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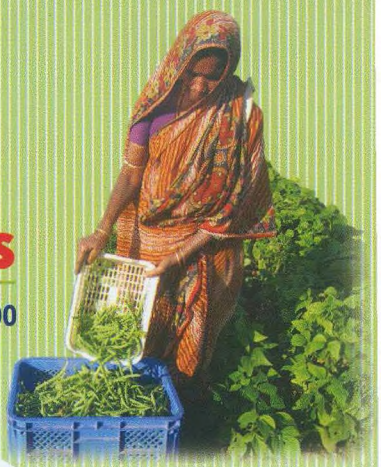
Naresh Babu, L.P. Sahoo, S.K. Srivastava and Tapaswini Sahoo



ICAR-Central Institute for Women in Agriculture
(ISO 9001:2008 Certified)
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Preface

Horticulture constitute a major part in Indian agriculture in terms of providing food and nutritional security. It provides protective foods, which contribute required minerals, vitamins and other nutrients of medicinal and therapeutic values. The production and productivity of different horticultural crops have increased significantly since last 3 decades as a result of researches undertaken by various agricultural institutes and private sector. Modern strategic approaches are however, necessary for sustainable development of this sector so as to meet the increasing requirement, both in domestic as well as export markets. The most important and feasible approach to enhance the productivity of horticultural crops would be the production of quality seeds and planting materials and making it available to the growers. The importance of good quality seeds and planting materials can hardly be over emphasized as it is crucial for higher productivity. Several high yielding varieties of horticultural crops with improved technologies have been developed by agricultural institutions and private organizations, but availability of quality seeds in sufficient quantity is a major constraint. To ensure better production, generally farm women purchase the seeds from the market which is very costly. With the knowledge of seedproduction technology of vegetable crops, the farm women can produce the seed at their own and save the money. However, they need proper knowledge to become well conversant with different aspects of quality seed production. In order to meet this challenge, there is a need to popularize the improved seed production practices in vegetable crops which, would in turn, provide comprehensive knowledge to the growers regarding the recent advances in technologies for quality seed production of vegetable crops. Production of quality seed is highly remunerative and can be produced in a area with minimum effort by small and marginal farm families for their prosperity.

The information on various aspects of seed production is provided in the bulletin will be of immense use for the extension functionaries, farming community preferably farm women and other stakeholders engaged in vegetable seed production.

S Srivastava

Bhubaneswar
Date : 03/08/2015

S. K. Srivastava
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INTRODUCTION

Vegetable cultivation is considered as an important technology for women in agriculture. It not only provides good income by huge production and use of the suitable varieties but also ensures nutrition of the farm family. Farmwomen can choose some vegetable crops as per their requirement from a pool of vegetables as per their climate, food preferences, local demand and resource availability. Vegetables like tomato, brinjal, okra, chilli, cowpea, leafy vegetables, cucurbits are very popular among farm women in Odisha. The vegetable production of Odisha is also high and farm women's contribution is immense in vegetable cultivation. They participate in different capacities in vegetable farming starting from farmer to supervisor to labour. In addition to vegetable cultivation in large and medium scale, farmwomen are also engaged in small scale vegetable planting like nutrition garden. However, quality of their participation in vegetable farming is reduced due to less access to quality seeds of vegetables of different varieties. The farmwomen need to be involved in vegetable sector to enhance the production and area under vegetables. Vegetable cultivation in India is mainly dominated by small and even landless farmers (Kishore *et al*, 2012). Further, vegetable cultivation in India is an important agricultural occupation where the whole family works together for maximum earning from small piece of land and the role of each and every member is important. Presently vegetable cultivation has become highly commercialized. But still there is a wide gap between current and potential production. The most important and feasible approach to enhance the productivity of vegetable crops would be the production of quality seeds and its availability. To ensure better production, generally farmwomen purchase the seeds from the markets which is costly. With the knowledge of seed production technology of vegetables, farm women can produce the seeds at home level in small scale and save the time and money. In case of onion, 20 percent of seeds comes from organized sectors like NHRDF, Nasik, NSC, MPKV Rahuri and NRC on Onion and Garlic and 80 percent is met from seed produced and maintained by the farmers themselves (Lawande, 2014) . So for improving the quality of farm saved seeds there is a need to improve their knowledge of proper seed production and management practices by systematic capacity building on different aspect of quality seed production. Seed production of vegetables can be taken up by women individually or in Groups at village level. Seed is the basic and most critical input for sustainable agriculture. The response of all other inputs depends on quality of seeds to a large extent and the seed is a significant components in the total cost of production. It is estimated that the direct contribution of quality seed alone to the total

production is about 15-20% depending upon the crop and it can be further raised up to 45% with efficient management of other inputs like fertilizer, irrigation, weedicides, insecticides, fungicides, harvesting and processing. For subsistence and commercial farming, necessary knowledge in seed production of vegetables is necessary. Keeping this in view, the seed production techniques of different vegetable crops are discussed where women can contribute substantially.

A good quality vegetable seed should be-

- Genetically pure
- Physically pure
- Physiologically viable
- Free from weeds and other crop seed
- Free from insect/pest and diseases

The duration of viability of seeds depends upon factors like the kind of seed, proper maturity, proper drying and storage conditions.

After harvesting, threshing and drying, seed is subjected to processing. The objective of processing is to maintain and improve various quality factors such as physical purity, germination, vigour and storability. This is done by removing various impurities and undesirable material such as inert matter, broken, immature, rotten, diseased and insect damaged seeds, weed seeds and seeds of other crops. Processing includes cleaning, grading, treating and packaging.

PRESENT STATUS OF SEED PRODUCTION IN ODISHA

Presently the demand of vegetable seeds is more and its availability is less in our country in general and Odisha in particular. Use of improved or high yielding or hybrid seeds could increase the yield by15%. Further, seed production of certain vegetables is quite profitable than vegetable production during the peak period of production. Although some farmers in the state are producing various vegetable seeds and selling to private seed companies as well to Orissa State Seeds Corporation Ltd, but the quantum of production is scanty.

The traditional farmers used to preserve their own seeds and some also get it by exchange system. This process is feasible only in case of open pollinated varieties. Further Directorate of Horticulture, Govt. of Odisha is also supplying some quantity of vegetable seeds under minikit programme. Seed production companies also sell their produce through their out lets spread throughout the state (Mohanty *et al*, 2012). The area, production and requirement of vegetable seeds, crop wise is given in Table1 & 2.

Table 1. Area, production and productivity of various vegetables in the state of Odisha

Year	Area (ha)	Production (MT)	Productivity (MT/ ha)
2005-06	629863	7808769	12.40
2006-07	631621	7920439	12.54
2007-08	632018	7952198	12.58
2008-09	675848	8454083	12.50
2009-10	694188	8961861	12.90
2010-11	698631	9027735	12.90

Source: Directorate of Horticulture, Odisha, Bhubaneswar data base.

Table 2. The crop wise requirement of vegetable seeds of the state of Odisha:

S No	Name of vegetable and spices	Area(000ha)	Production (000MT)	Productivity (MT/ha)	Requirement of seed (q)
1.	Brinjal	123.4	2135.2	16.13	662
2.	Cabbage	35.8	999.9	27.92	179
3.	Cauliflower	46.4	675.4	4.35	232
4.	Okra	73.9	651.8	8.82	11090
5.	Tomato	102.9	1394.6	13.55	515
6.	Onion	32.1	297.05	9.26	3208
7.	Chilli	75.5	64.3	0.85	566
8.	Peas	5.1	45.2	8.89	3049
9.	Corianader	19.1	9.4	0.5	3813

Source: Directorate of Horticulture, Odisha, Bhubaneswar data base

Considering the need and potential of vegetable seed in the country the package of practices for seed production of important vegetable crops are discussed . With these technique the small and marginal farmers including farmwomen will be able to produce vegetable seeds from their landholding for fulfilling their requirement and generating income.

ROLE OF FARMWOMEN IN SEED PRODUCTION OF VEGETABLES

Seeds are critical in the food chain and women's role as seed savers and breeders have been largely responsible for keeping the diversity alive. So the need of the hour is to encourage women's inherent capabilities in seed multiplication and management and establish their dominance in the fast growing seed sector. In seed production, women involve in selection, treatment, raising seedling, harvesting and post harvest activities like seed extraction, washing, drying, cleaning grading and storing. Development of new models of seed production for women enabling their access to land, skill, technology and critical inputs will go a long way in making them potential seed producers for fulfilling the seed need of the villages. Combined with this, a systematic seed production plan, involving farmwomen for locally adoptable cultivars, will help in the conservation of these rich germplasm. This holds the key to food and livelihood

security of the people especially in the wake of climatic changes. Knowledge on labeling, packing, testing and marketing techniques will empower them in quality seed production. Table shows women involvement in various activities of the crop for seed production (Pattanaik, 2014).

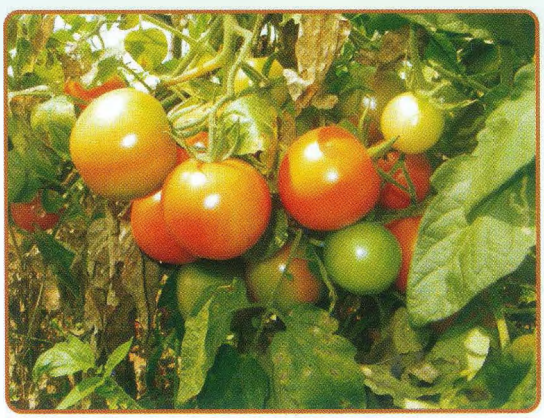
Table 3. Participation of farm women in seed production activities:

S No	Activity	Participation (%)	
		Men	Women
1	Land preparation	100	Nil
2	Seed preparation for sowing	8	82
3	Raising nursery and transplanting	25	75
4	Direct sowing	92	8
5	Irrigation	83	17
6	Applying FYM	75	25
7	Fertilizer application	83	17
8	Weeding	17	83
9	Plant protection	83	17
10	Harvesting	42	58
11	Storing of seed	17	83
12	Marketing	92	8
	Over all	60	40

SEED PRODUCTION TECHNOLOGIES

TOMATO

Tomato (*Lycopersicon esculentum L.*) is the most important and remunerative vegetable crop in India. It occupies second position amongst the vegetable crops in terms of production (Babu *et al*, 2011). It is a rich source of minerals and vitamins and is needed every day in every house as a salad, chutney, and mixed in other vegetables. It is a warm season crop and requires a frost free period of about 4 months for seed production. Optimum temperature for seed germination is 16- 29^{0}C and for growth and fruit set between 20^0 to 25^{0}C. Below 15^{0}C and at/ above 32^{0}C,the pollen germination is very poor. Hence, very high or very low temperature and drought adversely affect fruit setting. High temperature combined with dry winds causes blossom drop. A warm



Tomato fruit during maturity stage

and sunny weather is most suited for proper fruit set, fruit and seed development which results in higher seed yield.

Varieties: Pusa Ruby, Hisar Arun, B.T-10, Pantnagar Tomato-2, Pusa Gaurav, Pusa Shital, Punjab Kesari

Flower character and pollination

The number of flowers vary from 4 to 12 in each cluster, average number is 4-5 per cluster. The flowers are small, pendent, calyx are 5-6, sepals green in colour with many hairs. This persists until fruits mature. Corolla sulphur yellow in colour and form a short tube. Stamens-five in number and are borne on the throat of the corolla, long anthers partly united. Pistil two or multicarpellary, elongated style, Simple bulbous stigma extend through and somewhat beyond encircling androecious.

Daily temperature influences time of opening of flower, anther dehiscence and stigma receptivity. Anthesis is correlated with temperature and soil moisture. The petals open between 8-10.30 a.m..The dehiscence takes place between 9-10.30 a. m. The receptivity of stigma is between 8.30 to 11.30 a.m. The dehiscence is 24 to 48 hours earlier than opening of corolla, hence tomato is a self pollinated crop. Bumble bees sometimes visit tomato flowers and cause cross pollination has been reported under Delhi conditions.

Isolation: To maintain the purity of varieties, a minimum distance of 50 m for foundation seed and 25 m for certified seed should be provided all around the field to separate it from other varieties of tomato.

Climate and Soil: Tomato being a warm season vegetable, is grown extensively in cool season. The optimum temperature required for its cultivation is 16^0- 28^0 C. A well drained loamy, clay or silt loamy soil with fair moisture holding capacity and pH range of 6-7 is most suitable for tomato seed production.

Manure and fertilizers: 25 - 30 t of well rotten farmyard manure/ ha is incorporated in the soil. In addition, the crop requires about 100 kg N, 50 kg P and 50 kg K/ ha. FYM should be incorporated in soil 3-4 weeks before transplanting. Full dose of phosphorus, potash and one third of nitrogen should be applied before preparation of land. The rest of nitrogen is applied as top dressing in two equal doses i.e. 30 and 50 days after transplanting. After top dressing earthing up to be done followed by light irrigation.

Seed rate: Approximately 500 g/ha seed is required for one hectare of area.

Sowing time: Time of sowing is very important factor and in northern plains only spring-summer crop is recommended for seed production. The sowing time is middle December.

Nursery raising: The seed is sown in well prepared raised beds. When the plants are 4-5 cm tall. Thinning is done to avoid overcrowding.

Transplanting: Four to five weeks old 12-15 cm tall seedlings are transplanted in the field. The ideal time for transplanting of spring summer crop is from 20th January to 10th February. It

is always better to transplant the seedlings after the danger of frost is over. Spacing is 60- 75 cm to 45-60 cm. Transplanting should be followed by light irrigation.

