



**FACULTY OF AGRICULTURE SCIENCES AND  
ALLIED INDUSTRIES**

**Unit I**  
**(Protected Cultivation)**  
**For**  
**B.Sc. Ag (Third Year)**



RAMA  
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## Lecture No. 11 Protected cultivation-of Horticultural crops

Rose is the leading cut flower in the international cut flowers trade and is also the leading cut flower exported from India. In India, over 90 per cent greenhouses grow rose as cut flower. The leading export cultivars of rose are Cora, Corvetti, Diplomat, Femma, First Red, Grand gala, Kiss, Konfetti, Lambada, Laser, Nicole, Noblesse, Osiana, Papillon, Parea, Passion, Pavrotte, Rodeo, Rossini, Sacha, Samura, Sandy, Sangaria, Soledo, Susanne, Texas, Tineke, Vivaldi. The salient characters of rose cultivars for cut flowers are:

- ❖ More number of petals
- ❖ Petals open slowly
- ❖ More longevity
- ❖ Attractive colour
- ❖ Long and strong stem



### Environmental factors:

- ❖ Temperature (Day: 18-28 and night: 15-18° C)
- ❖ Light (Photoperiod over 12 hours and intensity: 6000-8000 foot candles)
- ❖ Relative humidity (50-60 %)
- ❖ Aeration (Good in air and soil)
- ❖ CO<sub>2</sub> (1000-3000 ppm)

### Soil and growing medium:

- ❖ Light, well drained
- ❖ pH - around 6.5
- ❖ EC less than 1.0

- ❖ Humus 10-12%

**Soilless growing medium:**

- ❖ sand
- ❖ coco-peat
- ❖ rock-wool

**Optimum spacing and planting density:**

- ❖ In greenhouse single, double or four row planting system in bed is being followed and spacing of 30 x 25 cm is kept.
- ❖ Optimum plating density in greenhouse is 60-70 thousand per hectare.

**Propagation:**

- ❖ Shield or T-Budding (Commercial method)
- ❖ Stenting method ( Budding done on cuttings, which are planted for rooting in mist chamber)
- ❖ Cuttings (Propagation of rootstocks- 15 to 20 cm long stem cuttings of pencil thickness having at least three buds)
- ❖ Micro-propagation

**Important root stocks:**

- ❖ *Rosa bourboniana*
- ❖ *Rosa indica* var. *Odorata*
- ❖ *Rosa multiflora*

**Budding and pruning time:**

- ❖ N.I. plains: Nov.-Dec.
- ❖ Low hills: Dec.-Feb.
- ❖ Mid hills: Jan.-Mar.
- ❖ High hills: Feb.-April.

**Optimum nutrients (ppm) status:**

pH: 6.2-6.8	Calcium: 55
EC: 0.7	Magnesium: 20
Nitrate: 180	Ammonium: 2
Phosphate: 4	Iron: 0.39
Potassium: 45	Manganese: 0.04
Sodium: 25	Zinc: 0.07
Chloride: 35	Boron: 0.08
Sulphate: 105	Copper: 0.05
Bi-carbonate: 30	Calcium: 55

**Pruning:**

- ❖ Cultivar
- ❖ Class or category of rose
- ❖ Health and vigour of plant
- ❖ Spacing
- ❖ Soil fertility
- ❖ Desired quality

**Other plant management practices:**

- ❖ Pinching
- ❖ Disbudding
- ❖ De-shooting
- ❖ Defoliation
- ❖ Removal of faded flowers
- ❖ Bending of shoots (about 25 %)

**Irrigation:**

- ❖ Irrigation is done through drip irrigation with one line along every row.
- ❖ One drip if inserted about 15cm below the soil level helps to maintain optimum moisture around root zone.
- ❖ Daily water requirement varies with the outside temperature from 2 to 5 litres/m<sup>2</sup>.
- ❖ Water soluble fertilizers are also given along with irrigation.
- ❖ During vegetative phase irrigation through sprinkler/ mister/ fogger is beneficial.

