

Organic Vegetable Farming: Techniques for Optimizing Yield and Soil Health

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Introduction

Organic farming refers to farming without use of fertilisers and pesticides. It is a specialised form of diversified agriculture with the goal of producing high quality nutrient rich food along with more income and employment generation. Under this system, there are limitations on the use of synthetic fertilizers, pesticides, growth regulators. To preserve soil fertility, organic farming insists on using the novel crop types, precision and efficient technologies, crop rotations, cover crops and natural products. Thus, organic farming can be defined as the practices that emphasize the use of renewable resources, conservation of energy, soil, water, environment maintenance and enhancement along with the production of optimum qualities of produce without the use of artificial or synthetic fertilisers. Growing vegetables organically can be more rewarding and productive than growing with the chemicals or fertilisers. Vegetable crops have been well advocated in solving the problem of food as well as nutrition security. They are rich source of minerals, vitamins, fibres and contain fair amount of proteins and carbohydrates. In addition to the local market demand, vegetables have potential for both domestic and export market.

Moreover, most of the vegetables, being short duration crops, fit very well in the different multiple and inter-cropping system and are capable of giving very high yields and very high economic returns to the growers in a short period of time, besides generating on farm and off farm employment as a result, in recent years major emphasis is given for commercial exploitation of vegetable crops. Organics added in its cultivation will lead to more value addition providing better income and a sustainable production.

Basic Concepts and Principle of Organic Vegetable farming:

The concept of organic farming is not clear to many concerns. Many people consider that traditional agriculture, sustainable agriculture, Jaivik Krishi etc, as organic farming. Some people are of the idea that the use of organic manures and natural methods of plant protection



instead of using synthetic fertilisers/ pesticides is organic farming but this is not true. Organic farming relies on comprehensive management approach to improve the health of underlying productivity of the soil.

The basic concepts behind Organic farming are:

- It concentrates on building up the biological fertility of the soil so that the crops take the soil nutrients, released in harmony with the needs of the plants.
- Control of pests, diseases, and weeds is achieved largely by the development of an ecological balance within the system and by the use of bio-pesticides and various cultural techniques such as crop rotation, mixed cropping, and cultivation.
- Organic farmers recycle all wastes and manures within a farm as the export of the products from the farm results in a steady drain of nutrients.
- In a situation, where conservation of energy and resources is considered to be important, community or country would make every effort to recycle to all urban and industrial wastes back to agriculture and hence the system would only need small inputs of new resources to “top up” soil fertility.

The International Federation of Organic Agriculture Movements (IFOAM) states that “Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.” According to *Codex Alimentarius* (FAO/WHO), organic agriculture is a holistic production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of 4 off-farm inputs, taking in to account that regional conditions require locally adapted system.

According to IFOAM, organic agriculture is guided by following four principles:

- ✚ **Principle of health:** Organic farming should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems - healthy soils produce healthy crops that foster the health of animals and people.

- ✚ **Principle of ecology:** Organic farming should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes, and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment.
- ✚ **Principle of fairness:** Organic farming should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and taking care of the shared world, both among people and in their relations to other living beings.
- ✚ **Principle of care:** Organic farming should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions.

Organic Vegetable Gardening:

Being component of organic agriculture, organic vegetable gardening enhances and promotes natural diversity and biological cycles on the farm. It is based on the making garden self-sufficient and sustainable rather than relying on synthetic fertilizers and pesticides.

Transitioning to organic gardening:

Organic production of vegetable is a long – term process which is carried out in stages rather than a single production practice adopted within one growing season. Adopting organic production techniques involves a transition from conventional to organic gardening.

The very first step in this transition is improving and maintaining soil fertility or quality. Thus we can say that healthy and fertile soils are the base of successful organic vegetable production.

- ✚ The soil is a biologically active and dynamic resource, providing plants with mineral nutrients, water and oxygen.
- ✚ Organic matter *i.e.*, living organism, fresh residues and decomposed residues, is an essential ingredient of healthy and fertile soils.
- ✚ Organic matter improves soil tilth.
- ✚ Carbon dioxide from the decaying organic matter is a source of mineral in soil solution, making it available to the plants.
- ✚ The target level for organic matter in healthy soil is 3 to 5%.

- ✚ Potential crop yield could increase about 12% for every 1% increase in organic matter.

Sources of Organic Matter

1. Animal Manure: -

- Excellent source of organic matter and nutrients in the soil.
- Manures should be composted according to the NOP's composting standards (National Organic Program).
- Composting manures stabilises the nitrogen and reduces the viability of weed seeds and disease pathogen that may be in the manure.
- Over application of manures is not favourable.



2. Compost: -

- Compost can be made from lawn clippings, leaves and other plant materials, if manure is not readily available.
- Adding compost to garden soils improve soil structure, increase the population of beneficial microbes, enhances soil moisture retention, reduces nutrient losses, maintains pH etc.
- Compost is applied generally 4-8 tons per acre in field vegetable production, 10-20 tons per acre (1-2 pounds per square feet) in garden for soil development.

3. Vermicompost: -

- Manure prepared by rearing of earthworm in an artificial or natural pit.
- Faecal waste of from earthworm are used as manure and referred to as vermicompost.

4. Cover Crops and Green Manure: -

- Helps in building soil quality.

- Cover crops add organic matter, reduces soil erosion, provide habitat for beneficial for insects, provides nitrogen, suppress weeds and loosen the subsoil
- Whereas, green manures are the cover crops that are incorporated into the soil to provide nitrogen to the succeeding vegetable crops.
- Examples of cover crops are, buckwheat, berseem, clover, oats etc.