Roguing: First roguing is carried out before the start of flowering on the basis of foliage, second roguing when the fruits are green and the third and final roguing at fruit maturity stage.

Field inspection: Number and stages of field inspection for certification are:

1. Before flowering, 2. Full flowering/ immature fruit stage and 3,. Mature fruit stage

Seed yield: Average seed yield will be 120-150 q/ha.

Seed drying: The washed seed is spread thinly in a airy under shade for few hours before it is allowed to dry in sun.

Management of insect pest and diseases :

During vegetable seed production, farm women and other stakeholders need to be aware about ordinances and guidelines for the reduced use of pesticides in order to control of residues in water and food. Therefore, it is suggested that a thought to change over to pesticides with lower risks and adoption of IPM should be advocated and adopted.

Pests

1.Whitefly (*Bemesia tabaci*): These are minute white insects which suck sap from lower side of leaves and leaves turn yellow. It acts as nectar to transmit viral diseases.

2. Jassids (*Empoasca devastans*): These insects suck the sap from lower side of leaves causing curling of leaves.

3. Fruit borer (*Helicoverpa armigera*): The moths are brown to yellowish brown with slight stripe. The caterpillars are greenish which after hatching crawl over the leaves and feed on tender leaves, buds, flowers and cuts holes and furrows in flowers.

4. Root knot nematodes (*Meloidogynae sp.*): Plants infected with root knot nematodes remain dwarf, foliage discoloured (yellowish) and growth remain stunted. Roots contain swelling which vary from spheroid gall to elongated spindles.

Diseases:

Damping off and root rot: This disease is caused by *Pythium spp. Rhizoctonia solanai, Phytopthora parasitica*. This is a serious disease of nursery which kills the seedlings pre- and post - emergence. Symptoms of post emergence damping off consists of rapid shrinking and darkening of critical tissues of the hypocotyls.

Early blight: Round or triangular brown spots are scattered over the leaf. These spots later show concentric narrow dark lines. Older spots become dark brown. In severe cases plants dry up and die. On fruits these spots first appear on the stem end.

Installation of pheromone trap

Leaf curl and mosaic viruses: In this disease, growth of plants is stunted, leaves show curling and reduction in size or thickening with uneven surface. Fruits remain smaller in size and in severe cases plants remain unfruiting.

Management:

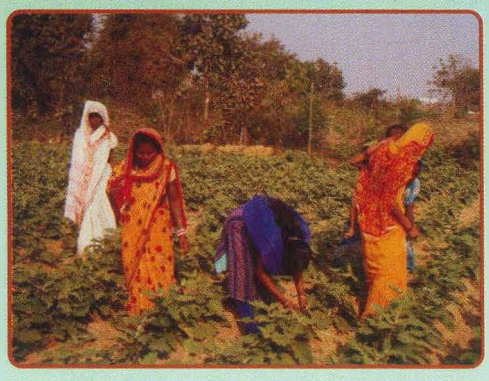
- Select nursery site far away from tomato fields to avoid spread of pests and diseases into the nursery.
- Use certified disease-free seeds of suitable varieties. Use varieties tolerant or resistant to pests and diseases. For example: Fortune Maker (resistant to fusarium and bacterial wilt); Kentom (resistant to bacterial wilt, root-knot nematodes and Tomato Mosaic Virus); Shengena (resistant to late blight and Tomato Mosaic Virus); Taiwan F1 (resistant to bacterial wilt).
- Avoid transplanting seedlings near an old tomato crop.
- Plant border rows of coriander, fenugreek, maize, marigold, millet, pigeon pea or sorghum. They act as windbreaks; fenugreek and coriander are repellent to whiteflies, and provide refuge for natural enemies.
- Keep tomato field weed-free. Weeds may be alternative hosts of diseases and pests.
- Stake and prune indeterminate varieties, mulch determinate varieties to reduce early and late blight and bacterial diseases.
- Do not work in tomato fields when plants are wet to avoid spread of diseases.
- Remove crop debris from fields after harvest to minimise carry-over of pests and diseases.
- Fruit borer can be managed by Intercrop of Marigold with Tomato 1:16. Forty days old yellow flower marigold plant should be transplanted with 25 days old Tomato plant *Heliothis* will lay egg on Marigold due to same flowering time and more in height.
- Mixed cropping of Tomato+Rajma(Bean) reduce the incidence of bacterial wilt .
- Plant castor (50/acre) as trap crop which attracts the egg laying moths of Tobacco caterpillar *Spodoptera litura.*

BRINJAL

Brinjal (*Solanum melongena* L.) is a widely grown vegetable crop in India. It occupies the third position amongst vegetable crops. It is thought to have originated from tropical regions of India. It can be grown in almost all parts of India year round except high altitudes. Brinjal is used in a variety of culinary preparation. It is very popular vegetable in Odisha state .

Climatic requirements

Brinjal is a warm- season crop and requires a relatively high average day and night temperature, and is susceptible to severe frost. A long and warm growing season is desirable for successful brinjal production and a temperature range of 20- 28^0 C is favourable. Late round varieties are tolerant to mild frost to some extent than early long varieties. A daily mean temperature of 13 to



Inspection of brinjal crop by farm women at flowering stage

21°C is most suitable for better growth and yield . Its seed germinates well at 25°C temperature.

Soil : Generally, silt loam and clay loam soils are preferred for brinjal. The soil should be deep, fertile and well drained and should have pH around 6.5 for higher seed yield.

Varieties

According to colour, there are white, yellow, brown, green, pink, black, purple, and striped, while according to shape they may be round, oblong, long and pear shaped. In north India pinkish purple or violet and black varieties are preferred.

Pusa Purple Long: Developed at IARI, New Delhi. The plants are semi-erect. It is early and fruits ready for picking in 100-110 days. Fruits are glossy, light purple in colour, 25-30 cm long, smooth and tender, suitable for spring and autumn plantings and average yield is about 275 q/ha.

Hissar Pragati: Developed at CCS HAU, Hissar. Early variety, leaves green, flowers white purple, fruits 15-20 cm long, attractive, dark purple in colour, yield 325q/ha.

Pusa Purple Cluster: Developed at IARI, New Delhi. Very early, ready for picking in 75 days. Plants erect and tall, leaves and stem are purplish in colour. Fruit small, dark purple in colour, and born in cluster. On an average, each fruit weighs about 21g with bearing of 50 fruits per plant.

Pusa Kranti: Developed at IARI, New Delhi, plants dwarf and spreading, stems are medium thick and half green, half purple to purple. Leaves long, narrow, highly serrated and light green in colour. Fruits oblong and stocky and dark purple in colour. This cultivar is good for both spring-summer and autumn-winter planning in north India. On an average, each fruit weighs 68g with a bearing of 22 fruits per plant.

Isolation : Minimum isolation recommended for production of foundation seed is 300 meters and for certified seed is 150 metres.

Manures and fertilizers: Being a long duration crops, requires good amount of manures and fertilizers. The general recommendation for improved varieties is to apply 25 tonnes of FYM at the time of land preparation. Full dose of phosphorus and potash and one third of nitrogen should be applied as basal dose. The remaining nitrogen should be applied in two equal instalments as side dressing at 30 and 60 days after transplanting.

Monitoring of brinjal crop

Seed rate: Approximately 400 - 500 g seed is require for one hectare of area.

Sowing time : For seed production in northern plains, only rainy season crop is recommended. Seed is sown in well prepared nursery beds in month of June-July.

Nursery Raising : Seed is sown in raised beds in lines about 8-10 cm apart. Cover the seed with well rotten FYM. Irrigate the nursery beds in the morning and evening daily. When the plants are about 4-5 cm tall, thinning is done to avoid overcrowding.

Transplanting: During the month of July-August, when the seedlings are about 4-5 weeks old and 12-15 cm in height are transplanted in well prepared field. In general, seedlings of long fruited varieties are transplanted at a spacing of 60x 60 cm whereas, round fruited varieties are transplanted at a spacing of 75 x 75 cm. Transplanting should preferably be done in the evening and should be followed by light irrigation.

After care of crop : Gap filling if required, is done 4-5 days after transplanting at the time of second irrigation. Later irrigation is applied as when required to maintain proper moisture and level in the field. Brinjal is shallow rooted crop, hence require frequent irrigations.

Initially brinjal is slow growing crop, hence incapable to offer any competition to the aggressive weeds. Infestation of weeds also increases insect pests and diseases. Therefore the weeds should be controlled as soon as they appear, either by traditional methods of hand weeding and hoeing or by application of herbicide. For chemical weed control spray one kg pendimethalin (3.3 litre Stomp 30 EC in 650 litre of water) per hectare 3-4 days after transplanting .

Roguing : The elimination of off-types on plant basis is most essential. Plant characters, fruiting habit, fruit characters and infection of diseases is taken into consideration while roguing. Plants affected with seed borne diseases like phomopsis fruit rot should rogued out. Plants affected with little leaf disease should also be eliminated before flowering. Second roguing is done at the time of early fruiting stage and final roguing when fruiting is complete .

Table 4. Specific field standards

Factors	Maximum permitted percentage	
	Foundation seed	Certified seed
Off type	0.10	0.20
Seed borne diseases (phomopsis blight)	0.10	0.50
Not seed borne disease	0.50	2.00

Field Inspections : field inspection should be done at :

1. Before flowering
2. At full flowering /immature fruit stage
3. At mature fruit stage

Harvesting and seed extraction: The mature yellow fruits are harvested, cut into pieces and crushed after adding required quantity of water. The material is then fermented for 48-96 hours (depending upon temperature). After fermentation the material is washed repeatedly with water to separate seeds from the pulp. Clean seed is then dried under shade.

Seed yield: Depending upon the variety and condition of crop seed yield varies from 4.0 to 6.0 q/ ha.

Table 5. Seed standards

Factors	Class of seed	
	Foundation seed (Min %)	Certified seed (Min %)
Pure seed (minimum)	98.00	97.00
Inert matter (maximum)	2.00	2.00
Other crop seeds (maximum)	None	None
Weed seeds	None	None
Germination (maximum)	70.00	70.00
Moisture content (maximum)		
i) Ordinary contained	8.00	8.00
ii) Vapour proof container	6.00	6.00

Management of insect pest and diseases :

Shoot and fruit borer (*Leucinodes orbonalis*): This insect alone may cause loss upto seventy per cent in yield. The pinkish larvae attacks the terminal shoots and bores inside as a result of which the shoots wither and dry. It also bores into young fruits by making holes and feed inside. In severe cases, it may cause rotting of fruits.

Aphid (*Aphis grossypii;Myzus persicae*) : The aphid is small, soft, yellowish green or greenish brown insect found in colonies on tender shoot and undersurface of tender leaves. Both nymphs and adults suck the sap of leaves. Affected leaves curl, fade gradually and finally dry up.

Whitefly (*Bemisia tabaci*): White minute insects suck the cell sap from the lower side of leaves. The affected leaves turn yellow.

Diseases

1. Phomopsis blight (*Phomopsis vexana*): This is a serious disease of brinjal. Infestation of this fungus may cause seedling blight, leaf spot and fruit rot. In seedling infection, it causes damping -off symptoms. On leaves, circular spots appear which become grey to brown with irregular blackish margins. The affected leaves may turn yellow and die. Infected area on fruit turns brown and fruits get rotten.

2. Little leaf (*Mycoplasma*): Little leaf affected plants generally remain shorter in stature, but possesses large number of branches, roots and leaves than a healthy plant. The petioles get

shorter considerably. The leaves are malformed into tiny chlorotic structure and plants give a bushy appearance. Flower parts are deformed leading the plant to be sterile.

Mosaic: Plants infected with viral diseases are stunted in growth and show mosaic symptoms on leaves.

Management

- Early removal of drooping shoots will reduce the fruit infestation.
- Proper collection of all the infested flower buds, fruits during harvest.
- Continuous cultivation of brinjal also favours the pest infestation.
- Varieties like Punjab Barsati, (moderate resistant cultivar) Pusa Purple Round, Punjab Neelam, found to be resistant to brinjal fruit borer.
- Installation of BSFB pheromone traps to monitor and mass trap the male moths.

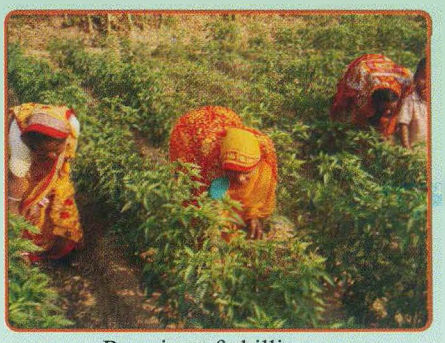
Removal of infected brinjal shoots

- Need based spray of cypermethrin (0.0125%) at 2% when flower buds damage threshold or at 15-20 days after flowering.
- Trap cropping with marigold (*Tagetus sp)* are effective in controlling *Meloidogynae incognita.*
- Crop rotation with non solaneceous crops to will avoid root knot nematode .
- Treat the nursery beds with Carbofuran 2g a.i/m^2 granules will give better control.
- The varieties such as Kalyanpur, Punjab Chamikila, GB-1, and GB-6 reported as resistant to Jassids, Aphids and Whitefly.
- Use yellow sticky traps to monitor the sucking pest activity.
- Crop rotation with cruciferous vegetables such as cauliflower, clean field and spraying of Copper fungicides (2% Bordeaux mixture.) to control the Bacterial Wilt caused by *Pseudomonas solanacearum.*

CHILLI

Chilli (*Capsicum annum*) is one of the most valuable crop of India. The crop is grown all over the country as it is valued for its diverse commercial uses. It is daily requirement of every family for culinary purposes. Women dry and store ripe chillies along with peduncle for maintaining its pungency and shelf life. The varieties of chilli are broadly divided into two groups, long pungent types and bell shaped non- pungent mild, thick fleshed type. The non- pungent types are used as vegetables and commonly known as Sweet pepper or Shimla mirch. The seed production of Shimla mirch is either done in the hills during summer or in areas with mild climate like that of Bangalore. Pungent type chillies are grown for their green and dried ripe fruits. Its ripe fruits are bright red, slender and thin walled which are specially liked for pungency and spicy taste.