**Diseases:**

- ❖ Die back (*Diplodia rosarum*, *Colletotrichum sp.*)
- ❖ Black spot (*Diplocarpon rosae*)
- ❖ Powdery mildew (*Spaerotheca pannosa*)
- ❖ Downey mildew (*Peronospora sparsa*)
- ❖ Gray mould (*Botrytis cinerea*)
- ❖ Rust (*Phragmidium sp.*)
- ❖ Crown ball (*Agrobacterium tumefaciens*)
- ❖ Wilt (*Marmor flaccumfasciens*)

**Insect-pests:**

- ❖ Red scales
- ❖ Red spider mites
- ❖ White ants
- ❖ Aphids
- ❖ Thrips
- ❖ Jassids
- ❖ Chafer beetles
- ❖ Mealy bugs
- ❖ Stem girdler
- ❖ Sawflies

**Physiological Disorders:**

- ❖ Bull head
- ❖ Bent neck
- ❖ Limp neck
- ❖ Blind shoot
- ❖ Vascular plugging

**Stage of flower harvesting:**

- ❖ For local market: When outer one/two petals start unfurling.
- ❖ For distant market: Fully coloured tight buds
- ❖ White, pink and yellow cultivars are harvested earlier to red as red may not open if harvested at tight bud stage

**Popular grades:**

- ❖ Large flower cultivars: Stem length 60-90 cm and bud size 3-3.5 cm.
- ❖ Small flower cultivars: Stem length 40-50 cm and bud size 2-2.5 cm.

**Packaging of cut flowers:**

- ❖ In bundles of 10, 12, 20 or 25.
- ❖ In corrugated card board boxes of 100 x 32.5 x 20 cm (L x W x H) accommodates about 80-100 cut roses of 60-65 cm length.
- ❖ Wrap flower bunches in cellophane sleeves.
- ❖ Inline the boxes with tissue paper or news paper.

**Average yield:**

- ❖ Indian greenhouses: 150-200 stems/m<sup>2</sup>/year.
- ❖ European greenhouses: 350-400 stems/m<sup>2</sup>/year.

## 2. Carnation:

Carnation is the leading cut flower grown in 52 ha area during 2009-10 under greenhouses in Himachal Pradesh. This has become popular on account of its following qualities:

- ❖ Excellent vase life
- ❖ Wide range of flower colours and forms
- ❖ Ability to withstand long distance transportation
- ❖ Rehydrate easily
- ❖ Lighter weight



Florist carnations:

- ❖ Standard
- ❖ Spray
- ❖ Mini
- ❖ Micro

Popular carnation cultivars:

- ❖ Dona, Pink Dona, Malaga, White Dona, Rony, Rhodos, Lipstick, Empire, Romana, White Tendra, Corleone, Design, Natila, Dark Tempo, Bagatel silvery pink, Solar, Cobra, Pendy, Lorella, Cabaret, Tanga, Sonsara, Dakar, Liberty, Solar, Green Lady, Tempo, Varna, Sun Shine and Charment.

Environmental factors:

- ❖ Light: Photoperiod (long days over 16 hours) and intensity (100 watts bulb spaced at 10.5m at 1.5m height)
- ❖ Temperature: Night ( winter: 10-11° C, spring: 12.7° C and summer: 13-15.4°C) and day ( 18-23° C)
- ❖ Ventilation: Free circulation of air
- ❖ Relative humidity: 50-60%.
- ❖ CO<sub>2</sub>: 500-1500 ppm

Propagation:

- ❖ Terminal stem cuttings (8-10 cm long with 4-6 leaf pairs)
- ❖ Micro-propagation

Soil and growing medium:

- ❖ Light texture loam or sandy loam soil which is well drained and aerated.
- ❖ Soil pH: 6-7

Planting time:

- ❖ N.I. plains: Sep.-Oct.
- ❖ Low hills: Sep.-Nov.
- ❖ Mid hills: Jan.-Feb.
- ❖ High hills: Mar.-April
- ❖ Staggered planting at 15 days interval ensure regular supply of cut flowers.

