

Nursery management in vegetable crops for enhancing farmers' income

The production of healthy seedlings plays a vital role in the establishment of a healthy crop in the main field. Nursery management of vegetable crops is primary and most important aspect in enhancing vegetable production and profitability. Majority of germinating tender saplings get damaged due to certain biotic and abiotic factors in the process of nursery raising due to which farmers incur great loss. Farmers are still following their age old traditional method of nursery raising of vegetables. Farmers of Diara region are compelled to raise their vegetable nursery at very limited and specified places located at higher elevation due to threat of floods every year and 60-70% saplings are lost. This article focusses on nursery management in vegetable crops to enhance the income and reduce losses.

IN nursery, plants are nurtured with optimum growing conditions to ensure proper growth. Nursery saves considerable time for the raising of the next crop. The aim of good nursery management is to make planting material of the highest possible quality available for new development areas and replanting. Poor planting materials lead to low yield and unnecessary maintenance in transplanted field. There are a number of vegetables, viz. tomato, brinjal, chillies, capsicum, cauliflower, cabbage, knol-khol, Chinese cabbage, Brussels sprouts, broccoli, kale collard, celery, parsley, etc. which need nursery raised seedlings for transplantation in the main field. Seedling production is a major expense of vegetable growers and every effort should be made to produce good quality seedlings at a reasonable cost. So, the efficient nursery growing techniques are essential for the growers so that they can reduce the total vegetable production costs.

A vegetable nursery is a place or an establishment for raising or handling of young vegetable seedlings until they are ready for more permanent planting. In other

words “A nursery could be considered as a location where plants are cared for during the early stages of growth by providing optimum conditions for germination and subsequent growth until they become strong enough for planting in the open field conditions.” Nursery bed is defined as a prepared area in a nursery where seed is sown to raise the seedlings. The seedling is defined as a young sporophyte developing out of a plant embryo from a seed.

Why to raise the vegetable nursery?

Healthy seeds and seedlings are the first and essential requirement for achieving full yield potential of any vegetable crop. In recent years, vegetable growers have become highly conscious of the importance of quality seeds or seedlings because of higher pest and disease incidence, and poor germination due to improper management of moisture in beds. A major portion of the area under vegetable cultivation in India is now sown with hybrid seeds, which are costly but give higher yields and quality produce. In view of the high cost of seeds, some vegetable crops like tomato, brinjal, capsicum and cucurbits are being transplanted after growing nursery to achieve maximum germination count and healthy plant establishment. There are a number of vegetables which require special care during their early growth period and cannot be grown directly in the field because of small size of their seeds. The other reason behind it is high cost especially for hybrid seeds.

There are several other advantages of raising seedlings in nursery as listed below.

- It is possible to grow and maintain a large number of plants per unit area.
- Valuable and very small seeds can be raised effectively



without any wastage.

- Possible to protect the seedlings against biotic and abiotic stresses.
- Convenient to look after the young and tender seedlings in nursery.
- The management of seedlings can be done in a better way by efficient use of land, labour and capital compared to direct sown crop with minimum care as the nursery area is small.
- Uniform and 100% crop stand in the main field can be maintained.
- Favourable growing conditions can be provided easily for raising seedlings successfully.
- An early crop / standing crop in the field can be harvested, which can fetch higher price.
- More time is available for the preparation of main field because nursery is grown separately.
- Possible to provide favourable growing conditions for germination as well as growth.
- Eliminates the problem of difficult soils.
- Easy weed control.
- More accurate prediction of uniform harvest date.
- Development of entrepreneurship in rural areas.
- Employment generation especially for rural women.

Types of Nursery

Temporary nursery: This type of nursery is developed only to fulfill seasonal requirements or a targeted project. Such a nursery is, usually, small in size and is set up for a short period after which it is abandoned. Temporary nurseries are mostly used for raising seedlings of vegetables. Such nurseries are found near the main planting area. The main feature of temporary nursery is constructed for a short period. Intensive manuring and fertilisation is not necessary in such a nursery as it is constructed at a site rich in humus. As it is located near a planting site, the distance between the nursery and the actual planting site is less. No major transportation is required, and if any, the cost is less. Mortality or injury due to shock of lifting and transportation of seedlings is negligible due to less distance between the nursery and actual planting site. Initial investment in a temporary nursery is less as compared to a permanent one.

