the extent of ¼ to 1/3rd before planting for quick sprouting. The lower portion which is disc like along with the roots are used for planting. Planting is done normally during Oct-Nov at a spacing of 30 x 30 cm.

Advantages :

Since roguing of bulb is done, the seeds are pure which is favourable for production of nucleus and foundation seeds.

Disadvantages:

(1) It takes two years for seed production. (2) It is more expensive as large quantities of bulbs are to be stored for planting, (3) Loss during storage of bulbs is high.

Seed to seed method:

After bulb formation the plants are left *in situ* for bolting. In this method, the seed yield is more because of more number of plants and seed heads per unit area. Seeds from seed to seed method should not be used again, for seed production.

When fruits open and expose the black seed, the seeds are ready for harvest. All the umbels do not mature at the same time. When the 10% of the heads in the field have black seeds exposed, the umbels are harvested along with 10-15 cm stalk. Heaped for few days, threshed and seeds are cleaned. Seeds are dried to 8% moisture for packing in porous containers and 5-6% for packing in Aluminium foil. Viability decreases with paper packing, remain viable for 3-4 years in sealed containers.

Average seed yield is 8-10 kg/ha.

Ex. No. 8

LAYOUT AND VARIOUS COMPONENTS OF A BOTANIC GARDEN

In order to break the monotony and to enhance the beauty, any garden should contain components of varying nature. Following are certain important features.

Avenue

An avenue is the row of trees grown on both sides of roads. Shade and beauty are the sole criteria which we should consider while selecting avenue trees. The trees should also be selected according to the length and breadth of the road.

Two level garden

This is also called "Italian style" garden or 'scroll' garden. It is symmetric with two tiers. the down tier is grown with flower beds, edges etc., A small pond at the centre will be attractive and useful for growing water plants. The upper tier is decorated with flowering shrubs, hedges etc.

Topiary

The art of developing the plant or training the plant into different forms or shapes like animals, birds, arches etc., is called topiary. The plant should be amenable for repeated pruning and also flexible with more vegetative growth.

(E.g) Hills – *Cupressus macrocarpa*

Plains – *Casuarina* sp., Divi-Divi *C.coriari*, Bougainvillea *Jaminum* sp.

Lawn

A garden is incomplete without a lawn. It serves to enhance the beauty of a garden whether it is large or small. It finds the most important component of a garden.

Trophy

It is the arrangement of colourful potted plants in different tiers around a central structure which may be a tree trunk, lamp post or a pillar.

Water garden

It may have a water course, a water pond and a water fountain or any one or more of these features. The water fountain can be so combined with a water-fall and stones that the sweet gurgling sound can be heard. A weeping willow over-hanging the water garden provides a restful setting (Eg. *Salix babylonica)*. Water garden provides for cultivation of

water plants, marsh plants and moisture loving plants. Water lilies **(***Nymphaea***)** are the most popular water plants.

Rock garden

A rock garden is the arrangement of rocks with plants growing in the crevices. Its bold ruggedness is a pleasant contrast to the softness of the flowers. A rockery should be functionally effective in providing a suitable home for the plants to grow. The stones help the plants in retaining their moisture and keeping their roots cool. In the hills, 'Alpines' can be grown on rocks to bloom successfully. In plains, on the sunny side some of the Cacti, Succulents, **Lantana, Setcreasea,verbena** etc can be grown successfully. Ferns and some indoor plants also look natural on the rockery slopes in shade.

Sunken garden

It is formed taking advantage of a natural depression. The depression is formed into different tiers and over which ground covers, edges, flower beds and small herbs may be grown. At the centre of depression a pond or pool is formed to grow water plants.

Summer house or fern house or conservatory (Mostly indoor plants)

Some of the rare and exotic plants need to grow only in summer houses where cool, humid atmosphere is created by making a wooden or bamboo framework which is covered on three sides except east with evergreen creepers. Copious watering of the plants or fixing a rotating fountain with a fine nozzle will take care of the required humidity.

Glass house

It is not so essential in plains as in the hills. A glass house is made on the south or south-west side using glass panels and iron frames on all sides sloping from the roof line. Also ventillators or windows provided for air circulation. Hardy plants like cacti can be grown successfully.

Garden paths, roads, and walks

A garden path is a piece of beauty and an architectural feature in itself. they should run from one point to another direct in a few bold, graceful and gentle sloping curves. Paths in straight lines intersecting each other at right angles are suitable for formal gardens only. Paths can be laid using bricks, stones, cuddapah, mosaic, marble, coal, gravel, concrete etc., Sometimes paving with irregularly sized stones to create an odd pattern will result in a `Crazy path'. The interspaces can be planted with lawngrasses.

Carpet beds

The art of growing ground cover plants closely and trimming them to a design or alphabetical letters is called a carpet bed. They require constant attention. Colourful foliage edge plants are found more suitable for this purpose (Eg) *Alternenthera*.

Shrubbery

Growing of shrubs in a group is called shrubbery. It is of two types (i) Pure shrubbery (ii) Mixed shrubbery. Pure shrubbery refers to planting of entire selected area with a single species and the opposite holds good for mixed shrubbery. The shrubs may be with attractive flowers or foliage.

Arboretum

Growing of different species of trees in one place is called `Arboretum'. The trees form the main frame work of the garden. Masses of trees in one place will help to give depth and perspective. Trees with beautiful flowers and attractive foliage are suitable for growing in gardens.

Flower beds and Borders

Annuals and herbaceous perennials are grown in flower beds to provide massing effect of different colours. Borders are continuous beds of more length than width containing plants of one kind only.

Ground cover

When a dicot plant, which is of straggling in nature is used to cover the ground surface, it is called ground cover (e.g.) *Vedalia,Verbena, Ipomoea,* Dwarf *Acalypha*, *Portulaca grandiflora*.

Picnic spot

It is meant for recreation and relaxing where only trees are grown for shade.

Pergola

It is just like an enclosed pavement formed by connecting a series of arches together. Usually flowering creepers are trained over the arches.

Statues

Elegant statues may be provided at different places in a garden. They may be erected over a mound or hillock to provide a natural effect.

Climbers and creepers

A group of ornamental plants used to grow over walls, trellices, arches, pergolas, arbours, pillars, bowers etc. These are grouped as light or heavy according to the amount of wood it produces.

Hedges

With the help of plants, live hedges can be formed and used as a fence or a green wall (e.g.) *Thevetia nerifolia, Acalypha, Casuarina, Dividivi* etc. They help to divide the garden into several parts.

Edges or edging

These are perennial herbs often used as a border for lawn or ground cover or dividing beds, borders etc from roads, walks or paths. These herbs often stand frequent trimming.(eg.) *Eupatorium, Alternenthera*, Golden *duranta*, dwarf marigold,etc.

Garden adornments

There are several garden adornments and accessories such as fountains, garden seats, ornamental posts and pillars etc. which make the garden more enjoyable.

Japanese garden

Japanese garden is mainly divided into three types namely

i) Mountain garden

ii) Island garden

iii) Tea garden

The paths and roads in these gardens are narrow and bushy plants are grown along the path to provide a concealment. Islands are interconnected by bridges made up of stones or bamboos or stems of palms. The mountains are the source of water located at one side of the garden. River stones, water plants, bamboos, dwarf trees, stone lanterns are the components in these gardens.

Ex. No. 9

ANNUALS, BIENNIALS AND HERBACEOUS PERENNIALS

Classification of annuals

Annuals are classified into three : i) Rainy season annuals, ii) Cool season or winter annuals, ii) Hot weather annuals

Biennials

These plants complete their life cycle in two seasons.

Herbaceous perennials

These plants can be grown for more than 2 years or 2 seasons.

Rainy season annuals

They can stand more rain than others and the sowing season for them is April - May in most of the places.

Winter annuals

These annuals will thrive and bloom best during winter and they are sown in September-October.

Hot weather annuals

These annuals are raised for blooming from March-Aprill and so they are sown in December-January.

Hints for raising flowering annuals

i) Sow the seeds in seed pans or in raised nursery beds. The sowing is necessary to get good sized vigorous seedlings. In a seed pan, a pot mixture consisting of 2 parts of soil, 2 parts of leaf mould and 1 part of sand may be used.

ii) Fine seeds may be mixed with 3 or 4 parts of sand before sowing. Annuals like Calendula which do not stand transplanting can be directly sown.

ii) Watering the nursery may be done with rose can.

iv) After the seeds germinate and grow, thin out over crowded seedlings. As transplanting often results in heavy casualties, the seedlings are pricked before transplanting.

Pricking is the practice of transplanting young seedlings in small pots or beds with richer soil giving wider spacing (10-12cm). This helps to increase the fibrous root system and to develop vigorous roots.

v) One month after sowing, when the seedlings have produced 6-8 leaves,transplanting can be done with a spacing of 20-30 cm on either side.

vi) Tall growing annuals like Holly hock can be provided with stakes. Pinch-off the terminal buds of seedlings after they establish, which encourages lateral growth and a more bushy growth.

Ex. No. 10

ORNAMENTAL TREES AND SHRUBS

Trees are very fascinating because of their graceful appearance and the abundance of bloom. They are grown for their economic importance or aesthatic value or both. The cultivation of trees for their aesthetic or recreational value is known as arboriculture. The trees are the most permanent elements in a landscape and a thorough knowledge of their ornamental properties, rate and mode of growth, their behaviour in different soils, situation and climate are essential. They should be planted carefully and thoughtfully for the benefit of height, shade, colour and vertical emphasis.

Avenues planted with trees are safer because of their restful and scenic views, reduce the monotony of driving and provide shade to the exhausted pedestrians. *Poinciana regia, Anthocephalus indicus, Cassia nodosa, Bauhinea purpurea* will add colour and charm to an avenue. But shade and economic utility should be the main criteria for highways, thus *Lagerstroemia speciosa, Tamarindus indicus, Swietenia mahagoni* should be selected. One type of tree should be planted for a considerable skyline and uniform crown.

ORNAMENTAL TREES

Trees form the main framework of the garden. Some trees produce attractive and beautiful flowers including fragrant flowers, a few trees are noted for their attractive foliage and a few more trees are known for their peculiar shape or form which are used as specimen trees. Shady trees are planted in chosen spots of large public garden which provide an useful place for picnic and rest. Such trees are also planted along the borders of roads as avenue trees for giving shade. In selecting ornamental trees the purpose should be decided first and then the place of its growth should be finalised. The following are the purpose of ornamental trees.

i) Shade

Most trees are planted to provide shade and they should be placed in locations where shade is most needed. They are also planted to protect the house during the hottest part of the day.

ii) Enframement:

Trees are used to enframe buildings. These trees are planted off the front corners and to the sides of a building. They assist in breaking the horizontal line of the roof.

iii) Background:

Trees can provide background for a building. Trees placed behind a structure should grow and provide foliage above the roof line.

iv) Screening the views:

Trees are useful for screening the views and creating privacy farm yard. Trees when used in groupings become the object of beauty in colour or form and draw attention away from undesirable view to draw attention to it.

v) Wind protection :

Dense planting of tall evergreen trees will reduce wind velocity and filter dust from the air. Grouping of trees at very close spacing will adequately provide wind protection.

vi) Accent material:

Flowering trees or trees with graceful and interesting branching habit are often used as an accent in the landscape. They are usually referred to as a terminal planting for a wall or hedge.

ORNAMENTAL SHRUBS

Shrubs are plants with woody stems which are smaller that trees but bigger than herbaceous plants. A typical shrub will have several stems arising from the main stem at ground level itself. They are either evergreen or deciduous. Some are attractive in their foliage, some produce attractive flowers and some are grown for their attractive berries. Groups of shrubs planted at corners will be useful in natural designs. Shrub borders are established on the sides of walks and paths. Shrubs are planted at the corners of lawn in a curving line. A shrubbery is a border planted with different kinds of shrubs and a shrub border is one where only one kind of shrub is used. Shrubs that stand frequent cutting and trimming can be used for topiary work. Groups of shrubs planted along the base line of the building will help to link the building with the ground.

Tall growing shrubs can be used to screen the disagreeable object and backyard activities. Handsome shrubs can make attractive pot plants for indoor and outdoor decoration. The following are the functions of shrubs in landscape gardens.

(i) Foundation plantings:

The selection and placement of shrubs along the foundation require more planning. Indiscriminate planting of foundation may result in a dense mass of over grown shrubs and provides a real maintenance problem.

(ii) Softening the harsh line:

The strong vertical lines at the corners of the building need to be softened. Shrubs that will soften these lines should have a round, oval or irregular shape. Shrubs having striking coloured foliage or course texture should be avoided.

(iii) Entry way planting:

The entrance to a building is the ideal location to use shrubs that attract attention. Here shrubs having bright coloured foliage are used. Course textured foliage shrubs can also create a desirable effect when used with plants having fine textured appearance.

(iv) Transition planting:

Shrubs that pull together the plantings at the corners and entry way plantings are called transition planting. Shrubs that do not call attention to themselves by having bright foliage or course leaf texture are used for this purpose.

Ex. No. 11

CLIMBERS AND CREEPERS

Climbers are very important ornamental plants and are commonly used on walls, arches and pergolas but in cities their utility is increased for the purpose of screening the premises from adjacent houses and maintaining privacy. Bare walls can be most effectively decorated by growing colourful climbers on them. Botanically, plants which have the special structure to climb on supports are defined as climbers.

Selection of climbers

1. **Annual climbers**

   (e.g) *Clitoria ternatea*, sweet pea, morning glory, (*Ipomoea rubrocaerulea*)

2. **Climbers for screening** (e.g.) *Anitgonon leptopus, Passiflora, Porana, Ipomoea, Clerodendron splendens, Thunbergia* etc.,

3. **Climbers for low walls or trellis**

   For this purpose only light climbers are selected.

   (e.g) *Lonicera japonica, Solanum seaforthianum, Tristellatia australis, Tecoma jasminoides, Jacquemontia violacea*

4. **Climbers for pergola**

   Usually heavy climbers are grown.

   (e.g.) *Quisqualis indica, Petrea volubilis, Adenocalymma allicea, Allamanda cathartica*, etc.

5. **Climbers for porches**

   (e.g) *Pyrostegia venusta, Petrea volubilis, Clerodendron splendens, Bougainvillea, Jasminum* sp, etc.

6. **Flowering climbers in partial shade**

   (e.g.) *Passiflora, Aristolochia, Quisqualis indica, Clerodendron splendens, Jacquemontia violacea*

7. **Foliage climbers**

   (e.g.) *Scindapsus aureus,Philodendron* sp.,*Monstera deliciosa*

8. **Climbers for pot culture**

   (e.g) *Tristellatia asutralis, Adenocalymma allicea, Clitoria ternatea, Bignonia purpurea* etc.,

Ex. No. 12

CACTI AND SUCCULENTS AND INDOOR PLANTS

These are group of plants which have developed a special capacity to store water in thick fleshy leaves or stems. They thrive best in sunny situations and are light loving. They need little care except when actively growing. All the cacti are succulents on account of storing water but all the succulents are not cacti. There is a clear cut distinction between both. Cactus is characterized by the presence of areoles sp., which often look like woolly cushions carrying spines, hairs or glochids and the flowers arise from or near the areoles. The spines in cactus are modified leaves which provide shade against scorching sun and help in conservation of moisture besides protecting against birds and beasts.

Cacti and succulents are very popular amongst gardeners, amateurs, and hobbysts which are used to adorn sunny situations of gardens, houses, window sills and rock gardens. Popular names have been given to them like 'Mother in law's chair' (*Echinocactus grusonii*), 'Old man' (*Cephalocereus senilis*), 'Silver torch' (*Cleistocactus strausil*), 'Moon cactus' (*Selenicereus*). 'Old lady' (*Mammillaria hahniana*). Mr. Red cap (*Gymnocalycium mihanovichii* var. *Friederickii*), Bishop's hood (*Astrophytum myriostigma*), 'Arab's turban' (*Crassula hemisphaerica*), 'Sea onion' (*Bowea volubilis*), 'Old man's tooth' (*Lithops sp.*), 'African milk barrel' (*Euphorbia horrida'*), 'Beads' (*Sedum stahlii*), Airplane plant (*Crassula falcata*), 'Elephant foot tree' (*Beaucarnea recurvata*) etc.

All the cactus plants belong to family 'Cactaceae' which is further divided into following three tribes.

Tribe 1 : Pereskieae

This is the primitive form and near to original forest trees. Plants are leafy bushes, look like citrus trees and have stalked flowers in clusters resembling wild roses.

Tribe II : *Opuntieae*

Plants are characterized by the glochids or sharp, easily detached bundles of barbed bristles in the aerioles sp. Stem or branches are fleshy, loosely joined either flat or pad like or cylindrical having spines but without ribs.

Tribe III : *Cereae*

This is the largest group and members are characterized by their ribbed, fleshy stems of continuous growth in columns or globes.

Climate

Cacti are adaptable to wide range of climatic conditions. The exposure to direct scorching sun and temperatures above 35°C results in yellowing and finally rotting. Very low temperature also inhibits the growth of cacti. Active growth starts during spring season and continues till autumn.

Soil

Cacti thrive well in porus and rich calcareous soil. The general ideal pot mixture for cacti consists of 2 parts garden soil : 1 part sand : 1 part leaf mould : 1 part well rotten manure : 1 part old mortar or lime stone gravel and 1/2 part charcoal. Undecomposed organic matter causes rotting of roots.

Propagation

Cacti can be multiplied sexually as well as asexually. Seeds are collected from ripened fruit and sown from March to September in pots, seed pans or boxes filled with 1 part garden soil. 1 part sand : 1 part leaf mould. Seedlings grow slowly and it takes long time to make a specimen plant from seeds. Division of off shoot or clumps or root suckers is an easy method of vegetative propagation. Another method consists of taking cuttings of convenient length and drying 7 - 30 days before planting. Then these cuttings are planted in sand and new growth shows that rooting has taken place.