Planting density and spacing:

- ❖ Ordinary: 25-32 plants/m<sup>2</sup>
- ❖ High : 40 plants/m<sup>2</sup>
- ❖ Standards: 20 x 20 cm
- ❖ Spray: 30 x 30 cm

Optimum nutrition:

- ❖ N: 5.4%, P: 0.31%, K: 3.8%
- ❖ Standards: FYM: 5 kg, N: 30g, P: 20g, K: 10g/ m<sup>2</sup>
- ❖ Spray: FYM: 5 kg, N: 40g, P: 20g, K: 10g/ m<sup>2</sup>
- ❖ Now commercially nutrition is given through fertigation



Fertigation schedule 5000 m <sup>2</sup>	
Day 11:	19/19/19 - 800g
Day 22:	plain water
Day 33:	0/52/34 - 700g
Day 44:	plain water
Day 55:	Ca(NO <sub>3</sub> ) <sub>2</sub> - 800g
Day 66:	plain water
Day 77:	13/0/45 - 400g
Day 88:	plain water
Day 99:	MgSO <sub>4</sub> - 350g + Micronutrient - 300g
Day 100:	plain water

Soil moisture and irrigation:

- ❖ Optimum soil moisture is 300-500 cm tension
- ❖ Irrigation is done through drip irrigation with three lines in five rows in a bed.
- ❖ Daily water requirement varies with the outside temperature from 2 to 3 litres/m<sup>2</sup>.
- ❖ Water soluble fertilizers are also given along with irrigation.
- ❖ During vegetative phase irrigation through sprinkler/ mister/ fogger is beneficial.

Pinching:

- ❖ In pinching terminal growing shoot about 2-3 cm long is removed to overcome apical dominance and to promote side branching when the plants are at 6-8 leaf pair stage.
- ❖ Pinching types:
  - Single
  - Pinch and half
  - Pinch plus pull pinch
  - Double

De-shooting:

- ❖ When the side shoots after pinching are 3-5 cm long then retain 3-5 shoots per plant in standard cultivars.
- ❖ When the side shoots after pinching are 3-5 cm long then retain 6-10 shoots per plant in spray cultivars.

#### Staking:

- ❖ Wire mesh, plastic nets, string or bamboo canes are used to support plants.
- ❖ Wire mesh or plastic nets having inner size of 10-15 cm squares are placed on the ground in three layers, which are erected at 20, 35 and 50 cm above the ground level with the growing plants.
- ❖ String or rope is erected in three rows at the same distance along the rows.

#### Disbudding:

- ❖ Disbudding is the removal of visible (5-10 mm diameter) undesirable buds.
- ❖ In standard cultivars terminal bud is retained and all the lateral buds are removed.
- ❖ In spray cultivars terminal bud is removed and lateral buds are retained.

#### Weeding:

- ❖ Three-four hand weeding.
- ❖ Chemicals viz., oxidiazon and napropamide @ 2.2 and 4.5 kg a.i. per hectare are good in greenhouse.
- ❖ In open fluchloralin (basalin) and pendimethalin (stomp) @ 1.0 a.i. per hectare each are effective.

#### Stages of flower harvesting:

- ❖ Standard cultivars for local market are harvested when flowers are half opened or at painting brush or outer petal is perpendicular to stem, while for distant market cross is developed on buds and colour is visible.
- ❖ Spray cultivars are harvested for local market when two flowers have opened and others have shown colour, while for distant market when 50% flowers have shown colour.

#### Popular international grades:

Parameter	Grade		
Bud diameter (mm)	Blue or Fancy	Red or Standard	Green or Short
Tight	50	44	None
Fairly tight	62	56	None
Open	75	60	None
Stem length (cm)	55	43	30

#### Common grades in India:

- ❖ A: over 45 cm
- ❖ B: 30-45 cm
- ❖ C: less than 30 cm

Packaging:

- ❖ In bundles of 10, 12, 20 or 25.
- ❖ In corrugated card board boxes of 120 x 60 x 30 cm (L x W x H) accommodates about 800-1000 cut flowers of carnation.
- ❖ Wrap flower bunches in cellophane sleeves.