Permanent nursery: In this type of nursery, the plants are nourished and kept for a longer period of time till they are sold out or planted in a field. The area covered under such a nursery is larger than a temporary nursery and it has all features that are required in a permanent nursery. Some of the important cultural operations carried out in the permanent nursery throughout the year are as follows:

- It requires a large area and must be well connected by road.
- Such type of a nursery requires intensive management and supervision.
- High initial cost is involved in the establishment of such a nursery.
- Permanent nursery comprises office, store, nursery beds, irrigation source, electricity, transportation facilities, packing yard, manure.

Factor affecting management of vegetable nursery

It includes all such operations right from the emergence of young plantlet till they are fully grown-up or are ready for uprooting and transplanting in the main fields. There are a number of factors which affect the management of vegetable nursery like selection of nursery site, soil preparation, soil and seed treatments, nursery bed preparation, seed sowing, seed and nursery bed covering, removal of nursery bed covering, watering, aftercare, protection from insect pest and diseases and hardening. Carelessness of any one of these factors hampers the germination, growth and development of seedlings.

Selection of site for vegetable nursery

A nursery must be located in a pollution-free environment away from brick kilns, smoke-emitting industries and rough motorised roads as dirt and dust settle on plants, covering the foliage, which not only reduces the photosynthetic efficiency of plants but also gives them a dull look. It must be ensured that the nursery site gets adequate sunlight. However, care must be taken that the plants are protected against severe heat. Site is the basic requirement of a nursery. Site is a place upon which one can produce seedlings of vegetables. Qualities of a good site must have the followings:

- Full day availability of sufficient sunlight
- Availability of good irrigation facilities
- Well protected against animal damage, strong winds
- Should be less weedy
- Free from water logging
- Ensure good access like nearness of road but minimize road dust
- Good soil conditions with good water holding capacity
- Protected against severe heat
- Proper drainage must be provided
- Site is away (at least 50 m) from other vegetable farms to avoid the spread of pests and diseases

Preparation of soil for vegetable nursery

Soil should be loam to sandy loam, loose and friable, rich in organic content and well drained for raising vegetables seedling. The soil pH should be around 7.0. Soil preparation needs a deep plough of nursery land either by soil turning plough or by spade and subsequent 2-3 hoeing with cultivator. Remove all the clods, stones, and weeds from the field and level the land. Mix 4-5 kg well rotten and fine FYM or 500 g vermi-compost per square meter nursery.

Soil treatment before seed sowing in nursery

Soil contains harmful insects, their eggs, larva and pupa, spores of disease causing fungi, bacteria, nematodes and even weed seeds, which affect the growth and further development of the seedlings. These can be overcome by chemical and solar treatments. Soil may be disinfected by heating to the temperature of about 60°C for 30 minutes with the help of fume generating machines or by solarization treatment. There are a number of ways to treat the nursery soils.

Soil treatment with Formalin: Formalin solution is used to sterilize the soil. It is prepared by adding 2.5



Soil Solarization (View of summer season)



Soil Solarization (View of rainy season)

ml commercial grade formaldehyde per litre of water and the soil is drenched @ 4-5 litre of solution per m^2 to saturate the top soil surface up to a depth of 15-20 cm. The drenched area is covered with a polythene sheet of 200 gauges so that the fumes of formalin penetrate into the soil to kill the pathogens. The polythene cover is removed after 48 hours. The soil is raked so that the fumes of formaldehyde gas escape from it. The bed is kept open for 7-10 days prior to seed sowing. It must be ensured that there are no fumes of formaldehyde gas prior to seed sowing. If there is insufficient time to wait for nursery, formalin dust can also be used. A mixture of formalin dust and well rotten FYM in the ratio of 15:85 can be well mixed with the soil on the beds @ 400-500 g per m^2 .

Soil treatment with fungicides: Fungicides like captan or thiram @ 5 g/ m^2 are used to control soil-borne pathogens. These fungicides can also be used to drench the soil by preparing a solution of 2.5-3.0% and drenching @ 4-5 litre/ m^2 .

