

PRODUCTION TECHNOLOGY OF SOLANACEOUS AND CUCURBITACEOUS VEGETABLE CROPS

OBJECTIVES

After studying this chapter, the students will be able to understand:

- Importance of a particular vegetable.
- Production technology to raise healthy crop of the respective vegetable
- Insect-pests and disease management
- Post-harvest handling

INTRODUCTION

We consume several types of vegetables both as cooked and as a salad. Vegetables in general are consumed when they are mature but tender. Have you ever tried to know how can we grow a healthy crop of different vegetables? How do we select a variety for a specific area? What should be the time of sowing/planting a particular crop and its varieties? How much seed is required to raise a crop in a specific area? What spacing should be adopted between rows and plants? When and how, we have to apply irrigation and do different intercultural operations with respect to weed and pest management? At what stage, a particular vegetable should be harvested? How harvested vegetables should be handled after harvesting? This chapter briefly gives you an idea about different cultural practices to be adopted to raise a healthy crop.

What is the necessity to follow agronomic practices?

Every crop has a specific requirement of season/environment to grow. Among the various growing requirements, suitable variety for a particular area and its quality seed play a vital role in determining the success of raising a healthy and economic crop. Therefore, always select a variety which is recommended for cultivation in a specific area/region for cultivation since every variety cannot be productive everywhere. Optimum sowing/planting date is also important to exploit the yield potential of any vegetable crop. Sowing/planting date is a critical factor in determining the environmental conditions at planting, anthesis and fruit development and thus has direct impact on the successful cultivation of vegetable crops. Seed is the most critical and costlier input, so optimum seed quantity should be used to raise the crop. Also, seed should be procured from a reliable source.

Spacing is another practice which should be given due consideration as closer planting results in overcrowding. This poses hindrance for access to proper sunlight and aeration, and results in more incidences of diseases and insect-pests. Wider spacing accommodates less number of plants per unit area which ultimately lead to less production. The use of chemical fertilizers to enhance soil fertility and crop productivity has often negative affect on the complex soil-biological cycles. For example, fertilizer use can cause leaching and run-off of nutrients, especially nitrogen (N) and phosphorus (P), leading to environmental degradation. The potential way to decrease negative environmental impacts resulting from inefficient use of chemical fertilizers is to follow integrated use of organic manures and mineral fertilizers. This will in turn help to meet out the nutrient requirement of the crops as well as maintaining sustainability in terms of productivity and soil fertility.

Management of weeds, diseases and insect-pests at initial growth stages is of foremost importance as losses caused by these pests to the total crop yield has been reported to the tune of 30-60 per cent. Optimum irrigation particularly at critical growth stages must be applied to harness maximum potential of a crop as vegetable crops cannot withstand prolonged dry conditions. Harvesting of produce at an appropriate growth stage having bright and tender appearance, result in better returns to the growers. With this background, you might have understood the importance of different cultivation practices to raise a healthy vegetable crop to harness maximum productivity and net returns.

The following chapters will briefly illustrate the agronomic practices to grow solanaceous and cucurbitaceous vegetable crops, their harvesting and post harvest handling.

Tomato

Botanical name	<i>Solanum lycopersicum</i>
Primary centre of origin	Peru
Secondary centre of origin	Mexico
Popularly known as	Poor man's orange

Importance and uses:

- The fruits are eaten raw or cooked
- Its large quantities is used to produce soup, juice, ketchup, puree, paste and powder
- It supplies Vitamin A, C, B₁, B₂ and dried tomato juice retains Vitamin C.
- It adds variety of colour and flavours to the food.



Plant Growth Habit in Tomato

Tomato varieties are grouped into two broad categories based on their growth habit:

1. Determinate or dwarf or bush type
2. Indeterminate or tall type

Determinate (Dwarf growth)	Indeterminate (Tall growth)
Inflorescence occur more frequently on every internode until terminal ones are formed	Inflorescence cluster occurs at every third internode
Plant growth stops at terminal point with a flower cluster (self topping).	The main branch continues to grow indefinitely and keeps on setting fruits until frost occurs.

Soil Requirement: Well drained, fairly light fertile loam with a fair moisture holding capacity is the most ideal soil for tomato cultivation.

Climate: Tomato is a warm season crop which require long season to produce a profitable crop and is highly susceptible to frost. High temperature and high humidity favours development of foliar diseases. Dry wind results in dropping of flowers. Seeds germinate at a temperature range of 15.5 to 30°C, optimum being 25°C. Night temperature is the critical factor in fruit setting, the optimum range is 15-20°C.

Important Varieties for Plains

- **Indian Agricultural Research Institute, New Delhi:** Pusa Rohini, Pusa Early Dwarf, Pusa 120, Pusa Ruby, Pusa Sadabahar, Pusa Uphar, Pusa Sheetal, Pusa Gaurav.
- **Indian Institute of Horticulture Research, Hasserghata (Bangaluru):** Arka Abha, Arka Vikas, Arka Saurabh, Arka Alok, Arka Abhijit, Arka Shreshtha, Arka Vardan (Root knot nematode resistant), Arka Ananya (resistant to Tomato Leaf Curl Virus and bacterial wilt)
- **Indian Institute of Vegetable Research, Varanasi:** Kashi Amrit, Kashi Hemant, Kashi Sharad, Kashi Anupam, Kashi Vishesh (resistant to Tomato Leaf Curl Virus),

Hybrids: Kt-4, Pusa Hybrid 1, Pusa Hybrid 2, Pusa Hybrid 4, Arka Vardan, Arka Meghali, Arka Vishal, Arka Samrat, Kashi Hybrid 1, Kashi Hybrid 2

Activity 1

Visit some vegetable market/garden and make a list of different vegetables. Classify these vegetables on the basis of their plant parts consumed.

AGRONOMIC PRACTICES

Nursery sowing & transplanting time in India

Crop/Region	Spring-summer	Autumn crop
North Indian plains	Late Nov (mid Jan)	July-Aug (Aug-Sept)
Eastern India	Nov (Late Dec)	Aug-Sept (Sept-Oct)

in parenthesis: Transplanting time is given.

Nursery Raising: For better survival in the field, it is advisable to harden the seedlings. Plants are allowed to nearly wilt for 2-3 days before watering and this practice can be repeated two- three times. Such seedlings can withstand better the extremes of temperature. Seedlings become ready for transplanting in 4-5 weeks time. Seedlings 5mm in diameter are better and about 15cm in length are the best for transplanting.

Soil preparation and transplanting: Tomato should be planted in well pulverized field by ploughing first with soil turning plough and afterwards with 4 to 5 ploughings with country plough. Ploughing should be followed by leveling. Tomato is normally planted in raised beds of 60-75 cm width.

Transplanting should be done during late afternoon and the seedlings are placed on side of the beds. This provides ample moisture for the plants to survive.

Seed Rate: Open pollinated varieties: 400-500g
Hybrids: 150-200g

Spacing: Determinate varieties should be transplanted at a spacing of 60cm between rows and 45cm between plants to plant. On the other hand, indeterminate varieties should be planted at a spacing of 90cm between rows and 30cm with in rows.