Diseases:

- ❖ Wilt (*Fusarium oxysporum f. sp. dianthi*)
- ❖ Foot- rot (*Phytophthora*, *Pythium*, *Rhizoctonia solani*, *Sclerotinia sclerotiarum*)
- ❖ Stem rot (*Fusarium roseum*)
- ❖ Flower bud rot (*Alternaria dianthi*)
- ❖ Bacterial wilt (*Pseudomonas caryophylli*)
- ❖ Rust (*Uromyces caryophyllinus* or *U. dianthi*)
- ❖ Flower blight (*Botrytis cinerea*)
- ❖ Fairy ring spot (*Heterosporium echinulatum*)
- ❖ Viral diseases

Insect-pests:

- ❖ Red spider mites
- ❖ Thrips
- ❖ Nematodes
- ❖ Aphids
- ❖ Helicoverpa/ Heliiothis/Spodoptera caterpillars

Physiological disorders:

- ❖ Calyx splitting
- ❖ Grassiness
- ❖ Sleepiness
- ❖ Splitting at nodes and bushiness
- ❖ Small narrow leaves and tied tips

Tinting in carnation:

- ❖ A concentrated liquid or powder colour is mixed in small amount of warm pure water (37°C) and stems are placed in it. The colour develops in different patterns on the petals after 10-24 hours.

Average yield:200-300 flower stems/m<sup>2</sup>/year.

### 3. Chrysanthemum:

Chrysanthemum (*Dendranthema grandiflora*) has origin in Northern hemisphere in China. Chrysanthemum is grown for cut flower, loose flower, pot mum, hanging baskets and bedding and border plant. It has become popular on account of its excellent vase life, wide range of flower colours and forms and lighter flower weight. It is classified on the basis of inflorescence, photoperiod and temperature.



The important cultivars of chrysanthemum for export are Snow ball, Snow Don White, Mountaineer, Sonar Bangla, Bright golden, Anne, Chandrama, Ajay, Birbal Sahni, Lehmans, Nanako and Sonali Tara. Although, chrysanthemum is a short day plant flowering when the critical day length is less than 9.5 hours. However, now the cultivars have been developed which can flower in any season. The important off-season blooming cultivars of chrysanthemum are given below:

- April-June: Himanshu, Jawala, Jyoti
- July-Aug.: Phuhar
- Sep.-Oct.: Ajay, Sharda
- Oct.-Nov.: Makhmal, Megami, Mohini, Sharad har

- Nov.-Dec.: Normal season cultivars
- Jan.-Feb.: Jaya, Lilith, Suneel, Vasantica.
- Feb.-Mar.: Maghi.
- Flowering of these cultivars is recorded at NBRI, Lucknow as these cultivars are developed in this institute.

**Soil:**

Sandy-loam having pH 6.2-6.7 is ideal for growing chrysanthemum.

**Climate:**

- Light (Intensity: 1.2-1.6 MJ/m<sup>2</sup>/day, Quality: 600-800nm, Photoperiod: less than 9.5 hours)
- Temperature (night: 10-16°C, day: 18-21°C)
- CO<sub>2</sub>: 500-1000ppm

**Propagation:**

- Terminal stem cuttings (4-5 cm) during June-July, and
- Suckers during February to April

**Planting density and spacing:**

- Greenhouse cut flowers: 40-54 plants/m<sup>2</sup>.
- Loose flowers: 30 x 20 cm or 20-25 plants/m<sup>2</sup>
- Standards: 20 x 20 cm
- Sprays: 30 x 30 cm
- Pot mums: 3-5 cuttings/pot (15 cm)

**Nutrition:**

- FYM: 3-5 kg/ m<sup>2</sup>
- N:P:K::30:10:15g/m<sup>2</sup> at monthly interval
- Loose flowers: FYM: 10-15 ton, N: 150kg, P: 100kg, K:120 kg/ ha)
- Spray of light solution of cake + SSP at bud developing stage is very beneficial. Apply nitrogen through CAN source as urea causes phyto-toxicity.