The seed of pungent types can be produced successfully in northern plains of country. The special features of seed production of pungent type chilli are as follow:


Roguing of chilli crop

Climate: Chilli is a plant of tropical and sub tropical region, requiring warm climate. Crop can tolerate high temperature but cannot withstand heavy rains during growth, flowering and fruit set. Temperature ranging from 20 to 25°C is ideal for chilli production. It is susceptible to frost. A warm and humid climate with moderate rainfall (60-120 cm) favours growth while dry weather enhances fruit maturity. Good germination occurs at soil temperature of 17- 30°C. High light intensity increases the yield but reduces the capsaicin content (pungency) and fruit colouring. In capsicum, fruit development is adversely affected at temperature of 37.8° C or more. High temperature and low humidity at flowering results in abscission of buds, flowers and small fruits. Higher night temperature increases the capsaicin content.

Varieties:

NP-46, A: Plants are dwarf and spreading type. The pods are red measuring about 10.5 cm long. The cultivar is less seeded and contains 0.53 mg capsaicin per gram of fruit.

Pusa Jwala: This is an early cultivar. The plants are long, thin and usually curved. The pods are red. The dried fruits have shrunken skin. The fruits contain 0.48 mg capsaicin / gram of fruit.

Hisar Shakti: Plant erect and medium in height, leaves light green in colour. Fruits 8-9 cm long, dark red at ripening and high in capsaicin content. Resistant to mosaic and leaf curl disease.

Hisar Vijay: Plants alike Hisar Shakti, leaves large and green in colour. Fruits 8-9 cm long, smooth and bear in clusters. Fruits highly pungent and good for making powder. Resistant to mosaic, and leaf curl disease.

Flower character and pollination: The flowers are complete, usually borne singly and open in the morning between 2.00 to 10.00 a.m. The anthers normally dehisce an hour after the flower opening and maximum dehiscence is between 8.00 to 10.00 a.m. Pollen viability and stigma receptivity is maximum on the day of anthesis. Flower opening and anther dehiscence to large extent depend on the weather condition. During cold and cloudy days, the opening is delayed.


A view of chilli field

Isolation: Since this is open pollinated crop and chilli can also be pollinated with Shimla mirch therefore, they should be isolated from each other in addition to their own varieties. A minimum isolation distance of 500 meters for foundation seed and 250 meters for certified seed is necessary.

Soil: A well drained sandy loam or clay loam soil rich in organic matter and lime are suited for chilli production. Acidic and alkaline soils are not suitable. Although sweet pepper can grow almost in all types of soil, well drained clay loam soil is considered ideal. It can withstand acidity to a certain extent. The ideal soil pH for sweet pepper is 6.0 to 6.5.

Manures and fertilizers: Apply 20 to 25 tonnes per hectare well rotten FYM or compost at the time of field preparation. The requirement of fertilizers varies with fertility status of the soil however, 70 kg nitrogen, 40 kg each of phosphorus and potash applied at the time of last ploughing. Remaining nitrogen should be applied after 6 week of transplanting.

Seed rate: One kg seed per hectare is sufficient.

Time of sowing: In northern plains, for chilli seed production the seed is sown in nursery during May- June. The sweet pepper is generally sown for autumn winter and in November for spring - summer crop. In hilly areas of north India seed is sown in nursery in March- April.

Transplanting: Four weeks old seedlings of chilli and four to five leaved seedlings of sweet pepper are transplanted in well prepared field at a spacing of 60x 45 cm. The nursery beds should be irrigated before seedlings are lifted. Transplanting should preferably be done in evening and should be followed by irrigation.

Care of the crop: Gap filling should be done 4-5 days after transplanting. This is shallow rooted crop, therefore, requires irrigation at frequent intervals. Depending on the rainfall, irrigate the field at an interval of 4-7 days during summer and 15- 20 days during winter. When there is danger of frost irrigate the field to keep the soil moist. Chilli being slow growing crop is incapable of offering any competition to aggressive weeds. The weed should be controled either by hand weeding and hoeing or by using herbicide i.e. spray 1.0 kg pendimethalin/ ha 3-4 days after transplanting.

Flower and fruit drop: There is problem of flower and fruit drop in chilli, particularly in the early stage. To overcome this problem, the crop may be sprayed with 10 ppm NAA (one ml planofix in 5.5 liter of water) at the time of flowering. Second spray should be done three weeks after the first spray.

Table 6. Specific requirement (Field standard)

Item	Maximum permitted (% age)	
	Foundation seed	Certified seed
Off type	0.10	0.20
Seed borne diseases (leaf blight, anthracnose)	0.10	0.50
No seed borne diseases (viruses)	0.50	2.00

Roguing: Roguing is done on the basis of plant as a whole rather than individual fruits. The off- types on the basis of growth (particularly leaf size), flowers and fruits (shape and colour) should be removed as soon as they are observed. Minimum three roguings are carried out at early growth stage, flowering stage and full fruiting stage. Plants affected with virus and seed-borne diseases (leaf blight and anthracnose) should be removed immediately.

Field inspections: Number and stages of field inspections for the purpose of certification are :

1. Before flowering
2. At flowering and immature fruit stage
3. At mature fruit stage

Harvesting and seed extraction: Red ripe fruits of chilli are harvested and dried under the sun. Completely dried fruits are threshed and cleaned and seed is extracted with the help of machine (seed extractor). Thereafter, the seed is dried to 8 percent moisture content. The fruits of sweet pepper should be picked when red ripe, cut and crushed. Seed is washed thoroughly to make free from pulp and peel. After washing it should be dried in sun.

Seed yield: Seed yield of chilli varies from 3 to 5 q/ha, whereas that of sweet pepper 1 to 2 q/ha.

Table 7. Seed Standard (%)

Items	Type of seed	
	Foundation seed	Certified seed
Pure seed	98.00	97.00
Inner matter	2.00	2.00
Other crop seeds (maximum)	0.05	0.10
Objectionable weed seeds (maximum)	0.05	0.10
Germination (minimum)	60.00	60.00
Moisture content		
Ordinary container	8.00	6.00
Vapour proof container	8.00	6.00

Management of insect pests and diseases

Pests

1. **Termite** (***Odontotermes obesus***): It is found in abundance in sandy soils. Its infestation starts soon after germination/ transplanting and may continue till harvest. The pest being sub terranean, lives in the roots and stem below the ground level and tunnels upwards. The affected plants turn pale, wither and dry away.

Thrips (*Scirtothrips dorsalis*): The leaves and adults infest tender leaves and feed on the sap causing curling of leaves. Severe infestation causes heavy curling and stunting of the plants . Buds and flowers are also damaged.

Aphids (*Aphis gossypii*): The insects suck the cell sap from leaves and petioles and cause considerable loss in yield.

Whitefly (*Bemisia tabaci*): These insects are white in colour and suck the cell sap of the plants. It acts as vector for transmitting leaf curl disease.

Mites (*Polyphagotarsonemus latus*): The tiny spider like creature may be found in large number on the undersize of leaves, covered with fine webs. Both nymphs and adults suck the cell sap and devitalize the plants.

Anthracnose and fruit rot (*Colletrotrichum capsici*) : The symptoms of this fungus appear mostly on ripened fruits. The spots are usually circular and sunken with black margins. As the

diseases advances, the spots starts spreading. The fruits with many spots drop off prematurely resulting in heavy loss in yield. The fungus may also attack the fruit stalk and spread along the stem causing dieback symptoms.

Management

- Plant pepper in well drained soils and avoid waterlogging to prevent *fusarium* wilt .
- If aphid population is limited to just a few leaves or shoots then the infestation can be pruned out to provide control; check transplants for aphids before planting; use tolerant varieties if available; reflective mulches such as silver coloured plastic can reduce aphids from feeding on plants.
- In the home garden, spraying plants with a strong jet of water can help reduce buildup of spider mite populations.
- Avoid planting next to onions, garlic or cereals where very large numbers of thrips can build up; use reflective mulches early in growing season to deter thrips.
- Mixed cropping of Chilli+ Marigold reduces the incidence of Mosaic and root knot nematodes.
- Mixed cropping of Chilli+Ramdana (Amaranthus) also reduces the incidence of Mosaic and root knot nematodes

OKRA

Okra (*Abelmoschus esculentus* L Moench) belongs to the family Malvaceace. It is a popular vegetable grown in summer and rainy seasons. Its fresh and tender fruits are consumed in various way. It is a vegetable suitable for backyard cultivation and the crop yield continues for three months in winter season. It is useful for home consumption and source of income for rural women. It is widely grown in the states of Uttar Pradesh, Bihar and Odisha.

Climatic requirement: Okra requires a long, warm and humid growing period. It can be successfully grown in hot and humid areas. It is sensitive to frost and extremely low temperature. However, it requires cooler night. The seeds of okra will not germinate below 16^0 C temperature. Optimum temperature for germination of seeds is 26- 30^0 C. Under Odisha condition seed yield of summer crop is much lower as compared to rainy season crop. Seed size of summer crop remains small. Moreover, early rains (June - July) at the time of pod maturity and drying impair the seed quality. Hence in Odisha conditions, seed should be produced from rainy season crop.

Varieties: Varsha Uphar, Punjab Padmini, Hissar Unnat, Pusa Sawani, Parbhani Kranti, Utkal Gaurav are to tolerant to yellow vein mosaic disease and suitable for seed production.

Flower characters and pollination:

Flower bud appears in the axil of each leaf from 4th to 8th leaf depending upon the cultivar. Flower bud takes about 22- 26 days from initiation to full bloom. The time of anthesis varies

with the cultivar, temperature and humidity and it ranges from 8 to 10 AM. The dehiscence of anthers is transverse and occurs 15- 20 minutes after anthesis. The pollen fertility is maximum during the period an hour before and an hour after opening of flower. The flowers remain open for a short time and they wither late in the afternoon. The stigma is receptive as flower open. Under Indian conditions cross pollination by insects has been reported to be 4.0 to 19.0 percent. The extent of pollination at a particular place will depend upon the cultivar, competitive flora, insect population and season etc.

Isolation: Okra is a cross pollinated crop. To prevent cross pollination an isolation distance of 500 mt for foundation seeds and 250 mt for certified seeds is necessary.

Soil: Okra can be cultivated in soil ranging from sandy to clay provided they are well drained, fertile and rich in organic matter. Quality seeds are however, obtained from a friable well fertilized soil. It is slightly tolerant to acidity. The optimum pH range is 6 to 7.

Sowing time: In Odisha okra crop is grown two times i.e. February- March for summer crop and in June- July for rainy season crop. However, for quality seed production, crop should be sown around mid June.

Seed rate : 8-10 kg/ha for rainy season crop and 18- 20 kg/ ha for summer season crop is recommended.

Method of sowing and spacing: Seed is sown either in flat beds or on the ridges depending upon the type of soil and irrigation facilities available. Spacing between lines or ridges should be 60 cm. At the time of sowing there should be enough moisture in the soil. Seed should be soaked overnight and two seeds are sown per hill at a spacing of 30 cm. Later. one healthy plant is retained per hill and the weaker one is thinned. Where sowing is done by seed drill, thinning should be done when plants are about 12-15 cm high to maintain 30 cm spacing between plants. Line sowing and spacing will be 60cmx 30 cm.

Manures and fertilizers: At the time field preparation about 30 tonnes of well rotten farmyard manure per ha is incorporated in the soil. In addition, the crop needs about 100 kg nitrogen, 50 kg phosphorus and 50 kg potash per hectare. Half of the nitrogen and full dose of phosphorus and potash is incorporated in the soil before sowing. The remaining half nitrogen is top dressed 30- 35 days after sowing.

Care of the crop: During summer and rainy season, depending upon the soil moisture the crop is irrigated as and when required. During rainy season, excess water should be drained off from the field. At pod formation and seed development stage crop should be irrigated at required interval to maintain moisture in the soil. To keep the crop weed free, hoeing and weeding should be done at regular interval. For chemical weed control spray basalin 45 EC @ 1.5 lit in650 liters of water per hectare two days before sowing of seed. Immediately after application rake the field upto 3-4 cm to incorporate the chemical. Never apply the chemical in bright sun shine.

Roguing: To check the spread of yellow vein mosaic disease, it is essential to rogue out the affected plants as soon as they are noticed. As per the standard, plants bearing pods after 6-7

nodes are off type and should be removed. On the basis of growth habit and flower colour off type plants, plants bearing pods having more than 5-6 ribs and wild bhindi should be removed.

Plant protection: For the control of insect pests spray alternately malathion 50 EC @ 800- 1000ml/ ha and carbaryl @ 750 to 1 kg /ha in 500- 600 litre of water.