Manures and fertilizers: Apply well rotten/decomposed farmyard manure (FYM) @ 200-250 quintals per ha at the time of field preparation. In addition, apply 75-100 kg N, 50-75 kg phosphorus (P_2O_5) and 50-60 kg potassium (K_2O) per hectare. Apply one third of nitrogen, full dose of phosphorus and half of potassium at the time of planting.

Another one third of nitrogen is to be applied after one month of transplanting. Remaining half of potassium should be applied along with one third nitrogen after two months of transplanting.

Table: Recommended dose of N, P and K fertilizers and their time of application

Recommended dose	Farmyard manure (q/ha)	Nitrogen (Kg/ha)	Phosphorus (Kg/ha)	Potassium (Kg/ha)
Open pollinated varieties	250	75-100	50-75	50-60
Hybrids	250	150-180	100-150	80-120

Time of application and dose to be applied:

At planting time	After one month of transplanting	After 2 months
Full dose of Farm yard manure and phosphorus + one third of nitrogen and half of potassium is applied	Another one third of nitrogen should be applied	Remaining one third of nitrogen and half of potassium is applied

During rainy season in tomato, foliar spray of urea @ 10% at an interval of 10 days is beneficial as it increases anther formation and more number of fruits per plant.

Interculture and weed control: Tomato is widely space planted crop. Hence, scope of weeds is more in initial stages. The most critical period of crop for weed competition is between 30-50 days after transplanting. Therefore, herbicides can be used to control weeds in initial stages of plant growth while hand weeding can be practiced in later stages of plant growth alongwith fertilizer top dressings. Application of Alachlor (Lasso) @ 2kg a.i./ha (4 litres/ha in 750 litres of water) before transplanting is beneficial for controlling annual and broad leaved weeds. Pendimethalin (Stomp) @1.2 kg a.i./ha (4 litres/ha) or Fluchloralin (Basalin) @ 1.32 kg a.i./ha (2.5 litres/ha) can also be used before transplanting if there is problem of annual weeds only.

Irrigation: Careful irrigation is required for better growth of tomato crop which should be supplied at right time. Both over-watering and insufficient irrigation is harmful. Insufficient irrigation in tomato arrests flower development, dropping of flowers and cease fruit growth. Flowering and fruit development are the most critical stages of irrigation.

Harvesting: Tomato fruits are harvested at different maturity stages depending upon the purpose for which it is used and distance over which they are to be transported. Fully developed mature green fruits are harvested for long distance transportation. Such fruits ripen after reaching the market and develop good colour under favourable conditions.

Pigmentation of fruits in tomato: Red colour is due to Lycopene pigment. Lycopene carries anticarcinogenic properties. Orange colour of fruit is due to carotenoid pigment which is a rich source of vitamin A. The consumption of single orange coloured tomato meets out the daily requirement of vitamin A of an adult.

Fruits at turning stage ($1/4^{\text{th}}$ of the fruit especially at blossom end shows pink colour), pink stage ($3/4^{\text{th}}$ of the surface shows pink colour) and hard ripe stage (nearly all red or pink with firm flesh) are harvested for local market. Over ripe fruits (Fully coloured and soft) are suitable for processing which ensure desired quality and red colour in processed products.

Fruit yield: Open pollinated varieties: 250 300 quintals per hectare
Hybrids: 500-800 quintals per hectare

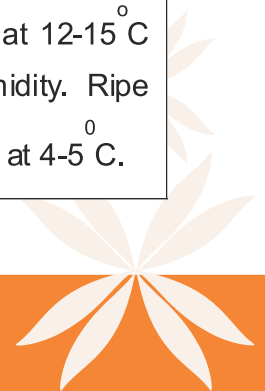
Activity 2

Visit a field where farmers are harvesting tomato fruits. Categorize these fruits into different grades and educate the farmers about the importance of categorization of fruits into different grades.

.....
.....
.....

Post Harvest Handling:

Grading	Tomato fruits are categorized into four grades namely, Super A, Super, Fancy, Commercial. Different grades determine the prices in the market.
Packing	Fruits are in general packed in bamboo or wooden baskets, plastic boxes or plastic crates for marketing.
Storage	Mature green fruits can be stored for one month at $12-15^{\circ}\text{C}$ temperature coupled with 85-90% relative humidity. Ripe fruits, on the other hand can be stored for 10 days at $4-5^{\circ}\text{C}$.



Disease management

1. Damping Off (*Pythium aphanidermatum*, *Rhizoctonia solani*): The fungus attack usually starts on the germinating seed, and further spread to the hypocotyl, basal stem, and developing tap-root.

Control: Drench the nursery bed with 5 litre formalin dissolved in 100 litres of water 15 days before sowing. Spray Mancozeb or Dithane- M-45 (25 gram in 10 litre of water), Carbendazim or Bavistin (10gram in 10 litre of water) on nursery seedlings. Before sowing, hot water treatment of seed at 52°C for 30 minutes should be done.

2. Buck eye rot (*Phytophthora infestans*): Symptoms appear on fruits as a brownish spot often at point of contact between fruit and soil.

Control:

- Grow resistant varieties
- Proper staking and drainage should be ensured.
- Spray Ridomil MZ @ 2g per litre of water or Dithane M-45 or Dithane Z-78 @ 2.5 g per litre of water at 5-7 days interval.



Buck eye rot symptoms on fruit

3. Bacterial Wilt (*Pseudomonas solanacearum*): Deadly disease of tomato which results in wilting of plant, stunting plant growth, yellowing of entire plant, and brown vascular system

Control:

- Crop rotation with Cruciferous vegetables
 - Grow resistant varieties such as Arka Ananya, Arka Rakshak etc.
 - Hot water seed treatment at 50°C for 25 minutes.
 - Spray with streptocycline @ 200ppm at 4-7 day interval
4. Early blight: Seed treatment with Carbendazim or Bavistin @ 2.5 g per kg of seed.
5. Late blight: Spray Dithane-M-45 (0.25%)
6. Leaf curl virus: It is transmitted by white fly.

Insect-pests

1. Tomato fruit borer: Initially, the larvae feed on tender foliage but later on it move on to flower buds, flowers and developing fruits. The caterpillars make holes into fruits and render them unfit for market.



Tomato fruit borer

Management:

- Crop transplanted late in summer (June) escapes the damage of fruit borer.
- Innundative release of egg parasitoid, *Trichogramma chelonis* and *T. brasssilensis* @ 2,50,000 adults/ha
- Application of *Bacillus thuringiensis* alone (1.0 litre/ ha) or in combination with endosulfan (0.035%) at flowering and fruit setting stage
- Foliar application of endosulfan (0.07%)/ carbaryl (0.1%)/ deltamethrin (0.0028%) and acephate (0.05%).