Soil treatment with insecticide: Insecticide, such as chloropyriphos @ 2 ml/litre of water is applied to a depth of 15-20 cm in the soil to kill insects, including ants, white ants, insects and their eggs, nematodes, etc.

Soil treatment with bio-agents: Certain biological agents like *Trichoderma* are used to control soil-borne pathogens. Bio-agents like *Trichoderma viridi* or *Trichoderma harzianum* @ 10-25 g/ m^2 are mixed in the soil, and after 2-3 days, the seeds are sown.

Soil treatment with hot steam: Hot steam can be used to treat the soil against harmful insect pests. After air tight covering using polythene sheet of the required area, hot steam is supplied for at least 4-6 hours continuously with the help of fumes generating machines.

Soil treatment with solar radiation (solarization): It is an environment-friendly method to control soil-borne plant pathogens, including bacteria, fungi, nematodes, insect-pests (eggs, larvae, pupa) and weeds. Solar energy increases the temperature of the soil, which helps control various soil-borne pathogens. The most appropriate time for soil solarization is April-June in North Indian plains when the temperature reaches 47°C or above. This treatment causes physical, chemical and biological changes in the soil.

Method of Solarization: After thoroughly wetting the raised nursery, beds are covered with transparent polythene sheet (200 gauge) for 5-6 weeks during summer as wet soil conducts heat better than dry soil and makes soil organisms vulnerable to being killed by heat generation. Make the covering airtight by covering the margins with compressed wet mud to check the loss of moisture and prevent the entry of air from beneath the polythene sheet. After 5-6 weeks, the polythene sheet should be removed and used for seed sowing. This way all weed seeds in top 5-6 inches soil, insect-pests, eggs, larva and pupa, damping-off causing pathogens are controlled.

Seed treatment

Some vegetables (example peppers) are relatively slow to emerge and need protection from seed and soil borne diseases. Seeds carry pathogen of certain diseases and insect pest. In order to avoid disease and insect pest problems, treating the seeds with chemicals prior to sowing the seed is advisable, because it protects the seeds both from seed and soil-borne infection. Most seed treatment products are fungicides or insecticides applied to seed before planting.

Nursery bed preparation

Nursery bed should be prepared according to the season and the crop. Field should be ploughed and leveled well. Soil should be worked thoroughly to obtain a fine bed, free of clods. In rainy season, raised beds are prepared but, in the winter, and summer season flatbed may also be prepared. However, it is beneficial to prepare beds 15-20 cm raised from the ground surface. The level of the bed surface should be made little slanting on the two sides. The breadth of the beds should not be more than 1 m and length 3 m. The standard size of nursery bed is 3 m × 1 m × 15-20 cm (l × w × h). A space of 30-45 cm between beds should be left for drainage and intercultural practices. 20-25 kg well rotten farm yard manure (FYM) is added in each standard size nursery bed. The number of nursery beds depends on the particular crop, season and growing area for transplanting. The length of beds should be prepared in North to South direction and width in East to West direction. Rows for sowing of seeds

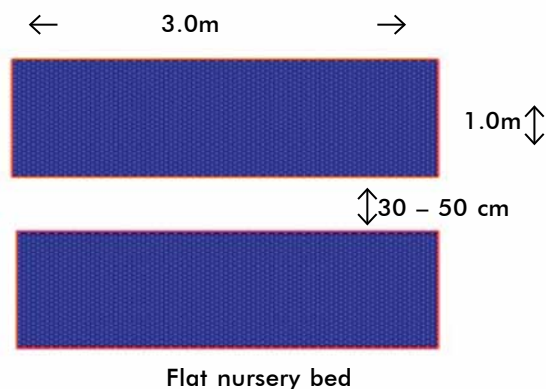


Orientation of nursery beds width (West-East)

should be made parallel in width from East to West at a distance of 3-5 cm apart so that full day availability of sunlight from sunrise to sun set is there in between the rows and chances of causing damping off seedlings could be avoided. During unfavourable weather conditions, the flower pots, polythene bags, potting plugs, wooden trays, earthen pots, etc. may be used for nursery raising. Soil, sand and compost mixture in the ratio of 1:1:2 are filled in seedling raising pots.