Inspections: Minimum three inspections are to be required:

1. Before flowering,
2. At flowering and immature fruit stage
3. At mature fruit stage

Harvesting and threshing: When the pods are completely dry they are harvested. The picking of pods may be affected by climatic conditions. If there is no danger of rain at pod maturity stage, the pods may be harvested in one lot. However, if there is danger of rains, the picking may be done twice or thrice. The pods are piled for curing for few days. Than they are threshed and seed is winnowed.

Drying and processing: After threshing the seed is further dried to a moisture content of 8-10%. The seed is cleaned and graded on air screen machine by using 11/64 inches grading screen. To remove insect damaged, black colored and light seeds, gravity separator may be used.

Seed yield: 12- 15 q/ha.

Table 8. Seed standards

Particulars	Class of seeds	
	Foundation seed	Certified seed
Off type	0.10	0.20
Pure seed (minimum)	99.00	99.00
Inert matter (maximum)	1.00	1.00
Other crop seeds (maximum)	None	0,05
Weed seeds (maximum)	None	None
Germination (minimum)	65.00	65.00
Moisture content (maximum)	10.00	10.00
Vapour proof container (maximum)	8.00	8.00

Management of insect pests and diseases

Pests

1. **Jassid (*Amrasca biguttula biguttula*)** Both nymphs and adults of this wedge shaped pale green leaf hopper cause damage to the crop by sucking sap and injecting some toxic materials, with the results that the leaves turn pale and curl upward. In case of severe infection, the leaves have a burnt look and fall down.

2. **Whitefly (*Benisia tabaci)*** Young and adult suck the sap from lower side of leaves and leaves turn yellow. Whitefly serves as vector and spreads yellow vein mosaic diseases in okra.
3. **Spotted boll worm (Earias spp.)** At the larval stage, they bore into the growing shoots, flower buds, flowers and fruits of okra, either killing the plant or destroying or shedding of fruit.
4. **Spider mite (*Tetranychus spp.*)** The nymphs and adults attack leaves, suck cell sap and ultimately cause defoliation.

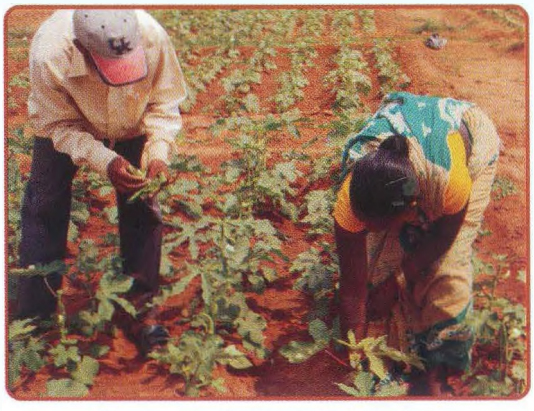
Diseases

1. **Damping off and root rot (*Pythium spp., Rhizoctonia spp. and Fusarium spp.*)**

   Attack of these fungus results in pre and post emergence death off seedlings.
2. **Yellow Vein Mosaic Virus**: This is most destructive viral disease of okra at all stages of the crop. Veins of leave become yellow and at later stages whole leaf becomes yellow. Severely reduces the growth and yield of crop.
3. **Root Knot nematode (*Meloidogynae incognita*)** It causes yellowing of leaves, patchy and unthrifty growth of plants. Knot like galls are found on roots.

Management

- Use resistant varieties viz. Parbhani Kranti, Makhmali, Tulsi, Anupama-1, Varsha Uphar, Hisar Unnat, Arka Anamika and Arka Abhay to control (YVMV) Yellow Vein Mosaic Virus.
- Plant resistant varieties if nematodes are known to be present in the soil; check roots of plants mid-season or sooner if symptoms indicate nematodes; solarizing soil can reduce nematode populations in the soil and levels of inoculum of many other pathogens.
- Collect and destroy the infected fruits and grown up larvae in order to reduce the multiplication of the pest and ultimately reduction in the use of pesticides.
- In the home garden, spraying plants with a strong jet of water can help reduce build-up of spider mite populations; if mites become problematic apply insecticidal soap to plants; certain chemical insecticides may actually increase mite populations by killing off natural enemies and promoting mite reproduction.
- If aphid population is limited to just a few leaves or shoots then the infestation can be pruned out to



Removal of virus infected plants

provide control; check transplants for aphids before planting; use tolerant varieties if available; reflective mulches such as silver colored plastic can deter aphids from feeding on plants; sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves; insecticides are generally only required to treat aphids if the infestation is very high.

- Grow maize/sorghum on borders as a barrier to check adult borers.
- Set up yellow sticky and delta traps for control of whiteflies.
- Mixed cropping of Bhindi+ Marigold reduces the incidence of Mosaic and root knot nematode.

ONION

Onion (*Allium cepa* L.) is a major bulbous crop among the cultivated vegetable crops and it is of global importance. Onion is the commodity, which is needed every day in every kitchen. Seed production of onion is essential at home level because women are not finding the quality seeds in time. The productivity of onion in India is 12.5 t/ha , which is much lower than the long day hybrids and open pollinated varieties. The reason lower productivity of onion in India could be attributed to the limited availability of quality seed and lack of development of hybrids in onion is the major limiting factors among the others. Onion is a major vegetable grown in kharif and rabi seasons by small and marginal farmers. The farmers in absence of cheap seed availability prefer to produce the local onion seed in traditional manner. The resultant seed is often inferior giving bolted onion, split onions and uneven sized onions affecting the marketable quality severely. The local onion cultivars are disease and pest tolerant but the yield is poor. In 1925, male sterility in onions was discovered and this finding quickly led to the development of a hybrid onion seed industry.

Inspection of onion crop during vegetative growth

Role of women in onion production

Onion is the labour intensive crop and about 180 man days are required for production of onion in one ha area in a season (Tripathi and Lawande, 2012). Various activities like seed sowing, weeding, uprooting of seedlings transplanting intercultural operation , harvesting and removal of leaves are done by women.

Table 9. The participation of women in onion production activities

Activities	Participation (%)	
	Men	Women
Application of farmyard manure	50	50
Preparation of nursery beds	80	20
Sowing of seeds	7	93
Uprooting of seedling from nursery	20	80
Preparation of seedlings and transplanting	12	88
Weeding	10	90
Fertilizer application	25	75
Spraying of fungicide/ insecticide	90	10
Harvesting	14	86
Cutting of neck and grading	10	90
Transport to shed	50	50

Potential areas for seed production:

In India, the short day types of onion is cultivated on large scale in the northern plains, central and southern of the country except higher hills where the long day type onion varieties like Brown Spanish and Yellow Spanish etc., are grown over a limited area. Therefore, the seed production of the short day type of onion is done in central part of the country particularly in Mandore and Khandawa region of M.P., Nasik and Pune of Maharashtra and Rajkot district of Gujarat. However, northern state like Punjab. Haryana and Rajasthan are not preferred by the seed industry due to sever attack of stemphyllum and purple blotch and lowers seed yield but there is a potential for seed production in north under delayed planting.

Floral biology and pollination :

Anthesis occurs in early morning (6-7 hrs). Anther dehiscence is between 7.0 and 17.00 hr and on next day also with peak between 9.30 and 17.00 hr. Pollen fertility is highest on the day of anthesis. Stigma receptivity is also high on the day of anthesis. The duration of anthesis is approximately 4 weeks on individual umbel. The anthesis begging from outer flowers and goes centrally in succession. The flower is protandrous in nature and stigma becomes receptive when shedding of pollen is over. Onion is a cross -pollinated crop in nature and pollinated by bees, flies and other insects to obtain quality seeds. The onion inflorescence is an umbel that produces 50 to 2,000 flowers. Flowering can be as long as two weeks and is not uniform since the umbel actually consists of aggregation of smaller 5to 10 flowered inflorescences called cymes. Onion does not produce quality seed if insects do not visit the flower. In commercial seed production, the crop depends on *Apis mellifera* for pollination in mountainous regions of India, the availability of natural pollinators is a major drawback in seed production. The utilization of honey bees on onion seed production would effectively increase seed quality and quantity.

Table 10. Important varieties of onion and their source:

Name of variety	Source
Kalyanpur Red Round	CSAUA&T,KANPUR
Pusa Red, Pusa Ratnar, Pusa Madhavi, Pusa White Flat, White Round,Early Grano, Brown Spanish	IARI, New Delhi Pusa
Co-1,Co-2,Co-3, Co-4	TNAU, Coimbatore
Arka Niketan , Arka Kalyan, Arka Bindu	IIHR, Bangalore
Agrifound Light Red, Agrifound Dark Red, Agrifound Rose , Agrifound Red	NHRDF, Nasik
Punjab Red Round	PAU, Ludhiana
Hisar-2	HAU, Hisar

Isolation

Onion seed field shall be isolated from contaminants viz., fields of other varieties and the field of the same variety not confirming to varietal purity requirement for certification at last 4 m for foundation seed and certified seed during mother bulb production and 1000 m and 500m for foundation and certified seed production respectively during seed production.

Methods of seed production:

There are two methods of seed production. The seed to seed and bulbs to seed methods and both the methods are in use in onion seed production but bulb to seed method is most commonly used method of seed production.

a) Seed to seed method:

In this method seedlings are transplanted in first week of October and allow over- wintering at the same place and allowing bolting (flowering).The seed are threshed from the mature umbel. This method does not allow to examine the mature bulb characters and field is rogued for off -types. Seed to seed method is not popular, since all the varieties are not suitable for annual seed production due to poor bolting habit and lower seed yield. The seed produces in this method is not suitable for further multiplication.

b) Bulb to seed method:

In this method, the seed is sown in raised bed at 4-5 cm spacing for raising the seedling. The seedlings of 12-15cm length are transplanted and this height attained 7-8 weeks after the seed sowing. Thus, 6-8 kg seed/ha is sown. The seedlings are transplanted in previously developed beds in 15x10 cm spacing. The bulbs are lifted when the 75% plant show neck fall/ top die down. The bulbs are dried/curing under naturally ventilated place then neck is trimmed leaving 2-3 cm attached with bulb. The bulbs are rogued at this stage based upon the colour, shape and size. The damaged, twin bulbs and long necked bulbs if any are discarded. The medium size bulbs weighing (50-80g) bulbs are selected and stored. The bulbs are examined again before replanting in the following season. The method helps to maintain purity of the variety and also gives higher seed yield, but disadvantage is it requires more labour.

Production practices

Land requirement: Land is to be used for seed production of onion should be free from volunteer plants . Although onion can be grown nearly in all types of soil from sandy loam to heavy clay soil, but clays are not satisfactory unless well supplied with humus to lighten them. The soil pH should be 6.0-6.8 for better seed production.

Weed control:

Weed should be kept under control condition manually or by using Pendimethalin @1.5 kg or Fluchloralin 1.5 g/ha which is followed by one hand weeding at 90 days after planting.

Mode of pollination: Onion is a cross-pollinated crop.

Half dose of N and full does of P and K is applied planting as hill placement. Rest dose of nitrogen is applied in two splits . Half at 35-40 days after planting and half at flowering time.

Time of inspection and roguing

Four field inspections are done undesirable plants if any are rogued out. the time of inspection is as follows:

1. 30-35 days after transplanting
2. When the bulbs are lifted.
3. At the time of bulb replanting.
4. At the time of flowering.

Specific Requirement

Table 11. Field standards: Max. percentage permitted.

Type of seed	Off type	Plant affected by diseases	Objectionable weeds
Foundation Seed	0.20	-	-
Certified Seed	0.50	-	-
Seed stranded(%)			
1. Pure seed		(F&C)	98%
2. Innert matter		(F&C)	2%
3. Other crop seed		F	0.05%
		C	0.1%
4. Weed seeds		F	0.1%
		C	0.2%
5. Objectionable weed seeds		(F&C)	Nil
6. Germination		(F&C)	70%
		TFL	65%
7. Moisture container			
a) Ordinary container			9%
b) Vapour proof container			6.5

Harvesting

Although all seed heads on an onion plant do not mature simultaneously, there still is usually one harvest the seed field. This is accomplished by harvesting the seed heads at about 30% moisture (the heads have some opened capsules with black, ripened seeds exposed)by hand cutting 10 to 15 cm(4 to 6 inches) of the flowering stem below the umbel. A study revealed that harvesting umbels with seed stalk had no effect in the seed yield and on seed physiological potential. The best harvesting period was at the beginning of capsule opening or when 10% of capsules were opened resulting in higher seed yield. Harvesting at 20-30 % dehisced capsules resulted in seed with better quality. When cutting, the umbel is supported in the palm of the hand and held between the finger to avoid seed shattering.

the seed are dried enough for threshing when the capsules and small seed stems are brittle and readily break when rolled in the palm of the hand. Yields range from 600 to 800 kg per hectare.

Management of insect pests and diseases :

Thrips (*Thrips tabaci*): Leaves have shining silver streaks or have brown spots. Many times yellow or white insects moving generally near the base or middle of leaves. As and when observed spray Monocrotophos (0.05% or neem formulations (2-3 ml/liter).

Mite (*Aceria tulipae*): Infested leaves show yellow patches, plants get stunted. Apply Dimethoate (0.05%) at initial stages of infestation.

Onion fly (*Delia antiqua*): Maggots feed on developing bulbs underground. Secondary infection by fungus causes soft rot of onion. For control of fly grow cultivars of *Allium fistulosum* which are resistant. Apply Carbofuron/ Phorate (0.05%) or neem cake (500kg/ha) in the soil at sowing time.