2. Fruit fly: The maggots after hatching feed on pulp of the fruits and render them unfit for human consumption.

Management

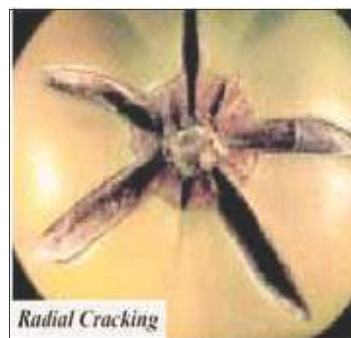
- Field sanitation *i.e.* removal and destruction of dropped fruits and insect-infested fruits daily to minimize the pest intensity.
- Use of pheromone traps for monitoring pest population.
- Application of cover spray of fenthion (0.05%)/ fenitrothion (0.05%), which kill the insects on contact or a bait spray that attracts and kill the adults. Bait spray is prepared by adding 50 g gur + 10 ml malathion in 10 L water.

Physiological disorders in tomato:

1. Blossom End Rot: A very common and destructive disorder. Rotting of fruits starts at blossom end of the fruit. Deficiency of Mg and Ca is the main cause. It can be managed by spraying calcium chloride @ 0.5% at fruit development stage. Also apply balanced irrigation and ensure proper staking.

Physiological disorders differ from disease infestation as they are non-parasitic and are the result of abiotic stresses which may be due to adverse weather conditions or nutritional deficiencies or improper cultural practices.

2. Cracking of fruits: Cracking of fruits at stem end is common and often results in large losses. Cracks appear to develop at maturity or ripening stage than mature green or turning stage. Deficiency of boron and long dry spell followed by heavy watering are the main reason of cracking. Soil application of 20-30 kg of borax per hectare is beneficial. Application of proper irrigation at right stage is also very important.



3. Puffiness/ Hollowness: The outer wall continues to develop but the growth of remaining internal tissues is retarded. This results in light weight fruits which lack firmness and are partially filled. High or low temperature, low soil temperature and high soil moisture are predisposing factors. Single application of 4-CPA @ 20mg/litre or CPPU @ 20-25mg/litre results in reduction of this problem.



Puffiness

4. Sunscald: Exposed fruits either green or nearing ripeness scald readily during extreme heat. White or grey colour appears on green or yellowish red fruits. More sun intensity cause injury to fruits in May & June (11-3 pm) during peak heat period. Grow varieties having heavy foliage which provide greater protection to fruits from sun rays.



Sun Scald

5. Cold Injury or Low temperature injury: Tomato is very sensitive to frost. At near freezing temperature, vines freeze, get withered and desiccated. Fruits show much severe symptoms as they become soft, water soaked and dull coloured. Cover the fruits with foliage to manage this problem. Planting should be adjusted in such a way that it does not coincide with frost.

6. Blotchy Ripening: Ripening of fruits is not uniform as certain portion develop colour while in others greenish-yellow or whitish patches can be seen on ripe fruits particularly in stem end portion. The possible reasons are imbalance of N and K nutrition especially when K is deficient. Even, more days or weeks of alternate sun and cloud during fruiting also lead to blotchy ripening. Balanced fertilization and proper irrigation help in managing this problem.

Activity 1

Collect plant samples which are affected by different diseases and inset pests. Try to diagnose the diseases and pests.

Check your progress

Short answer

1. What is the congenial temperature for tomato fruit formation?
2. Which are the most critical stages of tomato cultivation?
3. Mention the most critical period of crop for weed competition and also suggest some weedicides for controlling weeds in tomato crop.
4. In how many grades, tomato fruits can be categorized? List them.
5. Mention the stage of tomato fruits for long distance transportation.
6. Name the diseases whose symptoms appear on foliage and fruits, respectively?
7. Deficiency of which nutrients cause blossom end rot and cracking in tomato fruits?
8. Name the insect which transmits leaf curl virus in tomato.
9. Mention bacterial wilt resistant varieties of tomato.
10. In which material, tomato fruits are packed for transportation from field to market?

Fill in the blanks

1. Red colour of tomato fruit is due to _____ pigment.
2. The determinate varieties bear inflorescence at _____ node.
3. The growth of indeterminate varieties stops with the onset of _____.
4. _____ operation keep crop weed free and provide aeration to the root system in vegetable crops.
5. The recommended dose of fertilizers (N: P_2O_5 : K_2O) for tomato cultivation is _____ kg/ha.
6. Seed rate (kg/ha) for raising tomato hybrid is _____.
7. Spacing (inter and intra row in cm) for growing indeterminate tomato is _____.
8. Critical stages of irrigation in tomato are _____ and _____.
9. The stage with $\frac{1}{4}$ th of tomato fruit shows pink colour at blossom end is known as _____.
10. The herbicide recommended for managing weeds in tomato is _____.

Long answers

1. Describe the production technology of tomato with respect to climate, soil requirement, varieties, planting time, seed rate, spacing, manures and fertilizers, interculture and weed management, irrigation and harvesting



2. Describe the physiological disorders of tomato caused due to nutrient deficiency.
3. Make a list of important diseases and insect-pests of tomato crop and describe the symptoms and control of fruit rot and fruit borer.

Brinjal

Botanical name: *Solanum melongena*

Family: *Solanaceae*

Origin: *South East Asia-India.*

Importance and uses

- It is valued for its tender unripe fruits used as a cooked vegetable.
- White brinjal is said to be good for diabetic patients.
- It cures toothache if fruits are fried in sesamum oil.
- It acts as an excellent remedy for those suffering from liver complaints.
- It is rich in vitamin A and B.

Soil: It can be grown practically on all soils from light sandy to heavy clay. Silt loam and clay loam soils are generally preferred. The soil should be deep, fertile and well drained. soil pH 5.5-6.8 is most suitable.

Climate: It is a warm season crop and susceptible to severe frost. A long and warm growing season is desirable for its successful cultivation. It grows best at a temperature of 21-29 °C. Temperature below optimum (21°C) affects yield and quality and result in deformed fruits. It can tolerate drought and excessive rainfall and remains vegetative under high temperature and humidity.

Important varieties recommended for different regions of India:

- **IARI:** Pusa Shymala, Pusa Purple Long, Pusa Purple Cluster, Pusa Kranti, Pusa Bhairav, Pusa Anmol (H), Pusa Hybrid 5 (long), Pusa Hybrid 6 & 9 (round)
- **IIHR:** Arka Sheel, Arka Shirish, Arka Kusumkar, Arka Navneet (Hybrid), Arka Nidhi, Arka Keshav, Arka Neelkanth
- **PAU:** Punjab Chamkila, Punjab Sadabahar, Punjab Barsati, Punjab Neelam, PH-4, Selection-4
- **GBPUAT, Pantnagar:** Pant Samrat, Pant Rituraj, Pant Brinjal Hybrid-1
- **Others:** Hisar Jamuni, Hisar Shyamal Azad Kranti, T-3, Annamalai, Surya, Phule Hybrid 1, Aruna, Manjarigota

Agronomic practices

Nursery sowing and Planting time:

Crop/Region	Spring-summer	Rainy	Autumn crop
NI plains	Nov(mid Jan-Feb)	Mar-May(April- June)	June-July(July-Aug)
East and South Indian conditions: all the year round. Main season: July- August			

Soil preparation and transplanting: Brinjal should be planted in well pulverized field by ploughing first with soil turning plough and afterwards with 4 to 5 ploughings with country plough. Ploughing should be followed by leveling.