Watering

Cacti and succulents do not need liberal watering. Judicious application of water is required for successful growing. In winter months i.e. during rest period watering is to be done very sparingly. Little frequent watering is done during summer months when cacti grow. Every time the soil is to be drenched completely so that water comes out of the drain hole and overwatering should be avoided.

Ex. No. 13

LAWN AND LAWN MAKING

A lawn is a grass grown as a green carpet for a landscape and is the basic feature of any garden. It serves to enhance the beauty of the garden, be it larger or small. The lawn not only harmonizes with a decor of the drawing room, but also sets of a suitable background for a specimen tree or a shrub, as well as for colourful beds and borders. The position of the lawn largely depends upon the layout of the garden in relation to the house. In general lawn should be wide open with access to direct sunshine, especially in front of a rockery and a water pool.

SITE AND SOIL

After choosing the site, the next important thing is to decide the size and shape of the lawn. The preparation of site includes digging, levelling and enriching the soil with organic manures or by amending with fertile soil. If the soil is very heavy, coarse sand may be added by removing subsoil to 20 cm depth. The ideal soil pH should be 5.0 to 5.6. If it is very acidic 500g/m2 lime should be added and to clayey loam or alkaline soil gypsum of the same quantity may be added. Provision for drainage of excess rain water should be made if the ground is not slopy.

LEVELLING

The site should be thoroughly levelled with spade, pebbles and weeds are hand picked. The soil is rolled with a roller. Weeds especially nutgrass should not be allowed to grow and should be removed with roots atleast 2 to 3 times.

METHODS OF LAWN MAKING

BY SEEDING

The number of grass varieties suitable for fine lawn is very much limited in our country. The most popular grass suitable for most part of our country is "doob" grass (Cynodon dactylon). It has the fast spreading mat forming habit, branches profusely and radially forming roots at the nodes, the foliage is dark green, narrow with parallel vines. About 30 kg of seeds may require for an hectare. The site should be divided into suitable small squares or rectangles, the seeds are mixed with double the quantity of finely shifted soil and should be rolled again and watered liberally with rose of a water can. The seeds

take 4 weeks for germination. Care should be taken not to flood the site. Lawn mower may be used when the roots have established and are spreading.

BY TURFING

The turfs are nothing but pieces of earth with compact grasses on them. These turfs should be cut uniformly in squares from a place where the grass is compact and free from weeds. These turfs should be placed on the prepared ground site and beaten down with turf beater. The cavities in between should be filled with fine soil. The entire turfed area should be rolled and watered liberally. This is the most expensive way of lawn making.

TURF PLASTERING

The doob grass can be procured in large quantities free from weeds and chopped properly into small bits of 5-7 cm long. Two baskets of chopped grass pieces should be mixed with garden soil, fresh cowduing one bucket each and a shovel full of wood ash should be mixed well with required quantity of water to form a thick pasty substance. This mixture is then spread uniformly on the surface of a perfectly levelled ground to a thickness of atleast 2.5cm and watering should be done with a water can. The next day the ground should be rolled and the grass should be allowed to spread. The grass will shoot up in a fortnight. Cut with the scythe to start with and after three months use the lawn mower.

BY DIBBLING ROOTS

This is the cheapest but the slowest method. Small pieces of grass should be dibbled 10 - 15cm apart in a levelled ground when it was wet after rain. The roots spread and grow underground in the course of six months making fairly compact lawn by frequent mowing, rolling and watering.

After Care : It includes rolling, mowing, watering and restoration of patchy places should receive regular attention.

I) Fertilizing the lawn thrice a year is adequate to maintain rich greenness. Application of urea or ammonium sulphate at the rate of 1kg per 50 sq.m during February - March or June - July and October - November is quite beneficial. A times well decomposed compost at 10kg / 10 sq.m area will be sufficient as top dressing.

II) Weeds should be removed as soon as they appear and fillup the gaps with grass roots and fine soil. In the absence of rain, water it regularly at weekly intervals.

III) A mower should not be employed until a firm green sword has been formed. The grass is first cut with sickle and the surface is then rolled.

IV) Mowing should be done at brief intervals and never allow to produce seed stalks.

V) Once in a year rake the lawn before rain and top dress with rich mixture of decomposed manure and soil. This will accelerate the grass with new vigorous growth.

ASTRO TURF : A synthetic lawn popularly used in developed countries in roof gardens as well as in stadium (Football and Hockey). Constant water sprinkling in one of the prime requisites to bind the synthetic fibres to provide a surface.

DESCRIPTION OF LAWN GRASS SPECIES

	Botanical Name	Common name	Texture	Situation
1.	*Cynodon intermedius*	Hariyali (or) Arugu	Medium	Open sunny Location, drought
2.	*Stenotaphrum secundatum*	Buffalo grass (or) St. Augustine grass	Coarse	Shady situation requires frequent watering
3.	*Sporobolus tremulus*	Chain grass (or) Upparugu	Fine	Saline soils - open sunny locations
4.	*Poa pratensis*	Blue grass	Medium	Acid soils - suitable for higher elevations
5.	*Pennisetum clandestinum*	Kikiyu grass	Rough	Acids soils, suitable for higher elevations.
6.	*Zoysia japonica*	Japan grass	Coarse	Poor sandy soil, open sunny situation
7.	*Z. matrella*	Manila grass	Medium	Open sunny situation
8.	*Z. tenuifolia*	Korean grass (or) (velvet grass) or Carpet grass	Fine	Open sunny situation
9.	*Cynodon* sp.	Bermuda grass (or) Hyderabad grass	Fine	Open sunny situation
10.	*Cynodon* sp.	Dwarf Bermuda	Medium	Open sunny
11.	*Festuca* sp.	Fescue grass	Coarse	Shade tolerant, survive on inferior soils

PROBLEMS IN A LAWN

	Problem	Symptoms	Control
1.	Chlorosis	Grass turns yellow with the deficiency of magnesium and iron	Iron : Spray Ferrous sulphate 25 g dissolved in 10 liters of water per 100 sq. metre. Magnesium : Spray magnesium sulphate 100 g in 10 litres of water per 100 sq. metre.
2.	Dog urine	Dead grass in the lawn	Re-plant grass roughly circular
3.	Fertilizer burn	Grass browns especially in hot weather	Drench the lawn in injured areas to leach excess fertilizers deep into the soil.
4.	Improper mowing	Lawns cut too closely turn yellowish and often look diseased or dried	Mow enough to remove not more 1/3 of the grass height at a time. Keep mower blades sharp.
5.	Improper watering	Light sprinkling encourages shallow roots. Over watering causes diseases	Water the lawn to wet the soil about10 to 15 cm depth.

PLANT PROTECTION

	Pest	Symptoms	Control
1.	White ants	Form small mounds around the entrance to their nests	Apply Lindane 1.3% dust
2.	Cut worms	Eat away grass stems near the surface of the soil causing dead spots	Apply Lindane 1.3% dust
3.	Grubs	Eat away the roots of grasses creating brownish dead patches	Apply Lindane 1.3% dust
4.	Leafhoppers	Suck the juice from grass blades causing stripped white, then yellow and finally brown leaves	Spray Dimethoate 2 ml in litre of water
5.	Nematodes	Affect the roots, lawn takes a bleached out appearance	Apply Furadan at 40 g sq. metre

Ex. No. 14.

FLOWER ARRANGEMENT AND TERRARIUM CULTURE

PRINCIPLES OF FLOWER ARRANGEMENT

LOCATION AND STYLE

Before deciding upon flower arrangement, it is important to first review and determine your options. The foremost consideration is the location.

Flowers can beautify any location. But in each instance, the composition must be designed to suit its setting.

Traditional symmetrical arrangements like pyramidal, round and oval bowls always glorify a location where the vase has to be viewed from all sides.

An Ikebana or the Japanese style looks better in a quiet corner or niche as it is predominantly viewed from face only.

Traditional western arrangements employ more flowers, especially if they are to be viewed from all sides. Where there is a paucity of flowers, it would be a good idea to make an lkebana, geometric or a modern arrangement which allows for the addition of accessories like branches and stylished foliage so that the lack of flowers is compensated.

SELECTION OF VASES

Conventional round or oval bowls are suitable for low, western table arrangements. Vases with a stem are preferable for fan-shaped and triangular styles which require flowers and foliage to flow over the rim of the bowl and trail down. Such bowls may be used as well for Ikebana, but shallow trays are traditionally used for basic eastern styles.

FOCAL POINT

Flowers are arranged to attract the eye. For this primary requisite, an arrangement must have a focus of interest, the central point where the vision first pauses before moving on to the rest of the composition. This is important in any successful arrangement, regardless of the style. The focus is generally at the base of the design, near the rim of the vase.

PROPORTION

The material used should be proportionate to the vase. A general yardstick to determine this is to first establish the length of the tallest branch or flower and this should be approximately equal to the height plus width of the container. If the material is light and

slim, or, if the container is large, the height could be increased to one-and-a-half times or even twice this measurement. Similarly, very heavy material could be decreased in length.

BALANCE

A symmetrical arrangement, as the name suggests, achieves an even balance. In such a composition, it is easy to adopt first a central length and scale the rest of the material in an equal distribution on either side.

DEPTH AND RHYTHM

This is a crucial factor for the flower arrangement to come `alive'. Just as in a good painting, a three-dimensional effect is important, so too, in a floral design. This means that there should be an element of depth in the composition, and this is achieved through creation of rhythm.

EMPHASIS

Sometimes, certain types of colours or material are grouped together for the sake of emphasis. This is more so in the case of geometric and contemporary arrangements where blocking of colours and shapes is deliberately employed to draw attention to the design.

CONTRAST

For the sake of introducing interest to the arrangement, the element of contrast is almost as important as repetition. Light shades can be employed against dark colours, long shapes can be off set by round ones and smooth, shiny material by rough texture.

COLOUR

Every individual has an instinctive response to colour and this is a very basic element in flower arranging, depending largely on personal choice. Of course, the primary consideration would be to match the flowers with the colours of the interior setting and then to the colours of the vase.

SPACE

The final composition should not look overcrowded and contrived. The different styles of flower arrangement use varying amount of space within the design. Mass arrangements use little space, but geometric, modern and lkebana styles maintain a more visible amount of space between the material. As a principle, material should be finer at the top so that light passes through the arrangement.

Styles of flower arrangement

There are many styles of flower arrangement that can be created for any location and every occasion. Both Western and Eastern styles have made contributions to floral designs. Regal, formal western styles or classically charming eastern style Ikebans look unfailingly appealing.

I. Western styles

It is associated with `mass' or a number of flowers and foliage arranged together in a graceful manner. Traditionally, triangular, round or oval shapes were created, but later on more designs like the L-shape, crescent and S-shape were introduced. These designs may be scaled to large proportions with their symmetrical patterns.

Guidelines

a) The outline of the design is normally created first with finer, lighter `lines' (fine, distinct form to the arrangement).

b) There is not much emphasis on individual plant material due to the mass effect, but recently `points' (focus of attention) are woven through the `fillers' (material that fill the gaps between the flowers and create a contrast in texture or colour) so that the design looks more attractive. Colours are also used in the same manner.

c) The Western style arrangement gives a flowing, radiating effect, originating from the rion of the vase. However the final effect of the outline is broken and irregular because of the `long and short' arrangement of stems for the sake of rhythm.

II. Eastern styles or Ikebana

Contrary to western mass formations, eastern styles impress more by the beauty of individual material. Such styles have originated from Japan and are better known as `Ikebana' means `living flower'. As these arrangements are asymmetrical and normally viewed front facing, they are best placed in a corner or against a backdrop. These styles rely a lot on the strength of lines and so some charming arrangements can be made with very little material, using only the main lines and a few fillers as points. However, grand compositions can be made with the skillful use of plant material, artificial accessories and driftwood.

Concepts

a) Ikebana consists of three main lines, which represent three great elements of life viz., `Heaven', `Man' and `Earth' These lines are designated in Japanese as 'Shin', 'Soe' and 'Hikae'.

b) Shin is the tallest line and in keeping with the principle of proportion, it is 1.5 times or twice the length plus breadth of the vase. The second height is Soe, which is 3/4th the length of shin and the third line, Hikae is in turn 3/4th of the length of Soe.

c) Variations are created by changing the angles but without altering the basic styles.

d) Ikebana styles commonly use shallow vases and pinholders, as in `Moribana' styles.

e) In another version of the basic style, fruits or vegetables may be added as fillers to the main lines. Yet another presentation is by floating the flowers and leaves in a shallow tray of water following the twine arrangement.

III. Geometric or Linear styles

These styles fall between the category of western styles and Ikebana. As the name indicates, a `line' effect is achieved by placing the material, including fillers and points in a defined pattern.

Characteristics

a) More space is used between the material as compared to a mass arrangement in western style.

b) The principle of `transition' or distinct grading of material is more apparent in these styles.

c) Line arrangements may also use branches and driftwood. Other materials like twines or wires, corals, pieces of thermocol etc. and dried natural material may also be used.

d) The styles of arrangement include L-shape, triangular, crescent or even the angular lines of an Ikebana.

IV. Accessories used in flower arrangement

Accessories for flower arrangement would include a small sharp pair of secateurs, an array of flower vases, pin-holders of different sizes, small bits of chicken-mesh to position the plant material and other handy tools.

Terrariums

Growing of indoor plants and cacti and succulents in a covered glass-case is known as Terrarium. The size of terrarium may vary according to the need. The convenient size being 1 m x 0.5 x 0.5m (lbh). Aquarium cases can also be utilized for this purpose.

The terrarium has a glass cover at the top which is removed occassionally to provide ventilation which is necessary for the growth of the plant. Since the terrarium is closed, the plants do not need frequent watering, as the moisture from the transpiration of leaves and soil evaporation condenses on the glass and returns to the soil. At the bottom, a layer of coarse sand and about 3-6 cm thick charcoal pieces may be spread. The soil mixture should have 1 part each of the soil, leaf-mould and sand. The arrangement of plants and design should be planned before planting. The plants have to be firmly planted and watered carefully. Over-crowding of plants should be avoided. Very fast and vigorous growing plants are to be avoided.

Choosing plants for terrarium

Philodendron, Aglonema, chlorophytum, Syngonium, Begonia, Geranium, Asparagus, Maranta, Calathea, etc.

Ex. No. 16.

LANDSCAPE DESIGNING FOR HOME, INSTITUTIONS, INDUSTRY AND PUBLIC GARDENS

DESIGNING GARDENS

Bioaesthetic designing requires the involvement of architects, engineers, foresters and horticulturist for integrated action.

PUBLIC GARDENS

Public gardens act as lung space for the whole community. Such gardens need not be in an enclosed park isolated from the city but it has to spread over the entire city through avenue planting, traffic island planting, planting office complexes, hospitals, river banks, hotels, kalyana mandapams, temples, university complex, monumental buildings and railway line planting.

PRINCIPLES OF PLANNING A PUBLIC GARDEN

While planning for a public garden or town landscape, the space and aesthetic principles are taken into consideration. Landscaping concentrates more on space. It is supposed to be vertical dimension over an area.

SPACE : Landscape with two dimension, i.e., length and breadth is nothing but a drawing on a paper or on a canvas. The third dimension is space in landscape architecture and needs careful planning.

A small lawn with an edge and a central specimen simulates static space. An avenue planted on both sides of the road or footpath defines linear space in horizontal or vertical direction.

Thus, landscape designing for public purpose is to integrate the natural and constructed elements in a harmonious way to utilise the third dimension ie. space.

Land

Land is the screen on which the landscapes executed and it may have different forms like plains, plateau, hills, mountains, rocks, streams, soil, and existing vegetation. The plains may not vary in altitude in greater extent but there may be gentle ups and downs. The hills may have rugged spread, with high peaks and cliffs. The plateaus may be with raised land up to 1000-3000 MSL. The existing topography, soil and vegetation can be

considered for incorporating into the whole of the landscape with slight modification if needed.

Aesthetics

The beauty is the total effect of colour, shape, texture, pattern, line and point to please the vision perception rather than other senses.

Colour

Colour is the visual sensation created by decomposed light. Blue, yellow and red are primary colours and the combination (B+Y = G, Y+R = 0, R+B = V)produces the secondary colours viz. green, orange and violet. Intermediary colours are produced by mixture of any two colours.

While planning for the colour scheme, the factors like shade, distance, background and adjacent hues are to be considered for better visual effect.

Shape

Trees like palms are totally symmetrical and sculpturistic in nature in all directions. The travelers palm (*Ravenala madagascariensis*) has symmetry only in one direction. The shapes of trees and shrubs are conical, columnar roundish and if trimmed any shape can be created.

Texture

The texture of plant is highly variable and adds charm to the scenery. Leatheryness, waxiness, bloom coat, velvety, hairy etc. can add either fineness or roughness to the surface.

Pattern

The plant model is a total physical architecture of a plant with varying leaf, stem flower positions offer interesting patterns to the sight.

1. Radiating leaves of palm.
2. Cane leaves in travelers palm.
3. Tiered branching in Terminalia sp.

Point and line

Both are aesthetic elements. The outlines of plants provide the skyline to the total scene.

EXECUTION OF PUBLIC GARDEN

The size of the park should be proportionate to the size of the population in city.

First Phase of garden

Close to the entrance, a formal design can be created with avenue trees on both sides in vertical dimension and carpet design in horizontal dimension. Topiary and trophy components can be effectively projected in formal garden. Water works like cascades, fountain etc can be provided at vantage points. A green luscious lawn should be established on a leveled ground or on a gently undulating ground in a British garden style.