Flat nursery beds: Flat beds should be prepared 1 m wide from East to West and length of 3-5 m in North to South direction according to the need. After soil preparation, the recommended dose of manure and fertilizers is mixed in the nursery bed. A distance of 30-40 cm is left between two rows for drainage channels in case of heavy rain or excess irrigation during rainy season and also to look after the beds. Such a bed is prepared during non-rainy season (summer and winter) so that there is no water logging.

Raised nursery bed: Raised nursery beds are preferred in all the seasons and particularly during the rainy season. The nursery soil is labeled and made free of weeds, stumps, stones, pebbles, etc. The soil of the nursery bed is thoroughly mixed with 5–10 kg per m² well rotten farmyard manure. This type of bed is prepared about 15-20 cm high from the ground level and 3×1 m or 5×1 m in size in the same direction as given in flat beds. This enables adequate drainage during rains and checks water stagnation. A space of 30–40 cm is left between two beds in order to carry out cultural practices smoothly.



Flat nursery bed

Seeds and area required for one hectare transplanting

Seeds and area for raising nursery for planting in hectare varies with vegetable type and season. Early varieties require more seed than main season or late crop. Tomato, chillies, capsicum, cauliflower, cabbage, broccoli, etc. require 300-400 g of seeds and 100 to 150 m² nursery area for raising seedlings to transplant in one hectare while brinjal requires 200-300 g, knol-khol requires 700-800 g, Onion requires 8-10 kg seeds and about 500 square meter area to raise the nursery for one hectare transplanting.

Sowing of seeds in the nursery

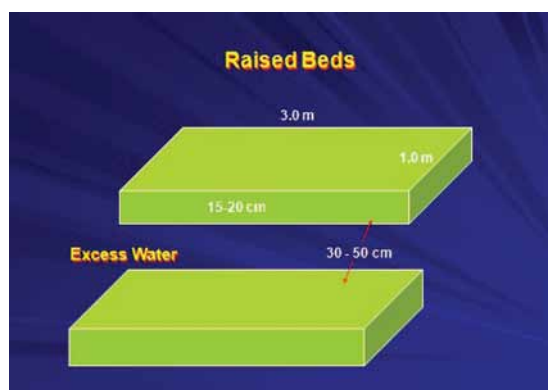
Seeds in nursery are sown by different methods like broadcasting, line sowing and in different pots. Among them the line sowing is the best method of raising vegetable seedlings. Lines are made 0.5 cm deep parallel to the width (East to West) keeping 5 cm distance apart. The seeds are sown or placed singly at a distance of about 1-2 cm apart. The seeds are covered with fine mixture of sand, soil and well rotten and sieved FYM or leaf compost, etc. in the ratio of 1:1:2. After the seed covering, a light irrigation must be given with the help of rose can. Line sowing facilitates less incidence of damping-off disease and reduces seedling mortality. Besides this, it also has the advantages as listed here.

- Each and every seedling will be healthy, bold and uniform because each of them will get uniform light and air.
- Less seeds are required compared to the broadcasting method.
- Weed management of seed beds will be easy.
- Less amount of seed bed covering mixture will be required.
- Conservation of moisture in the root zone will be less. Hence, spread of nursery diseases will be less and slower.

Mulching

For better germination of seed in the nursery; moisture, oxygen and temperature are the most important factors to be considered. Therefore, to get good healthy seedlings, care must be given to the following factors:

- Mulch the seed bed immediately after seed sowing until germination.
- Mulching is important to regulate temperature, maintain moisture, protect the seeds from moving



Raised nursery bed

away by rain drops, suppress weed and can be used later as fertilizer after being decomposed.

- Protects against bird damage.

The mulch should be removed during evening hours to avoid harmful effect of bright sun on newly emerging seedlings.

Watering

The nursery beds require light irrigation with the help of rose can till the seeds get germinated. Excess rainwater or irrigated water should be drained out from the field as and when it is required, otherwise plants may die due to excess water. Watering in the beds depends upon the weather condition. If temperature is high, open irrigation is applied.