Seed Rate: 500-700g (OP varieties), 350-400g (hybrids) 1g seed contains 250 seeds

Spacing: Dwarf varieties-60 × 45 cm, Tall variety- 90 × 60 cm

Manures and fertilizers: FYM @200-250 quintals per ha should be applied at the time of field preparation. In addition, apply 75-100 kg N, 50-60 kg phosphorus (P_2O_5) and 50-60 kg potassium (K_2O) per hectare. Apply half of nitrogen and full dose of phosphorus and potassium at the time of sowing and remaining nitrogen after one month of sowing.

Interculture and weed control: Like tomato, brinjal is also a widely space planted crop. Hence, scope of weeds is more in initial stages. The most critical period of crop for weed competition is between 30-50 days after transplanting. Therefore, herbicides can be used to control weeds in initial stages of plant growth while hand weeding can be practiced in later stages of plant growth alongwith fertilizer top dressings. Application of Alachlor (Lasso) @ 2kg a.i./ha (4 litres/ha in 750 litres of water) before transplanting is beneficial for controlling annual and broad leaved weeds. Pendimethalin (Stomp) @ 1.2 kg a.i./ha (4 litres/ha) or Fluchloralin (Basalin) @ 1.32 kg a.i./ha (2.5 litres/ha) can also be used before transplanting if there is problem of annual weeds only.

Irrigation: Same as tomato crop. Apply Irrigation at an interval of one week in summer season and 10-15 days during winter. In rainy season, it depends upon the frequency and intensity of rain. About 100-110 cm of irrigation water is required.

Harvesting: Fruits should be harvested when they attain a good size, attractive colour and its surface should not loose its bright and glossy appearance. Timely harvesting of tender

Four types of flower are formed in brinjal based on style length namely, True short style, pseudo short style, medium style and long style. Medium and long style flowers form fruit under natural conditions. Therefore, PGRs can be sprayed to enhance fruit set in brinjal e.g. NAA (50ppm) after 30-35 days of transplanting or PCPA (20 ppm).

fruits increases the total growing period and number of pickings along with yield.

Yield: 300-500 q/ha (OP var.), Hybrids: 600-800 q/ha

Post harvest handling

- i) **Grade:** Fruits of brinjal are categorized into three grades e.g. Super, Fancy and commercial.
- ii) **Packaging:** Fruits are packed in baskets or gunny bags

Diseases:

1. Phomopsis blight {*Phomopsis vexans*}: Portion of fruit is bleached and gives burning appearance.

Management: Seed treatment with thiram @3 gm per kg. Spray the crop in the nursery with Dithane M-45. Grow resistant variety like Pusa Bhairav.

2. Bacterial wilt: Grow resistant varieties Arka Nidhi, Arka Keshav, Hisar Shyamal

3. Leaf Spot (*Alternaria solani*): Spray the crop at regular intervals with Dithane M 45 (0.2%).

4. Little Leaf: Caused by Mycoplasma transmitted by leaf hoppers. The affected plants are shorter in structure. The leaves are malformed. Floral parts turn into leaf-like structures. No fruit bearing takes place.

Insect-pests:

Brinjal Fruit and Shoot Borer: It is the most serious pest of brinjal crop. Plant shoots wilt and dry. Small holes appear below the calyx of fruits. Fruits are filled with frass.

Management: Grow the resistant/tolerant varieties like Pusa Purple Cluster, Arka Kusumkar. Avoid ratooning of brinjal crop, close spacing and continuous planting. Remove and destroy the infested shoots. Foliar application of carbaryl (0.1%)/ endosulfan (0.07%)/ fenvalerate (0.01%).



Brinjal shoot and fruit borer
Bt or GM brinjal has been developed for effective management of this pest

Check your progress

Short answers(One word or one line)

1. Mention the place of origin of brinjal.
2. Which crop is called as poor's man crop?

3. Give one example each of long and round fruited varieties.
4. At what spacing, brinjal plants are transplanted?
5. Which problem in brinjal is caused by mycoplasma?
6. Which is the most serious insect-pest of brinjal?
7. Which type of brinjal is good for diabetic patient?
8. What is the ideal stage of harvesting brinjal fruits?
9. How many crops of brinjal can be grown in north Indian plains? Mention the seasons.
10. Which type of flowers have the maximum fruit set in brinjal?

Fill in the blanks:

1. The seed requirement of brinjal to raise nursery for an hectare area is _____.
2. Little leaf is caused by _____.
3. Brinjal fruits are packed in _____.
4. Apply Irrigation at an interval of _____ week in summer season to raise a good crop of brinjal.
5. _____ crop can tolerate drought and excessive rainfall.
6. Bt or GM brinjal has been developed for effective control of _____.

Do as directed in reference to brinjal crop

1. Planting time
2. Seed rate and spacing
3. Critical stages of irrigation in brinjal
4. Phomopsis blight
5. Role of flower structure in fruit set
6. PGRs with regards to fruit set

Long answers

1. Describe the production technology of brinjal with respect to varieties, soil preparation, planting time, seed rate, spacing, manures and fertilizers, interculture and weed management, irrigation and harvesting
2. Make a list of important diseases and insect-pests of brinjal crop and describe the symptoms and control of phomopsis blight, and shoot and fruit borer.



Chilli and Bell Pepper

Botanical Name: *Capsicum annuum* var. *hortense* (chilli)
Capsicum annuum var. *grossum* (Bell pepper)

Family: Solanaceae

Origin: New world (American) Mexico and surroundings of central America

Types of Capsicum

a. **Alkaloid:** Pungent due to crystalline volatile alkaloid capsaicin, located mainly in the placenta of fruit, cultivated for vegetables, spices and pickles etc., potential foreign exchange earning crop and rich source of vitamin A and C.



(a)



(b)



(c)

- b. **Sweet Pepper (Shimla Mirch):** Bears bell shaped, non pungent/mild and thick pericarp/fleshed fruit, used as vegetable.
- c. **Paprika:** Mild in taste and slightly pungent than sweet pepper. Used as spice in European countries, gives colour and mild pungent taste to food stuff, used in pickles and sandwiches

Importance and uses

Chillies

- It is very important and indispensable item in every kitchen valued for its pungency, spicy taste and appealing colour.
- Its demand in the pharmaceutical industries is increasing day by day on account of its medicinal values since green chillies are rich in rutin.
- The fruits are rich in vitamins A and C.

Bell pepper or Shimla Mirch

- Sweet pepper green, or red or yellow, may be eaten cooked or raw, sliced in salads and pizzas.
- They are also used for pickling in brine, baking and stuffing.
- Sweet pepper imparts a novel flavour in stews.

Bell pepper is commonly called as Shimla Mirch because it was first introduced in Shimla hills of Himachal Pradesh for want of congenial environmental conditions for its cultivation.

Soil: Chilli can be grown practically on all type of soils except on saline soils provided the soil is well drained and well aerated. Sandy and sandy loam soils are generally preferred for an early crop or where season is short. The soil should be deep, fertile and well drained. It can be raised on the soil with a pH range of 5.8-6.5 for its better growth and development. It is not very sensitive to soil acidity.