The wood lots arboretum and palmatum can be located at different places and not in succession. Pergolas, arches and arboretum may be used to link the various components. Flowers of annual may be planned in the formal garden itself.

Edges and hedges may be suitably interworked to tone up the components. A green house or conservatory can be located in a cooler place and the children's garden is to be provided with play items in one corner. Single gigantic trees can be introduced for every 100m for the aged people to relax.

Adequate number of ornamental benches should be provided. Sale of seeds and ornamental plants should be arranged near the gate. The roads and foot paths should be adequate to link all parts of a garden. The cacti and succulents may be housed in a glass house for the public to see and enjoy.

Second phase of garden(Informal style)

Mixed or free style garden can be planned in the second phase. This area aims at engaging the modern free style public particularly youth. Any thing as is where is basis or something of freak in nature will reflect the tendencies of the people and thus settles them. The shrub grouping may be informal and the lawn may be wavy and irregular but neatly maintained.

Adornments and topiary may be put up in an informal way as a mix up. Open sunlight is to be ensured without thick shaded trees as many of such people may be made to wonder about the vast sky above. Annuals may be spray planted in this phase to giggle with the psychs of the person.

Third Phase of a garden

Total informality is to be ensured based on Japanese style. The nature is to be replicated. This will suit for the balanced persons, who have lived the life for a lengthier

period and would like to ponder over and retire. Lakes, islands, rustic bridges etc. should add value to informality. A single banyan tree of gigantic size will be opt at this phase.

All the three phases are to be suitably integrated so that there is unity in the garden.

Home garden

Gardening for personal residences involves the planning for both inside and outside of the house in totality. The utility and beauty, and unity are the principles to be kept in mind while planning for a house garden. The other principles of space and aesthetics are same as in public gardens.

i. Utility and beauty

House garden may either be productive with maximum proportion of edible fruits, vegetables and leaves or may be with massive dose of flowers for beauty. It is left to the choice of the individual.

ii. Unity

Both garden and house should hang together harmoniously. Attention should be paid to base planting or foundation planting to merge the various parts of the house. Location of the house is another factor to consider before planning because the following criteria are to be considered.

i. Neighbouring house and garden : The trees and shrubs to be planted should have contrasting characters to that of neighbouring house.

ii. Direction of the house, viz. North facing, South facing etc. : Direction should ensure plenty of sun shine in most part of the year.

iii. Whether the house is in sub road or main highway: The sound and dust pollution are to be checked by planting trees with dense foliage and columnar shape.

iv. Whether it is close to industry: House type is another influencing factor to be considered. Old houses do not have any area for gardening whereas in the new housing colonies each house has been provided with minimum space for gardening. Nowadays, apartments also have been mushrooming up and for which a common garden ground is provided. Else, indoor gardening will suit best for apartment. While planning for home garden, the area may be divided as follows :

i. Approach or public area : The front yard, drive way and portico form the public area. Trees, lawns, and shrubs can be elegantly put up to welcome the visitors.

ii. Service area comprising of kitchen garden, playing court and sheds, etc. : This area can be screened off from the rest of the area by suitably planting the hedges, fruit trees, vegetables and cut flowers.

iii. Private garden area is the actual outdoor living area. This area needs to be designed, to suit the taste of the family members. The privacy should be ensured. Depending upon the actual area available, the garden may be designed as formal, informal or free styles.

INDUSTRIAL GARDENS

Industrial zones are created on National Highways and many of them happen to close to a city or village. The industries emit sound, dust and chemical gases which are pollutants. The outer area is to be richly planted with gigantic trees with dense foliage to arrest pollutions and they should be capable of withstanding pollutions. Enterolobium saman, Neem, Pungam, etc. are good examples. Close to factory, a lawn with rough grass with shrub edges will enthuse the workers to overcome the mental weariness. Foliage shrubs are preferred rather than flowering ones. Near the corporate office, where the executives work, lawns on undulating grounds will relive them from official tension. A fine display of colour scheme, through annuals is worth maintaining. All the main roads are to be planted with shady foliage avenues with benches underneath to enable the workers to relax after the shift.

SCHOOL GARDEN

The world is wonderful for children. That too when they observe a seed to germinate. School garden can be planned not as a separate enclosed area but scattered right from entrance, close to the walls of compound, base planting of buildings, etc. Shade trees are provided over the entire space unoccupied by the buildings where the children can lunch, play, work and study. Botanical significance may be given priority in as much as they aid in botany practical classes. Pond and fountain structures also can be introduced provided the depth is not more than two feet. Edible fruited (West Indian Cherry, gooseberry) trees and shrubs may be introduced. There should be a pot plant section and pots can be used for festive occasions A butterfly garden will be a scene of attraction in school. A bush is enclosed with wire mesh with sufficient air space and butterflies can be reared and the multicoloured wings are beautiful scene for the kids to enjoy. The play ground is to be planted with broad canopied trees like *Peltophorum* to act as stadium. To facilitate physical exercise classes, shady trees may be provided at one corner.

DETAILS OF ORNAMENTAL FLOWERS FOR ARRANGEMENT

Botanical name	Common name	Description	Approx. vase life	Suggested use
1. *Alyssum* sp.	Alyssum	Seasonal dainty white flowers grown in borders.	5 - 7 days	Use as fillers. Excellent in rose bowls and small arrangements.
2. *Ammi majus*	Ladies' Lace	Tall-stemmed seasonal flowers with umbrella-like white dainty florets.	7 - 10 days or everlasting	Defoliate before use as leaves look untidy and wilt. Use for creating lines or for fillers. Dry by hanging upside down.
3. *Anthurium andreanum*	Anthurium	Glossy, red or white spade shaped single petal with a pointed tongue. Tropical hothouse flowers bought at the florist, normally high-priced.	10 - 15 days	Make eyecatching geometric, modern or Ikebana styles with economic use as only a few of these unusual flowers are enough for `Lines' or strong points for the focus. A solitary flower can also look compeeling.
4. *Antirrhinum majus A. namum*	Snapdragon or Dogflowers	Tall-stemmed seasonal flowers in yellow, pink magenta and white.	5 - 7 days	Use graceful bud-tipped stems for lines for all styles. Also as fillers for mass arrangements.
5. Aster chinensis	Aster	Bi-annual medium sized flowers. Purple, pink or white in colour with petals grouped around yellow centres. Also in double `pompom' varieties. Usually sold by the bunch.	3 - 5 days	Substantial trimming of leaves and selective use of flowers required. Use as points or fillers.
6. *Calendula officinalis*	Calendula	Sunny yellow, orange seasonal flowers with short stems and broad leaves. Medium sized with brown centres.	3 - 5 days	Flower heads usually turn when arranged. `Doctor' beforehand with teel wire. Suitable points for all styles.
7. *Iberis umbellata*	Candytuft	Small white seasonal border flowers growing in clustered stems	5 - 7 days	Very useful for fillers. Make a dainty combination with roses or strike a pleasing contrast against dark colours.
8. *Dianthus caryophyllus*	Carnation	Elegant, aromatic spring flowers with ruffled textures in several colours also available in the upper price range.	5 - 7 days	A universal appeal for all styles. Use as attractive points. but double varieities can serve as lines in geometric styles as stems are fairly tall. Can also combine well with roses as both are quality flowers.
9. *Celosia* sp	Cockscomb	Early summer seaonsal flowers with tall stems and velvety textures in shapes suggestive of the common name. In shades of pink, yeloow, red and white.	5 days to everlasting	Remove leaves from stems as flowers alone are ornamental. Use for lines or fillers. Also good for drying.
10. *Chrysanthemum sp*	Chrysanthemums or `mums'	High quality annuals available in late autumn and early winter months, before the frost set in. Several colours ranging from while, honey brown, yellow, pink. Several shaped varieties include small `button', medium sized spoon, incurving, decorative and reflex.	5 - 10 days	Versatile uses according to individual shapes. `Button' variety ideal for small bowls. All varieties suitable for mass, or geometric styles. Ideal for Ikebana arrangements. Make the most of these flowers as seaon is short lived.

Botanical name	Common name	Description	Approx. vase life	Suggested use
11. *Coreopsis* sp	Coreopsis	Thin stalked seasonal flowers in sunny double colours of yellow and maroon.	3 - 5 days	Use as points in western mass arrangements. Essentially supported by wiremesh.
12. *Cosmos bipinnatus*	Cosmos	Flower textures similar to coreopsis, in single colours of yellow, pink, white, magenta.	3 - 5 days	Recommended for tall vase mass arrangements. Use like coreopsis, wire mesh essential.
13. *Dahlia variabilis*	Dahlia	Attractive bi-annuals in varying sizes, single-layered or many-layered petals. Small be gigantic dimensions in brilliant colours, including white, pink, magenta, red, maroon, orange, yellow. Double varieties also immixed colours.	3 - 5 days	Preferably use double varieties as single varieties have thin stems and heavy flowers that may not last well. Cut life is prolonged in tall vase designs with wire mesh support rather than a pinholder. Adopt reel whire method for reinforcing weak stems.
14. *Dimorphotheca sp*	African Daisy	White single petalled spring flowers circled around yellow centres.	5 - 7 days	Pretty for mass arrangements. Round forms serve well as points for all styles. Use with wire mesh support.
15. *Gaillardia sp*	Gaillardia	Seasonal flowers, with serrated petals in mixed yellow-maro colours. Medium, thin stems.	3 - 5 days	Best for mass arrangements or table bowls. Wire mesh necessary to support stem.
16. *Gerbera jamesonii*	Gerbera	Ornamental seasonal flowers with ribbon like petals in bright hues of pink, peach, white, red, yellow, orange. Single and double varieties.	5 -7 days	Best used as points. Attractive for all styles but particularly charming for Japanase arrangments.
17. *Gladiolus sp*	Gladioli	Tall and elegant almost perennial flowers with florets along the stems. Beautiful colurs such as white, pink, orange, puple manuve, yellow available in double `Dutch' varieties during Spring. Smaller single varieties in rust-red orange colours available in summer.	7 - 10 days	Graceful for all styles. Use stems with buds on the tips for creating lines and stalks with fuller flowers as fillers. Leaves are equally useful. Curl by rolling over a pencil.
18. *Gomphrena globosa*	Bachelor's Button	Small round button-like purple seasonal flowers with papery textures. Thin stems.	7 days to everlasting	Use in mass arrangements. Ideal for small bowls. Wire mesh necessary flowers dry well.
19. *Gypsophila elegans G. paniculata*	Gyposphila or Baby's Breath	Small, delicate seasonal flowers on thin branching stems. Usually in white, but also available in pink.	7 - 10 days	Dainty as fillers, especially when partnered with roses. Also useful for drying.
20. *Helichrysum bracteatum*	Paper flowers or straw flowers	Seasonal flowers with papery textures. Commonly available in yellow, pink, magenta and white. Round small to medium forms.	Everlasting	Use in fresh arrangements as points or fillers. Dry by hanging upside down. Use reel wire to support stems. Defoliate leaves.

Botanical name	Common name	Description	Approx. vase life	Suggested use
21. *Limonium sinuatum*	Statice	Papery textured flowers in vivid colours, purple mauve, yellow, white, pink. Fairly tall stems.	Everlasting	Use as fillers lines in fresh arrangements. Hang upside down to dry.
22. *Orchids*	Orchids	Top quality topical flowers eliciting universal appreaciation. Several varieties including spurred spidery forms on long stems, or large flecked petals with a tongue like mount. Wiry sturdy stems. Common colours; white, puple orange, yellow pink	10 - 15 days	Excellent for all styles. Impressive for special occasions. Use tall stemmed varieties for mass arrangements, individual large flowers for points of focus.
23. *Phlox* sp	Phlox	Colourful seasonal flowers growing in clusters, along borders. Available in white, pink, magenta, red short stems.	5 - 7 days	Useful for fillers for all arranagements.
24. *Polianthes tuberosa*	Rajinigandha	Tall, erect bi-annual flowers, in fragrant white. Single varies have spurred star shaped flowers. Double varieties have the same form but heavier textures.	A week or more	Select stems with buds at the tips for a longer cut-life. Use as lines for all styles. Use as fillers in mass arrangements. A good choice for ethnic themes.
25. *Rosa* sp	Rose	Popularly loved flowers in several colours and varieties. Mixed colours also available in cross-bred culture. special fragrant varieties.	3 - 5 days	Project charm in all kinds of arrangements. Make single rose designs, Ikebana, geometric or modern styles. Or make mass arrangements. Roses mix well with all other varieties of flowers. Use tall stems and buds as lines, and fuller blown flowers as fillers. Hang to dry (Refer to Chapers seven and eight)
26. *Sterlitzia reginae*	Bird of paradise	Vigorous tall stemmed flowers with exceptional forms shaped like a bird's head. Orange in colour with a purple `eye'. Oval tough leaves. Tropical or hothouse flowers. Bought at the florist.	10 - 12 days	Make ey-catching geometric, modern or Ikebana arrangements as exceptional forms stand out well if they are spaced out. Leaves are equally useful for arranging. When dried upside down, they adopt interesting sculptured shapes.
27. *Tithonia* sp	Tithonia	Brightly coloured seasonal flowers in red, yellow, white, pink. Single petals grouped around yellow centres. Fairly long stems.	5 - 7 days	Use as points for all styles.
28. *Verbena hybrida*	Verbena	Small seasonal flowers in clustered heads on short stems. Purple mauve in colour.	5 - 7 days	Use as fillers in small bowls or in large arrangements towards the focus as stems are short. Wire mesh support is advisable.
29. *Zinnia elegans*	Zinnia	Colourful bi-annual flowers in round forms with multilayered petals. Usually in white, pink, red, yellow, purple. Small `lilliput' variety also available.	5 - 7 days	Round forms make good points for all styles. Or use as fillers in mass arrangements.

DETAILS OF ORNAMENTAL FOLIAGE PLANTS FOR DECORATION

Botanical name	Common name	Description	Approx. vase life	Suggested use
1. Aglonema whiterajah/ A. crispum	Aglonema or Silver Queen	Houseplant, green leaves with yellow markings or with light green markings variegated varieties	7 - 10 days	Cut short leaves from parent stem. Use as fillers.
2. Araucaria heterophylla	Araucaria	Tree. Pine variety. Enjoys cool climate. Branches green and feathery.	7 - 10 days	Use branches for line or fillers. Leaves can be dried.
3. Areca lutescens	Areca palm	Garden palm or houseplant. Tall feathery light green fronds.	10 days to everlasting	Clip edges of leaves . Curve into shapes. Excellent for stvlished designs. Dry after use.
4. Asparagus sprengeri/ A.densiflorus	Asparagus	Houseplant. Fern with many varieties. Feathery or `furry tail'. Lush green in colour	5 - 7 days	Dainty as fillers. Useful for breaking two similar lengths of material in an arrangement. Tall stems may be used as lines.
5. Begonia	Begonia	Outdoor potted ornamental plant with pink flowers. Can be kept indoors for short spells. Glossy round leaves tinged pink.	7 - 10 days	Circular shapes of leaves pretty for fillers and for concealing the pinholder / netting.
6. Bambusa sp.	Bamboo	Outdoor plant. Grows in groves. Tall thick green woody stems with flat, thin pointed leaves.	10 days or more (stems only)	Remove leaves as they wilt quickly. Stems recommended for Ikebana, geometric or modern designs. Very thick stems can be carved out for making receptacles for containers.
7. Caladium	Caladium	Outdoor plant in gigantic variety. Smaller varieities make ornamental house-plants. Spade shaped leaves, can be variegated with pink strips. Stems fairly long.	5 - 7 days	Make picturesque additions to the design. Tall enough to use as lines, or group together near focus.
8. Callistemon	Bottlebrush	Ornamental tree with feathery leaves and red brush-like flowers in Spring. Thick main stems with thin, curving branches.	7 - 10 days	Decorative particularly for Ikebana arrangements. Use graceful thicker branches, preferably in bloom. Short feathery branches can be used as fillers for all styles. Leaves may be dried.
9. Canna indica / C. hybrida	Canna	Garden plant with broad green or purple leaves and bright yellow, red, flecked flowers.	7 - 10 days	Use for large designs, goemetric, modern or Ikebana. Trim leaves along edges if necessary. Leaves can be curled and moulded with scotch tape. Can also dry leaves.