Cut - worm (*Agrotis ipsilon*): Seedlings are cut from the base at night by this insect. As and when observed soil application with Chlrorpriphos (0.1%) or neem cake (500kg /ha may be applied into soil.

Diseases:

Damping-off (*Fusarium oxysporum f.sp.cepae; Pythium sp.; Sclerotium rolfsii and S. cepivorum and Colletotrichum sp.):* The disease is more prevalent during kharif season and causes about 60-75% damage. High soil, moisture and moderate temperature along with high humidity especially in the rainy season leads to the development of the disease. The pathogen attacks the collar region of seedlings on the surface of soil. The collar portion rots and ultimately the seedlings collapse and die.

Control: Healthy seed should be selected for sowing. Soil solarization by spreading 250 gauge polythene sheet over the bed for 30 days before sowing and application of bio-control agent *Trichoderma viride* in soil @ 1.2kg/ha is also found effective to control damping-off to considerable extent. Continuous raising of nursery in the same plot should be avoided. The seed should be treated with Thiram @ 2g/kg of seed before sowing. The topsoil of nursery should be treated with Thiram @ 5g/m^2 area of the soil and nursery should be drenched with the same chemical @ 2g/litre of water at fortnightly interval.

Purple Blotch (*Alternaria porri*): It is an important disease prevalent in all the onion growing areas. Hot and humid climate with temperature ranging from 21-30°C and relative humidity (80-90%)favour the development of the disease. It is more common in kharif season. The symptoms occur on leaves and flower stalks as small, sunken, whitish flecks with purple coloured centres. The lesions may girdle leaves/stalk and cause their drooping. The infected plants fail to develop bulbs .The intensity of disease varies from season to season.

Control: Use of healthy seeds for planting and crop rotation of 2-3 years with non-related crops checks the disease. Spraying Mancozeb (0.25%) or Chlorothalonil (0.2%) after one month from transplanting at fortnightly interval reduces the disease incidence.

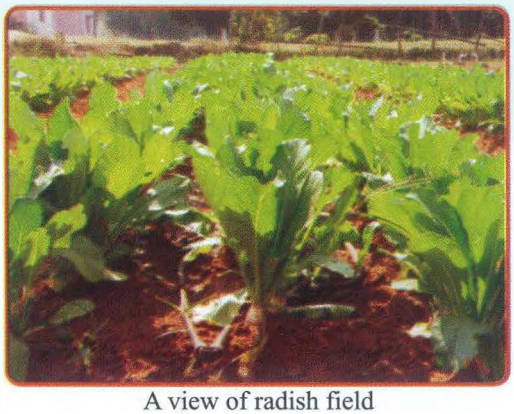
Black Mould (*Aspergillus niger*): The disease is common in onions stored in hot climates where the temperature ranges between 30- 45°C. It is characterized by the black powdery mass of spores that appear on the exterior of the scales. The black spore masses are also seen on inner scales. It reduces the market value of the bulbs.

Control: For effective control of the disease, left for drying in the field for two days. These bulbs should be further dried in shade for 10-15 days before storage. Care should be taken to avoid injury to the bulbs during post harvest handling. The crops should be sprayed with Carbendazim (0.2%) 10-15 days before harvesting.

RADISH

Radish (*Raphanus sativus L.)* belongs to family cruciferae is one of the most ancient and popular vegetable grown in our country. Radish is a good source of vitamin C and variety of minerals. Leaves of radish are good source of protein and young leaves are cooked as vegetable. Root are eaten raw as salad. Radish preparation is useful in liver and gall-bladder troubles.

Climatic requirement



A view of radish field

For proper vegetable grown and root development of radish, cooler or moderate climate is best suited. The Asian cultivars with higher temperature adaptation can resist heat more than the European cultivars. So far as the seed production of radish is concerned, the cultivar in India can be classified in to three groupes (i) Japanese or winter radish (biennial) which produced seed only in temperate hills of India. These cultivars require low temperature for flowering. (ii) The second group includes summer radishes of temperate region (e.g. white Icicle, Rapid red white). These cultivars are very quick in root development and behave like winter radish for seed production. (iii) The third groups include cultivars which produce seeds freely in the plains and can produce good seeds in the hills. Generally, the seed of first two groups is produced in the hills.

Flowering of radish, especially of biennial types, is influenced by temperature. Low temperature is a critical factor for flowering which is accelerated by long photoperiod. In Japanese type , low temperature treatment for longer period (about 25 to 30 days) hasten flower bud differentiation; flower stalk development, earlier and more uniform flowering, higher percentage of fruit set, large fruits and heavier seed. Bolting and flowering of Asiatic types are more sensitive to temperature then day length, whereas, European types respond equally to both factors. A temperature of 32^{0}C or higher causes the stigma to become dry and pollen fail to germinate. For good quality seed production radish requires low humid climate but long dry periods are not suitable.

Varieties

Pusa Chetki: Developed at IARI, New Delhi. Roots are medium large and stumpy, pure white, tender and medium large and mildly pungent. It can be grown as summer and monsoon crop from March to September. Roots become ready for harvesting in 40-45 days. The cultivar sets seeds profusely in the plants.

Pusa Himani: Developed at IARI Vegetable Research Station, Katrain by crossing temperate type (black) and Asiatic type (Japanese White). Roots are 30-35 cm in length and 10-12 cm girth with green stem end They are semi -stump to tapering with shot tops the skin is pure white, flesh is crisp and sweet-flavoured with mild pungency. It can be grown successfully in spring in plans of north India with mild climate.

Pusa Rashmi: The roots are 35-45 cm long, white green tinge on top. It is suitable for early sowing in cooler months, but can tolerate slightly higher temperature. Roots are ready for harvest in 55-60 days.

Japanese White: Released by IARI, New Delhi . Roots are cylindrical , 22-25 cm in length and 5cm in diameter . The skin is snow white, flesh crisp, solid and mildly flavoured. Suitable for growing between October- December in plains and July- September in hills.

Flower characters

The inflorescence of radish is a typical terminal raceme of cruciferous . Flowers are small, white, rose of lilac in colour with purple veins in bractless racemes: sepals erect and petals clawed.

Pollination

The radish is cross-pollinated by honeybees. Flowering in temperate varieties usually starts by second fortnight of March depending on the temperature. The pod formation begins by second fortnight of April. In Asiatic varieties flowering start by the end of February or early March and pod formation a month later.

Radish crop at flowering stage

Isolation

As per Indian seed certification stands radish cultivars for foundation and certified seed production is to be isolated at a distance of about 1600 m and 1000 m, respectively.

Methods of seed production

Both seed to seed and root to seed methods are employed for seed production. The later method is preferred for nucleus and stock seed production. For commercial seed production seed to seed method is preferred and it provided the stock seed is of high quality.

Soil

Fertile loamy soils are best suited for radish crop. Even light sandy soils with liberal user of organic manures give good results. Very heavy clay and sandy soils are, however, not suitable for radish root as well as seed crops.

Root production

Apply 20-25 tonnes of well rotten FYM and NPK @ 80:40:40 per hectare and prepare the field well . Forty kg nitrogen and 40 kg each of phosphorus and potash per hectare is applied during land preparation. The remaining dose of nitrogen is applied three weeks after sowing as top dressing.

Seed rate

About 10kg of seed is required to plant one hectare. This provides sufficient stecklings to plant 4-5 hectares.

Sowing

The spacing depends on the variety. The temperate types which become ready in 25-30 days are sown closely whereas, tropical types need larger spacing and sown on 45 cm apart.

Hills:

Mid-September to first week of October.

Plains:

Asiatic varieties-first fortnight of October.

After care of crop

After germination plants are thinned to a distance of 7-8 cm. one or two hoeing are done to keep the crop weed free. Irrigate the field as and when required.

In seed to seed method, the crop is further thinned when roots are mature to maintain proper spacing between plants. The crop should be earthed up during spring after bolting to support the plant .

Lifting and selection of roots

Plants with off-type foliage and early bolters should be removed prior to lifting of roots. Fully developed roots are taken out and true to type roots are selected. The roots are observed for shape, size and colour etc.. All the under developed, deformed, forked, diseased and off-type roots are discarded.

Planting of steckling

Depending upon the variety steckling are planted at a spacing of 60x60 cm in well prepared field. The crown of the steckling should be kept levelled with soil surface of slightly below it. If the crown produces above the soil, shrivelling and ultimately death of steckling may occur.

Manures and fertilizers

For seed crops apply 20-25 tonnes of well rotten FYM prepare the field well. Forty kg each of nitrogen, phosphorus and potash per hectare is added before last ploughing. A second dose of 40 kg nitrogen is top dressed at the time of bolting and should be followed by earthing up and light irrigation.

Care of crop

Irrigate the crop as and when required. Weeding is done regularly to keep the weeds under check. Care should be exercised to avoid water stress at flowering and seed set stage as it may reduce the seed yield and its quality considerably. Honeybees are the major pollinating insect and hence, radish seed yield is greatly influenced by the number of honeybees visiting the flowers.

Roguing

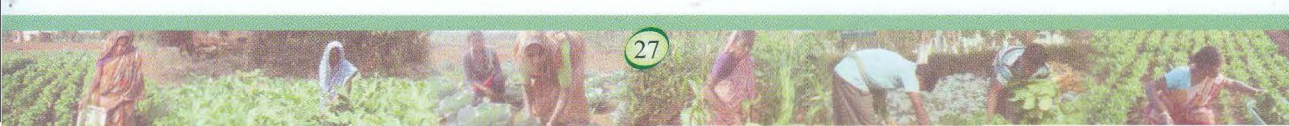
Minimum three roguing are recommended. First roguing out at vegetative stage i.e. about a month after sowing off-type plants on the basis of foliage characters are removed. The second when roots are lifted and replanted and the third at flowering on the basis of flower colour. All early and late flowering plants and plants having different colour flowering are removed.

Table 12. Field standards (specific requirements)

Items permitted	Maximum percentage	
	Foundation seed	Certified seed
Off -type	0.10	0.2
Seed borne diseases	0.10	0.50
Not seed borne diseases	0.50	1.00
Objectionable weeds	-	-

Yield

Average seed yield of temperate varieties is 175 to 250 kg/ha and Asiatic varieties 400 to 600 kg/ha.



Harvesting and threshing :

Unlike other cruciferous crops, radish pods do not dehisce. Since there is no danger of shattering, the pods are allowed to mature and ripe fully before harvesting.

Threshing of radish seed crop is difficult, it is always better to dry the pods thoroughly before threshing. After thorough drying the pods break open easily during threshing processing. Immediately after threshing, the seed is thoroughly dried in the sun otherwise its viability may be effective adversely. After drying, the seed is cleaned and graded through air-screen cleaners.

Table 13. Seed standards(%)

Items	Class of seed	
	Foundation seed	Certified seed
Pure seed	98.00	97.00
Inert matter	2.00	3.00
Other crop seeds Germination	0.05	0.10
Moisture content	70.00	60.
i) ordinary container	6.00	6.00
ii)vapour proof container	5.00	5.00

Management of insect pests and diseases:

Mustard saw -fly ***(Athalia lugens proxima)***: Black larvae looking like caterpillars feed gregariously on leaves. One spray of Quinalphos or Chlorpyriphos at may be done .

Aphids (*Lipaphis erysimi ,Myzus persicae)*: Green to black nymphs and adults suck sap and devitalise plants. One spray of Phosphamidon,Dimethoate and Oxymethyle demeton (0.05%) is enough for control the infestation.

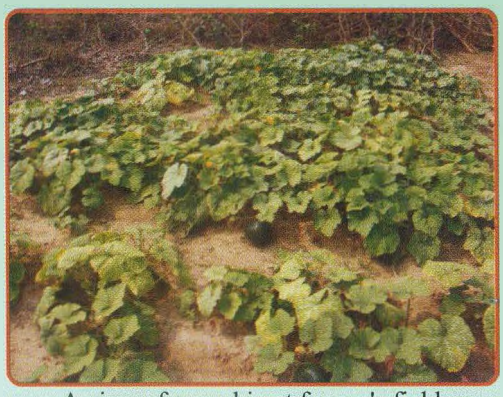
Striped flea beetle *(Phyllotreta striolata)*: Seedling have large number of adults feeding on them and causing small holes. Spray Quinalphos or Chlorpyriphos (0.05%).

Diseases

Mosaic: It is transmitted by aphids. The affected plants are conspicuous by stunting, reduced leaf lamina and root size. Diseased leaves show interveinal chlorosis, vein banding and dark green patches on light green leaves. The disease incidence is 10- 60%. The disease spread can be minimized by one soil application of Carbofuran @ 1.5 kg/ha at the time of sowing, followed by 2-3 foliar sprays of Phosphamidon (0.05%) at 10 days interval.

CUCURBITACEOUS VEGETABLES

Being warm season crops, cucurbits are of tropical origin, mostly in Africa, tropical American and South East Asia. This group consist of a wide range of vegetable crops cultivated in India. Cucurbits are used either for cooking (all the gourds) or as salad (cucumber and long melon) or as desert fruits (muskmelon and watermelon) or canded or preserved (ash gourd). In general, the cucurbits are annual except few perennials like chow-chow and ivy gourd. Participation of


A view of pumpkin at farmer's fields

women in pumpkin cultivation was found to be high in activities like seed cleaning, grading, sowing, watering, manuring, staking, harvesting and storage of fruits and seeds for sowing in next season crop. It has been observed that women cooked and consumed its young leaves, tender stem and flowers. When the pumpkin attains a deep orange color, it is time for harvesting. Seed production of cucurbits vegetables is easy and women can be produce seeds at their home for future use. Cut it with several inches of stem, so that the pumpkin stays fresh for longer periods of time. Put it in sun for about one week and then stored it in a cool and dry place. Most of the cucurbits are propagated by seed, besides few vegetatively propagated ones like pointed gourd (parwal). This group commonly called vine crops belong to the family "cucurbitaceae". This family include about 117 genera and 825 species distributed in the warmer regions of the world. In India alone 36 genera and about 100 species of cucurbits have been reported, however, in this chapter seed production method for crops commonly grown in North-India is discussed below .