Climate: Chilli requires a warm humid climate and can tolerate extremes of climate better than tomato and brinjal. It is highly sensitive to frost. The most ideal temperature for its better growth and development is 20-25 °C. Temperature 16-32 °C is the most congenial for fruit set but maximum fruit set occurs at 16-21°C. It is mostly grown as a rainfed crop in areas having moderate rainfall with in the range of 60-120cm. Excessive rainfall results in poor fruit set, rotting of fruits and defoliation of plant.

Varieties recommended for cultivation in India

Chilli: G-3, Pusa Jwala, Pusa Sadabahar, Bhagya Lakshmi (G-4), HC-28, HC-44, Andhra Jyoti, Punjab Lal, Punjab Surkha, Punjab Guchhedar, NP-46A, Pant-C-1, Sindhur, Pant-C-2, X-235,

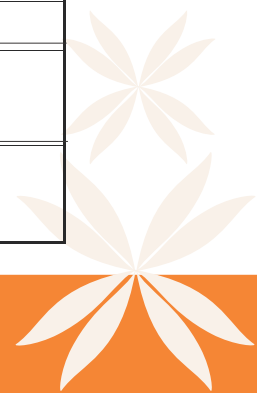
Chilli hybrids: CH-1, CH-3, Arka Meghana, Arka Harita, Arka Sweta, CCH-2, CCH-3

Bell Pepper: California Wonder, Yolo Wonder, Arka Mohini, Solan Hybrid 2, Arka Basant, Arka Gourav, Bharat (hybrid), Solan Bharpur, Pusa Deepti (hybrid)

AGRONOMIC PRACTICES

Planting time under Indian conditions

Chilli	
In frost free areas	3 crops i. Autumn-winter (Oct-Nov) ii. Spring-summer (Jan-Feb) iii. Rainy season (June-July)
South India	Mainly as <i>Kharif</i> season crop (June to October)
Northern Indian plains	2 crops i. December sowing (Feb) ii. May-June (June-July)
Bell pepper	
North India	Autumn-winter (sowing in Aug) Spring-summer (Nov)
South India	Extreme of temperature does not prevail so can grown for quite long from June-Feb



Seedlings are ready for transplanting when they attain a height of 15cm with 4 leaves in 4-6 weeks. Plantation is done on flat or raised (rainfall prone areas) beds.

Soil preparation and transplanting: Soil should be thoroughly prepared by being ploughed 4 to 5 times before planting the seedlings. Farmyard manure or compost should be applied and incorporated well into the soil. Transplanting should be done during late afternoon.

Seed Rate:

Crop	Seed Rate
Chilli	1 kg/ha (<i>Open pollinated varieties (op)</i>) (2 or 3 kg/ha for direct seeded) 400-500 g/ha (<i>Hybrids</i>)
Capsicum	1.25 kg/ha (seed size is bold) (<i>OP varieties</i>)
	700 g/ha (<i>Hybrids</i>)

Spacing: **Chilli** 45 cm × 45 cm or 60 cm × 45 cm
 Capsicum 60 cm × 45 cm

Manures and fertilizers: Apply FYM @250q/ha, Nitrogen @ 75 kg/ha, Phosphorus @60-75kg/ha and Potassium @ 50 kg/ha. Full dose of farmyard manure, phosphorus and potassium and half of N should be applied at the time of transplanting. Remaining part of N should be top dressed in two equal parts at an interval of one month each.

Interculture and weed control: These are space planted crops, hence scope of weeds is more in initial stages. Hand weedings at 20 and 40 days after transplanting are essential. Among herbicides, application of Alachlor (Lasso) @ 2kg a.i./ha (4 litres/ha in 750 litres of water) or Pendimethalin (Stomp) @1.2 kg a.i./ha (4 litres/ha) can be used 24-48 hours before transplanting. These herbicides can be used to control weeds in initial stages of plant growth while hand weeding should be done in the later stages of plant growth alongwith top dressing of fertilizers.

Irrigation: Chillies are grown mostly as rainfed crop though crop should be irrigated when there is insufficient rainfall. A light irrigation is given during the third day of transplanting and thereafter at weekly interval. Gap filling is done during second irrigation after 10 days of transplanting. The most critical stages for irrigation are blooming (flowering), fruit setting and development.

Harvesting

Chilli: The picking of fruits depend upon the type and purpose for which they are grown

1. **Green fruits:** Fruits are harvested when they are still green but fully grown. It needs 5-6 pickings for harvesting the whole crop.
2. **Pickles:** The fruits are harvested either green or ripe
3. **Drying:** Red when fully ripe fruits are picked at an interval of 1-2 weeks and harvesting continues for a period of about three months. The ripe chillies are dried under sun for 8-15 days, while commercially it is dried at about 54.4 °C in 2-3 days.

Red colour of chilli fruit is due to capsanthin which is used as natural colourant. Oleoresin extracted from chilli is used in cosmetic products indicating its industrial importance

Bell peppers: Fruits are usually harvested and sold when they are of suitable market size and are green, and are relatively firm and crisp. There is a limited demand for the mature red fruits. These are picked with an upward twist which leaves a piece of stem attached. Young, immature peppers are soft and yield readily to mild pressure of the fingers.

- **Irrigated conditions:**

Green Chilli	200-300 q/ha,
Dry	15-25 q/ha
- **Rainfed :**

Green Chilli	50-60 q/ha,
Dry	5-10 q/ha
- **Capsicum:**

OP Varieties:	125-150 q/ha
Hybrid:	250-300 q/ha



Blossom end rot is also a serious disorder in bell pepper.

Post harvest management

As soon as peppers are harvested they should be hydro-cooled to remove field heat quickly. Due to the higher respiratory and metabolic rates of immature fruits, a shorter shelf life can be expected. Peppers should not be stored with ethylene releasing commodities. Waxing peppers before shipping is a very common practice to reduce moisture loss and resist bruising while in transit.

Always harvest vegetables early in the mornings or the late evening hours for better quality and storage life.

Disease Management:

1. **Damping Off:** Spray Mancozeb/ Indofil M-45 (25gm/10 litre of water) or Carbendazim/ Bavistin (5gm/10 l). Follow five years of crop rotation.
2. **Anthraxnose/Ripe fruit rot/die back:** Water soaked spots appear on the fruits which gradually turn brown to black. Spray Dithane M-45 or blitox (0.1%) or Bavistin (0.1%) and repeat at 8-10 days interval.

Go for seed treatment. Use disease free seed.

3. **Powdery Mildew:** Spray Sulphur based fungicide i.e. Karathane at an interval of 15 days interval @ 0.2 %.

4. **Leaf Spot:** There is formation of small circular and water soaked spots on the leaves, stems and petioles. Leaves turn yellow and finally drop. Remove severely affected plants and destroy them. Spray Bavistin @ 0.1 % at 15 days interval. Go for seed treatment with Bavistin.



Anthracnose

5. **Bacterial Wilt:** Wilting of plant or stunting growth or yellowing of entire plant are the symptoms. Grow resistant varieties. Crop rotation with Cruciferous vegetables is recommended. Field sanitation and crop rotation reduces the disease incidence.

Insect-pests management.