Botanical name	Common name	Description	Approx. vase life	Suggested use
10. Casuarina sp.	Casuarina	Outdoor tree. Pine family. Feathery leaves.	10 - 15 days	Use leaves as fillers for all styles.
11. Cordyline sp.	Cordyline / Dracaena var. Vokart & yellow king	Houseplant. Thin leaves, sometimes with red edges, growing in clustered heads formation. Dracaena family. Stems throw roots when kept in water over a long period.	10 - 15 days to a month	Cut stems with the `head' for making compelling designs, geometric, modern or Ikebana. Do not use liberally as plant is slow growing (Individual leaves make good fillers).
12. Cycas revoluta *C. circinalis*	Sago palm	Ornamental garden palm, spreading out gracefully with resilient shiny dark green fronds. Can be used as houseplant when potted.	15 days to everlasting	Clip edges and use for giving beautiful interesting lines for all styles. Extremely pliable, can be curved and tied in circular shapes. Slow growing plant, hence use leaves economically. Dry leaves in curved forms.
13. Cyperus alternifolius, *C. circinalis*	Umbrella plant	Outdoor plant or houseplant. Commonly grown beside ponds for decorative value. Tall erect stems with ribbon like leaves in the formation of an umbrella.	10 days to everlasting	Clip edges of leaves. Use for creating lines for unusual designs. Use heads as fillers. Stems alone can be used for geometric or modern styles. Dry leaves after use.
14. Diffenbachia sp.	Diffenbachia `Seguine'/ `Tropic snow' / Tropicsun	Houseplant. Broad green leaves with yellow flecks growing along a thick parent stem. Several varieties.	10 - 15 days	Use as attractive fillers as leaves are short. Add colour to any design or to an all green arrangement with these leaves.
15. Ferns (Individual names vary with each variety)	Ferns	Several varieties. Medium sized fronds growing in shady outdoor conditions. Can be used as houseplants over short spells. Delicate, feathery textures in all varieties.	7 - 10 days	Graceful fillers for all styles. Combine well with delicate flowers. Taller stems can be used for lines.
16. Grevillea robusta	Sliver Oak	Tree with feathery leaves, dark green in colour with greyish underside.	5 days to everlasting	Leaves make pretty fillers. If branches are tall, use as lines for large arrangements. Dry leaves between newspaper.
17. Ipomoea tuberosa	Woodrose	Outdoors climber in cool temperate climates shiny green leaves with ornamental seed pods.	Everlasting seed pods	Seed pods of wood roses make beautiful points in dry arrangements. Can be combined as well with fresh flowers.
18. Howea palm (also known as kentia)	Sentry palm	Garden palm or indoor plant with tall fronds.	10 days to everlasting	Clip edges and use for designs. Dry after use.

Botanical name	Common name	Description	Approx. vase life	Suggested use
19. Ixora coccinea	Flame-of-the-woods	Outdoor shrub with light green leaves and orange, clustered flowers.	5 - 7 days	Trim branches to remove top heavy foliage. Curve gently and use as lines for Ikebana geometric or modern styles. Use small dusters of leaves for fillers in mass arrangements. Flowers wilt, but may be used for spreading styles.
20. Jatropha sp	Jatropha	Ornamental outdoor shrub with small red flowers.	5 - 7 days	Pliable branches. pretty especially for Ikebana or for creating lines.
21. Juniperus sp	Juniper	Coniferous picturesque tree. Commonly trained for bonsai.	10 - 15 days	Associated with Japanese arrangements. Use branches as fillers for mass arrangements.
22. Livistona chinensis	Chinese fan palm	Durable species with fan shaped leaves. Garden palm or indoor plant.	10 days to everlasting	Clip edges to use for designs. Hang upside down to dry.
23. Maranta bicolor	Maranta	Houseplant. Oval green leaves with markings and purple underside.	5 - 7 days	Ornamental as fillers or for creating lines for small arrangements.
24. Monstera deliciosa	Monstera or Swiss Cheese Plant	Houseplant. Broad green leaves with incisions.	7 - 10 days	Use for fillers or in focus for all styles suitable especially for modern designs. Use leaves selectively as plant is slow growing.
25. Nerium oleander	Oleander	Outdoor shrub with oval narrow spurred leaves bearing pink or white flowers in single and double varieties.	5 - 7 days	Use for lines in large arrangements or as fillers in small arrangements. Flowers last for two-three days. Stems ooze latex. Treat by singeing ends.
26. Philodendron (Several varieties)	Philodendron	Outdoor and indoor plant. Climber with arrow shaped leaves. Creeps along tree trunks or can be trained to climb around moss sticks several varieties.	7 - 10 days	Cut short stems off parent twine. Use as fillers or group around focus in tall arrangements. Ideal for concealing wire or pinholder.
27. Phoenix roebeleni	Phoenix palm	Grand outdoor palm with feathery fronds. Also used indoors.	10 days to everlasting	Clip and use for stylished arragements, as other palms. Dry after use.
28. Sansevieria trifasciata var. `Laurenti'	Mother-in-law's tongue	Very hardy narrow days sword shaped succulent variety leaves. Plain varieties have light green pattern. Variegated varieties have yellow border. Can be used as houseplants.	10 - 20 days	Very versatile for creating imaginative designs. Leaves can be twisted, curled and split to assume different forms. Use as lines, or curl leaves as points near the focus.

Botanical name	Common name	Description	Approx. vase life	Suggested use
29. Scindapsus aureus *S. pothos*	Marble Queen / money plant	Money plant variety with strongly variegated, leaves with whitish markings, Climber.	7 - 10 days	Short stemmed leaves. Use for fillers. Very ornamental as light markings can relieve an arrangement with dark colours or offset dark green foliage.
30. Thuja orientalis	Thuja	Oval shaped formation of outdoor shrub, composed of feathery leaves, associated with Christmas. Evergreen variety. Can also be used as an indoor plant.	10 - 15 days	Pluck leaf stems of parent bush. Use as fillers for western arrangements, also for other styles. Tall stems can be used for lines. Recommended for X' mas arrangements. Dries initially to light green colour. Foliage tends to fall when dry, but can be used.
31. Typha latifolia *T. augistifolia*	Bulrush	Tall stems with slim brown oval heads. Plants grow near water. Ribbon like grass.	Everlasting	Excellent for lines and dramatic effects for geometric, modern styles. use for creating waterside scenes for Ikebana styles. Use for dry arrangements as well.
32. Zebrina pendula	Zebrina	Trailing houseplant for hanging baskets. Oval shaped leaves with purple central stripe.	7 - 10 days	Use for giving trailing effects to the arrangement. Stems make colourful fillers for all styles.

DESCRIPTION OF ANNUALS AND HERBACEOUS PERENNIALS

	Botanical name	Common name	Family	Height	Colour	Month of flowering	Remarks
1.	*Althea rosea*	Holly hock	Malvaceae	1.5-2.5 m.	Scarlet rose, lilac, deep violet white,etc.	August-September	Propagated by seeds, blooms, 9 months after sowing. It is a perennial but often considered as a biennial.
2.	*Amaranthus* sp.	Lovelies Bleeding	Amaranthaceae	0.5-1.0 m	Red	-do-	It is an ornamental foliage as well as a flowering annual
3.	*Aster amellus*	Blue Aster	Asteraceae	20-25 cm	Blue	Almost throughout the year	It is a herbaceous perennial and a very good cut flower suitable for beds & borders
4.	*Calendula officinalis*	Pot marigold	Asteraceae	20-25 cm	Mostly orange	August-September	It is an ideal bedding plant, easy to grow
5.	*Celosia plumosa*	Cock's comb	Amaranthaceae	Dwarf : 10-20 cm Tall : 30-60 cm	Golden yellow and shades of red	Throughout the year	A group of half hardy annuals with terminal fasciated flowers of varying colours. Useful for borders and mixed borders
6.	*Chrysanthemum sagetum*	Annual chrysanthemum	Asteraceae	60-90 cm	Crimson, Yellow, white, etc.	August – September	Excellent cut flower. Flowers are eigther single or double or with quilled petals
7.	*Coreopsis drummondii*	Tick seed	Asteraceae	50-60 cm	Yellow crimson	Throughout the year	It is good for beds and background borders

	Botanical name	Common name	Family	Height	Colour	Month of flowering	Remarks
8.	*Cosmos bipinnatus*	Mexican aster or cosmos	-do-	50-120 cm	Yellow, orange, rose, pink, purple and white with yellow centre	Throughout the year	Good for cut flower, borders, beddings and also for growing in a mass in the midst of tall shrubs.
9.	*Dianthus caryophyllus*	Carnation or fairy queen	Caryophyllaceae	15-30 cm	White, red, scarlet, pink violet and maroon	August – September	Single or double flowered cultivars are available. Produces flowers throughout the year.
10.	*Gaillardia pulchella*	Blanket flower	Asteraceae	40-45 cm	Yellow, yellow-purple, orange maroon and their combination	Almost throughout the year	Useful for bedding, border and for cut flower
11.	*Gomphrena globosa*	Globe amaranthus or Bachelor's button	Amaranthaceae	30-60 cm	Pink, purple orange and white	Throughout the year	A highly esteemed bedding plant and can be grown in carpet beds and rose beds and also used as a ground cover
12	*Gerbera jamesonii*	Gerbera	Asteraceae	15-30 cm	Various colours	August – September, December– February	It is a herbaceous perennial propagated by suckers and divisions. Suitable for beds and borders
13	*Helianthus* sp.	Ornamental sunflower (Annual.)	-do-	1-3 m	Yellow	August – December	May be useful as a screen or hedge against a wall

	Botanical name	Common name	Family	Height	Colour	Month of flowering	Remarks
14	*Helichrysum bracteatum*	Everlasting flower or straw flower	-do-	50-80 cm	Silvery white to rich yellow / rich red	August – November & January – March	Both dried and fresh flowers are used for table decoration and dry arrangement
15	*Impatiens balsamina*	Perennial Balsam	Balsaminaceae	50 m	Pink, shades of white, violet purple, rose pink, red & mauve with single & double flowers	August – September	The stem is succulent, hollow & brittle, both annuals and perennial varieties are available, Seed pods burst and scatter their seeds when touched. Can be grown throughout the year.
16	*Mirabilis jalapa*	4'O clock plant	Nyctaginaceae	60-90 cm	Red, yellow, pink, white & often striped	Throughout the year	The plants will flower in afternoon or cloudy weather, They can be grown as a border at the rear end of the flower garden
17.	*Petunia hybrida*	Petunia	Solanaceae	20-40 cm	Pink, red, pale blue, violet, yellow, cream and purple	June to November– December	Flowers are trumpet shaped. It is a popular bedding plant
18.	*Phlox drummondii*	Phlox	Polemoniaceae	15-45 cm	White, pink, crimson, violet & purple	September – October & December to January	They are excellent for beds, borders and as cut flowers
19.	*Portulaca grandiflora*	Sun plant or Table rose	Portulacaceae	10-15 cm	White, purple, sulphur yellow, pink	Throughout the year	Widely used as a ground cover, good for rock garden, edging along paths and for growing in shallow pots and for containers
20	*Salvia* sp. *S. splendens*	Sage plant	Labiatae	60-90 cm	Scarlet, pink, violet	Grown throughout the year	Ideal for growing in mass and in beds and borders as background

	Botanical name	Common name	Family	Height	Colour	Month of flowering	Remarks
21	*Salidago canadensis*	Golden rod	Asteraceae	20-40 cm	Yellow	-do-	Herbaceous perennial used as a bedding plant and a good cut flower
22.	*Tagetes erecta*	African marigold or tall marigold	Asteraceae	90 cm	Yellow, bright yellow, lemon yellow and orange	August-September &December–February	A common bedding plant equally useful for mixed border and ideal for cut flower
23	*Tagetes patula*	French marigold or dwarf marigold	-do-	30-40 cm	Scarlet, yellow orange, combination of these colours	August-September & December-February	Generally preferred for carpet beds and edging and also for growing in small pots
24	*Tithonia rotundifolia*	Mexican sunflower	-do-	120-180 cm	Orange with yellow	May-September & December-January	Suitable for growing as a hedge and for background in beds, used as a cutflower
25.	*Verbena* sp. *V. hybrida*	Verbena	Verbanaceae	20-30 cm	White, pink, purple, mauva red, & deep violet	Throughout the year	Suitable for beds, borders and as cut flowers and thrives well in any garden soil.
26	*Zinnia elegans*	Zinnia	Asteraseae	Dwarf 15-20 cm Tall: 80-90 cm	White, cream, yellow, orange, red, pink, purple, etc.	August-September & December-January	Suitable for cut flower as it lasts long. Also suitable for beds and borders

DESCRIPTION OF ORNAMENTAL SHRUBS

COMMON NAME	BOTANICAL NAME	FAMILY	REMARKS
1. Pavala malli or coral plant	*Nyctanthes arbon-tristeris*	Nyctaginaceae	Tall growing shrub, nocturnal in flowering
2. Hibiscus varieties (Thilagum, Punnagai, CO3)	*Hibiscus* sp.	Malvaceae	Various colour forms are available; white, Red, Orange, Pink, Yellow, Rose etc. single & Multi whorls are available.
3. Snow fall bush	*Phyllanthus nivosus*	Malvaceae	Newly emerged leaves are white and appear like a plant covered by snow.
4. Nandiyavattai or star flower	*Tabernaemontana coronaria*	Apocynaceae	Single and double forms are available. Flower is star shaped with little fragrance. Leaves are single and glossy.
5. Coral bush	*Jatropha multifida*	Euphorbiaceae	Flower colour is coral red. Poisonous plant: Leaves are multiple and Somewhat sagitate in shape.
6. Thangarali	*Tecoma stans*	Bignoniaceae	Flowers are tubular & yellow colour; profusely flowering in bunches, used as a hedge as well as shrub.
7. Night queen	*Cestrum nocturnum*		Flowers are dull white; Flowering during night time and flowering is profused.
8. Tecoma	*Tecoma capensis*	Bignoniaceae	Flowers are orange red in colour; flowering is profuse, tubular in nature; flowering throughout the year. Used as a border plant & amenable for pruning.
9. Tecoma	*Tecoma biflorus*	Bignoniaceae	Flowering is profused and in bunches. Flower colour is orange yellow & somewhat tubular in shape.
10. Euphoria	*Euphorbia leucocephala*	Euphorbiaceae.	Flowering is highly profuse in nature; flowers are white in colour; small. Flowering almost throughout the year & from a distance periphery is fully covered by flowers.
11. Jathi malli	*Jasminum grandiflorum*		Shrubs grown for fragrance.
Gundu malli	*Jasminum sambac*	Oleaceae	
Mullai	*Jasminum auriculatum*		
12. Rose	*Rosa indica*		Various colour forms are available; white, pink, orange, yellow, dark pink, pink, orange etc. giving fragrance Australian Blue rose-Neelam bari
	Rosa odorata	Rosaceae.	
13. Eranthemum	*Eranthemum seticulatum*	Acanthaceae	Green, yellow, white, dark purple, & light purple forms are available. Suitable for semi shoded conditions.
14. Pentas	*Pentas carnea*	Rubiaceae	Rosy red, violet, purple, dark, red forms are available suited for semi shaded conditions.
15. Idlypoo or Ixora.	*Ixora singaporensis* (Red) *Ixora coccinia* (White)	Rubiaceae	Heads, Nuisance to the growes used as a foliage plant grown under shaded & semi shaded conditions foliage is variegated & attractive foliage can be seen in different colours.

COMMON NAME	BOTANICAL NAME	FAMILY	REMARKS
16. Crotons	*Codiaeum variegatum*	Euphorbiaceae	Used as a foliage plant grown under shaded & semi shaded conditions foliage variegated & attractive, foliage can be seen in different colours.
17. Aralia	*Aralia* sp.	Euphorbiaceae	Leaves are variegated; vary in size & shape, used as a foliage plant for shaded and semi shaded condition.
18. Plumbago	*Plumbago capensis*	Plum paginaceae	Flowers are azor bule colour; Doesnot produce woody branch; straggling shrub, in small bunches flowers are produced.
19. Acalypha	*Acalypha* sp. *Sanderina*	Euphorbiaceae	Foliage shrub; flowers appear as long pendulous catkins; f oliage is attractive; suitable for open & semi shaded condition
20. Hibiscus	*Hibiscus mutabilis*	Malvaceae	In the morning, flower colour is pink; when opened white in colour in the evening, single whorled and attractive.
21. Tree lettuce (Lachsakottai keerai)	*Pisonia alba*		Used as a green; foliage shrub; grown under semi shaded & indoor conditions.
22. Mandharai (mountain eboni)	*Bauhinia tomentosa* (Yellow) *B. purpurea*. (Purple)	Fabaceae	Both yellow & purple forms are available, when leaves dried used for rolling tobacco leaves.
23. Mayil kondri (peacock flower)	*Caesalpinia pulcherrima*	Febaceae	Flowers appear in bunches; usually at the tip of the shoot, yellow & Red colour forms are available.
24. Thumbergia	*Thumbergia erecta / Meyneya erecta*	Acanthaceae	Flowers are single; petals are violet in colour; base is tubular in shape; calyx is cup like with prominant yellow centre; white colour flowers are also available.
25. Lantana	*Lantana* sp. *L. camera* *L. lutea*	Rubiaceae	Flowers are red with yellow centre.
26. Sarpaganthi	*Rauvolfia canescence*	Apocynaceae	Berries of the plant are red in colour & attractive berries are also available in green & black forms. Roots possess medicinal value.
27. Ruby plant	*Hemelia patens*	Rubiaceae	Flowers arise in bunches, red-orange in colour, used as a flowering shrub; suitable for semi shaded & open conditions.
28. Nithya kalyani (periwinkle)	*Catharanthus roseus*	Apocynaceae	Flowers are single; available in rose &white forms

COMMON NAME	BOTANICAL NAME	FAMILY	REMARKS
29. Dragon bush	*Dracena* sp.	Liliaceae	Leaves are green, purple, yellow & variegated forms are available ; No veination in leaf & leaves are no stalked (Sessile) suited for semi shaded & indoor conditions.
30. Nerium	*Nerium oleander*	Apocyanaceae	Flowers are single & dos mulli whorled white forms, flowers one use for pooja purpose.
31. Yellow oleander	*Thevetia nerifolia*	Apocyanaceae	Yelllow & creamy white flowers are available; Tall shrubs used for fencing; plant are poisonous .
32. Notchi/chinese chastetree	*Vitex negundo*	Acanthaceae	Used as samll tree or shrub violet flowers & funnel like; appear in clusters.
33. Duranta	*Duranta plumeri*	Verbenaceae	Blue flowering in drooping clusters with light orange berries & attractive; used as shrub as well as hedge; amenable for pruning.
34. Unnimul / unnipalam	*Lantana camera*	Rubiaceae	Flowers appear in colour ; Red with yellow centre; emerging flowers are pink; changed to Red after opening; white yellow & variegated colours one available.
35. Changing rose	*Dombeya spectabilis*	Sterculiaceae	Flowers are light rose; appear in globular heads; after flowering the colour become foded and the flowers look ugly.
36. Graphtophyllum	*Graphtophyllum* sp	Acanthaceae	Foliage plant; can be grown as indoor & semi shaded condition; leaves are variegated.
37. Cassia	*Cassia biflora*	Fabaceae	Yellow flowers in bunches or clusters; and from each axile there will be 2 flowers.
38. Lantana	*Lantana lutea*	Rubiaceae	Flowers are yellow in colour modified bracts look like flowers.
39. Mussanda	*Mussanda erythrophylla*	Rubiaceae	Modified bracts look like flowers.
40. Hibicus	*Hibicus schizopetalous*	Malvaceae	into 5 of each petal at the & CP it looks like cut flowers . Flowers are drooping in nature.
41. Lantern plant	*Malvaviscus arboreus*	Malvaceae	Red, pink,white flowers are available ; the flowers open only partially.
42. Poinsettia	*Euphorbia pulcherrima*	Euphorbiaceae	Bracts are modified & look like a flower are samll & appear in cluster in shoot tip.
43. Mehanthi	*Lawsonia alba*	Lythraceae	Red colouration is due to the action of dye with some amino acids in the skin.
44. Aduthinna palai	*Adathoda vasica*	Acanthaceae	Medium shrub & used as a hedge or grown as hedge.
45. West Indian cherry	*Malphigia coccigera*	Malphigiaceae	Ornamental; attractive edible red berries.
46. December flower	*Barleria cristata*	Annonaceae	Violet, pink, white , violet striped, yellow are available.