Climate:

Cucurbits are warm season crops hence, mainly cultivated in tropical and sub-tropical regions. For proper growth and development cucurbits require long warm dry weather and abundant sunshine except few which do not stand extreme dry weather but require moderate humid condition (pointed gourd).These crops are sensitive to even slightest frost, hence require partial protection if grown during winter months (river bed cultivation). Excessive humid conditions promote disease and pests.

Most of the cucurbits germinate best when day temperature is above 25^0 C. For normal growth average monthly temperature should be around 30^0C with minimum and maximum range between 20^0 C - 40^0 C. Melons grow best in tropical climate with fairly high temperature of 35 -40^0 C particularly during fruit development stage. Other such as gourds are grown mostly in summer as well as rainy season.

Varieties :

Cucumber:

I) **Poinsette**: An American introduction multiplied by National Seeds corporation. Originally developed at Charleston (South Carolina) USA. Fruits dark green, 20 to 25 cm long and cylindrical. Resistant to downy mildew, powdery mildew, anthracnose and angular leaf spot diseases.

II) **Kalyanpur Green**: Vines of this variety are about 2.5 meters long with light green hairy leaves. Fruits green and ready for picking in 60 days.

Watermelon

i) **Charleston Grey:** Old variety of USA characterized by large sized oblong to cylindrical fruits. Flesh red, thick with less seeds. Suitable for long distance transportation, Resistant to fusarium wilt and anthracnose.

ii) **Sugar Baby**: An early American variety released by IARI, New Delhi. Fruits smaller weighing 3-4 kg, round having bluish black rind, deep pink flesh (11 to 13% TSS) and small seeds, Fruits ripen within 85 days.

Management of inspect pest in pumpkin

iii) **Asahi Yamato:** A mid season Japanese variety released by IARI, New Delhi. Fruits medium weighing 6 to 8 kg. Rind colour light green with deep pink flesh (11 to 13%TSS). Fruits ripen in 95 days.

vi) **Durgapura Meetha**: Released by Agriculture Research Station, Durgapura, Rajasthan . A late variety maturing in 125 days . Fruits round and light green, rind thick with good keeping quality. Flesh sweet (11% TSS) with dark red colour. Average fruit weight 6-8 kg.

Bottlegourd

i) **Pusa Summer Prolific Long:** Released by IARI, New Delhi. A prolific bearer (10-15) fruits per vine), fruits 40-50 cm long, pale green in colour. Suitable for both summer and rainy season.

ii) **Pusa Navin:** Released by IARI, New Delhi. Fruits green, straight, smooth, 20-25 cm long weighing about 250 g. Suitable for both summer and rainy season.

iii) **Punjab Komal:** Released by PAU, Ludhiana. This variety is prolific bearer 10-12 fruits per vine, fruits medium sized, light green. Bear fruits on fifth node and tolerant to cucumber mosaic virus.

iv) **Pusa Summer Prolific Round:** Released by IARI, New Delhi .Prolific bearer, fruits round 15-18 cm in girth when young) and green in colour.

Bittergourd

i) **Pusa Do Mausmi**: Released by IARI, New Delhi. Fruits reach edible stage in about 55 days, fruits dark green, long, medium thick, club shaped with 7-8 continuous ridges, 18 cm long at edible stage, 8-10 fruits weigh one kg. Suitable for both spring summer and rainy season.

ii) **Coimbatore Long:** A selection by National Seeds Corporation, prolific bearer, fruits long and white in colour. Suitable for rainy season.

iii) **Arka Harit:** Released by IIHR, Bangalore, Fruits are attractive , spindle shaped with green colour, small in size with smooth regular ribs. Suitable for both summer and rainy season.

V) **Pusa Vishesh**: Developed by IARI, New Delhi.Vine growth less, hence planted at closer spacing. Fruits tender, green with medium length. Suitable for pickles and canning.

vi) **Kalyanpur Baramasi:** Developed at Vegetable Research Station, Kalyanpur, Kanpur. Vines dark green, fruits 20-25 cm long, dark green with flat and pointed ends having 8-10 seeds. Picking starts in 65 days. Tolerant to fruit fly and mosaic.

Ridge Gourd:

i) **Pusa Nasdar:** Released by IARI, New Delhi. An early variety, starts fruiting in 60 days, fruits ridged club shaped,15-20 per vine, light green in colour.

ii) **Punjab Sadabahar**: Developed by PAU, Ludhiana. Vine growth medium having dark green leaves. Fruits 3-5 cm thick, green, ridged and tender. This variety is suitable for rainy season.

Pumpkin

i) **Pusa Vishwas**: It is developed by IARI, New Delhi .Vine growth vigorous, leaves dark green with white spots. Fruits round and light brown. Flesh thickness good with yellow colour. Average fruit weight 5 kg and mature in about 120 days.

ii) **CO-1** : Released by Tamil Nadu Agricultural University, Coimbatore. Late maturing, globular fruits weighing 7-9 fruits.

Ash Gourd

i) **CO-1:**Released by Tamil Nadu Agricultural University, Coimbatore. Crop duration medium (140 days), fruits globular weighing 5-6 kg with less seeds. Six to eight fruits per vine.

ii) **CO-2**: Released by Tamil Nadu Agricultural University, Coimbatore. Early maturing (120 days), fruits small weighing 3 kg, spherical, flesh light green with less seeds. High yielder than CO-1.

Flower Characters and Pollination

Flowers are borne in singles and clusters in leaf axils. They are classified mostly as monoecious, andromonoecious (in musk melon) and dioecious (which are usually propagated vegitatively). Staminate flowers born on long pedicels have complete corolla, free filaments and three stamens of which two stamens have two locules and one unilocular. Pistillate flowers are

epigyeous, usually with three carpels terminated by three biloped or devided papillate stigma and these are usually borne singly or short peduncles.

The very fact that staminate and pistillate flowers are separate on the same plant, imposes a situation conducive to cross pollination. This group of crops is classified, but in nature, self pollination does take place. The extent of cross pollination ranges from 60 to 80 per cent under different environmental conditions. Flowering in cucurbits, normally starts in about 40 to 45 days after sowing. The sequence of flowering follows a set pattern, namely the first 4 to 5 flowering nodes would bear staminate flowers and later pistillate flower appear on few nodes on the main axis and secondary branches.

Anthesis, pollen dehiscence and fruit set in cucurbits are influenced by environmental factors. Usually, fruit set takes place in the early morning between 6 a.m. to 8 a.m. in the month of March and April in cucumber, muskmelon, watermelon and pumpkin. Optimum temperature favouring anthesis and dehiscence is from 13^{0}C to 18 ^{0}C. Cucurbits like bottle gourd and bitter gourd, which flower later in the day and sets fruits at higher temperature in after noon.

Isolation: Minimum distance of 1000 meters for foundation seed and 500 meters for certified seed between two varieties of the same species has been recommended for maintaining the purity of a variety.

Method of seed production

Soil: A well drained loamy and fertile soil rich in organic matter is preferred for cultivation of cucurbits. Soil pH should be between 6 to 7. All cucurbits are sensitive to acidic and alkaline soils. For quick germination and early maturity the soil temperature should not go below 10^{0}C and maximum beyond 25^{0}C, the optimum range is around 18-22^{0}C. Cucurbits require good moisture but not excessive during vegetative growth.

Manures and fertilizers

All cucurbits respond well to organic manure and fertilizers. Approximate 15 tonnes well rotten FYM, 50-55 kg nitrogen, 25-30 kg potash per hectare is required. FYM or compost is applied about 3 weeks before sowing at the time of field preparation. Full dose of phosphorous and potash and one third dose of nitrogen is applied before last ploughing. Remaining two third nitrogen is applied in two equal splits i.e. first at the time of vining and second 15 days later.

Sowing time: In north India seed of water melon, bitter gourd and pumpkin is sown from mid-February to 1st week of March, while other cucurbits are sown during rainy seasons i.e. June-July.

Care of crop: Soil moistures is an important factor for germination particularly in crops like bottle gourd, bitter gourd and luffa whose seed coat is thick, therefore, adequate moisture has to be maintained at the time of emergence. After germination, irrigate the crop as per requirement. Irrigation water should be restricted to the base of plant or root zone and it should not wet the

vines or vegetative parts, particularly during flowering, fruit set and fruit development stage. Usually, irrigation frequency is reduced, when the fruits reach near maturity and completely stopped in the last stage of harvest.

Table 14. Seed rate and planting distance:

Crops	Seed rate (kg/ha)	Planting	
		Row to row (mt)	Hill to hill(cm)
Watermelon	3.5-5.0	3.0-4.0	60-90
Muskmelon	2.5-3.0	2.0-2.5	45-60
Pumpkin	5.0-6.0	2.5-3.5	60-90
Cucumber	2.5-3.0	1.5-2.0	45-60
Bottlegourd	4.0-5.0	3.0-4.0	60-90
Bittergourd	4.0-5.0	1.5-2.0	30-45
Ridgegourd	4.0-5-0	1.5-2.0	60-75
Sponge gourd	4.0-5.0	3.0-4.0	60-90

Roguing : The cross pollinating nature of cucurbits promote variation even within a pure cultivar. Therefore, removal of off type variants is absolutely necessary to maintain purity of a cultivar. In most of the cucurbits selection of desirable plants is possible at the time of fruit maturity. To maintain purity, all wild species and off type plants should be rogued out before flowering. All plants infected by mosaic and viruses should be rogued out as and when observed. In fact there is need to continuous roguing during vegetative, flowering and fruit development stage should be carried out.

Table 15. Specific requirement (Field standard)

Items (for all cucurbits)	Max. permitted percentage	
	Foundation seed	Certified seed
Off type	0.10	0.20
Seed borne diseases (mosaic in muskmelon)	0.10	0.20
Not seed borne diseases (viruses)	0.10	1.00
Wild spp/objectionable weeds	none	none

Field inspections :Number and plant growth stages for Field inspections for certification purposes for all cucurbits are as under :

1. Before flowering
2. At flowering and immature fruit stage
3. Mature fruit stage

Harvesting and seed extraction : For seed purpose harvest only the earlier set, full ripe fruits because such fruits produce plump seeds and higher yield.

In case of bottlegourd, sponge gourd, and ridge gourd seed is extracted when fruits are dry and seeds rattle inside the shell. The shells have to be broken to extract the seed and clean them.

In case of water melon select fully mature and ripe fruits on the basis of quality characters (TSS and flesh colour). The seed of cucumber, bitter gourd and pumpkin is mixed with pulp and placentae. There are three methods of seed extraction:

i) The seed of these crops is scooped out with pulp. This scooped material is rubbed with sand or ash (to remove the pulp), washed and dried.

ii) The pulp with seed is fermented for 48 hours (add some water, if required). This fermented material is washed to separate the seeds from pulp and then seed is dried.

iii) The seed can also be separated by acid treatment. Add 25 to 30 ml HCI or 10 ml commercial sulphuric acid per 25 kg of pulp containing seed and stir well and left for 25-30 minutes. Then wash the seed thoroughly to remove the acid, pulp and floating seeds. After washing is dried in sun.

Seed yield: Seed yield varies with location and availability of pollinators, however, the average seed yield is given below;

Table 16. Crops and their seed yield

Crops	Seed yield(q/ha)
Long melon, muskmelon,watermelon, round melon	2-3
Cucumber	1-2
Bottle gourd, sponge gourd, summer squash	5-6
Bitter gourd, Ridge gourd	4-5

Table 17. Specific requirement (Field standard)

Items	Class of Seed	
	Foundation seed	Certified seed
Pure seed (minimum)	99.00	99.00
Inert matter (maximum)	1.0	1.0
Other crop seeds (maximum)	0.05	0.10
Total weed seed (maximum)	0.10	0.10
Objectionable weed seed (maximum)	None	None
Germination (minimum)	60.00	60.00
Moisture content (maximum)		
i) Ordinary container	7.00	7.00
ii) Vapour proof container	6.00	6.00

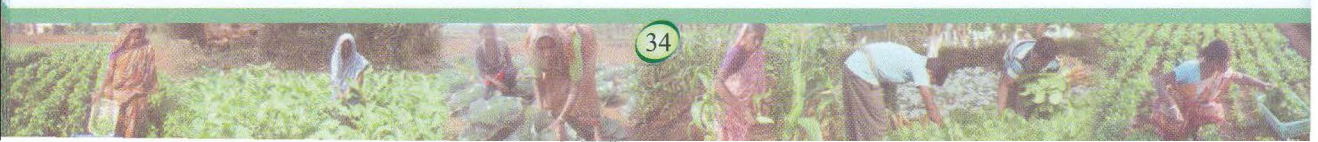
Management of insect pests and diseases

Pest

1.**Red pumkin beetle**

Raphipoplpa foveicollis

These are orange-red coloured elongated small beetles. The beetles attack most of cucurbits at seedling stage and make holes in newly leaves. In case of severe attack the crops is totally destroyed .They attack the vines in grown up stage also. Grubs feed on the roots at a depth of 5-10 cm resulting in wilting of plants.