1. **Fruit Borer:** Adults lay eggs on the upper and lower side of leaf. Larva bore circular holes and usually thrust only head inside the fruit to another and may destroy many fruits. Spray Deltametharin 25 EC or spray 5% neem seed kernal extract to kill early stages larvae Placement of 15-20 bird perches (T shaped) per ha helps in inviting insectivorous birds.

2. **Aphids and Thrips:** Spray malathion (0.05%) and repeat the spray after 15 days if they are not killed completely.

Check your progress

Short answers

1. Make a list of different kind of peppers.
2. Explain harvesting practices in chilli based on its requirement.
3. Explain the climatic requirements for raising a healthy crop of chilli.
4. Elaborate the intercultural operations and irrigation requirement for Bell pepper.
5. Which is the most serious disease in the nursery of vegetable crops? How can it be controlled?

Fill in the blanks:

1. Pungency in chilli is due to _____.
2. The seed rate of bell pepper (kg/ha) is _____.

3. _____ is a variety of bell pepper.
4. The fruits are harvested either green or ripe for _____.
5. Pusa Jawala is a variety of _____.
6. _____ gives colour and mild pungent taste to food stuff.

Long answers

1. Describe the agronomic practices for the cultivation of bell pepper crop.

Cucurbitaceous Crops

Importance

- Cucurbits form an important and a big group of vegetable crops cultivated extensively during summer season.
- This group consist a wide range of vegetables which are used either as salad, pickling (cucumber) or for cooking (all gourds) or candied or preserved (ash gourd) or as dessert fruits (musk melon and water melon).
- All cucurbits belong to the same family cucurbitaceae but genera may be different.
- The cultural requirements of all crops in this group are more or less similar.

Soil: A well drained soil of loamy type is preferred for cucurbits. Lighter soils which warm quickly in spring are usually utilized for early yields while heavier soils are suitable for more vine growth and late maturity of the fruits. In sandy river beds, alluvial substrata and subterranean moisture of river streams support the cultivation of cucurbits. The soil should not crack in summer and should not be waterlogged in the rainy season. It is important that soil should be fertile and rich in organic matter. The most suitable pH range is between 6.0 and 7.0.

Climate: Cucurbits are warm season crops. They do not withstand even light frost and strong winds though cucumber tolerates a slightly cooler weather than melons. Seed does not germinate below 11°C, optimum germination occurs at 18°C and germination increases with rise in temperature till 30°C. Cucurbits grow best at a temperature range of 18-24°C. Proper sunshine and low humidity are ideal for the production of cucumber. Melons prefer tropical climate with high temperature during fruit development with day temperature of 35-40°C. Cool nights and warm days give better quality fruits in melons.



Varieties:

Crop/botanical name	Origin	Varieties for India
Cucumber (<i>Cucumis sativus</i>)	India	Japanese Long Green, Pusa Uday, Pusa Barkha, Pant Kheera-1, Pusa Sanyog (F ₁ hybrid,) Poinsette, Sheetal, Priya
Bottle Gourd (<i>Lagenaria siceraria</i>)	Africa	Pusa Naveen, Pusa Samridhi, Pusa Sandesh, Pusa Santushti, Pusa Hybrid 3, Punjab Round, Punjab Komal, Punjab Long, Arka Bahar
Bitter Gourd (<i>Momordica charantia</i>)	Tropics of the old world	Arka Harit, Pusa Do Mausami, Pusa Vishesh, Pusa Hybrid-2, Coimbtore Long, Kalyanpur Baramasi, Solan Hara, Solan Safaid
Summer squash (<i>Cucurbita pepo</i>)	Central American and Maxican region	Pusa Alankar, Australian Green, Punjab Chappan Kaddu1, Early Yellow Prolific
Sponge Gourd (<i>Lufa cylindrica</i>)	India	Pusa Sneha, Pusa Supriya, Pusa Chikni
Ridge Gourd (<i>L. acutangula</i>)	India	Pusa Nutan, Pusa Nasdar, Arka Sumeet, Arka Sujat, Satputia (hermophrodite flower)
Ash Gourd (<i>Benincasa hispida</i>)	Japan and Jawa	Pusa Ujjawal, Co-1, Co-2, S-1 (PAU), Karikumbala, Boodikumbala, APAU Shakti
Snake Gourd (<i>Trichosanthes anguina</i>)	India	Co-1, Co-4, TA-19, Chichinda
Water melon (<i>Citrullus lunatus</i>)	Africa	Arka Jyoti (F ₁), Arka Manik, Sugar Baby, Durgapur Meetha, Durgapur Kesar, Asahi Yamato
Musk melon (<i>Cucumis melo</i>)	North west India and hot valleys of Iran	Pusa Madhuras, Pusa Sharbati, Hara Madhu, Punjab Rasila, Punjab Sunheri, Punjab Hybrid, Arka Jeet, Arka Rajhans, Hisar Madhu, Durgapur Madhu, Kashi Madhu

Agronomic practices

Showing Time:

- In northern plains, most of the cucurbits are sown during winter season *i.e.* in the month of November (in the riverbeds).
- In the garden soils, sowing is done in February.
- Melons are grown only when the weather is warm and dry during fruit development *i.e.* November to February.
- For rainy season, grow only those cucurbits which can tolerate rains. *e.g.* bitter gourd in June-July.

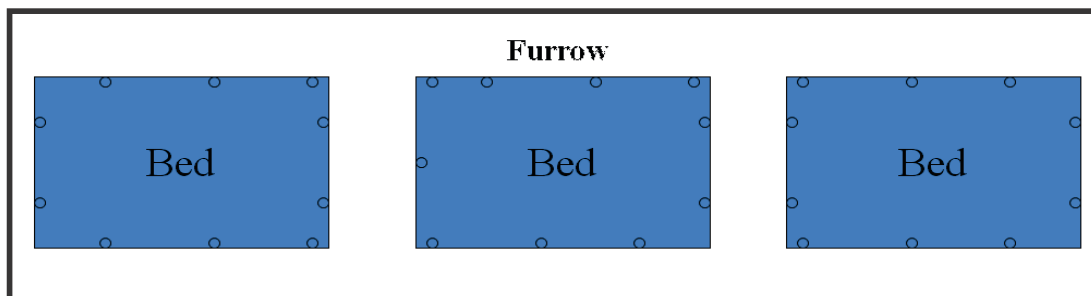
- In north-eastern states, most of the cucurbits are sown from November to March when the weather is comparatively dry.
- In southern and central India, winters are not severe and long, therefore, these can be grown throughout the year. November sown crop is over by March-April
- In Northern Indian hills, sowings start from April-May and the crop is over by August-September.
- In western India, sowings are done from September upto February.

Methods of planting: Mostly in cucurbits, *in situ* method of sowing is followed. But in certain areas of Northern India and hills where the main objective is to get early fruit harvest, the seedlings are raised in polythene tubes and plantation is done in the field when the conditions are favourable without disturbing the soil ball. Transplanting is done at 2-true leaves stage.