List of some ornamental flowering trees suited to landscape gardening

Sl. No.	Common Name	Botanical Name and family	Colour of flowers	Flowering Time	Salient characters
1.	Silver wattle	*Acacia dealbata* (Leguminaceae)	Yellow	Feb-March and July August	A small tree, finely cut leaves, underside silver white, propagated by seeds, sucker.
2.	Queen of flowering trees	*Amherstia nobilis* (Leguminaceae)	Vermillion	April - May	Trees 6 to 12 m, high leaves coppery green, clustered and hanging
3.		*Bauhinia purpurea* (Leguminaceae)	Purplish rose	Throughout the year	Good sized trees, fragrant flowers
4.	Thiruvatti	*B. tomentosa*	Sulphar yellow flowers	-do-	Small trees, 2 to 3m. height
5.	Trumpet flowers	*Bignonia megapotamica* (Bignoniaceae)	Light pink flowers	March-April	Handsome deciduous trees 7 to 9 m. height
6.	Pinnai	*Calophyllum inophyllum* (Guttiferae)	Fragrant white flowers	May - June	A beautiful evergreen tree with large racemes, round fruits raised from seed
7.	Sara konnai or Golden shower	*Cassia fistula* (Leguminaceae)	Bright yellow flower	February - May	Medium size beautiful tree with long pendulous racemes, propagated by seed and suckers
8.	Pink shower	*Cassia grandis*	Rose pink	March -April	Spreading quick growing tree, pinnate leaves, pods are long
9.	Nagalingam or cannon ball tree	*Couropita guinensis* (lecythidaceae)	Pink or marron	-do-	Flowers have curious hood-like structure made up of united stamens in the centre of the flowers, fruits are large and round
10.	Gul mohar	*Poinciana regia* (Leguiminaceae)	Orange scarlet flowers	Apri l -May	Raised from seed
11.	Kalyana Murungai or Indian coral tree	*Erythrina indica* (Leguiminaceae)	Scarlet red flowers	March - May	Propagated by seed and cuttings
12.		*Jacaranda mimosaefolia* (Bignoniaceae)	Blue color	March - May	Deciduous often grows to 10 m. height, pretty foliage, feathery
13.	Persian Lilac	*Melia azedirach* (Meliaceae)	Lilac flower	March - May	Deciduous 15 to 20 feet height. bipinnate leaves small heliotropic scented lilac flowers in large panicle

Sl. No.	Common Name	Botanical Name and family	Colours of flowers	Flowering Time	Salient characters
14.	Shenbagam	*Michelia champaca* (Leguminaceae)	Light yellow whitish and red flowers	April - May and Sept-October	Seedling takes three years to bloom
15.	Bad-minton ball tree	*Parkia biglandulosa* (Leguiminaceae)	White flower	April - May	Pretty foliage, pinnate leaves, small white flowers with long peduncle, propagation through seed
16.	Copper shield	*Peltophorum ferrugneneum* (Leguiminaceae)	Pale yellow colour	April - May	Quick growing tree, fine graceful feathery foliage, pinnate leaves, raised from seed
17.	Indian Tulip	*Spathodia campanulata* (Bignoniaceae)	Orange Scarlet flowers	June - July	Leaves are glossy and bright green raised from seed

Ornamental foliage trees

Botanical Name	Family	Salient features
1. *Araucaria excelsa*	Coniferae	A very tall tree, conical in shape, short, slender, horizontal branches, starting from the trunk with a certain regularity
2. Causuarina equisetifolia	Causuarinaceae	Tamil: Chavukku, a lofty tree, rapid growth, slender branches, ornamental, fuel value, propagated by seeds
3. Cupressus macrocarpa	Pinaceae	Cypress, evergreen tree suited to higher elevations propogated by cuttings and seeds
4. Grevillea robusta	Proteaceae	Silver oak, reaches 8 to 11 m height, handsome foliage, propagated by seed
5. Terminalia catappa	Combretaceae	The Indian Almond tree-quick growing tree reaches, about 10 m height handsome stately growth with branches 10 m spreading horizontaly and coming from the main stem or axils in whorls, propagation from seed

Shade trees

Botanical name	Family	Salient characters
1. Albizia lebbek	Leguminaceae	Tamil: Vahai, quick growing shade trees with thin feathery foliage.
2.Azadirachta indica	Meliaceae	Tamil: Vembu, medium sized ever green tree with foliage, light green, serrated leaves.
3. Ficus elastica	Moraceae	Indian Rubber Tree, quick growing often reaching 15 to 60 m height, smooth shining leaves.
4. Enterolobium saman	Leguminaceae	Rain tree: large wide spreading tree propagated by seed.
5. Swietenia mahagoni	Meliaceae	Mohogani tree: ever green good- looking tall tree with good shape and attractive foliage;
6. Tectona grandis	Verbenaceae	Teak: It is truly a grand and majestic tree with large leaves.

List of commonly available shrubs.

A. Shrubs grown for flowers.

Sl. No.	Botanical Name	Family	Colour of the flowers
1.	*Acalypha hispida*	Euphorbiaceae	Long drooping spikes of crimson red flowers
2.	*Allamanda grandiflora*	Apocynaceae	Yellow funnel shaped flowers
3.	*Artabotrys odoratissimus*	Annonaceae	scented flowers, green and turn to yellow on ripening
4.	*Barleria cristata*	Acanthaceae	Flowers are pink, violet, yellow in colours
5.	*Bauhinia tomentosa*	Caesalpiniaceae	Sulphar yellow in colour
6.	*B. acuminata*	Caesalpiniaceae	White flowers
7.	*B. galpinii*	Caesalpiniaceae	Bright scarlet flowers
8.	*Bougainvillea sp.*	Nyctaginaceae	Single or double in red, rose, pink, yellow or white colour, including variegated leaves
9.	*Camellia japonica*	Theaceae	Double flowers with white, rose, or pink colour
10.	*Cestrum nocturnum*	Solanaceae	Scented flowers at night
11.	*Clerodendron inerme*	Verbenaceae	White flowers
12.	*Dombeya spectabilis*	Sterculiaceae	Cream/deep pink flowers
13.	*Duranta plumeri*	Verbenaceae	Blue flowers
14.	*Hamelia patens*	Rubiaceae	Orange red flowers
15.	*Hibiscus rosa-sinensis*	Malvaceae	Mostly red in color, yellow, pink and orange colours also avilable
16.	*H. mutabilis*		Flowers fade from pink to crimson
17.	*Ixora singaporensis*	Rubiaceae	Red
18.	*Mussaenda erthyrophylla*	Rubiaceae	Red, pink, yellow and white colour
19.	*Nerium oleander*	Apocynaceae	Single or double in rosy pink colour
20.	*Pentas cornea*	Rubiaceae	Red, pink or violet colour

Sl. No.	Botanical Name	Family	Colour of the flowers
21.	*Poinsettia pulcherrima*	Euphorbiaceae	Red, pink or violet colour
22.	*Tabernaemontana coronaria*	Apocynaceae	White
23.	*Tecoma stans*	Bignoniaceae	Yellow
24.	*Thevetia nerifolia*	Apocynaceae	Yellow colour
B. Shrubs grown for attractive leaves			
1.	*Acalypha sp.*	Euphorbiaceae	Red and green coloured leaves
2.	*Aralia sp.*	Araliaceae	Large pinnated/pinnatifid, variegated, trilobed leaves.
3.	*Codiaeum sp.*	Euphorbiaceae	Variably coloured and haped leaves.
4.	*Eranthemum elegans*	Acanthaceae	Blotched with white, green, grey and bronze coloured leaves.
5.	*Graptophyllum hortense*	Acanthaceae	Variegated blotched creamy white
6.	*Panax fruiticosum*	Araliaceae	Feathery, tripinnate leaves
7.	*Phyllanthes nivosus*	Euphorbiaceae	Small mottled pinkish white leaves
8.	*Pisonia alba*	Nyctaginaceae	Pale yellow foliage
C. Shrubs grown for attractive berries			
1.	*Duranta plumeri*	Verbenaceae	Yellowish Orange coloured berries
2.	*Ardesia crenata*	Myrsinaceae	Greyish red or crimson berries
3.	*Nandita domestica*	Berberideae	Red colour fruits

DESCRIPTION OF POPULAR INDOOR PLANTS / HOUSE PLANTS

S. No.	Botanical name / Common name / family	Propagation	Remarks
1.	*Aglonema commutatum* / Aglonema /Araceae	Tip cuttings / stem cuttings	A hardy houseplant with oblong-lanceolate leaves, 20-30 cm long rounded at the base, green silvery marking
2.	*Ananas comosus* var *variegata* Bromeliaceae	Suckers	Leaves green, broadly marginated, creamy-yellow, tinged red towards the margins, spiny and in a rosette form.
3.	(i) *Anthurium andreanum* (ii) *A. clarinenum* (iii) *A. crystallinum* Flamingo plant Araceae	Stem cuttings / seeds	(i). spathe erect, scarlet, cordate (ii) plants with rosette of fleshy ling, shining, green elliptic leaves 75-90 cm iii) Large cordate leaves, velvetty, ivory veins, delicate
4.	Asparagus (i) *A. sprengeri* (ii) *A. plumosus* (iii) *A. falcatus* / Liliaceae	Division of clumps	(i) Needle-like leaves borne on long, trailing and thorny stems. Ideal for hanging baskets. (ii) dark-green plume-like leaves on smooth, wiry, trailing stems (iii) A climbing plant with slender branches and bright green sickle-shaped leaves borne in clusters.
5.	*Araucaria heterophylla* / Araucariaceae	Seeds / tip cuttings	Symmetrically arranged branches with needle-like leaves on the central stalk
6.	*Begonia rex* / Begoniaceae	Division of rhizomes	Rex begonias are grown for the beautiful foliage, also flowering spp are available.
7.	*Schefflera actinophylla* / Araliaceae	Stem cuttings	It is tall, woody and branched with palmetely lobed, soft, feathery leaves forming umbrella like tops.
8.	*Caladium biocolor* / Araceae	Bulbs	It bears fancy, long-stalked, arrow-head leaves with many colours.
9.	*Calathea zebrina* / Marantaceae	Division	These are rhizomatous herbaceous plants and grow rapidly in warm humid condition.
10.	*Chlorophytum comosum* / variegatum / Liliaceae	Offsets / Division	Variegated narrow leaved foliage plant tolerate both shade and partial shade.
11.	*Codiaeum variegatum* var. *pictum* /crotons / Euphorbiaceae	Stem cuttings	The leaves are gorgeously coloured with red, maroon etc. Leaf shapes are also different.
12.	*Coleus blumei* / Labiatae	Stem cuttings	Ideal for growing in pots in a sunny-situation
13.	*Cordyline terminalis* / Liliaceae	Stem cuttings	Many varieties available. Bronze leaves with shades of brown or red.
14.	*Cyperus alternifolius* / Cyperaceae	Seeds or stem cuttings	Plant has ribbon-like stems, leaves grass-like arranged like umbrella spokes
15.	*Dieffenbachia picta* / Dumb cane /Araceae	Stem cuttings	The plant is tall with thick stem and lame-shaped, dark green, broad leaves.

S. No.	Botanical name / Common name / family	Propagation	Remarks
16.	*Dracaena sanderiana* *D. fragrans* *D. godseffiana* / Liliaceae	Stem cuttings	Hardy house plants
17.	*Episcia cupreata* / Flame violet Gesneriaceae	Stolons produce plants at the nodes which are separated and planted	Perennial herbs with beautiful-foliage
18.	*Ficus elastica decora* / Indian Rubber Plant	Stem cuttings / Air-layering	The leaves oblong, dark-green leathery leaves with bright red growing tip.
19.	*Heliconia metallica* / Musaceae	Division of clumps	Slender perennial herb, oblong leaves on long red stalk.
20.	*Maranta leuconeura* / Marantaceae		Leaves are oval, round, pale green with dark-brown markings along the central vein.
21.	*Peperomia argyreia* / Piperaceae	Stem / leaf cuttings	Ornamental, foliage plants, succulent and herbaceaus, quick growing.
22.	*Philodendron* spp / Araceae	Stem cuttings	Several ornamental species are grown indoor-plants.
23.	*Pilea muscosa* syn. *P. microphylla* / Artillery plant. Urticaceae	Stem cuttings	A dwarf trailing plant having small leaves in the attractive markings
24.	*Polyscias balfouriana* / Araliaceae	Stem cuttings	Plants are bushy with attractive foliage
25.	*Rheo discolor* / Commelinaceae	Division of clumps	The plant has a short, thick, fleshy stem bearing a rosette of leaves.
26.	*Sansevieria trifasciata* / Liliaceae	Division of rhizome	Thick fleshy leaves emerge erect from the ground and are sword-shaped.
27.	*Scindapsus aureus* / Money plant. Araceae	Stem cuttings	It has a trailing habit with small heart shaped, light green leaves flecked with yellow.
28.	*Sstcresia purpurea*	Stem cuttings	It has thick and fleshy stem with a tendency to trail and has pale purple leaves.
29.	*Spathiphyllum wallisii* *Peace lily* / Araceae	Division of clumps	The flowers are pure white, arum-shaped with glossy green leaves.
30.	*Syngonium podophyllum* Araceae	Division / Stem cuttings	A trailing plant with rough, triangular-shaped, bright emerald-green leaves with extended base.
31.	*Tradescantia fluminensis* / Wandering jew. / Commelinaceae	Stem cuttings	It has trailing habit with glossy-green leaves. Variegated varieties also available.
32.	*Zebrina pendula* / Commelinaceae	Stem cuttings	It closely resembles Tradescantia. It is also a trailing plant with paired leaves and are glisting silvery-grey green stripes down the centre.

Description of popular cacti and succulents.

Sl. No.	Botanical Name / Common name	Propagation	Remarks
1.	*Agave filifera* *A. americana*	Detach small plants forming around the base. Seed propogation also possible	Succulent-like plants that develop a rosette of fleshy leaves, some of which end in thorns can be kept outdoor during summer.
2.	*Aloe arborescens*	Offsets	An erect plant with thorny, curving, tentacle-like fleshy leaves. Spikes of orange-red flowers.`
3,	*Aporocactus flagelliformis* *Rat's-tail cactus*	Rooted cuttings, seeds	Green cascading stems, 40-60 cm long, covered with small thorns. Rose flowers 7 to 10 cm long.
4.	*Astrophytum ornatum* *Bishop's cap catus*	-Seeds -Grafting	A spherical to cylinderal cactus with eight ribs edged with clumps of spines. The surface has pathes of white scales. Flowers yellow.
5.	*Chamaecereus silvestrij* *Peanut cactus*	Shoot cuttings, Seeds	Finger-like, usually eight ribbed, Orange-red flowers, star like.
6.	*Crassula arborescens* *(Cape Province)*	Shoot tip cuttings Leaf cuttings	Thick, sturdy stems, branching tree-like to give bonsai appearance. white flower.
7.	*Echinocactus grusonii* *Golden barrel cactus*	Seeds	A spherical cactus, becoming more barrtel-shaped with age. Yellow flowers
8.	*Epiphyllum hybrids* *Orchard cactus*	Rooted / cuttings	The flowers are in shades of red or yellow or white, 10-15 cm width. The long notched stems are leaf-like in appearance.
9.	*Haworthia fasciata* *Wart Plant*	Offsets	Small succulents grown for their thickned attractively marked leaves, arranged as a rosette.
10.	*Kalanchoe sp.* *Syn: Bryophyllum* *(i) Flowering K. blossfeldiana* *(ii) Viviparous K. diagremontiana*	Cuttings & seeds (Flowering type)	Leathery, glossy green leaves, brittle and easily broken clusters of red / orange / yellow flowers
11.	*Lobivia* sp.	Offsets	A densely thorned, short cylindrical cactus. Red, Orange or yellow funnel shaped flowers 5 cm across.
12.	*Mammillaria* sp.	Offsets	A large group of spherical or columnnar cacti, grown for their interesting shape or spines & sometimes flowers
13.	*Notocactus* sp. *(golden ball cactus)*	Offsets, Seeds	Cylindrical light green stems, forming clusters. 20-30 ribs with fine, pale yellow spines. Flowers lemon yellow inside, green outside.

