

Chapter-2

SELECTION OF SITE AND SOIL FOR GROWING VEGETABLES

Objectives

Students will be able to learn about

- Importance of location and timing for vegetable cultivation
- Role of soil and organic matter in vegetable cultivation
- Techniques of growing vegetable seedlings in nursery
- Planting time and selection of variety

Introduction

Vegetable cultivation in India is mainly concentrated near or around big cities or town which are commonly referred as peri-urban areas. The main advantage of this area is greater demand of vegetables in urban area and fetching higher prices, making vegetable cultivation more profitable. This production system is an intensive, year round, diversified and high cost growing system of many kind of vegetables for supply to local or nearby market. Marketing of fresh vegetable is major consideration before deciding its cultivation. A survey should be made about demand and supply of vegetables in nearby or expected market location at different time and their prevailing prices. The available databases of different organizations like National Horticulture Board (NHB) or local *mandi* may be searched for getting quick and reliable information. We should plan to make our produce available in market when its prices are usually high and all other activities right from sowing to harvesting should be planned accordingly. Generally, prices of vegetables are high in early season and again when season is coming to an end.

Site selection:

Vegetable crops need proper sunlight in order to grow well and produce higher yields. A good site should receive minimum of 6 hours of full sun each day, with 810 hours being ideal. Consider shading from buildings, fences, trees, and shrubs while selecting cultivation site especially in peri-urban areas. Vegetables do not compete well with trees or other plants for sunlight, moisture, and nutrients. But we should consider the amount of shade that trees will cast as they grow. Sites with southern exposures are generally warmer than those with northern exposures. Cool season vegetables and some root vegetables tolerate more shade than warm season, fruiting varieties. Beets, cabbage,

green onions, lettuce, parsley, radish and Swiss chard are a few that can be grown in light shade. Unfortunately, no vegetable can grow in complete shade and even these will require at least 4 hours of direct sun.

Soil

Soils are made up of different particles called sand, silt and clay. Sand makes up the largest of these particles (0.052.0 millimeters in diameter) followed by silt (0.050.002 millimeter in diameter), and clay makes up the smallest particles (less than 0.002 millimeter in diameter). Most soils are made up of a combination of sand, silt and clay which affects soil drainage, structure and fertility. We should select a site with good drainage for vegetable cultivation. This is important for promoting good root growth and avoiding plant diseases, particularly root rots. Soil type affects drainage. Heavy clay soils are slow in drying out and are difficult to cultivate and work properly. Extremely sandy soils may lack organic matter and may dry out too rapidly between watering. The best soil is between these two extremes. The exact type of soil, however, is not as important if it is well drained, adequately supplied with organic matter and retains moisture. One strategy for selecting a site is to avoid areas where water stagnates for long periods of time. Adding organic matter in the form of decaying plant or animal material effectively improves soil structure. Well-drained, fertile soil is essential to a productive vegetable cultivation. Manure and compost provides an excellent source of organic material for successful vegetable cultivation.

Advantages of adding organic matter into soil

- Increase the ability of soil to hold water and tiny particles of clay apart so they can drain out excess water more easily
- Provide clay soil with needed pore space, which lets in air essential to good plant growth
- Prevent tiny particles of clay soil from cementing themselves together and, therefore, becoming more easily penetrated by plant roots
- Fill in excess pore space of sandy soil, thus slowing down drainage and increasing the ability to hold water.
- Moderate soil temperature
- Release nitrogen and other nutrients for plant use through the process of decay
- Increase the cation exchange capacity of soil specifically, calcium, potassium and magnesium so that soils can hold and release more nutrients
- Buffer soil to reduce stresses such as drought on plant growth
- Provide a food source for the soil microorganisms that improve overall soil properties.



Soils containing large amounts of very fine clay tend to harden and crust on the soil surface. Clay soils are resistant to changes in their structure; however, incorporating coarse sand or organic matter may improve a small area. Sand improves soil drainage and workability of clay soils, but beyond that it is of limited value compared to organic matter. Sources of organic matter include manure, compost, peat moss, spent mushroom substrate, and sawdust. Organic matter can be produced in the form of cover crops or green manure crops like dhaincha (*Sesbania*) during pre-kharif season and gets incorporated into soil when rain starts. Soil test should be carried out to more accurately for determining the fertility status of the soil and availability of micronutrients many of which are essential for vegetable crops. If other plants are growing healthily at the site, it is likely to have good fertility status.