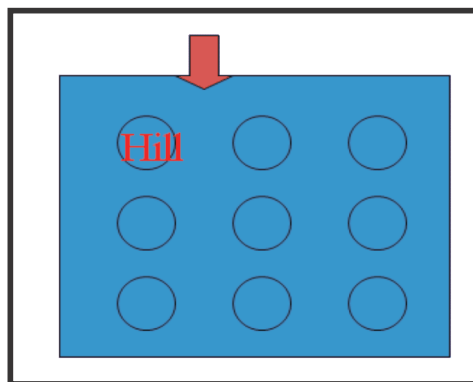
1. Furrow method: Furrows are made at 1 to 1.5 m in case of cucumber and bitter gourd. The sowing is usually done on the top of the sides of furrows and the vines are allowed to trail on the ground especially in summer season.



2. Bed method: In some regions, bed system is in fashion where the seeds are sown on the periphery of beds. The width of the bed is almost double to the row to row spacing.



3. Hill method or raised beds or raised point: The hills are spaced at a distance of 0.5-0.75m and 2-3 seeds are sown per hill, after germination retain only one or two plants per hill. This method facilitates proper drainage especially in heavy rainfall regions.



4. Pit Method: Generally, it is followed in southern India. The pit is lower than the normal bed surface. Training is done by Pargolla or Pandal system.

Seed rate, spacing and yield:

Crop	Season	Seed rate (kg/ha)	Spacing (m)	Fruit yield (q/ha)
Cucumber	Summer/Rainy	2.5-3.5	15x0.60-0.90	250-300
Bottle gourd	Summer	4-5	2-3x1-1.5	300-400
Bitter gourd	Summer/Rainy	4-6	1.5-2.5 x0.60-1.20	150-200
Summer Squash (dwarf)	Summer/Rainy	8-10	0.60-0.75X0.45-0.60	250-300
Sponge gourd	Summer/Rainy	2.5-3.0	2.50-3.0x0.60-1.20	150-200
Ridge gourd	Summer/Rainy	3-3.5	2.50-3.0x0.60-1.20	150-200
Ash gourd	Summer/Rainy	5-7	1.5-3x0.6-1.20	100-150
Watermelon	Summer	3-4	2.5-3.5x0.90-1.20	300-500
Muskmelon	Summer	1.5-2.0	1.50-2.0x0.60-0.90	150-200

Manures and fertilizers:

Farmyard manure (q/ha)	Nitrogen (N)	Phosphorus (P ₂ O ₅)	Potassium (K ₂ O)
	(Kg/ha)		
200-250	60-100	50-75	50-85

Full dose of farmyard manure, phosphorus and half of potassium and N should be applied at the time of sowing. Remaining part of N should be top dressed in two equal parts after one month and at flowering stage while half of K is applied when good growth takes place.

Interculture and weed management: Thinning of plants should be done 10-15 days after sowing retaining not more than 2 healthy seedlings per hill. The beds or ridges are required to be kept weed free in the early stages before vine growth start. Weeding and earthing up are done at the time of top dressing of split application of nitrogenous fertilizers. Apply Fluchloralin or Trifluralin @ 0.75-1.0 kg/ha or Bensulide @ 5-8 kg/ha as preplant soil incorporation at 2 weeks before sowing. Butachlor @ 1 kg/ha or chloramban @ 2-3 kg/ha as pre emergence and Naptalam @ 2-4 kg/ha as post emergence after first weeding efficiently helps in controlling the weeds in cucurbitaceous crops. In general, vertical training is more helpful in increasing the yield of cucumber.

Irrigation: In spring-summer crop, frequency of irrigation is very important, while in rainy season crop, well distributed rainfall between July to September reduces the frequency of irrigations. Ridges or hills or beds are to be irrigated a day or two prior to sowing of seeds and then light irrigation is to be given 4 or 5 days after sowing. Flooding of hills is to be avoided and crust formation on the top soil should be prevented. Irrigation once in 5 or 6 days is necessary depending upon soil, location, temperature *etc.* Irrigation water should not wet the vines or vegetative parts, especially when flowering, fruit set and fruit development are in progress. Wetting promotes diseases and rotting of fruits, so it is essential to keep beds or inter row spaces dry as far as possible so that developing fruits are not damaged. In rainy season, therefore, these crops are trailed over supports to prevent rotting of fruits

- **Cucurbits are cross pollinated vegetable crops. There are nine types of sex forms found in these crops, of which monoecious type is the most common.**
- **“Satputia” variety of ridge gourd bears hermaphrodite (bisexual) flowers.**
- **Gynoeceous lines (bears only female flowers) are used for hybrid seed production in cucumber and bitter gourd.**



Sex expression and sex ratio: It is of great significance in most of the cucurbitaceous crops which have monoecious plants that means they bear male and female flowers separately on the same plant. In the beginning, monoecious plants bear only male flowers and female flowers appear late. The female to male ratio goes on increasing with the age of the plant. Though sex expression and sex ratio are varietal characteristics but they are influenced by environmental conditions. Low fertility, high temperature, and long light periods induce maleness.

- Gibberellic acid (GA) at higher concentration induces maleness but at lower concentration of 10-25 ppm increases the number of female flowers.
- Two sprays, first at 2-leaf stage and again at 4 –leaf stage with 100 ppm of NAA, 200 ppm of ethep, 3 ppm of Boron or 3 ppm of Molybdenum can suppress the number of male flowers and increases the number of female flowers, fruit set and ultimately the yield.

Under open field conditions, bees or other insects facilitate pollination in cucurbits. Under poly-house/protected conditions, natural pollination is not possible as insects cannot enter inside. Therefore, parthenocarpic hybrids of cucumber are recommended under protected conditions where fruit forms without fertilization.

Harvesting:

- Harvesting of crop at right time is very important in cucurbits as in most cases, seed development is undesirable.
- Harvest cucumber, bottle gourd, bitter melon, snake melon, ridge melon and sponge melon when they are still young, tender and have soft seeds inside.
- Harvest before fruit colour changes from green to yellow.
- **Musk melon:** It is a climacteric fruit which ripens during transportation and storage. Hence, it should be harvested before it attains fully ripe stage.
- **Water melon:** It is harvested at fully ripe stage. Maturity signs are withering of tendril, change in belly color or ground spot to yellow and the thumping test produces dull sound on maturity and metallic sound in unripe fruits.

Disease management:

1.Powdery mildew: Powdery mildew is often serious in dry weather and is the main cause of early dying of plants. White or grayish spots appear on the upper surface of leaves which may cover the whole plant.

Management:

Spray Dinocap or Bitertanol or Hexaconazole @ 0.05% as the initial symptoms appear on the leaves.



Powdery mildew

2.Downy mildew: It does not attack the fruit but causes defoliation and yield loss. Symptoms are first evident as blocky, chlorotic spots that become necrotic. Grayish fungal sporulation may be observed on the underside of the lesions. Poor air circulation and overhead watering can contribute to the problem.

Management:

Spray Dithane-Z-78 (0.25%)



Downey mildew

3.Anthracnose: Leaves initially show small, pale yellow or water-soaked areas that enlarge rapidly and turn tan to dark brown. These lesions may develop holes or cracks in the centre. Depending on weather, leaf and fruit spotting may occur on young plants, especially in late plantings.