Sl. No.	Botanical Name / Common name	Propagation	Remarks
14.	*Opuntia sp.* *Prickly pear*	Cuttings and allow them to dry for two days before planting	Commonly grown cactus for fencing in fields. Broad, flat pads are spiny yellow flowers only on older plants.
15.	*Parodia sp.*	Seeds	A globular cactus with spiralled ribs. Apricot. colured flowers.
16.	*Rebutia sp.*	Offshoots, seeds	Small, globular free flowering cacti. Red flowers.
17.	*Rheo discolor* *Boat lily*	Cuttings, offsets	Semi-erect, strap-shaped leaves, long dark-green on top, purple beneath.
18.	*Sanevieria trifasciata* *Mother-in-law's tongue*	Division of established plants and leaf cuttings	Sword-like thick, fleshy leaves,. Dull green with mottled grey cross-banding.
19.	*Sedum* sp. *S. Pachyphyllum*	Seeds, cuttings	Plants mostly used in the rock garden succulent, Club-shaped to cylinderical blue-green leaves.
20.	*Sempervivum sp.* *Houseleek*	Offsets around the parent plant	Rosette of bright green leaves with pink flowers
21.	*Setcreasea purpurea* *Purple heart*	Cutting	Erect, oblong to lance-shaped purple leaves. Stems are also purple. Small rose-purple flowers.
22.	*Yucca aloifolia*	Rooted sideshoots	Spiky rosette of stiff, spine-tipped, sword shaped leaves. Often a stout trunk-like stem.

CLIMBERS AND CREEPERS

Sl. No.	Botanical Name	Family	Colour of flowers
1.	*Allamanda grandiflora*	Apocynaceae	Bright yellow
2.	*Antigonon leptopus*	Polygonaceae	Bright pink and white
3.	*Aristolochia elegans*	Aristolochiaceae	Dark purple and cramy yellow
4.	*Asparagus sprengeri*	Liliaceae	Leaves are attractive
5.	*Bignonia venusta*	Bignnoniaceae	Golden orange
6.	*Bougainvillea sp*	Nyctagineae	Varios colours
7.	*Ipomoea palmata*	Convolvulaceae	Purple
8.	*I. tuberosa*	-do-	Yellow
9.	*Jacquemontia violacea*	-do-	Bright blue
10.	*Jasminum grandiflorum*	Oleaceae	White, tinged pink scented
11.	*Monstera deliciosa*	Araceae	Leaves are attractive
12.	*Petrea volubilis*	Verbenaceae	Purple blue
13.	*Porana volubilis*	Convolvulaceae	White
14.	*Quisqualis indica*	Combretaceae	Pale pink and white
15.	*Scindapsus*	Aroidae	Variegated leaves
16.	*Solanum seaforthianum*	Solanaceae	Purplish blue
17.	*S. wenlandi*	do	Lilac blue
18.	*Tecoma jasminoides*	Bignoniaceae	White with rose purple streak in the throat
19.	*Thunbergia grandiflora*	Acanthaceae	Bluish, purplish or white
20.	*Vallaris solanacea*	Apocynaceae	White scented flower

Ex. No. 15.

FLOWER CROP VARIETIES RELEASED FROM TAMIL NADU AGRICULTURAL UNIVERSITY

Sl. No.	Crop	Variety	Parentage / Breeding method	Duration (days)	Yield (t/ha)	Special features	Year of release
1.	Rose	YCD.1	Selection from progeny	Perennial	100-200/ plant	Bright yellow with tinge of pink on the outer whorl	1985
2.	Rose	YCD.2	Clonal progeny of seedling No.1043	Perennial	150-200 flowers/ plant	Bright yellow with a scarlet red with yellow shade at the petal base	1992
3.	Rose	YCD.3	Selection from open pollinated progeny	Perennial	80-100 flowers/plant/annum	Deep vermillion	1995
4.	Mullai	Parimullai	Clonal selection	Perennial	5800 kg/ha	Buds are white with moderate corolla tube length	1972
5.	Mullai	Co.1	Selection from local	Perennial	8800 kg/ha	Buds are white and bolder with long corolla tube	1980
6.	Mullai	Co.2	Clonal selection	Perennial	11,198 kg/ha	Field tolerance to phyllody disease and gall mite infestation	1988
7.	Pitchi	Co.1	Secondary clonal selection	Perennial	10,144 kg/ha	Pink tinged flower bud with long corolla tube	1980
8.	Pitchi	Co.2	Induced Mutant from Co.1	Perennial	116800 kg/ha	Bolder pink buds	1991
9.	Chrysanthemum	Co.1	Selection from Hosur Local	9 months	16.7 t/ha	Canary yellow flowers	1985
10.	Chrysanthemum	MDU.1	Selection from the germplasm type	8 months	16.59 t/ha	Sulphur yellow color	1985

Sl. No.	Crop	Variety	Parentage / Breeding method	Duration (days)	Yield (t/ha)	Special features	Year of release
11.	Chrysanthemum	Co.2	Selection from germplasm type received from NBRI, Lucknow	8 months	18.47 t/ha	Purple colour (Rhodamine purple-29)	1989
12.	Gerbera	YCD.1	Clonal selection	Perennial	56 flower/clump/year	Flowers are double in form with cherry red colour	1992
13.	Gerbera	YCD.2	Selection from germplasm	Perennial	80 flowers/clump/year	Rose pink flowers	1995
14.	Gladiolus	KKL.1	Selection from American Beauty	120 days	2,11,100 flowers (spike) /ha	Red purple flower with white flushed throat	1993
15.	Hibiscus	Co.1 Thilagam	Intergeneric hybrid (*H. rosasinensis* X *Malvaviscus arboreus)*	Perennial	3055 flowers/bush/year	Flowers are carmine red colour	1981
16.	Hibiscus	Co.2 Punnagai	Selection from OP seedlings of Chandrika	Perennial	1000 flowers/bush/year	Apricot yellow flowers	1981
17.	Hibiscus	Co.3	Hybrid between Bright Yellow X Red Gold cvs.	Perennial	1309 flowers/bush/year	Chinese yellow with Turkey red throat	1984
18.	Barlaria	Co.1	Clonal selection from local type	Perennial	2.11 kg flowers/bush	Pink colour flowers	1982
19.	Marigold	MDU.1	Selection from a germplasm type	4 months	41.54 t/ha	Light orange colour	1986

EX.NO.2

BRIEF DESCRIPTION OF THE VARIETIES OF VEGETABLE CROPS

1.	**Tomato**	**CO.1**	**(1969)**	It is a pureline selection from an exotic type. It is a semi determinate type. The crop duration is 135 days and yields 38 tonnes/ha. It bears in clusters of 6 to 8 fruits. The fruits are round pale green at unripe stage and turns to capsicum red on ripening. The plants are dwarf and semi round and need no staking. The fruits contain high TSS (4.2°Brix) and acidity (0.69%).
2.	**Tomato**	**CO. 2**	**(1974)**	It is a pureline selection from U.S.S.R. type. The plants are semi-dwarf, leaves broad and thick. Fruits are ovate, large, devoid of cracking and rich in ascorbic acid (18-21 mg/100g). 4.22°Brix TSS and 0.90% acidity. It yields 42 t/ha (18.2% increase over CO.1).
3.	**Tomato**	**CO. 3**	**(1980)**	It is an induced mutant from CO. 1 having 100 days duration with very dwarf, compact and determinate plants. Fruits are globular attractive red, borne in cluster of 4-5 fruits, rich in vit C (25 mg/100g), TSS (3.2° Brix) and acidity (0.8%) with a flesh to seed ratio of 17%. It yields 50 t/ha and is suitable for summer season also.
4.	**Tomato**	**PKM 1**	**(1978)**	It is an induced mutant from Annanji giving 32.0 t/ha in a duration of 135 days. The plants are determinate with fruits of attractive capsicum red in colour with green shoulders and uniform ripening. The fruits are best suited for long distance transport. The fruits contain 3.6°Brix of TSS 23.7 mg/100 g of vitamin C and 0.99% acidity.
5.	**Tomato**	**Paiyur 1**	**(1988)**	This variety is a hybrid derivative evolved by crossing Pusa Ruby x CO 3. It is suitable for rainfed cultivation. It yields about 30 t/ha.
6.	**Tomato**	**COTH.1**	**(1999)**	This was developed at the Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore by crossing IHR 709 and LE 812. It is a determinate F_1 hybrid requiring minimum staking. The fruits are round to slightly oblong each weighing 50 g

				with deep red skin and thick flesh and borne in clusters of 4-5. The juice is acidic rendering the fruits for use in culinary preparation unlike the most of the hybrids developed by a number of private firms which lack acidity and hence used mostly for salad. The plants can be planted at a spacing of 60 x 45 cm. The estiamted yield is 96 tonnes / ha in a crop duration of 110-115 days after transplanting.
7.	**Brinjal**	**CO. 1**	**(1978)**	It is a selection. The crop duration is 160 days. The plants are erect, medium, bushy with greenstem and leaves and greenish purple petiole. Fruits are light green with
8.				white base, medium sized (50-60 g/fruit) with good keeping quality. It is moderately resistant to root-knot and reniform nematodes. It yields 24.0 t/ha.
9.	**Brinjal**	**CO. 2**	**(1988)**	It is a selection from the local cultivar called Coimbatore Varikkathiri. The plants are medium in height and spread and capable of yielding as high as 38 t/ha. The fruit are oblong in shape having eminent deep purple colour with inter mittent pale green streaks. The crop duration is 150 days. The quality is very good and this variety is suitable for growing in Coimbatore and Periyar districts.
10.	**Brinjal**	**MDU 1**	**(1979)**	It is a selection from a local type and yields 34.0 t/ha in a crop duration of 135 days. The plants are compact and medium spreading. The fruits are round, bright, purple coloured and each weights 280g. The leaves are broad with light green pigments. The fruits contain 0.38% acidity and 11.36 mg/100 g of ascorbic acid.
11.	**Brinjal**	**PKM 1**	**(1984)**	It is an induced mutant of a local type. It is high yielding (34.75 t/ha) with a duration of 150-155 days. The fruits measure 6 to 8 cm and 10-14 cm in length and girth respectively with a mean weight of 45 to 65 g. It is drought tolerant and can withstand long distance transport. It stores well under normal room temperature. The fruits contain 0.29% acidity and 14 mg/100 g of ascorbic acid.

12.	**Brinjal**	**PLR 1**	**(1990)**	This is a selection. The fruits are small to medium in size. Sometimes borne in clusters. Egg shaped and with bright glossy purple colour. It fetches premium price in the markets of Cuddalore, Chenglepet and Chennai. It has got a self life of 8-10 days under ambient temperature. It yields an average of 15 t/ha.
13.	**Brinjal**	**KKM 1(Killikulam-1)**	**(1995**	It is a pureline selection from Kulathur local. It is suitable for cultivation both under rainfed and irrigated conditions in Tirunelveli district. Fruits medium sized, egg shaped, milky white in colour and bears in clusters of 2-4 per cluster. It yields 37 t/ha in a duration of 135 days.
14.	**Chilli**	**CO. 1**	**(1979)**	It is a selection from Sathur Samba. The crop duration is 210 days and yields 2110 kg of dry pods per hectare. The plants are erect, medium tall and compact with medium branching. The fruits are green when unripe and bright shiny red on ripening. The fruits are 6-6.5 cm long with sharp tip and bulged shoulders. The seed content is 55% with high capsaicin (0.72 mg/g).
15.	**Chilli**	**CO. 2**	**(1982)**	It is a selection from a local Gundu type. The crop duration is 210 days and yields 2200 kg of dry pods per hectare. The stem is angular semidwarf and less spreading. The pods are oblong and bright red in colour. Seed content is high (60%) Capasicin content of dry pod is 0.56%. It is suitable for harvest as green pods and red ripe pods.
16.	**Chilli**	**PKM 1**	**(1990)**	This is a hybrid derivative of the cross between Ac.No. 1797 x CO. 1 selected in F_1 generation and fixed by selfing. It has very bold pods which are dark red in colour. It has got a very high yield potential of 3000-3200 kg of dry pods per hectare in a crop duration of 180 days.
17.	**Chilli**	**CO. 3**	**(1991)**	This is a dwarf and compact growing samba culture suitable for very close planting of 30 cm x 15 cm. The potential yield at this spacing is 3000-3500 kg of dried chilli per hectare. It is also suitable to be used as green chilli. It has a very low stalk weight in comparison with pod weight unlike other cultivars and high oleoresin and capsaicin content and hence suitable for

				export purpose.
18.	**Vegetable Chilli**	**CO.4**	**(2000)**	It is a pureline selection made from an open pollinated type introduced from Sri Lanka with a crop duration of 165 days after transplanting. It is suited for *kharif* and *rabi* seasons. This variety recorded 96.58% increased yield over PKM-1. The fruits are dark green, stout, less pungent and turns to capsicum red colour after ripening. It has the potential to yield 23 t/ha of green chilli.
19.	**Chilli**	**K 1**	**(1964)**	It is a selection from local Sathur Samba. The crop duration is 210 days and yields 1.8 t/ha. The fruits are long and contain high capsaicin. The variety is suitable for rainfed cultivation in southern districts of Tamil Nadu.
20.		**K 2 Chilli**	**(1975)**	It is hybrid derivative of the cross B 70-A and Sathur Samba. The crop duration is 210 days and yields 1980 kg of dry pods/ha. The plants are tall and compact. The pods are long and bright red in colour with high seed content. The increased yield is 29% over K1 chilli.
21.	**Chilli**	**MDU 1**	**(1978)**	It is a mutant from K 1 chilli. The fruits are longer and bears in clusters of 6 to 8. The crop duration is 210 days with an yield of 1.9 tonnes of dry pods per ha. It is more suitable for southern districts of Tamil Nadu. The fruits contain 0.70 mg/g of capsaicin.
22.	**Chilli**	**PLR 1**	**(1994)**	It is a pureline selection from Kandengadu local. It is more suited for green chillies and yields per hectare. The crop duration is 210 days.
23.	**Chilli**	**PMK 1**	**(1993)**	Plants are medium tall. Duration is 200 days and suitable for semi-dry cultivation in Ramanathapuram district. It yields about 2.4 tonnes of dry pods/ha.
24.	**Bhendi**	**CO. 1**	**(1976)**	It is a selection from 'Red Wonder' of Hyderabad. The crop duration is 90 days with an

				yield of 14.25 t/ha. The plants are medium tall, moderately vigorous and deeply lobed leaves. Pods are slender, smooth and fleshy.
25.	**Bhendi**	**CO.2**	**(1987)**	It is a F_1 hybrid bhendi involving two parents AE 180 and Pusa Sawani. First harvest can be done 45 days after sowing and the crop duration is 90 days. It yields 16.5 t/ha accounting for 26 to 64% increase over CO. 1, MDU 1 and Pusa Sawani. It can be grown throughout the year.
26.	**Bhendi**	**MDU 1**	**(1978)**	It is an induced mutant from Pusa Sawani. The fruits are long and light green in colour. It yields 12 to 14 t/ha in a crop duration of 100 days. The pods contain 12.3% crude fibre.
27.	**Hybrid Bhendi**	**CO.3**	**(1991)**	It is a high yielding hybrid evolved from the cross between Parbhani Kranti x MDU 1 and suitable for fresh Market with dark green colour of medium sized fruits. This hybrid has high degree of field tolerance to Yellow Vein Mosaic Disease. The yield is 18.75 t/ha.
28.	**Amaranthus**	**CO.1**	**(1968)**	It is a selection from a local type. The crop duration is 25 days for mulakkeerai and 50 days for thandukeerai. The yield is 8 t/ha. The leaves are dark and seeds are black and small sized. The greens contain 4.8% calcium and 3.85% iron.
29.	**Amaranthus**	**CO.2**	**(1979)**	It is a selection from a germplasm type with a duration of 25 days for mulakeerai and 35-50 days for thandukeerai. It yields 10.75 tonnes of greens/ha. The plants are erect, with moderate branching. The seeds are bolder with early germination and early vigorous growth. The crude fibre content is less (1.3%) with 19.0 mg of iron, 20.0 mg of calcium per 100 g.
30.	**Amaranthus**	**CO.3**	**(1988)**	It is a selection from the local type and yields 30.72 tonnes of greens per hectare. It lends itself for 10 clippings, commencing from 20 days after sowing and provide a continuous supply of luscious tender green for three months. It has high leaf to stem ratio (2.0). The plants are erect with green nutritious leaves containing 25.2 mg per 100 g of vitamin C, 1.75% crude fibre, 0.8% iron and 2.48% Ca. The seeds are black in colour.
31.	**Amaranthus**	**CO.4.**	**(1989)**	It is a selection from *A. hypochondriacus* which is suitable for growing in plains and hills

				throughout Tamil Nadu. It is a high yielding grain amaranthus with an yield of 2,555 kg/ha in addition to 8,200 kg/ha of leaf on 25 the day. The crop duration is 90 days/ The seeds are rich in protein (15.95%) and amino acids like lysine (7.5 mg/100g), phenylalanine (5 mg/100g), leycine (1.2 mg/ 100 g) and isoleucine (1.8 mg;/100 g). The grain can be substituted for minor millets like ragi and tenai. It is amendable for various food preparations just like any other grains.
32.	**Amaranthus**	**CO.5**		It is a single plant selection (A 166-I) from an OP plant introduction. The variety has double coloured leaves (green and pink). It gives a rosette growth in early stages. The stem is also free of fibres. The first harvest starts 25 days after sowing and in a crop duration of 55 days it produces on an average of 40 tonnes of green leaves per hectare.
33.	**Onion**	**CO. 1**	**(1963)**	It is a selection. The crop duration is 90 days and yields 10 t/ha. Bulbs are medium sized, pink in colour with 8 bulbs per plant weighing 55 to 60 g. The bulbs are fairly pungent.
34.	**Onion**	**CO.2**	**(1975)**	It is a selection from a germplasm type, CS 911. The crop duration is 65 days yielding 12 t/ha. It is a photo insensitive type. This variety is pungent with high total soluble solids (12.0°Brix).
35.	**Onion**	**CO.3**	**(1979)**	It is a clonal selection from open pollinated progenies of CS 450. The crop duration is 65 days and yields 15.8 t/ha. The bulbs store well over 120 days. The variety contains 17.5% dry matter, 0.53 per cent sulphur and 13.0°Brix TSS.
36.	**Onion**	**CO.4**	**(1982)**	It is a hybrid derivative of the cross AC 863 x CO3. The crop duration is 65 days and yields 19.0 t/ha.. The bulbs store well over 150 days devoid of sprouting in well ventilated store rooms.
37.	**Onion**	**MDU 1**	**(1984)**	This is a selection from a local type, Sempatti. Bulbs are big sized with attractive red colour. It yields 52.7% higher than CO 2. It keeps well for a long time with less reduction during storage in bulb weight (45%) for 5 months compared to 65% in CO 2 onion.