Raising of vegetable crops

Most of the vegetables crops are propagated by seeds except a few like sweet potatoes, asparagus, garlic, potato and pointed gourd which are propagated vegetatively. Among the vegetable crops which are propagated by seeds, many of them like beans, peas, okra, radish, turnip, carrot and leafy vegetables are sown directly in the fields. Other vegetables like cabbage, cauliflower, tomato, onion, chilli *etc.* are first sown in nursery-beds for raising seedlings and then transplanted. Both direct seeding as well as transplanting are practiced in most of the cucurbits like gourds, cucumber, muskmelon, watermelon, pumpkin *etc.*

Nursery raising

A nursery could be considered as a location where plants are cared for during the early stages of growth, providing optimum conditions for germination and subsequent growth, until they are strong enough to be planted out in their permanent place. The seeds of solanaceous vegetables, cole crops, onion *etc.* are first sown in the nursery.

Advantages of nursery raising in vegetable production:

- It is convenient to look after the tender seedlings in smaller area.
- Eliminates the problem of emergence in difficult soils
- Weed control easy
- Easy to maintain desired plant population
- Easy to adjust suitable date of planting
- Provide early harvest
- Reduced field management costs
- More uniform crop possible



- More optimal use of expensive hybrid seeds
- Temporary protection from extreme weather can be easily provided
- Easy and convenient pest and disease management up to 4-5 weeks
- Facilitates intercropping and relay cropping

Factors to be considered for raising nursery

Location of the nursery:

- Nursery area should be near the main field for transplanting
- Well exposed to the sun but protected against severe heat
- Well protected against animal damage, strong winds

Water

- Nursery area should be near the water source
- Continuous supply of good quality water
- The seed bed should be kept moist not continually wet
- Proper drainage and no water logging.

Soil

- Soil should have large quantity of organic matter
- Soil texture should be neither too coarse nor too fine
- Sufficiently porous and is adequately aerated
- Has a fair degree of water holding capacity
- Normally rich in all the necessary elements, but can be further improved by the normal cultivation and with addition of manure

Germination of seeds:

For a seed to germinate, certain conditions like supply of sufficient water, air and temperature must be met. The germination temperature requirement for specific crops is given in Table 1. The reasons for failure of seed to germinate are -

- Temperature is too cold or too hot
- Soil may be too dry or too wet
- Old non-viable seeds or had been eaten by pests
- Disease like pre-emergence damping off.
- A hard layer on surface causing hindrance to emerging shoot to reach the surface.
- Sown too deeply or too shallow.
- Seed dormancy.



Table 1. Soil temperature requirement for germination of vegetable seeds

Vegetable Crop	Minimum(°C)	Optimum (°C)	Maximum (°C)
Cabbage	4	20	25
Carrot	4	24	35
Brinjal/Chilli	15	29	35
Tomato	10	25	30
Pea	4	22	29
Radish	4	24	35
Beet Leaf	10	25	35
Onion	2	24	35

NURSERY MANAGEMENT

Land preparation

Land preparation refers to making the soil suitable for sowing or transplanting of crops in the field. The soil should be fine, moist and firm to provide better germination and excellent medium for seedling growth. Prior to seeding, the field should be levelled and worked to obtain a fine textured soil free of clods and debris.

Enough of well decomposed farmyard manure should be mixed thoroughly in the soil. Land preparation is necessary to facilitate the growth of the crops. A proper land preparation must:

- Get rid of the weeds from the field
- Kill the insects by exposing them to the natural hazards and predators
- Provide sufficient support to the growing plant
- Supply with well balanced nutrients
- Provide with optimum soil moisture
- Facilitate good soil aeration

Operations involved in land preparation

Irrigation

Irrigation is firstly necessary to facilitate the germination of weed seeds so that they can be removed during land preparation. Secondly, irrigation facilitates the other field preparation operations like ploughing/digging which otherwise is difficult in hard, dried soils.

Ploughing

Ploughing turns the soil from lower layer to the surface exposing the insects in the soil to the predators and natural hazards. Ploughing also exposes the weed seeds to the birds and insects. Simultaneously, it mixes the soils of different layers and ensures that the nutrients are well distributed in the soil.