Management:

*Grow resistant varieties such as Poinsette (Cucumber) Arka Manik (Water melon).

*Sowing of seed after treatment with Blitox or Bavistin (2.5 g/kg of seed)



Anthracnose

4.Fusarium wilt: A fatal fungal disease that cause wilting of plants followed by dying. Symptoms may include white mold on the vines, stunted growth and discolored roots.

Management:

*Long term crop rotation.

*Seed treatment and drenching of soil with blitox or bavistin (2.5g/kg of seed).

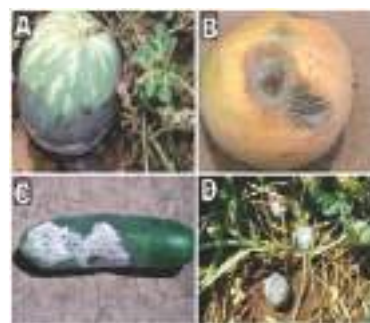


Fusarium wilt

5.Fruit rot: Symptoms occur on the underside and blossom end of the fruit that are in contact with soil. As the disease progresses, lessions become sunken and irregular in shape which result in rotting of the entire fruit.

Management:

*Seed treatment with bavistin or thiram or captan (2.5g/kg of seed). Avoid flood irrigation.



Fruit rot



6.Angular leaf spot: Plants show elongated irregular lesions with yellow margins on the leaves. Warm, wet weather may cause stem and leaf spots in midseason.

Management:

* Seed treatment with mercuric chloride solution (1:1000) for 5-10 minutes.

7.Cucumber mosaic: Plants have mottled yellow-green and green leaves, and may be stunted. They may show epinasty, downward bending of the petioles. It is transmitted by aphids, so control of this pest at right stage is essential.

8.Pumpkin yellow vein mosaic: Plants often die shortly before or during harvest, and fruit show necrosis of the rind when cut open. It is transmitted by white fly which is important to be control at right stage.



Angular leaf spot



Cucumber mosaic

Insects Pests:

1. Fruit Fly: The maggots after hatching feed on pulp of the fruits and render them unfit for human consumption.

Management:

*Field sanitation should be ensured by removal and destruction of fallen fruits and infested fruits daily to minimize the pest intensity.



Fruit Fly

* Growing 2-3 rows of maize as a trap crop in between the cucurbits. Trap crop act as resting site for the adult fruit fly. Any contact insecticides can be sprayed on maize during evening hours to kill adult fruit flies.

*Use of pheromone traps for monitoring pest population.

*Apply cover spray of fenthion (0.05%) or fenitrothion (0.05%) to kill the insects on contact or a bait spray that attracts and kill the adults. Bait spray is prepared by adding 50 g gur +10 ml malathion in 10 ltr. water.



2.Epilachna beetle: Adults and larvae feed on leaves leaving a fine net of veins. Damaged leaves shrivel and dry up. Young plants can be entirely destroyed while older plants can tolerate considerable damage.

Management:

* Hand picking and destruction of eggs, grubs and adult beetles is effective, if the cropped area is small.

*Foliar application of malathion (0.05%) and carbaryl (0.01%) checks the pest.



Epilachna beetle

3.Red pumpkin beetle: It is the most serious insect pest of cucurbits. The larvae and adult of this pest cause damage by eating away the young leaves and flowers at the seedling and flowering stage, respectively. Creamy yellow coloured larvae feed on the roots, stems and fruits touching the soil whereas red coloured adults feed on leaf and flowers.



Red pumpkin beetle

Management:

*Collection and destruction of beetles in the early stage of infestation.

*Spraying the crop with malathion 50 EC or dichlorvos @ 2ml per liter of water can control this pest.

4. Aphids: The first sign of aphid damage is a downward curling of the leaves. Aphids are often found on lower leaves and on flower buds and flowers. They are also involved in the spread of several viruses that affect all cucurbits.

Management:

*Spray cypermethrin (0.5-1.0ml/liter) or Acetamiprid (0.4g/liter) or Abamectin (0.05 ml/liter) or Bifenthrin (0.5 ml/liter) or Malathion @ 0.1%.



5. White flies : They can affect the crop directly by its feeding and by acting as a vector of viruses. When white flies are very numerous, they produce sticky honeydew which supports the growth of sooty mould on leaves.

Management:

*Spray Acetamiprid (0.4gml/liter) or Abamectin (0.5 ml/liter) or Bifenthrin (0.5 ml/liter)



Check your progress

Short answers:

1. Give one example each of the cucurbits which are consumed as salad, candy and dessert fruit.
2. Mention the seed rate, spacing and fertilizer requirement of cucumber.
3. Which type of sex expression is found in cucurbits? How can it be modified?
4. Explain furrow method of planting in cucurbits.
5. Explain interculture operations in cucurbits.

Tick the correct option

1. The seed rate (kg/ha) for cucumber is
a) 5-10 b) 10-12 c) 15-20 d) 25-30
2. Which kind of cucumber hybrids are the most suitable for cultivation under protected environment
a) Monoecious b) Parthenocarpic c) Andromonoecious d) Gynoecious
3. Which one of the following has climacteric fruits?
a) Water melon b) long melon c) Musk melon d) Round melon
4. Most common sex expression in cucurbits is
a) Monoecious b) Dioecious c) Gynoecious d) Bisexual
5. For distant marketing, musk melon fruits are picked at
a) Full slip stage b) Half-slip stage c) Green mature d) Pink stage
6. Name the cucurbit which is candied or preserved
a) Water melon b) Ash gourd c) Musk melon d) Squash
7. Pheromone traps are used for monitoring pest population of
a) Fruit fly b) Red pumpkin beetle c) Aphids d) White fly
8. Thumping test is done to judge the maturity of
A) Water melon b) Pumpkin c) Bitter gourd d) Cucumber

Long answers:

1. Describe the production technology of cucumber or musk melon with respect to varieties, soil preparation, planting time, seed rate, spacing, manures and fertilizers, interculture and weed management, irrigation and harvesting
2. Make a list of important diseases and insect-pests of cucurbits and suggest the control of powdery mildew, anthracnose, downy mildew and fruit fly.

References:

1. Bose TK and Som MG. *Vegetable Crops in India*. Naya Prokash.
2. Bose TK, Som G and Kabir J. *Vegetable Crops*. Naya Prokash.
3. Bose TK, Som MG and Kabir J. *Vegetable Crops*. Naya Prokash.
4. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. *Vegetable Crops*. Vol-I. Naya Udyog.
5. Choudhary B. *Vegetables*. National Book Trust, India.
6. Gopalakrishanan TR. *Vegetable Crops*. New India Publ. Agency.
7. Hazra P and Som MG. *Technology for Vegetable Production and Improvement*. Naya Prokash.
8. Rubatzky VE and Yamaguchi M. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
9. Salunkhe DK and Kadam SS. *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker.
10. Swarup V. *Vegetable Science and Technology in India*. Kalyani Publishers.
11. Thamburaj S and Singh N. *Vegetables, Tuber Crops and Spices*. ICAR.
12. Thompson HC and Kelly WC. *Vegetable Crops*. Tata McGraw-Hill.