38.	**Snake gourd**	**CO. 1**	**(1976)**	It is a selection from a local germplasm type. The crop duration is 135 days and yields 18.0 t/ha. The fruits are dark green with white stripes, long fruits (160-180 cm) each weighing 500 to 750 g with good cooking quality. It is moderately resistant to powdery mildew.
39.	**Snake gourd**	**CO.2**	**(1986)**	It is a selection from a local type. The fruits are short and stout. It yields on an average 36 t/ha. The fruit is light greenish white and each weighs 400-600 g. The crop duration is 105 days. The variety does not require pandal.
40.	**Snake gourd**	**MDU 1**	**(1981)**	It is a hybrid between Panri Pudal and selection 1. It is an early flowering type (84 days) with an average yield of 31.74 t/ha. The fruits are medium long (66.94 cm) and short with an average weight of 551 g. The fruits are fairly rich in Vit. C (44.4 mg/100g) and very low in fibre content (0.6%).
41.	**Snake gourd**	**PKM 1**	**(1979)**	It is an induced mutant from H 375 type and yields 25.5 t/ha in a duration of 145 days. The vines are vigorous giving fruits of dark green colour with white strips outside and light green inside. Each fruit weighs 700 g.
42.	**Bitter gourd**	**CO.1**	**(1978)**	It is a selection from a local type. The crop duration is 115 days and yields 14.0 t/ha. The fruits are green, long (30-35 cm) and contain 1.8 mg/100 g of iron, 20 mg/100g of calcium and 1.1g/100 g of minerals.
43.	**Bitter gourd**	**MDU 1**	**(1984)**	It is an induced mutant, developed by gamma irradiation of local cultivar (MC 103). It is early in flowering (60 days) and yields 16.66 fruits/plant. The fruits are long with mean length of 40.34 cm and a girth of 17.54 cm and each fruit weighs 410.0 g on an average. It yields 32.19 t/ha.
44.	**Ribbed gourd**	**CO.1**	**(1976)**	It is a selection from a local type. The crop duration is 125 days and yield of 14.0 t/ha. Fruits are long (60-75 cm), light green, attractive in appearance each weighing 300 g on an average. Moderately tolerant to pest and disease.

45.	**Ribbed gourd**	**CO.2**	**(1984)**	It is a selection from a germplasm type. The fruits are green, long (1 m) and fleshy. The crop duration is 120 days with an yield of 25 t/ha.
46.	**Ribbed gourd**	**PKM 1**	**(1980)**	It is an induced mutant from the type H 160 and gives 28.0 t/ha of fruits in a duration of 160 days/ The fruits are dark green with shallow grooves. The plants are tolerant to pumpkin beetle, fruit fly and leaf spot.
47.	**Bottle gourd**	**CO.1**	**(1981)**	It is a selection from a germplasm type. The crop duration is 135 days and yield of 36.0 t/ha. Fruits are round at the base with a prominent bottle neck at the top., medium sized, attractive light green in colour with mean weight of 2.025 kg.
48.	**Pumpkin**	**CO.1**	**(1971)**	It is a selection from a local type and yields 30 t/ha. The vines are vigorous and spreading. The fruits are bigger and globular, each weighing 7.00 kg. One vine yields 6 to 7 fruits. First harvest can be had 115 days after sowing and the total crop duration is 180 days.
49.	**Pumpkin**	**CO.2**	**(1974)**	It is a selection from a local type. The duration is 135 days and yields 23.0 t/ha. The vines are moderately vigorous and less spreading. Individual fruit weighs 1.5 to 2.0 kg with 5 to 6 fruits per vine. It is a small fruited variety suitable for kitchen garden. The fruits contain 9.2% starch, 10.8 brix TSS, 10 mg/100 g of ascorbic acid and 0.14% acidity.
50.	**Ash gourd**	**CO.1**	**(1971)**	It is a selection from a local type with a crop duration of 150 days. The fruits are globular, light green with ash coating with less seeds. The yield is 25 t/ha.
51.	**Ash gourd**	**CO.2**	**(1982)**	It is a selection from a local type. The duration is 120 days and yields 34.0 t/ha. The fruits are light green with waxy bloom, small sized with a mean weight of 2.5 to 3.0 kg. The fruits contain 200-300 seeds. It takes 85-90 days from sowing to harvest.
52.	**Annual Moringa**	**PKM.1**	**(1989)**	It is a pure line selection from the population generated by continuous selfing of the seed moringa types for six generations. The plants grow to a height of 4-6m and come to flowering 90-100 days after planting. The first harvest starts 160-170 days after planting. Each tree bears

				on an average 200-225 fruits/year (3 kg). The pods are 65-70 cm long with 6.3 cm girth and 150 g weight. Ratoon crops can be taken for 3 years. Every year after the harvest is completed, the trees have to be cut back to about one metre from ground level.
53.	**Annual Moringa**	**PKM.2**		It is a high yielding type with an increase of 9.18% in number of pods over PKM-1 Annual Moringa. The pods are long, less seeded, more fleshy and delicious. It comes to bearing in six months after sowing. It yields 98 tonnes/ha/year.
54.	**Tapioca**	**CO.1**	**(1977)**	It is a clonal selection with a crop duration of 8½ -9 months. The tuber is whitish brown with white flesh, and is suitable for industrial uses and consumption purpose. The starch content of tubers is 35.0 per cent with an out turn of 10.35 tonnes of starch per hectare. The HCN content is less (10g/g) in the flesh. It yields 30 t/ha. The plants are tolerant to mosaic virus.
55.	**Tapioca**	**CO.2**	**(1984)**	It is also a clonal selection. The tubers are medium sized with whitish grey skin, creamy white rind and white flesh. The crop duration is 8 ½ to 9 months . The starch content is 34.50 per cent. It yields 38.6 t/ha of tubers. The incidence of mosaic virus is low. The tubers contain low HCN of 10 g/g in the flesh.
56.	**Tapiaco**	**CO.3**	**(1993)**	It is also a clonal selection from open pollinated seeds obtained from Ibadan, Nigeria. It yields 43 t/ha in a crop duration is 8 months. The tubers contain high starch 35.6% and low HCN of 77.89µg/g. The plants exhibit field tolerance to mosaic virus disease. It is a branching type. Tuber flesh is white with brown skin and creamy white rind.
57.	**Sweetpotato**	**CO.1**	**(1976)**	It is a clonal selection. The crop duration is 135 days and yields 28 t/ha. The tubers have light pink skin and white flesh. The number of tubers per plant is 3.2 with a starch content of 24% and a TSS of 10.6° brix.

58.	**Sweetpotato**	**CO.2**	**(1980)**	It is a clonal selection. The crop duration is 110 to 115 days and yields 32 t/ha. Tubers have pink skin and white flesh and have a starch content of 29.5 per cent and TSS of 10.8°Brix.
59.	**Sweetpotato**	**CO.3**	**(1982)**	It is also a clonal selection. The crop duration is 105-110 days and yields 42 t/ha. It is suitable for cultivation in both seasons and tolerant to root weevil. The tubers have light pink skin and orange flesh and contain a carotene of 13.28 mg/100 g and starch of 30.72 per cent.
60.	**Sweetpotato**	**CO.CIP. 1**		It is a clonal progeny of IB 19.10.20 developed through half-sib evaluation of open pollinated seedlings. Duration is 95-110 days September-October, February-March and June-July are best suitable seasons. It yields 31.76 t/ha. Tolerant to weevil incidence (14.85%).
61.	**Coleus**	**CO.1**	**(1991)**	It is a clonal selection. It yields 32 t/ha in a crop duration of 180-190 days. The tubers have 21.5 per cent starch. The cooked tubers are tasty and have lesser soil odour.
62.	**Dioscorea**	**CO.1**	**(1991)**	It is a clonal selection. It gives 44.8 tonnes of tubers/ha in a crop duration of 8 to 8½ months. The tubers are big in size with white flesh. Tubers are rich in carbohydrate (28%) and protein (2.5%).
63.	**Colocasia**	**CO.1**	**(1991)**	It is a high yielding selection. It has an yield potential of 24 t/ha. Tubers have high starch content (22.5%) and higher protein content (2.4%) than cassava and sweet potato. Tubers have less acidity and good cooking quality.
64.	**Radish**	**CO.1**	**(1971)**	It is a selection from a germplasm type. Roots are milky white, less pungent, long (22 cm) cylindrical and tapering and thick (12.5 cm girth) and medium sized (226 g). Roots contain 10.9 mg/vit. C per 100 g and 1.28% crude fibre, suitable for intercropping and other systems of cropping. Roots have better consumer's preference. Top to root ratio is 0.99.
65.	**Beetroot**	**Ooty-1**	**(1992)**	It is a selection and yields 31.4 t/ha in the hills. The crop duration is 120-130 days if direct sown and 135-150 days if transplanted. It is suitable for growing in all seasons. The roots are blood red in colour with thin skin.
66.	**Moringa**	**KKL-1**	**(1996)**	It is a selection from a local type. The selection yields 7 tonnes of green pods/ha with 31

	bean			per cent increase over local. Pods are green, fleshy and thick.
67.	**French bean**	**YCD.1**	**(1994)**	It is a pureline selection from a local type and suitable for rainfed cultivation in the hills upto an elevation of 1500 m above M.S.L. It yields 9 tonnes of green pods or 6 tonnes of grain per hectare in a duration of 105 days. The pods are flat, green with dark purple bold seeds. It exhibits field tolerance to yellow vein mosaic and anthranose disease.
68.	**Butter beans**	**KKL-1**	**(1991)**	KKL-1 butter beans (*Phaseolus lunatus*) is a selection from a type collected from Vilpatti. It is a pole type and bears pods in clusters. The pods are 11.6 cm long, beans are 5-6 in number per pod. The crop will be ready for harvest from 100 days. The harvest will continue upto 140 days. It yields 3.47 t/ha in 3 to 4 pickings.
69.	**Dolichos bean**	**CO.1**	**(1993)**	It is a selection. Pods are dark green flat and slightly curved, tender and fleshy. Pods contain 4.69% protein, 12 mg vit. C, Fe 2 mg, P.14 mg, Ca 39 mg. 100 g or edible portion with 1.33% crude fibre. Matured seed is black in colour. Yield 18 t/ha, duration 165 days.
70.	**potato**	**CO. Simla**	**(1970)**	It is a selection from the hybrids obtained from CPRI, Simla. It is suitable for cultivation in the plains during monsoon seasons. The yield is 12 t/ha in a crop duration of 110 days.
71.	**Palak**	**Ooty 1**	**(1995)**	It is a selection and can be grown all through the year. It is tasty green leafy vegetable in which first picking can be had 45 days after sowing and continued at 15 days interval for a period of 2 years. It yields 15 t/ha/harvest. The leaves contain higher carotene.
72.	**Watermelon**	**PKM.1**	**(1993)**	Fruits are oblong, green in colour with light green stripes. Each fruit weighs about 3-4 kg. Duration is 120-135 days and yield is 38 t/ha.
73.	**Cucumber**	**CO.1**	**(1989)**	It is a selection from Kanyakumari local type. It is a high yielding selection (25-28 t/ha). The fruits are long (60 to 65 cm), slightly curved, tapering towards stalk end.
74.	**Garlic**	**Ooty.1**	**(1991)**	It is a high yielder and gives on an average 17.1 t/ha. Comes to harvest in 120-130 days. The bulb is dull white in colour.

EX.NO.2

BRIEF DESCRIPTION OF THE VARIETIES OF VEGETABLE CROPS

No	Crop	Variety	Year	Parentage	Breeding method	Duration	Yield	Special features
1	Tomato	CO.1	(1969)	American variety Pearl Harbour	Pureline selection	135 days	38 tonnes/ha	It is a semi determinate type. It bears in clusters of 6 to 8 fruits. The fruits are round pale green at unripe stage and turns to capsicum red on ripening. The plants are dwarf and semi round and need no staking. The fruits contain high TSS (4.2°Brix) and acidity (0.69%).
2	Tomato	CO. 2	(1974)	Russian introduction	Pureline selection	145 days	42 tonnes/ha	Fruits are smooth medium size, flat with 4-5 furrows, green colour when unripe and reaching capsicum red after ripening. The plants are semi-dwarf and need no staking. Fruits are ovate, large, devoid of cracking and rich in ascorbic acid (18-21 mg/100g). 4.22°Brix TSS and 0.90% acidity. (18.2% increase over CO.1).
3	Tomato	CO. 3 (Marthusm)	(1980)	Induced mutant of CO.1 (IM.39)	Mutation breeding	100-105 days	45 tonnes/ha	It is an induced mutant from CO.1, very dwarf, compact and determinate plants. Fruits are globular attractive red, borne in cluster of 4-5 fruits, rich in vit C (25 mg/100g), TSS (3.2° Brix) and acidity (0.8%) with a flesh to seed ratio of 17%.
4	Tomato	PKM 1	(1978)	Inducted mutant from Annanji	Mutation breeding	135 days	32 tonnes/ha	The plants are determinate with fruits of attractive capsicum red in colour with green shoulders and uniform ripening. The fruits are best suited for long distance transport. The fruits contain 3.6°Brix of TSS 23.7 mg/100 g of vitamin C and 0.99% acidity.
5	Tomato	Paiyur 1	(1988)	Pusa Ruby x CO.3	Hybridization		30 tonnes/ha	It is suitable for rainfed cultivation. It is early flowering extended harvest (10-12). Fruits are round medium size slide ribbing at calyx end with medium keeping quality

								and long distances transport and low incidence of fruit borer.
6	Tomato	COTH.1	(1999)	IHR.709 x LE.812	Hybridization	110-115 days	96 tonnes/ha	The fruits are round to slightly oblong each weighing 50 g with deep red skin and thick flesh and borne in clusters of 4-5. The juice is acidic rendering the fruits for use in culinary preparation unlike the most of the hybrids developed by a number of private firms which lack acidity and hence used mostly for salad. The plants can be planted at a spacing of 60 x 45 cm.
7	Brinjal	CO. 1	(1978)		Pureline selection	160 days	24 tonnes/ha	The plants are erect, medium, bushy with greenstem and leaves and greenish purple petiole. Fruits are light green with white base, medium sized (50-60 g/fruit) with good keeping quality. It is moderately resistant to root-knot and reniform nematodes.
8	Brinjal	CO. 2	(1988)	Local variety vari kathiari of Nagamam	Pureline selection	150 days	38 tonnes/ha	The plants are medium in height and spread and capable of yielding as high as 38 t/ha. The fruit are oblong in shape having eminent deep purple colour with inter mittent pale green streaks. The quality is very good and this variety is suitable for growing in Coimbatore and Periyar districts.
9	Brinjal	MDU 1	(1979)	Kallampatti local of Madurai	Selection	135 days	34 tonnes/ha	The plants are compact and medium spreading. The fruits are round, bright, purple coloured and each weights 280g. The leaves are broad with light green pigments. As the fruit matures, the purple colour fades to pale pink. The variety is preferred in Madurai and Trichy districts of Tamil Nadu.
10	Brinjal	PKM 1	(1984)	Mutant from Puzhuthi Kathiri	induced mutant	150-15 days	34.75 tonnes/ha	The fruits measure 6 to 8 cm and 10-14 cm in length and girth respectively with a mean weight of 45 to 65 g. It is drought tolerant and can withstand long distance transport. It stores well under normal room temperature. The fruits contain 0.29% acidity and 14 mg/100 g of ascorbic acid. The fruits are small with green stripes. Adapted to rainfed cultivation in