Management

Spray 500 ml Endosulphan 35 EC or 150 ml Cypermethrin 10 EC in 250 litre of water per hectare. For the control of grubs apply 4.0 litre Chlorpyriphos 20 EC or 2.5 litre Endosulphan 35 EC with irrigation water on moth after sowing.

Note :

i) Use only recommended quantity of pesticides as cucurbits are sensitive to pesticides.

ii) Do not dust when leaves are wet.

2.Aphids (*Aphis* sp.) and mites (*Tetranychus* sp.)

These pests cause damage by sucking the plant sap.

Management

To control these pests spray 625 ml malathion 50 EC in 625 litre of water hectare at 10 days interval.

3.**Fruitfly** (***Bactrocera cucurbitae***)

The adult fly lays eggs below the skin of the young ovaries. The eggs hatch into maggots which feed inside young fruits and cause rotting. The fly attack is severe after summer rains when the humidity is high. The damage is more serious in ridgegoud, bitter gourd and watermelon.

Management

Control of maggots is very difficult because they are living inside the developing fruits. The adult flies can be controlled by spraying 625 ml fevitrothion (Eccothion /folithion/sumithion) 50 EC or 1.250 kg carbaryl-50 WP in 625 litre of water. Add 3.0 kg Gur molasses in this solution. Repeat the spray at 10 days interval.

Note : Collect and destroy the rotten fruits.

Diseases :

1.**Powdery mildow** (*Sphaerotheca fuliginea*)

The fungus forms white flory patches or coating on the leaves, stem and other succulent parts of the plant, particularly in dry weather. In severe cases disease covers both the surfaces of leaves which shrivel and defoliation may occur.

Management

A single dusting of Wettable sulphur (0.2%) @ 20-25 kg /hectare on the affected plant check the disease entirely. Apply dust in the morning or in the evening. Avoid dusting when the temperature is high during the day.

2. **Downy mildew** (*Psedoperonospora cubensis)*

This disease is prevalent in areas of high humidity, especially when summer rains occur regularly. The disease is characterized by formation of yellow or purplish, angular spots on upper surface of leaves. In severe cases leaves dry up and death of plant may occur.

Management

Removed badly infected leaves followed by spray the crop with Mancozeb at 10-15 day interval prevents spread of disease.

3.Anthracnose (*Colletotrichum* sp.)

This disease is promoted by high humidity and moist weather. In case of cucumber reddish brown dry leaf spots are formed which cause shrivelling and death of leaf. Lesions on petioles and stems are water soaked and yellowish. It spreads to fruit in bottle gourd and watermelon in severe case of incidence.

Management

Spray 500 g of Mencozeb (0.25%) in 250 litre of water hectare at 15 days interval.

4. Mosaic

Leaves of affected plant shows yellowish and greenish spots. Yield is reduced considerably.

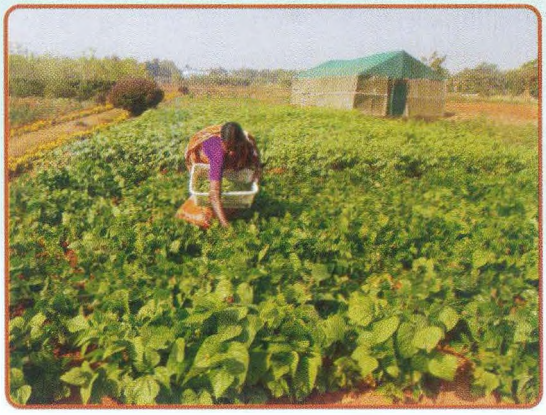
Management

i) Rogue out all infected plants at regular interval.

ii) To control insect vectors foliar spray of 625 ml Malathion 50 EC in 625 litre of water per hectare at 10 days interval. Select seeds from healthy plants for sowing.

COWPEA

Cowpea (*Vigna unguiculata*) also known as southern pea and black -eye pea, is one of the most important vegetables. It is cultivated for its long , green or purplish pods to cooked as vegetable or for dry seeds used as pulse. Its foliage is also used as fodder or green manure. Cultivated cowpea belongs to 3 groups common cowpea, producing 20-30 cm long pods with small seeds. In India, cowpea has been known since the Vedic period and it is grown throughout the country.



Harvesting of cowpea at regular interval

Climate and soil

Cowpea can be grown almost in any type of soil but well-drained loam or slightly heavy soils are better. Saline or alkaline soils are not good . It is a warm season crop and can be grown in all tropical and subtropical areas. It can tolerate drought to some extend but cannot tolerate water logging. The germination is better at 12^0-15^0 C temperature and the crop thrives best between 20^0-35^0C temperatures. Frost is harmful to this crop. Partial shade can be tolerates. The varieties show varying response to temperature and day length.

Varieties

The criteria in the development of cowpea varieties for vegetables purpose have been primarily the pod yield and its quality. However, some varieties are dual purpose and are suitable for green pods seed production .

Cowpea 263 : Its pods are 20 cm long, flat and tender. The first harvesting is a available in 45-50 days. It is suitable for rainy as well as summer season. It is less susceptible to mosaic virus and yield much better than Pusa Dofasali in both the seasons.

Narendra Lobia 1: The plant becomes 40-50cm long with large leaves. Green pods are 28-30 cm long with purple terminal end. Each pod contains 10-12 seeds which are bold with black hilum. It takes 45-48 days to gives first pod harvest and 75-80 days for seed maturity. Being photo -insensitive, it is also suitable for rainy as well as summer season.

Pusa Barsati: It is suited for rainy season cultivation. It is early maturity variety giving first picking in 45 days. The pods are light green, 25-28 cm long , conditioning larger green seeds.

Pusa Dofasali: The plants are dwarf and bushy yielding first harvesting in 50 days. The pods are light green, erect, about 18 cm long with creamy-white seeds having red coloured hilum. It is photo -insensitive and can be grown in rainy as well as summer season.

Pusa Komal: The plants are dwarf and bushy and the first green pods are available in about 60 day. Pods are light green, cylindrical, about 22-22 cm long with creamy- white seeds. It is resistant to bacterial blight and suitable for rainy as well as spring- summer sowing.

Pusa Phalguni: Its plants are dwarf and bushy and yielding first picking in 60 days . The pods are dark green, erect, about 12.5 cm long with cylindrical white seeds. It is more suited for spring sowing .

Pusa Rituraj: The plants are bushy and prolific-bearer. The pods are about 22-24 cm long . Thin with brown seeds when dry. Being highly photo-thermo insensitive, it can be grown during rainy as well as summer season. It takes 40 -50 days to yield first harvest. It is a dual purpose variety since its pods as well as seeds are suitable for cooking .

Yard Long Bean: This is commonly grown in home gardens particularly in eastern Uttar Pradesh, Bihar and West Bengal. Its pods are 50 cm long. The plants are pole type having 2-3 m height. It is a late -maturing verity.

Harvesting of cowpea for seed purpose

Cultivation

In most of the areas, cowpea is grown during the rainy and summer season. Sowing in June- July is common for rainy season crop, but it could be extended to August for early-maturing bush varieties. Similarly, sowing in February -March

is common for summer crop, particularly in northern plains, which could be extended up to mid-April. In areas having mild climate it is also grown during winter season. In hills, it is sown during April -July.

A seed rate of 12-15 kg/ha is enough for rainy season crop , while 20-25 kg/ha is required during summer. Keep a spacing of 45-60 from row to row during rainy season and 30 cm during summer season. Adequate moisture in the soil is essential before sowing.

Manuring and fertilization: Depending upon availability, 15- 20 tonnes /ha of farmyard manure may be incorporated in the soil at the time of field preparation. Being a leguminous vegetables, cowpea does not require heavy nitrogen fertilization. Thus, only 20-25 kg/ha N along with 50-70 kg/ha of P_2O_5 and K_2O may be applied as basal dose before sowing. Seed inoculation with *Rhizobium* culture is beneficial. In zinc -deficient areas zinc sulphate @ 10-15 kg/ ha may be applied in the soil.

Irrigation : Cowpea requires lighter but frequent irrigation. It is sensitive to water logging. During rainy season no irrigation may be required but in absence of timely rains period 1or 2 irrigations may be essential. The summer crop needs irrigation after every 8-12 days depending on soil and weather conditions. In sandy loam soil irrigation at 75% available moisture is optimum.

Aftercare

Effective weed management in first 25-30 days of the crop period is essential at least 2 weeding and hoeing are needed to check the weeds . Fluchloralin @ 1kg/ha as pre plant incorporation in the field or Alachlor or Nitrofen @ 2.0kg /ha each as pre-emergence spray are effective in controlling the weeds.

The pole type varieties need support, since the plants have twining growth habit. Such varieties are often restricted to kitchen gardening. The bush type cowpea can also be intercropped with maize. Cowpea is suitable to fit in several copping sequences consisting of cereals and vegetables. Spraying of maleic hydrazide (50-200ppm) before flowering improves pod set and yield.

Harvesting and post harvesting management: Depending on the season and variety, grain crop matures in 75-125 days. Generally for grain purpose, the pods are allowed to full maturity on plants and then the crop is harvested and threshed after proper drying. On an average cowpea provides 50-80q/ha of green pods, the dry seed yield being 12-15 q/ha.

For remunerative price it is better to remove the insect and disease damaged pods before marketing. Similarly fibrous and over mature pods should also be sorted out. For seed purpose, the harvested pods are dried for a few days before threshing. The threshed seeds after also dried sufficiently before storage in a cool and dry place.

Management of insects pests and diseases

Stem fly (*Ophiomyia phaseoli*): White puncture marks on basal leaves. Larvae are found at the base of plant beneath bark. Clean the field. One spray should be apply as and when observed

the insect infestation. If incidence is high, spray Phosphomidon (0.05%) or neem seed kernel extract (4%).

Pod borer (*Muruca testulalis, Lampides boeticus*): Caterpillars of the insect bore flower buds and pods. Remove the affected plants as soon as possible and spray Chlorpyriphos (0.05%) at flower -bud stage.

Bruchid (*Callosobruchus chinensis*): Damage is mainly caused in storage but infestation starts from field. Seeds are eaten by the grubs from inside and turned hollow. Dry seeds thoroughly before storage. Add 2 % edible oil (volume/ weight). It prevents incidence for 6 months.

Aphid (*Aphis craccivora*): Colony of aphids are noticed on young leaves and inflorescence. Apply Monocrotophos, Phosphamidon, Dimethoate, Oxymethyle, Imidachlorpid (0.05%).

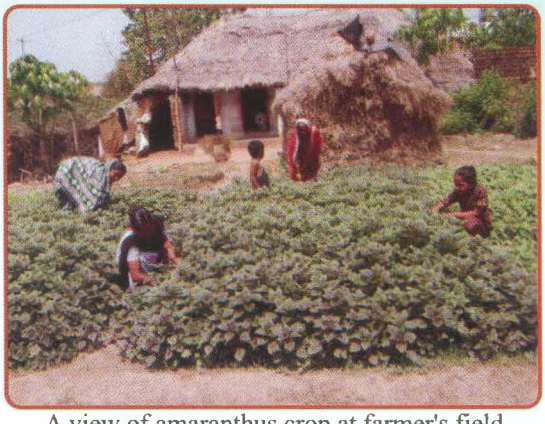
Diseases

Mosaic: Disease is transmitted by aphids. Mosaic mottling, vein banding and at time blistering of leaves. Use resistant varieties and diseases free seeds for control it.

Yellow flecks: It is transmitted by whitefly. Irregular bright yellow flecks gradually coalesce covering the entire leaf lamina. Leaves are reduced in size and defoliation starts early, losses in yield being 20- 30 %. Apply granular or emulsifiable insecticides and mineral oil.

AMARANTHUS

Leafy vegetables provide income and food security to the resource poor farmers especially for women. Among leafy vegetables amaranthus (*Amaranthus spp.*) popularly known as *chaulai* , is very nutritive and highly suitable crop for kitchen gardening and commercial cultivation . It is one of the cheapest leafy vegetable in sub tropical part of the country and could be a very valuable source for combating under- nutrition and mal nutrition in our country. Rapid growth ,quick rejuvenation after each harvesting and high yield if edible matter/ unit area in limited time as well as high nutritive value are its important features . Amaranthus can be grown throughout the year.



A view of amaranthus crop at farmer's field

Climate and soil: Amaranth can be grown on a wide variety of soil. However, sandy loam soil is best- suited for its successful cultivation. Soil should be prepared well by 2-3 repeated ploughings. Amaranth is a C-4 plant which can be make efficient use of CO_2 and suppresses its photorespiratory loss. The plants also grow better under adverse environmental conditions. They can photosynthesize at high rate even under high temperature. Hence, it is grown successfully in hot summer season and humid condition of *kharif* season.

Varieties

Important varieties developed through mass selection, polyploidy breeding and hybridization are described below:

Badi Chaulai: It is highly suitable for commercial cultivation. A quick-growing with green leaves this variety is suitable for growing both in summer and *kharif* seasons in plains. The leaves and stems are bigger in size. The variety is suitable for commercial cultivation.

Inspection of amaranthus crop at flowering stage

Chhoti Chaulai: Its plants are erect, thin and dwarf, leaves are small size and green . It is low yield and is suitable only for kitchen and container gardening.

Co1: Its leaves are dark green, broad with ridge surface, stem is round, glossy green and succulent. It yields 100 q/ha 30-35 days after sowing. The flowers mature in 90-95 days .