**Pinching:**

Twice after 4 and 8 weeks of transplanting

**De-shooting:**

Retain 4-5 shoots in standard and 8-12 shoots in spray cultivars.

**Disbudding:**

Remove lateral buds in standard and terminal bud in spray cultivars.

**Irrigation:**

Soil should have 60-70 per cent moisture. Depending upon weather 8-10 irrigations of 2.5-5 cm depth are required.

**Staking:**

Wire mesh, plastic nets, string or bamboo canes are used to support plants. Wire mesh or plastic nets having inner size of 10-15 cm squares are placed on the ground in three layers, which are erected at 20, 35 and 50 cm above the ground level with the growing plants. String or rope is erected in three rows at the same distance along the rows. In pots for standard cultivars single bamboo stick is used and in spray cultivars 3-4 sticks are placed on the sides to protect the plant.

**Weeding:**

Three-four hand weedings are sufficient. Atrazine @ 1.0 a.i. per hectare is effective before transplanting.

**Diseases:**

Wilt (*Fusarium oxysporum f. sp. chrysanthemi*) Stem and foot rot (*Rhizoctonia solani*)

Root rot (*Pythium, Phytophthora spp.*)

Bacterial rot (*Erwinia chrysanthemi*)

Powdery mildew (*Oidium chrysanthemi*)

Leaf spot and flower blight (*Alternaria,*

*Septoria spp.*) Gray mould (*Botrytis cinerea*)

Viral diseases (chrysanthemum stunt, tomato spotted wilt, tomato aspermy, flower distortion, chrysanthemum mosaic and chrysanthemum rosette)

**Insect-pests:**

- Aphids
- Red spider mites
- Hairy caterpillars
- Thrips
- Grubs
- Leaf miners, and
- Nematodes



**Disorders:**

- Premature budding
- Quilling of florets
- Crown bud formation
- Heat delay, and
- Petal burn

**Harvesting Stages:**

Standards: When outer row of florets start unfurling for distant market and for local market half opened flowers.

Sprays: Harvested for local market when two flowers have opened and others have shown colour, while for distant market when 50% flowers have shown colour.

Loose flowers: Fully open flowers

Pot mums: 50% buds have developed colour.

**Grades of chrysanthemum cut flowers suggested by Society of American Florists:**

Commodity	Grade			
	Blue	Red	Green	Yellow
Stem length (cm)	75	75	60	60
Flower diameter(cm)	15	12.5	10.0	-----
Stem strength	Strong			

**Packing:**

In bunches of 10, 20 or 25 in corrugated card board boxes of 91 x 43 x 15 cm (L x W x H) accommodates about 80-100 cut flowers of chrysanthemum. Wrap flower bunches in cellophane sleeves.

**Yield:**

- Standard: 2.5 to 4.5 lakh/ ha
- Spray: 1.5-1.75 lakh/ ha
- Yield in Greenhouse: 150-250 flower stems/m<sup>2</sup>/year.

**4. Gerbera:**

Gerbera is commonly known as Transvaal daisy or Barberton daisy or African daisy. Its name was coined in honour of German naturalist, Traugott Gerber and it has origin in Natal and



Transvaal in South African and Asian region. Important species in genus *Gerbera* are given below:

- ❖ *asplenifolia*
- ❖ *aurantiaca*
- ❖ *jamesonii*
- ❖ *kunzeana*
- ❖ *viridifolia*

Important cultivars of *Gerbera*:

- ❖ Diana, Thalsa, Sonsara, Paganini, Anneke, Nette, Rosetta, Gloria, Ginna, Ingrid, Pricilla, Alexias, Intense, Sunway, Zingaro, Balance and Monique.