								Maduari and Dindigual districts.
11	Brinjal	PLR 1	(1990)	A Nagpur ecotype.	Pureline selection	145-150 days	25.1 tonnes/ha	The fruits are small to medium in size. Sometimes borne in clusters. Egg shaped and with bright glossy purple colour. It fetches premium price in the markets of Cuddalore, Chenglepet and Chennai. It has got a shelf-life of 8-10 days under ambient temperature.
12	Brinjal	KKM 1 (Killikulam-1)	(1995)	Kulathur local	Pure line selection	135 days	37 tonnes/ha	It is suitable for cultivation both under rainfed and irrigated conditions in Tirunelveli district. Fruits medium sized, egg shaped, milky white in colour and bears in clusters of 2-4 per cluster. Preferred in the markets of Sourthern districts.
13	Brinjal	COBH.1	(2001)	EP.45 x CO.2	Hetersosis breeding	145-150 days	65 to 70 tonnes/ha	F1 hybrid fruit, medium sized, oblong in shape and dark violet in colour, each weighing around 60 to 65g. It has as much as 16.65 mg of ascorbic acid / 100 g of edible portion, 1.78 per cent protein and 3.10 per cent of total sugars. It is suitable for Coimbatore, Erode, Salem, Cuddalore, Trich, Karus, Dharmapuri, and Thiruvannamalai districts.
14	Chilli	CO. 1	(1979)	Reselection from Sattur Samba (CA (p) 247).	Selection	210 days	1.8 tonnes/ha	The plants are erect, medium tall and compact with medium branching. The fruits are green when unripe and bright shiny red on ripening. The fruits are 6-6.5 cm long with sharp tip and bulged shoulders. The seed content is 55% with high capsaicin (0.72 mg/g).
15	Chilli	CO. 2	(1982)	Selection from Nambiyur local 'Gundu' type (CA (p) 63)	Selection type	210 days	1 tonnes/ha	The stem is angular semidwarf and less spreading. The pods are oblong and bright red in colour. Seed content is high (60%) Capasicin content of dry pod is 0.56%. It is suitable for harvest as green pods and red ripe pods.
16	Chilli	PKM 1	(1990)	Ac. No.1797	Hybridizati	180 days	3000 –	It has very bold pods which are dark red in colour. It

				x CO.1	on		3200 kg	has got a very high yield potential of 3000-3200 kg of dry pods per hectare.
17	Chilli	CO. 3	(1991)		Open pollinated	165 days	3000 – 3500 kg	This is a dwarf and compact growing samba culture suitable for very close planting of 30 cm x 15 cm. It is also suitable to be used as green chilli. It has a very low stalk weight in comparison with pod weight unlike other cultivars and high oleoresin and capsaicin content and hence suitable for export purpose.
18	Vegetable Chilli	CO.4	(2000)		Open pollinated type	210 days	23 tonnes/ha	It is suited for *kharif* and *rabi* seasons. This variety recorded 96.58% increased yield over PKM-1. The fruits are dark green, stout, less pungent and turns to capsicum red colour after ripening.
19	Chilli	K 1	(1964)	Local Sattur Samba	Pure line selection	210 days	1.8 tonnes/ha	The fruits are long and contain high capsaicin. The variety is suitable for rainfed cultivation in southern districts of Tamil Nadu.
20	Chilli	K 2	(1975)	B 70-A (Assam type) x Sattur Samba	Hybridazation	210 days	1980 kg	The plants are tall and compact. The pods are long and bright red in colour with high seed content. The increased yield is 29% over K1 chilli.
21	Chilli	MDU 1	(1978)	Induced mutant form K.1	Mutation breeding	210 days	1.9 tonnes/ha	The fruits are longer and bears in clusters of 6 to 8. It is more suitable for southern districts of Tamil Nadu. The fruits contain 0.70 mg/g of capsaicin.
22	Chilli	PLR 1	(1994)	Kandengadu local	Pure line selection	210 days		. It is more suited for green chillies and yields per hectare
23	Chilli	PMK 1	(1993)	CO.2 x Ramanathapuram gundu		200 days	2.4 tonnes/ha	Plants are medium tall., suitable for semi-dry cultivation in Ramanathapuram district. The fruits are conical in shape with attractive red colour with 0.36 per cent capsaicin content.

24	Bhendi	CO. 1	(1976)	'Red Wonder' of Hybridizatio n	Pureline selection	90 days	14.25 tonnes/ha	The plants are medium tall, moderately vigorous and deeply lobed leaves. Pods are slender, smooth and fleshy.
25	Bhendi	CO.2	(1987)	AE.180 x Pusa Sawani	F1 hybrid	90 days	16.5 tonnes/ha	Fruit surface is less hairy with a better consumer's appeal and market preference equal to Pusa Sawani. It is suitable for both kitchen garden and commercial gardens basides as an intercrop.
26	Bhendi	MDU 1	(1978)	Mutant from Pusa Sawani	Mutation	100 days	12 to 14 tonnes/ha	The fruits are long and light green in colour. The pods contain 12.3% crude fibre. The plants are dwarf with determinate plant growth having shorter internodes, each node bears fruits.
27	Hybrid Bhendi	CO.3	(1991)	Parbhani Kranti x MDU.1	Mutation		18.75 tonnes/ha	It is a high yielding hybrid evolved from the cross between Parbhani Kranti x MDU 1 and suitable for fresh Market with dark green colour of medium sized fruits. This hybrid has high degree of field tolerance to Yellow Vein Mosaic Disease.
28	Amaranthus	CO.1	(1968)		Selection	25 days	8 tonnes/ha	The leaves are dark and seeds are black and small sized. The greens contain 4.8% calcium and 3.85% iron.
29	Amaranthus	CO.2	(1979)	A. trucolor (syn. A gangeticus)	Germplasm type	25 days	10.75 tonnes/ha	The plants are erect, with moderate branching. The seeds are bolder with early germination and early vigorous growth. The crude fibre content is less (1.3%) with 19.0 mg of iron, 20.0 mg of calcium per 100 g.
30	Amaranthus	CO.3	(1988)	--	Local type	20 days	30.72 tonnes/ha	It lends itself for 10 clippings, commencing from 20 days after sowing and provide a continuous supply of luscious tender green for three months. It has high leaf to stem ratio (2.0). The plants are erect with green nutritious leaves containing 25.2 mg per 100 g of vitamin C, 1.75% crude fibre, 0.8% iron and 2.48% Ca. The seeds are black in colour.

31	Amaranthus	CO.4.	(1989)	Grain type from A. hypochondriacus	Selection	90 days	2,555 kg/ha, addition 8,200 kg/ha of lead	The seeds are rich in protein (15.95%) and amino acids like lysine (7.5 mg/100g), 3phenylalanine (5 mg/100g), leycine (1.2 mg/ 100 g) and isoleucine (1.8 mg;/100 g). The grain can be substituted for minor millets like ragi and tenai. It is amendable for various food preparations just like any other grains.
32	Amaranthus	CO.5		--	A 166 –I	55 days	40 tonnes/ha	The variety has double coloured leaves (green and pink). It gives a rosette growth in early stages. The stem is also free of fibres. The first harvest starts 25 days after sowing and in a crop duration of 55 days it produces on an average of 40 tonnes of green leaves per hectare.
33	Onion	CO. 1	(1963)	--	Germplasm type	90 days	10 tonnes/ha	Bulbs are medium sized, pink in colour with 8 bulbs per plant weighing 55 to 60 g. The bulbs are fairly pungent.
34	Onion	CO.2	(1975)	--	Germplasm type	65 days	12 tonnes/ha	It is a photo insensitive type. This variety is pungent with high total soluble solids (12.0°Brix).
35	Onion	CO.3	(1979)	--	Open pollinated crop	65 days	15.8 tonnes/ha	The bulbs store well over 120 days. The variety contains 17.5% dry matter, 0.53 per cent sulphur and 13.0°Brix TSS.
36	Onion	CO.4	(1982)	AC.863 x CO.3		65 days	19.0 tonnes/ha	The bulbs store well over 150 days devoid of sprouting in well ventilated store rooms.
37	Onion	MDU 1	(1984)	--	Local type		52.7%	This is a selection from a local type, Sempatti. Bulbs are big sized with attractive red colour. It yields 52.7% higher than CO 2. It keeps well for a long time with less reduction during storage in bulb weight (45%) for 5 months compared to 65% in CO 2 onion.
38	Onion	CO.on.5	(2001)	Mass pedigree method	Selection	95-100 days	18 tonnes/ha	Seed propagated aggregatum onion free flowering and seed setting type. Setting ability (250-300 kg/ha). Attractive pink in colour. 3-5 bulp per clump. Seed bulb is 90 days. TSS of 13.17°C brix, pyruvic acid is 2.37 micro moles.

39	Snake gourd	CO. 1	(1976)	--	Pureline selection	135 days	18.0 tonnes/ha	The fruits are dark green with white stripes, long fruits (160-180 cm) each weighing 500 to 750 g with good cooking quality. It is moderately resistant to powdery mildew.
40	Snake gourd	CO.2	(1986)	--	Pureline selection	105 days	36 tonnes/ha	The fruits are short and stout. It yields on an average 36 t/ha. The fruit is light greenish white and each weighs 400-600 g. The variety does not require pandal.
41	Snake gourd	MDU 1	(1981)	Panripudal and Selection .1	F1 hybrid	145 days	31.74 tonnes/ha	It is an early flowering type (84 days). The fruits are medium long (66.94 cm) and short with an average weight of 551 g. The fruits are fairly rich in Vit. C (44.4 mg/100g) and very low in fibre content (0.6%).
42	Snake gourd	PKM 1	(1979)	Mutant from H.375	Mutation	145 days	25.5 tonnes/ha	The vines are vigorous giving fruits of dark green colour with white strips outside and light green inside. Each fruit weighs 700 g.
43	Bitter gourd	CO.1	(1978)		Local type	115 days	14.0 tonnes/ha	The fruits are green, long (30-35 cm) and contain 1.8 mg/100 g of iron, 20 mg/100g of calcium and 1.1g/100 g of minerals.
44	Bitter gourd	MDU 1	(1984)	Induced mutant	Mutation		32.19 tonnes/ha	It is early in flowering (60 days) The fruits are long with mean length of 40.34 cm and a girth of 17.54 cm and each fruit weighs 410.0 g on an average.
45	Bitter gourd	CoBgoH.1	(2001)	MC.84 x MDU.1		115-120 days	44 tonnes/ha	F1 hybridization. The fruits creamy white in colour with pale green tinge, pointed at both the ends, stout and having short pointed warts on the skin.
46	Ribbed gourd	CO.1	(1976)		Local type	125 days	14.0 tonnes/ha	Fruits are long (60-75 cm), light green, attractive in appearance each weighing 300 g on an average. Moderately tolerant to pest and disease.
47	Ribbed gourd	CO.2	(1984)		Germplasm type	120 days	25 tonnes/ha	The fruits are green, long (1 m) and fleshy.
48	Ribbed gourd	PKM 1	(1980)	Induced mutant	Mutation	160 days	28.0 tonnes/ha	It is an induced mutant from the type H 160 and gives 28.0 t/ha of fruits. The fruits are dark green with shallow

								grooves. The plants are tolerant to pumpkin beetle, fruit fly and leaf spot.
49	Bottle gourd	CO.1	(1981)		Germplasm type	135 days	36.0 tonnes/ha.	Fruits are round at the base with a prominent bottle neck at the top., medium sized, attractive light green in colour with mean weight of 2.025 kg.
50	Pumpkin	CO.1	(1971)		Local type	115 days	30 tonnes/ha	The vines are vigorous and spreading. The fruits are bigger and globular, each weighing 7.00 kg. One vine yields 6 to 7 fruits.
51	Pumpkin	CO.2	(1974)		Local type	135 days	23.0 tonnes/ha	The vines are moderately vigorous and less spreading. Individual fruit weighs 1.5 to 2.0 kg with 5 to 6 fruits per vine. It is a small fruited variety suitable for kitchen garden. The fruits contain 9.2% starch, 10.8 brix TSS, 10 mg/100 g of ascorbic acid and 0.14% acidity.
52	Ash gourd	CO.1	(1971)		Local type	150 days	25 tonnes/ha	The fruits are globular, light green with ash coating with less seeds.
53	Ash gourd	CO.2	(1982)		Local type	120 days	34.0 tonnes/ha	The fruits are light green with waxy bloom, small sized with a mean weight of 2.5 to 3.0 kg. The fruits contain 200-300 seeds. It takes 85-90 days from sowing to harvest.
54	Annual Moringa	PKM.1	(1989)		Pure line selection	The first harvest starts 160-170 days after planting.	200-225 fruits /year	The plants grow to a height of 4-6m and come to flowering 90-100 days after planting. The pods are 65-70 cm long with 6.3 cm girth and 150 g weight. Ratoon crops can be taken for 3 years. Every year after the harvest is completed, the trees have to be cut back to about one metre from ground level.
55	Annual Moringa	PKM.2	(2000)		Hybridazation		98 tonnes/ha	It is a high yielding type with an increase of 9.18% in number of pods over PKM-1 Annual Moringa. The pods are long, less seeded, more fleshy and delicious. It comes to bearing in six months after sowing.
56	Tapioca	CO.1	(1977)		Clonal	8.5-9	35.0	The tuber is whitish brown with white flesh, and is

					selection (ME.7)	months	tonnes/ha	suitable for industrial uses and consumption purpose. The starch content of tubers is 35.0 per cent with an out turn of 10.35 tonnes of starch per hectare. The HCN content is less (10g/g) in the flesh. The plants are tolerant to mosaic virus.
57	Tapioca	CO.2	(1984)		Clonal selection (ME.167)	8.5-9 months	38.6 tonnes/ha	The tubers are medium sized with whitish grey skin, creamy white rind and white flesh. The starch content is 34.50 per cent. It yields 38.6 t/ha of tubers. The incidence of mosaic virus is low. The tubers contain low HCN of 10 g/g in the flesh.
58	Tapiaco	CO.3	(1993)		Open pollinated	8 months	43 tonnes/ha	The tubers contain high starch 35.6% and low HCN of 77.89µg/g. The plants exhibit field tolerance to mosaic virus disease. It is a branching type. Tuber flesh is white with brown skin and creamy white rind.
59	Sweetpotato	CO.1	(1976)		Clonal selection	135 days	28 tonnes/ha	The tubers have light pink skin and white flesh. The number of tubers per plant is 3.2 with a starch content of 24% and a TSS of 10.6° brix.
60	Sweetpotato	CO.2	(1980)		Clonal selection	110-115 days	32 tonnes/ha	Tubers have pink skin and white flesh and have a starch content of 29.5 per cent and TSS of 10.8°Brix.
61	Sweetpotato	CO.3	(1982)		Clonal selection	105-110 days	42 tonnes/ha	It is suitable for cultivation in both seasons and tolerant to root weevil. The tubers have light pink skin and orange flesh and contain a carotene of 13.28 mg/100 g and starch of 30.72 per cent.
62	Sweetpotato	CO.CIP.1				95.110 days	31.76 tonnes/ha	Tolerant to weevil incidence (14.85%).
63	Coleus	CO.1	(1991)		Clonal selection	180-190 days	32 tonnes/ha	The tubers have 21.5 per cent starch. The cooked tubers are tasty and have lesser soil odour.

64	Dioscorea	CO.1	(1991)		Clonal selection	8-8.5 months	44.8 tonnes/ha	The tubers are big in size with white flesh. Tubers are rich in carbohydrate (28%) and protein (2.5%).
65	Colocasia	CO.1	(1991)		Germpleasm type		24 tonnes/ha	It is a high yielding selection. It has an yield potential of 24 t/ha. Tubers have high starch content (22.5%) and higher protein content (2.4%) than cassava and sweet potato. Tubers have less acidity and good cooking quality.
66	Radish	CO.1	(1971)					Roots are milky white, less pungent, long (22 cm) cylindrical and tapering and thick (12.5 cm girth) and medium sized (226 g). Roots contain 10.9 mg/vit. C per 100 g and 1.28% crude fibre, suitable for intercropping and other systems of cropping. Roots have better consumer's preference. Top to root ratio is 0.99.
67	Beetroot	Ooty-1	(1992)		Selection type	120-130 days & direct sown 135-150 days	31.4 tonnes/ha	It is suitable for growing in all seasons. The roots are blood red in colour with thin skin.
68	Moringa bean	KKL-1	(1996)		Local type		7 tonnes/ha	Hreen pods/ha with 31 per cent increase over local. Pods are green, fleshy and thick.
69	French bean	YCD.1	(1994)		Pure line selection	105 days	9 tonnes/ha	Suitable for rainfed cultivation in the hills upto an elevation of 1500 m above M.S.L. The pods are flat, green with dark purple bold seeds. It exhibits field tolerance to yellow vein mosaic and anthranose disease.

70	Butter beans	KKL-1	(1991)				3.47 tonnes/ha	It is a pole type and bears pods in clusters. The pods are 11.6 cm long, beans are 5-6 in number per pod. The crop will be ready for harvest from 100 days. The harvest will continue upto 140 days.
71	Dolichos bean	CO.1	(1993)		selection	165 days	18 tonnes/ha	Pods are dark green flat and slightly curved, tender and fleshy. Pods contain 4.69% protein, 12 mg vit. C, Fe 2 mg, P.14 mg, Ca 39 mg. 100 g or edible portion with 1.33% crude fibre. Matured seed is black in colour.
72	potato	CO. Simla	(1970)		Selection from the hybrids	110 days	12 tonnes/ha	It is suitable for cultivation in the plains during monsoon seasons.
73	Palak	Ooty 1	(1995)		Selection type		15 tonnes/ha	It is tasty green leafy vegetable in which first picking can be had 45 days after sowing and continued at 15 days interval for a period of 2 years. It yields 15 t/ha/harvest. The leaves contain higher carotene.
74	Watermelon	PKM.1	(1993)			120-135 days	38 tonnes/ha	Fruits are oblong, green in colour with light green stripes. Each fruit weighs about 3-4 kg.
75	Cucumber	CO.1	(1989)		Selection type		25-28 tonnes/ha	It is a high yielding selection (25-28 t/ha). The fruits are long (60 to 65 cm), slightly curved, tapering towards stalk end.
76	Garlic	Ooty.1	(1991)			120-130 days	17.1 tonnes/ha	It is a high yielder and gives on an average 17.1 t/ha. Comes to harvest in 120-130 days. The bulb is dull white in colour.