Thinning

It is an important operation to remove weak, unhealthy, diseased, insect pests damaged and dense plants from the nursery beds keeping a distance of about 1.0 cm from plant to plant. The thinning facilitates balanced light and air to each and every plant.

Weed control

Weeds compete with seedlings for food, space and other essentials with the young tender seedlings. So, timely control of weeds is necessary. For weed control, manual weeding, use of cover crops, mulching and use of chemicals (weedicides) are practiced. Pre-emergence herbicides can also be sprayed soon after seed sowing to control the weeds. Stomp @ 3 ml/litre of water or should be sprayed on the nursery beds after the seed sowing and seed covering with mixture of FYM, soil and sand. Basalin or post-emergence weedicide like 2, 4-D and roundup are useful.

Uprooting and packing of nursery plants

After the seedlings become ready (25-30 days), 5-6 leaves should be uprooted and sent for transplanting. Care should be taken in uprooting to not damage any roots in the seedlings for early establishment and open root should not be used for transplanting. Slurry of soil+water+biofertilizers and captan/thiram is prepared. Seedlings are bundled in 50-100 and roots are dipped in the slurry. Packing is the method or way in which the young plants are tied or kept together till they are transplanted. Seedlings should be packed in such a way that they do not lose their turgidity and are able to establish themselves on the new site. For packing baskets, wooden boxes, plastic bags are used. In some parts of the country, banana leaves are also used for packing the plants with earth ball. This is useful for local transportation.

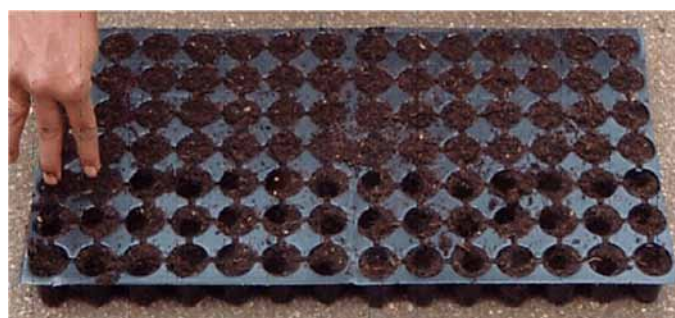
Hi-tech vegetable nursery management

High Tech Nursery is a combination of poly green house and agrinet house. Hi-tech nursery management includes aspects of Hi-tech greenhouse, Microirrigation, Fertigation, Hi-tech plant propagation and automation in nursery. Hi-tech nursery enhances physiological and physical activities due to which plant performs well. It also enhances seed germination rate, higher germination

percentage, increased grafting success, prolongs the period of propagation, successful propagation is possible in extremely harsh and adverse climatic conditions and insect free planting material. The infusion of latest technology has become essential for increased productivity. Unless uniform planting material of desired type is available, increased productivity levels cannot be achieved, so adaption of hi-tech nursery management is the basic need for preparation of quality planting material and supply to nurserymen across the country. The main aim of high-tech nursery management is to make available planting material of the highest possible quality and health round the year. High tech management of nursery includes various activities like potting, seeding, manuring, irrigation, plant protection measures, weed control, packing of nursery plants, and management.

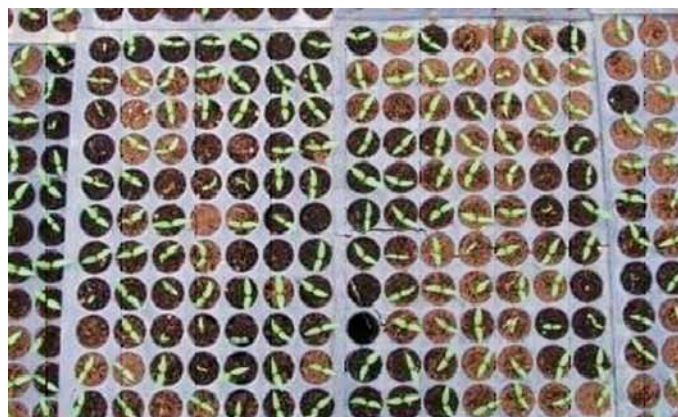
Plug tray nursery raising technique

In high-tech nursery, plastic trays or pro-trays having different cell sizes are commonly used for raising vegetable seedlings. Mainly two kinds of plastic pro-trays are used for raising the seedlings. In case of cucumber, muskmelon, tomato, and brinjal plastic trays of 187 cells of 3.75 cm (1.5") size are required, whereas lettuce, cabbage, cauliflower, and capsicum require trays having 345 cells of 2.5 cm (1.0") size. These trays help in proper germination, provide an independent area for each seed to germinate, reduce the mortality rate, maintain uniform and healthy growth of seedlings, are easy to handle and store, reliable and economical in transportation.