Factors affecting growth and flowering of gerbera:

- ❖ Light (Long days are good)
- ❖ Temperature (Day: 16-22°C and night: 12-15°C)
- ❖ Growth regulators (GA<sub>3</sub> and CCC)

Propagation:

- ❖ Seeds
- ❖ Division of plants
- ❖ Cuttings
- ❖ Micro-propagation



Ideal planting density and spacing:

- ❖ 8-10 plants/m<sup>2</sup> or 30 X 30 cm or 40 x 25 cm

Nutrient status in gerbera:

- ❖ N: 2.7-3.1%, P: 0.19-0.35%, K: 3.06-3.64%, Ca: 1.66-2.18% and Mg: 0.3-0.48%.

Ideal fertilizer application schedule in gerbera:

- ❖ Vegetative stage: N: P: K: Ca: Mg:: 3: 2: 3: 1: 1 @ 75g/m<sup>2</sup>
- ❖ Flowering stage: N: P: K: Ca: Mg:: 3: 2: 4: 1: 1 @ 75g/m<sup>2</sup>

Diseases:



- ❖ Root rot (*Pythium irregularae*, *Rhizoctonia solani*)
- ❖ Foot rot (*Phytophthora cryptogea*)
- ❖ Sclerotium rot (*Sclerotium rolfsii*)
- ❖ Blight (*Botrytis cinerea*)
- ❖ Powdery mildew (*Erysiphe cichoracearum*, *Oidium crysiphoides*)
- ❖ Leaf spots (*Phyllosticta gerberae*, *Alternaria spp.*)
- ❖ Viral disease (Cucumber mosaic virus and Tobacco rattle virus)

Insect-pests:

- ❖ White fly
- ❖ Red Spider Mites
- ❖ Nematodes
- ❖ Aphids
- ❖ Leaf miner
- ❖ Caterpillars

Harvesting stages of cut flowers:

- ❖ Before outer row of ray florets show pollen
- ❖ When outer row of petals is perpendicular on stalk.

Packaging of cut flowers:

- ❖ In insulated boxes to avoid freezing injury
- ❖ Plastic coated metal grids 50 x 70 cm with mesh size of 2 x 2 cm.

Average yield of gerbera cut flowers:

- ❖ Greenhouse: 200-250 flowers/ m<sup>2</sup>/year
- ❖ Open field: 120-150 flowers/ m<sup>2</sup>/year

# Strawberry

## INTRODUCTION

Strawberry can be produced in any season by protected conditions. We can produce according to its demand in the market. Several types of varieties have been developed in India based on the weather. Strawberry farming is generally done in the hill area in India (Awasthi, 2010). But through protected cultivation, it can be cultivated in any state. Greenhouses are mainly used in protected cultivation. Under which moisture and fertilizers are provided in time. The farmer can get more income by producing strawberries at a lower cost. Subsidy is also being given by the government to do protected cultivation.



## Climate

Strawberry grows well under temperate climate. some cultivars grown in sub-tropical climate. But also strawberry grown in protected structure its required day light period 12hrs and Rh 50-80%

## Soil

Strawberry can be grown in sandy loam soil. In soil organic matter and drainage is present. soil with ph. 5.7-6.5 is ideal for strawberry cultivation.

## Varieties

Pajaro, Chandler, Tioga, Torrey, Selva, Belrubi, Fern, Local Jeolikot, Bangalore, Florida 90, Katrain Sweet, Pusa Early Dwarf.

## Propagation

Strawberry is commercially propagated by runners plants. Generally, one plants produces 7-10 runners but under proper management 15 runners / plant. Runners formation can be stimulated with the application of IBA 1000ppm.

**Planting Time:** Sept-Oct is ideal time for planting.

## Bed Preparation

Two-row system used in strawberry cultivation. Bed width: 60 cm'

- Pathway: 50 cm
- Height: 45 cm

**Plant Spacing** Two rows planted on one bed having the distance between 30 cm x 30 cm. Total plant population in 24,000 per acre plants.