Soil treatment

For raising the healthy seedlings, soil must be treated to make it pathogen and pest free. Different methods adopted for this purpose are:

Soil solarization

- May-June is ideal time for soil sterilization in North Indian plains as temperature rises up to 45°C
- Provide light irrigation in the nursery area
- Spread white polythene of 200 gauges on nursery area
- The margin of the polythene should be covered by wet soil to check the entry of air from outside.
- It increases temperature inside polythene up to 48-56°C which kills all pathogens
- After 5-6 weeks, remove the polythene sheet
- Prepare the beds for seed sowing

Formalin treatment

- This treatment should be done 15-20 days before seed sowing.
- Prepare formalin solution (1.5 to 2%) in one container and drench the soil @ 4.5 litre of solution per square meter soil surface to saturate it up to a depth of 15-20 cm
- Cover the drenched area with polythene sheet of 200 gauge
- Put the wet soil on the margin of the covered polythene sheet so that it does not allow the polythene film blown away by the wind and air from the covered area to out side
- Removes the cover (polythene) after 15 days
- Prepare the beds for seed sowing

Nursery bed preparation

Bed preparation facilitates the ease in the cultivation operations like sowing and transplanting and later in the intercultural operations. The width of a bed should not be more than 120 cm. This width facilitates weeding and watering without trampling the bed. The bed is kept raised so as to provide proper drainage of excess water and the level of the bed surface is also made slightly raised in the centre with a little slope on the two sides.

- For the uniform and high percentage of germination, the soil must be fine and moist enough.



- Length of the bed may be kept 3 to 5 meter; however, width is restricted to 1 meter only which facilitates intercultural operations
- The beds are raised 15 to 20 cm high from the ground level
- A space of 20 - 25 cm is left between two beds
- The space between two beds helps in weeding, nursery care against diseases and insect-pests and also for draining out the excess rain water from the nursery beds
- The number of beds depends on the particular crop, season and growing area of crop.
- The beds should be prepared in the east and west direction and line should be made from north to south direction on the beds.

Seed treatment

Seed treatment with suitable fungicides and insecticides is essential to keep the seed free from harmful diseases and pests. Most of the vegetable seeds are treated with captan or thiram @2.5-3 g/kg of seed. Seeds and fungicides are taken in a wooden or earthen pot or glass jar provided with lid on it. It is shaken well so that chemical sticks on seed surface as coating material.

Seed Sowing

The common practice is to broadcast seeds in the nursery-bed but line sowing is preferred so as to check proper germination and to facilitate weeding, hoeing and plant protection operations. The rows are usually about 5 cm apart. Small seeds are sown mixed with a little sand and covered with soil. The soil covering should be lighter in heavy soils. General rule for sowing seeds is to sow seeds 2-3 times their own thickness deep. If seeds are sown too deep nutrient reserves will be exhausted before the plant emerges or emerging plants will be weak or liable to die. If sown too shallow, then it is likely to be eaten by birds or washed away by water. Spacing allows for seed losses. However if you think the seed losses will be higher than normal then test the seed viability beforehand. A week before transplanting, the seedlings may be exposed to full sunshine and moisture stress to make the seedlings sufficiently hardened for field settings.

Covering of Seed

After sowing the seed, seed bed is covered for better emergence. Therefore, a mixture of sand: soil: FYM in the ratio of 1:1:1 is prepared, well mixed together and treated with any method of soil treatment as discussed above. It will be better to treat this mixture while treating the nursery soil. Care should be taken that every seed is well covered by seed covering material.

Use of mulch

To maintain the soil moisture for seed germination, cover the seed bed with a thin layer of mulch of paddy straw or sugar cane trash, or sarkanda or any organic mulch during hot weather and by plastic mulch (plastic sheet) in cool weather. It has following advantages.

- It maintains the soil moisture and temperature for better seed germination
- It suppresses the weeds
- Protects from direct sunlight and raindrops
- Protects against bird damage

Removal of mulch

Due attention is given to remove the covered mulch from the seedbed. After three days, observe the seed beds daily. As and when the white thread like structure is seen above the ground, remove the mulch carefully to avoid any damage to emerging plumules. Always remove mulch in the evening hours to avoid harmful effect of bright sun on newly emerging seedlings

Use of shading net

After seed germination, if there is very high temperature ($>30^{\circ}\text{C}$) during the seedling growth then beds should be covered by providing 50% or 60% shading nets of green/green+black coloured, about 60-90 cm above ground by the use of suitable support.

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 of water.
- Watering in the beds depends upon the weather condition. If temperature is high, open irrigation is applied. Need not to irrigate the beds during rainy days.

Thinning

- It is an important operation to remove weak, unhealthy, diseased, insect pests damaged and dense plants from the nursery beds keeping distance of about 0.5 to 1.0 cm from plant to plant.
- The thinning facilitates balance light and air to each and every plant. It also helps in watching the diseased and insect pest attacked plants while moving around the nursery.