High-tech nursery raising techniques of vegetables

1. The seedling tray (pro-tray) is filled with the growing medium (coco peat, perlite, and vermiculite).
2. A small depression (0.5 cm) is made with a fingertip



- in the center of the cell of the pro tray/ plug tray for sowing the vegetable seeds.
- One seed per cell is sown and covered with medium either by hand or automatic seeding machines.
 - Coco peat with 300 to 400% moisture is used and hence no immediate irrigation is required until germination.
 - The entire stack will be covered using a polyethylene sheet to ensure the conservation of moisture until germination. The stacked trays are spread once the germination commences avoiding etiolation.
 - The trays are shifted to the net house on germination of seedlings and spread over the beds/ plate form.
 - The trays are irrigated lightly every day depending upon the prevailing weather conditions by using a fine sprinkling rose can or with a hose pipe fitted with a rose. Drenching the trays with fungicides as a precautionary measure against seedling mortality is also being done.
 - Spraying of 0.3% (3 g/litre) water-soluble fertilizer using poly feed (NPK- 19:19:19 with trace elements) twice (12 and 20 days after sowing) is practiced to enhance the growth of the seedlings.
 - The trays are provided with protective cover from rain by covering with polyethylene sheets in the form of a low tunnel whenever it rains.
 - The seedlings at the right stage of planting are hardened by withholding irrigation and reducing the shade before transplanting or selling to the growers.

- Systemic insecticides are sprayed 7-10 days after germination and before transplanting for managing the insect vectors.
- The seedlings would be ready in about 21-42 days for transplanting to the main field depending upon the crop.
- Transplanting may be done any time in day as compared to the afternoon hours transplanting in traditional nursery raised seedlings as there is less root damage.

SUMMARY

Production of good quality vegetable seedlings ensures high yield and quality. The seedlings raised in unscientific manner have poor germination, and are infested by insects, pests and diseases. This often results in increased mortality of seedlings when they are planted in the main field, and subsequently farmers realize low yield. The advent of scientific nursery growing techniques has opened new vistas for growing healthy vegetable seedlings with less effect from biotic and abiotic stresses. Such innovative techniques are facilitating the growers in producing higher yield and fetching remunerative prices. The high-tech nursery opened new window for raising healthy vegetable nursery round the year under soilless medium commercially.

For further interaction, please write to:

S N S Chaurasia (Principal Scientist and I/c Head), Division of Crop Production, ICAR-IIVR, Varanasi, Uttar Pradesh 221 305.
*Corresponding author email: chaurasiaiivr@gmail.com

Profitable Nursery through “Mini-Shade Net”

Shri M. Sankara Rao is a marginal farmer, belonging to a remote village of Naiduvalasa of Rambadrapuram Mandal of Vizianagaram district in Andhra Pradesh. He is an ex-trainee of KVK, Vizianagaram. Having gained knowledge and skill in nursery, he established nursery unit with “mini-shade net” under the technical guidance of KVK faculty. He raised seedlings of different vegetables and papaya under *mini-shade net* (60 sq m) and produced high quality virus-free papaya seedlings (2,500) and vegetables seedlings, viz. Tomato (5,000), Brinjal (5,000), Chilli (5,000) during May 2021 to October 2021, with which, he received a net income of ₹ 25,700. Farmers from the neighbouring villages got attracted with the benefits gained by protected shade-net nursery production; and accordingly, approached KVK, Vizianagaram for further guidance to adopt the technology.



A view of nursery unit of Shri M. Sankara Rao with mini-shade net

Source: ICAR Annual Report 2022-23