**Mulching** Unless plants are established through polythene, crops should be strawed down to ensure the developing fruits are prevented from coming into contact with the soil. Plastic mulching sheet mostly black and silver mulching arrest weed growth and keep the root temperature well for fast growth and prevent the loss of fertilizer nutrients through vaporisation. Keeping the inter row areas mulched with straw helps to reduced fruit decay, clean fruits, soil moisture conservation, saving irrigation water, preventing weed growth and lowering soil temperature during hot weather and protecting flower from frost.

**Irrigation** Plants are irrigated with a drip tape with 5 cm emitter spacing and 9.45 ml discharge per minute per emitter. Plants receive nutrients with every irrigation and each plant receives about 140 ml nutrient solution per day.

**Fertilization** Macronutrients (ppm in final solution) N: 85 ppm P: 60 ppm, K: 90 ppm Ca: 100 ppm, Mg: 50 ppm, S: 60 ppm.

**Training** Four different types of training systems viz. spaced row, matted row hill and plastic mulch are used to train the strawberry plants. Mated Row System is commonly used in India.

**Weed control** Land should, where possible be free from perennial weeds either by use of herbicide or by cultivation to dry out roots or the use of stale seedbed techniques. Weeds can hamper harvesting and cause uneven ripening. In the plasticulture system, the greatest concern for weed control is to be the bare soil areas between the rows of plastic. Polyethylene sheeting can be laid up to 4 weeks before planting to encourage weed seedlings to emerge and die under the covering. Weeds growing between the rows compete with the strawberries for water or nutrients, reduce air flow which results in problems with plant diseases (Mohan,1999). Planting low growing grasses or legumes is another option for weed control.

**Harvesting** Strawberries are harvested when half to three –fourths of skin develops colour. Picking should be done every second or third day. Berries should be picked along with a small stem portion attached. picking should be done in the morning.

**Yield** The yield varies according to season. A yield of 20 to 25 tons per hectare is excellent, though yields upto 50 tons per hectare have been reported under protected conditions.

**Plant Protection Management Pests:** Strawberries are susceptible to several common problems such as garden pests. Some of these are Aphids, Red spider mite, Vine weevil, Tarnished Plant Bug. Adult sap beetles,

Spider mites. Control: Application of malathion (0.05%) on appearance of caterpillars has been found to be effective in most cases.

Diseases Diseases such as Anthracnose (*Colletotrichum* spp.), powdery mildew, Red core, Crown rot and gray mold may cause serious losses as well. Root Rot-Many root-rotting diseases including

Verticillium wilt, Red stele, Fusarium, Rhizoctonia, and Pythium root rots affect planting of strawberries. Control To avoid diseases use an important cultural practice is to rotate crops. Application of carbendazim has been found to be effective in most cases.

## **Cucumber (*Cucumis sativus* L.) Cucurbitaceae**

### **Varieties**

Japanese Long Green, Straight Eight and Poinsettee are mainly cultivated.

### **Soil**

Sandy loam rich in organic matter with good drainage and pH range from 6.5-7.5 are ideal for cucumber cultivation. This crop requires a moderate warm temperature.

### **Season**

Sow the seeds during June or January to April

### **Seed rate**

About 2.5 kg of seeds are required for a hectare.

### **Seed treatment**

Treat the seeds with *Trichoderma viride* 4 g/kg or *Pseudomonas fluorescens* 10 g/kg or Carbendazim 2 g/kg of seeds before sowing.

### **Preparation of field**

Plough the field four times and form long channels at 1.5 m apart.

### **Sowing**

Sow the seeds on one side of channel giving a spacing of 0.6 m between hills. Thin the seedlings to two/hill at 15 days after planting.

### **Irrigation**

Irrigate the field before dibbling the seeds and thereafter once a week.

### **Application of fertilizers**

Apply FYM 40 t/ha as basal and 35 kg of N/ha at 30 days after sowing. Apply Azospirillum and Phosphobacteria 2 kg/ha and Pseudomonas 2.5 kg/ha along with FYM 50 kg and neem cake @ 100 kg before last ploughing.

### Drip irrigation

Install drip system with main and sub-main pipes and place the inline lateral tubes at an interval of 1.5m. Place the drippers in lateral tubes at an interval of 60 cm and 50 cm spacing with 4 LPH and 3.5 LPH capacities respectively.