Weed control

- Timely weeding in nursery is very important to get healthy seedling. If there are some weeds in the seed bed, remove them manually either by hand or by hand hoe (thin forked Khurpi).



- Pre emergence herbicides can also be sprayed soon after seed sowing to control the weeds. Stomp @ 3 ml/litre of water should be sprayed on the nursery beds after the seed sowing and covering of seed with mixture of FYM, soil and sand.

Plant protection

Adoption of plant protection measures in the nursery against the incidence of insect pest and diseases is very important task to get the healthy seedlings. Damping off is a very serious disease affecting seedlings in the nursery. The care for controlling them time to time is essential.

Damping off

- Pre-emergence death of seeds is seen
- In first instance, girdling takes place on the stem near base of the stem and seedlings bent down near the ground and die
- The causal organisms are *Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium* fungi
- Treat the nursery bed either by soil solarization, formalin solution or formalin dust or fungicides like thiram or captan as discussed earlier
- Treat the seeds as discussed in seed treatment. If the disease appear after the seed emergence, drench the nursery beds with 0.1% solution of brassicol or 0.7% captan or thiram after germination. It will be better to remove and burried the affected seedlings from the beds otherwise spread will be more.

The disease can be controlled to some extent by applying treated sand, soil and FYM mixture up to the level from where the seedlings are falling.

Hardening of the plants in the nursery

- The term hardening includes "Any treatment that makes the tissues firm to withstand unfavourable environment like low temperature, high temperature and hot dry wind."
- Hardening is a physiological process.
- Plants accumulate more carbohydrates reserves and produce additional cuticle on the leaves.
- In this process seedlings are given some artificial shocks at least 7-10 days before uprooting and transplanting. These shocks includes
- Exposure to the full sunlight,
- Removal of all the shading nets, polythene sheets
- Irrigation is stopped slowly and slowly.

Techniques of hardening: The hardening is done by the following ways.

- By holding the watering to the plant by 4-5 days before transplanting

- Lowering the temperature also retards the growth and adds to the hardening processes.
- By application of 4000 ppm NaCl with irrigation water or by spraying of 2000 ppm of cycocel.

Duration and degrees of hardening

- It is very necessary that plants should be hardened according to their kind so that there is an assurance of high percentage of survival and slow growth under the condition to be expected at the time of transplanting.
- Hardening should be gradual to prevent or check the growth.
- Warm season crops like tomato, brinjal and chillies do not favour severe hardening. In Indian condition, allowing the soil to become dry for 5-6 days does the hardening.

Effect of hardening

The following effect may be observed by the hardening

- Hardening improves the quality and modifies the nature of colloids in the plant cell enabling them to resist the loss of water.
- Hardening increases the presence of dry matter in the plants but decrease the percentage of freezable water and transpiration per unit area of leaf.
- Decreases the rate of growth in the plants
- Hardened plants can withstand better against unfavourable weather conditions like hot day winds or low temperature
- Hardening of the plants increases the waxy covering on the leaves of cabbage.

Transplanting

Some vegetables grow better when transplanted (cabbage, tomato, chilli) and some does better when directly sown (root crops). While there are some vegetables which can be either direct sown or transplanted depending on circumstances such as land availability and labor.

Selection of seedlings for transplanting: After attaining proper growth, seedlings are transplanted in main field. At the time of transplanting, seedlings should be:

- Stocky and sturdy
- Should have good root system
- Should be free from any insect pests and disease infection.

Tips for transplanting

- Transplanting should be done as soon as seedlings are about 4 to 8 weeks old, 10 to 15 cm tall and have formed about 3 to 4 true leaves.
- The nursery bed should be watered 24 hours before uprooting the seedling for transplanting so that they may not suffer from desiccation and minimize root damage.
- The seedlings should be dug up not pulled up.



- When the seedlings are uprooted it experiences transplanting shock. Therefore, it is essential to water plants immediately after transplanting and till the plant has recovered.
- Always transplant under cool conditions in the late evening hours so that plants may establish themselves in the cool weather in the night and may recover from the shock of transplanting before sunrise.
- Avoid seedlings which have grown too tall. Such seedlings become weak and may start flowering very early.
- During transplanting, care should be taken to protect seedlings against wilting by frequently sprinkling water on them and covering the roots one with moist soil or leaves.
- Setting the seedlings to a depth of first true leaves during transplanting result in earlier fruiting and larger fruit size in some crops.