Co2: It leaves are long, green and lanceolate. The stem is green, highly suited for tender greens. Its greens become ready for picking 20 -25 days after sowing, the yield being 130q/ha. Inflorescence is green, terminal and unbranched with small flower clusters in the leaf axil. It flower in 40-45 days and matures in 85-90 days .

Pusa Kiran: Its leaves are glossy green with broad ovate lamina. The lamina is 7-9 cm long and 6-7 cm wide. The petiole is 5.5-6.5cn long. The stem is glossy green. It is suitable for *kharif*. It becomes ready for first picking 21-25 days after sowing, the duration of harvest being 70-75 days. It takes 95-100 days to flower and yield is 35 tonnes/ha.

Pusa Lal Chaulai: It is suitable for kitchen gardening as well as for commercial cultivation in northern plains . Since the colour of stems and leaves is bright red (magenta), it is suitable for ornamental purpose also. The red dry extracted from its plants could be used as natural food-additive . The dry can also be used in textile or woollen industry for dyeing. Pusa Lal Chaulai is suitable for growing in both summer and rainy season. On an average, it yields 45-50 tonnes/ha.

Pusa Kirti: It is recommended for commercial cultivation in summer season. The leaves of Pusa Kirti are green with broad obvate lamina 6-8 cm long and 4-5cm wide. Petiole is 3-4 cm long . It is ready for first picking 30-35 days after sowing . Its subsequent cuttings may be taken at 10-12 days intervals, the yield being 50-55 tonnes /ha.

Sowing: Amaranth should be sown during mid- March for summer crops and mid July for *kharif* crop. About 1.5-2.0 kg seed is enough for a hectare. Since seeds are very small, they should be mixed well with sand and sown in rows at 1cm depth at a spacing of 30 cm. After sowing, a light irrigation is essential for ensuring good germination. Seedlings 2-3 cm long is thinned out to a spacing of 3-4 cm.

Manuring and fertilization: A dose of well-rotten farmyard manure @ 10-25 tonnes/ha should be incorporated at the time of field preparation. Application of 150kg single superphosphate and 80-100 kg potassium sulphate/ha is also recommended at the time of land preparation. A dose of 75-90 kg/ha urea should be top dressed in 3 split doses. The first dose should be applied 15-20 days after sowing, whereas second and third after first and second cuttings.

Irrigation: Since amaranth is first grown as a short duration crop, it requires plenty of water for growth and high yield. In summer, frequent irrigation is required at 4-6 days interval. Similarly in *kharif*, irrigation is scheduled as per the moisture content of the soil.

Weeding: One or two weedings or hoeings are sufficient for controlling weeds. Hoeings between the rows not only check weeds but also reduce the number of irrigations.

Seed production: The agro-techniques for seed production are normally similar to those for leaf production. For seed crop, the plants should be maintained at 30cm x 30cm spacing. The fertilizer schedule of 50kg each of N and P and 30kg K/ha is recommended for better seed yield.

Isolation: Since it is a cross-pollinated crop, an isolation distance of about 400m is required between 2 cultivars. Generally, the crop used for leaf production is not used for seed production. Roguing of off-types is highly essential at different stages of crop growth.

Harvesting: Harvesting of seeds starts when the plants turn yellow or deep brown in colour. Drying of inflorescence is practiced while the sample seeds contain less than 15% moisture. Seeds are threshed with 6% moisture content are stored after treating with Bavistin @ 2g/ kg seed (Chadha,2001).

Management of insect pests and diseases

Leaf eating caterpillar (*Hymenia recurvalis*): Green slender caterpillars fold leaves on top of the plant, feed inside and skeletonize them. For control them destroy all wild amaranth plants and grasses from the surrounding areas. Remove infested plants. Spray Dichlorvos (0.05%), if required. Avoid spraying as far as possible to leafy vegetables.

Leaf - webber (*Lamprosema indicata*): Gregarious young green caterpillars fold leaves feed inside and skeletonize the plants. For control them destroy all wild amaranth plants and grasses from the surrounding areas. Remove infested plant parts. Spray Dichlorvos (0.05%), if required.

Aphids (*Aphis croccivora, Lipaphis erysimi*): Sometimes aphids or scales attack the plants, suck the plant sap and thus reducing marketability. For control them remove infested plant parts. If required, apply Monocrotophos or Phosphomidon (0.05%).

Scale (*Coccus hesperidum*): Sometimes scale attack the plants, suck the plant sap and thus reduce marketability. For control this insect, remove infested plants from the field. Avoid Damping-off spraying as far as possible. If absolutely essential then only spray Monocrotophos (0.05%).

Diseases

Damping-off (*Rhizoctonia* spp. *Pythium* spp.): Poor germination; seedling collapse; brown-black lesions girdling stem close to soil line; seedling fail to emerge from soil.

Management

Avoid planting seeds too deeply; do not plant seeds too thickly to promote air circulation around seedlings; do not over-water plants.

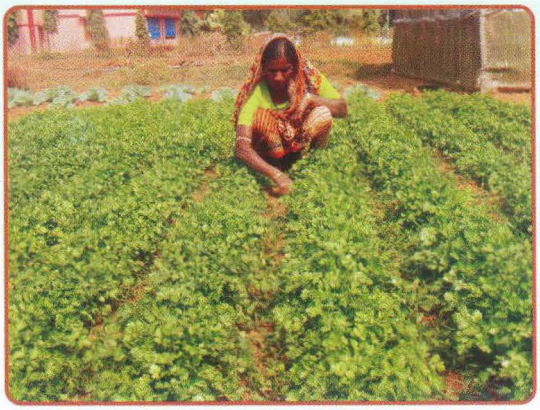
Wet rot (Choanephora rot *Choanephora cucurbitarum):* Water-soaked lesions on stems; lesions have hairy appearance due to presence of fungal spores; may cause loss of leaves. It is spread by fungus.

Management

Plant varieties resistant to disease; only use certified seed; do not plant crop densely; treat disease with copper fungicides if it emerges.

CORIANDER

Coriander (*Coriandrum sativum*) is used as common flavouring substance. The used stems, leaves and fruit have a pleasant aroma. The whole young plant is used in preparing chutney. Its leave is used for flavouring curries, sauces and soups. Dry fruits are extensively used in preparation of curry powder, pickling spices, sauces and seasonings. In medicines, its seeds are used as a carminative, refrigerant and diuretic. In India, coriander is cultivated in Andhra Pradesh, Rajasthan, Madhya Pradesh, Karnataka, Tamil Nadu and Utter Pradesh.



Weeding of coriander crop

Climate : Coriander is a tropical crop, it requires frost- free climate particularly at the time of flowering and seed formation. Dry and moderately cool weather during seed formation increases yield as well as quality of the produce.

Soil: In irrigated conditions, loamy soil is best suited for its cultivation, whereas in unirrigated ones black or heavy soil is better than loamy. Saline, alkaline and sandy soils are not suitable for its cultivation.

Varieties

RCr41: Its plants are tall, erect with small- sized grains. It is highly resistant to stem gall and wilt but moderately tolerant to powdery mildew. It matures in 130-140 days with an average yield of 9.2q/ha.

RCr20 : It plants are bushy and spreading with medium height. It produces oval, large-size grains. It is moderately tolerant to powdery mildew, wilt as well as stem gall. It matures in 100-110 days with an average yield of 10q/ha.

RCr 446: Its plants are leafy and erect with higher number of grains. Seeds are medium- size. It matures in 110-130 days with an average yield of 12q/ha.

GC 1: Its plants are erect with medium -size, round, yellow, coloured grains. It is moderately tolerant to wilt and powdery mildew. It matures in 122 days with an average yield of 11q/ha.

GC 2: Its plants are of semi-spreading habit with dense, dark green foliage and medium -size grains. It is moderately tolerant to wilt and powdery mildew. It matures in 110 days with an average yield of 14. 5 q/ha.

Sindhu: Its plants are dwarf with bold, oval, straw-coloured grains. It is tolerant to wilt and powdery mildew, and resistant to aphids. It matures in 120 days with an average yield of 10.5 q/ha.

Sadhna: Its plants are semi erect with bold, oval , straw-clouded grains. The variety is tolerant to white fly and mites. It matures in 100 days with an average yield of 10.3q/ha.

Co3: Its plants are dwarf with medium-bold, oblong, brownish -yellow grains. It is tolerant to wilt, powdery mildew and grain mould. It matures in 86-104 days with an average yield of 6.5 q/ha.

CS 287: Its plans are early-maturing with medium -sized, oblong , straw grains. It is tolerant to wilt and grain mould . It matures in 78-97 days with an average yield of 6.0 q/ha.

RD 44 (Rajendra Swathi): Its plants are medium -size with fine, round, aromatic grains. It is resistant to stem gall and moderately resistant to wilt, aphids and weevil. It matures in 100 days with an average yield of 13q/ha.

Sowing : Last week of October is optimum sowing time of coriander. Delayed sowing reduces the plants growth and increases the incidence of diseases and pests. A seed rate of 12-15 kg/ha is sufficient under irrigated conditions , whereas 25-30 kg/ha is required for un irrigated conditions. Sowing should be done 30 cm apart in lines with a plant to plant distance of 10 cm, whereas in heavy soils or fertile soils 40 cm spacing between rows is recommended.

A view of coriander crop

Manuring and fertilization: Add farmyard manure @10-20 tonnes/ ha while preparing the field. Apply 20kg N, 30 kg P and 20kg K ha/at the time of sowing in irrigation as well as in un irrigated crop. In irrigated coriander, an additional dose of 40 kg N/ ha should be applied in 2 equal splits 30 days and 75 days after sowing.

Weed control: Thinning, first hoeing and weeding should be done 30 days after sowing as initial growth of coriander is slow. Second hoeing and weeding in irrigation coriander may be done between 50 and 60 days of sowing depending upon the growth of weeds. Pre-plant Fluchloralin @ 0.75kg/ha, pre - emergent Oxyfluorfen @ 0.15 kg/ha or Pendamithalin @1.0kg /ha are effective herbicides.

Coriander crop during flowering stage

Irrigation: Depending upon the climatic condition, moisture retaining capacity of soil and variety used, 4-5 irrigations 30-35, 60-70, 80-90, 100-110 and 110-150 days after sowing respectively are to be done.

Harvesting: Its seeds should be harvested when 50% seeds turn yellow. Leaf plucking (50%), 75 days after sowing helps generate extra income . The harvested material should be dried in shade to retain seed colour and quality. If it is not possible then material should be kept in bundles upside down to avoid direct sun ray on seeds which reduces their quality. After drying, seeds are separated by light beating with sticks and winnowing.

Yield: An yield of 12- 25 q/ha under irrigation condition and 7-8 q/ha under unirrigated condition can be easily obtained. Clean and dried seeds filled in bags are stored in damp-free aerated stores.

Management of insect pests and diseases

Cutworms (*Agrotisspp; Peridromasaucia Nephelodes minians)*: Stems of young transplants or seedlings may be severed at soil line; if infection occurs later, irregular holes are eaten into the surface of fruits; larvae causing the damage are usually active at night and hide during the day in the soil at the base of the plants or in plant debris of toppled plant.

Management

Remove all plant residue from soil after harvest or at least two weeks before planting. This is especially important if the previous crop was another host such as alfalfa, beans or a leguminous cover crop.

Aphids (*Cavariella aegopodii)*:

Small soft bodied insects on underside of leaves and/or stems of plant; usually green or yellow in colour; if aphid infestation is heavy it may cause leaves to yellow and/or distorted, necrotic spots on leaves and/or stunted shoots; aphids secrete a sticky, sugary substance called honeydew which encourages the growth of sooty mold on the plants.

Management

If aphid population is limited to just a few leaves or shoots then the infestation can be pruned out to provide control; check transplants for aphids before planting; use tolerant varieties if available; reflective mulches such as silver coloured plastic can deter aphids from feeding on plants; sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves; insecticides are generally only required to treat aphids if the infestation is very high.

Diseases

Wilt (*Fusarium oxysporum f.sp. corianderi)*: Root infestation results in dropping of terminal shoots, followed by withering and drying of leaves. Partial infection shows yellow to pink foliage. Adopt summer ploughing twice or thrice and crop rotation. Select healthy seed. Use tolerant lines- Sindhu, Co3, Gujarat Coriander I and II.

Powdery mildew (*Erysiphe polygoni*): Infection occures as whitish circular patches on leaves and stems and later white powdery mass appears. Affected inflorescences dry up. Total loss of crop in case of death of plants. When partially infected plants appear stunted. Occasionally plants become sterile, if seed- set noticed seeds are light and immature. Use disease- tolerant varieties e.g. Sindhu, Co3, Gujarat Coriander I and II and Swathi. Use wettable sulphur (0.25%).

Stem gall (*Protomyces*): Tumour like swelling on stems, petioles, pedicels and vein of leaves. Tumour like growth affects the yield up to 30- 90%. Treat seed with Thiram @ 250g/100kg seed. Spray plants with 0.25%Thiram.

CONCLUSION

Hence, seed production of vegetable crops have a huge potential for providing livelihood security to farmwomen. It will be helpful for income security of farmwomen in the field of horticulture. After attending skill "Training cum exposure visit programmes on seed production" women will able to produce seeds of vegetable crops like tomato, brinjal, chilli, pumpkin, bittergourd, cowpea, okra etc., at their home. Therefore, it is important that seed production technology, enterprise and scheme can be promoted among farmwomen by the State Agriculture Department and Private Seed Industries for an employment opportunity and as a source of income throughout the year.

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Gender friendly vegetables seed production technologies