### Field preparation

Form raised beds of 120 cm width at an interval of 30 cm and the laterals are placed at the centre of each bed.

### Sowing

Sow the seeds at an interval of 60 cm distance at the centre of the bed along the laterals. Sow the seeds in polybags @ one per bag for gap filling. Spray pre emergence weedicide like fluchloralin 1 kg *a.i.* or metalachlor 0.75 kg *a.i.*/ha on third day of sowing.

### Fertigation

Apply a dose of 150:75:75 kg NPK/ha throughout the cropping period through split application for F1 hybrid. In respect of phosphorous, 75% has to be applied as a basal dose.

### Fertigation Schedule - Cucumber (Hybrid)

Recommended Dose: 150:75:75 Kg/ha

Stage	Crop stage	Duration in days	Fertilizer grade	Total Fertilizer (kg/ha)	Nutrient applied			% of requirement		
					N	P	K	N	P	K
1	Crop establishment stage	10	19:19:19 + MN	19.72	3.75	3.75	3.75	10.00	5.00	10.00
			13-0-45	8.24	1.07	-	3.75			
			Urea	22.11	10.19	-	-			
			Subtotal		15.01	3.75	7.50			
2	Vegetative stage	20	12-61-0	9.21	1.09	5.63	-	30.00	7.50	30.00
			13-0-45	49.49	-	-	22.49			
			Urea	95.27	43.91	-	-			
			Subtotal		45.00	5.63	22.49			
3	Flower initiation to first picking	20	19:19:19 + MN	29.61	5.62	5.63	5.63	30.00	7.50	20.00
			13-0-45	20.61	2.62	-	9.37			
			Urea	80.00	36.71	-	-			
			Subtotal		45.00	5.63	15.00			
4	Harvesting stage	40	19:19:19 + MN	6.13	0.73	3.75	-	30.00	5.00	40.00
			13-0-45	66.00	8.57	-	30			
			Urea	77.47	35.69	-	-			
			Subtotal		44.99	3.75	30.00			
<b>Total duration</b>		<b>90 days</b>		Subtotal	<b>150.00</b>	<b>18.75</b>	<b>75.00</b>	<b>100</b>	<b>25</b>	<b>100</b>

**\*75% RD of Phosphorus applied as superphosphate = 352 Kg/ha**

1. 19:19:19 = 55 kg/ha

2. 13:0:45 = 144 kg/ha

3. 12:61:0 = 9 kg/ha
4. Urea = 275 kg/ha

**After cultivation**

Hoe and weed twice or thrice.

**Plant protection**

**Pest**

**Fruit fly**

1. Collect the affected fruits and destroy.
2. The fly population is low in hot day conditions and it is peak in rainy season. Hence adjust the sowing time accordingly.
3. Expose the pupae by ploughing.
4. Use polythene bags, fish meal trap with 5 g of wet fish meal and 1 g of Dichlorvos in cotton, 50 traps are required per hectare. Fish meal and Dichlorvos impregnated cotton are to be renewed once in 20 and 7 days respectively.
5. *Neem oil* @ 3.0 % as foliar spray as need based

*Do not use copper and sulphur dust, as these are phytotoxic.*

**Disease**

**Downy mildew**

Downy mildew can be controlled by spraying Mancozeb or Chlorothalonil 2 g/lit twice at 10 days interval.

*Do not use DDT, copper and sulphur dust, as these are phytotoxic.*

**Harvest**

Harvest can be done 45 days after sowing. On an average 8 – 10 harvests can be done.

**Yield**

8 - 10 t/ha in 80 to 90 days for salad.

**Market Information**

<b>Crop Growing districts</b>	Kanyakumari, Dindigul, Tirunelveli, Theni
<b>Major markets in Tamil Nadu</b>	Periyar Vegetable Market Koyambedu, Chennai Gandhi Market, Oddanchathiram Natchipalayam vegetable market, Coimbatore