Planting time

Planting time for vegetable cultivation varies according to crop, variety, growing season and area. Some of the important vegetables grown in different seasons are:

Rabi season vegetables: Potato, tomato, cole crops (cauliflower, cabbage, broccoli), root crops (carrot, radish, turnip), bulb crops (onion, garlic), pea, broad bean

Kharif season vegetables: Okra, brinjal, chilli, cowpea, some cucurbits, french bean,

Zaid season vegetables: Cucurbits (cucumber, bottle gourd, bitter gourd, pumpkin etc.), cowpea, okra, french bean

Selection of varieties and seed material:-

The time of sowing of vegetable depends upon the soil and weather conditions, kind of the vegetable and demand in the market. Seeds of the variety suitable to the season and location should only be sown. Tomato varieties to be grown during *kharif* season in North Indian plains should have resistance to leaf curl virus. Similarly tomato varieties having resistance to leaf curl for Bangalore region might not be successful in New Delhi region as strain of virus differ at these two places. Cauliflower varieties can form curd under a wide range of temperature from 5 to 28°C, so we must be careful while selecting a variety to be grown in early, mid or late season. Early varieties of pea can mature in 60-65 days if sowing is done during mid October but if planting is delayed it will take more time to mature. Further, maturity period of same variety also differs in hills and plains due to difference in prevailing temperature. Radish can be grown whole the year around by carefully selecting the different varieties. Growing period and area of cultivation of cabbage and carrot has been extended due to development of heat tolerant varieties. Some of the cucurbits can be grown during summer as well as *kharif* season but different varieties are available for both season or few varieties are also suitable for both season. Many varieties of cucurbits perform better under bower or pandal system during *kharif* season.

Okra varieties to be grown during *kharif* season should have very high level of resistance to yellow vein mosaic virus however, other varieties may perform well during summer as problem of virus is not much severe. Cowpea can also be grown both in summer as well as *kharif* but varieties should have resistance against virus for *kharif* season growing. Specific varieties of onion can only be grown during *kharif* season. Only pure, true to type and healthy seed having minimum prescribed germination should be taken for sowing. The seed should be free from seeds of weeds, other crops or varieties. Such a seed can be purchased from reputed firms or research organization only. The vegetables like all the other crops if not sown in time fail to perform to their potential.

Useful tips for successful vegetable production

- Use reliable and fresh seed and select those varieties which are suitable for your area, climate and having consumer preference in the market.
- Always plant early maturing crops together in one row so that area may be available at a time for later vegetable crops.
- Prepare a list of vegetables to be sown along with suitable crop rotation and the proper time for planting the various types of vegetable crops and their varieties.

References

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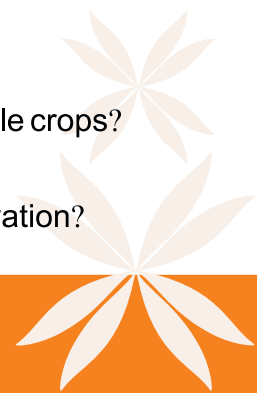
Activity:

1. Try to prepare a vegetable nursery for your home/kitchen/ school /community garden.
2. Make a survey of local vegetable *mandis* to know the demand, supply and price of different seasonal vegetables.

Check your progress

Short answers (one or two words)

1. Which is the most common disease occurring in nursery?
2. Which month is ideal for soil solarization?
3. What is the optimum temperature for seed germination of tomato?
4. Which vegetable is propagated vegetatively?
5. Which is the most popular chemical used in seed treatment of vegetable crops?
6. What is the ideal age of seedling for transplanting?
7. How much minimum hours of sunshine is required for vegetable cultivation?



Fill in the blanks

1. Tomato variety to be grown during *kharif* season in North India must have.....
2. Hardening of seedling can be achieved by..... water.
3.colour plastic sheet of.....gauge is used for soil solarization.
4. Nursery beds should be raised by.....
5. Hardening of seedling is a..... process.
6. Nursery should be located..... water source
7. resistant variety of okra can be grown during kharif season.
8. Seed treatment is done with..... @.....

Long answers:

1. What are the advantages of growing seedlings in a nursery?
2. What are the different techniques used for protecting seedlings from different pathogens?
3. Write down the different steps for a successful nursery.
4. What are the different points to be considered while selecting a variety for cultivation of vegetable crops?
5. What are the benefits of adding organic matter to the soil?