5. Bio-fertilizers: -

- Carrier based preparations, containing beneficial microorganisms, such as bacteria, fungi and algae in sufficient quantities, which provide nutrition and enhance plant growth.
- The efficiency of bio- fertilizers will increase with addition of phosphorus.

Organic Fertilizers

- The amount of fertilizer (fish meal, bone meal *etc.*) applied to any vegetable crop depend on soil type and characteristics, previous cropping history and nutrient uptake by the vegetable.
- Soil should be tested every two years to determine total nutrients within the soils.

Organic disease management.

Site selection.

- Choose a well-drained soil for growing vegetables.
- Avoid planting close to trees or buildings that may influence air circulation or the intensity or duration of sunlight.
- Use raised beds to promote soil aeration and drainage whenever possible.

Resistance or tolerance.

- Select disease-resistant vegetable varieties for growing.
- The seed package usually lists disease resistance information of the variety, especially for hybrid (F1) varieties.

Disease-free transplants.

- Many vegetables can be established as transplants.
- Carefully inspect transplants for any spots or lesions on the stems or leaves.
- Healthy roots are white or light in colour, and show no signs of decay or excessive wrapping of the fibrous roots around the root ball.

Crop rotation.

- Continuous cropping of plants in the same botanical family allows for build-up of disease organisms.
- Vegetables that are in the same botanical family should not be grown in the same area for at least three years.
- For example, watermelon, cucumber, squash, cantaloupe and pumpkins are in the Cucurbitaceae family and often are attacked by the same disease organisms. Rotating cucurbits with vegetables in the Solanaceae family such as peppers, tomatoes, eggplants or potatoes can potentially lower the incidence of diseases.

Plant spacing and training.

- Dense plantings can often increase susceptibility to diseases.
- Therefore, by increasing the spacing between plants, air circulation and light intensity are enhanced, creating a less favourable environment for disease development.
- Always stake or cage plants to keep the plants and fruit from touching the soil.

Mulching.

- Organic mulches such as straw, hay, compost, newspaper or wood shavings will aid in disease prevention by reducing direct contact between soil and the plant.
- Organic mulches usually lower soil temperatures. Thus, warm-season vegetables such as tomatoes and peppers should be mulched only after the soil has warmed.
- Plastic mulches also can be used by organic growers. Plastic mulches are available in a variety of colours and are particularly effective in warming the soil.

Rogue infected plants.

- Root out and destroy any plant showing severe disease symptoms to prevent the spread to adjacent plants. Plants infected by viruses should be removed from the garden immediately.

Sanitation.

- To prevent plant diseases from one growing season to the next, clean all planting trays and growing supplies such as wooden tomato stakes, planting trays and harvest containers.

Organic pesticides.

- Organic fungicides for vegetables include copper (Bordeaux mixtures or sulfates), hydrogen peroxide, and sodium bicarbonate (baking soda).

- High concentration (70%) of Neem oil can be used to kill powdery mildew spores.
- Organic growers should check the OMRI list or consult the certifier before applying any new chemical.

Organic weed management

Weeds are plants that compete with vegetables for light, water and nutrients. Weeds also interfere with harvesting and can harbour many diseases. Although completely eliminating weeds in the garden is not realistically possible or necessary, several strategies in addition to hoeing or hand-weeding can be employed to reduce weed competition.

Reduce the weed seed bank.

- Raw manure, immature compost, hay or straw may contain weed seeds.
- Clean tillage or harvesting equipment after use to prevent contamination from adjacent fields.
- Do not allow weeds to form seed heads.

Vegetable type.

- Certain vegetables are relatively more competitive with weeds.
- For example, Irish and sweet potatoes, winter squash, sweet corn and tomatoes can effectively compete with weeds.

Flame weeding.

- Flame weeding, or using a hot flame to kill weeds, is effective for stale seed bed weed removal or weeds that emerge before the vegetable crop.
- Flame weeding is effective for weed control in slow-germinating vegetables such as onions, parsnips and carrots.

Drip irrigation.

- Drip irrigation reduces weed emergence by reducing the soil area that receives water.

Solarisation.

- Clear plastic spread across an area where crops will be planted can kill weeds, weed seeds and even some plant pathogens.
- Apply the plastic close to the ground during the hot part of the year and leave it in place for four to six weeks.

Organic herbicides.

- Organic gardeners can use various organic herbicides, including acetic acid (vinegar), citric acid and corn gluten meal to control weeds.

Organic insect management

- Organic management of insect pests is based on avoiding a pest outbreak rather than dealing with the pest after it has acquired a foothold in the garden. The following are a few techniques that can be used to control insects organically:

Habitat for beneficial insects and trap cropping

- Create an environment favourable for natural enemies of harmful insects. More than 100 families of insects, spiders and mites contain species that are natural enemies of harmful insects.
- Plant the borders of the garden in native flowers or plants such as clover or alfalfa to attract beneficial insects such as lady beetles.
- Insect traps are used to monitor and reduce populations of insects by trapping and killing them. For eg, yellow sticky traps attract whiteflies, aphids and other insects by colour.



Intercropping.

- Avoid planting large blocks of any single vegetable in the garden.
- Mixing vegetables prevents spread and build-up of harmful insects.

Fall ploughing.

- Ploughing the vegetable garden after fall harvest exposes insects and insect eggs to birds or to desiccation during winter freezing and thawing.

Organic insecticides.

- Several organic insecticides are available for use by vegetable gardeners, including Bt (*Bacillus thuringiensis*), pyrethrums, rotenone, insecticidal soaps, diatomaceous earth, neem and horticultural oils.

Row covers.

- Row covers are lightweight, spun bonded fabrics that can be suspended or draped over vegetables to protect them from invasive insects.
- Row covers are particularly effective in reducing damage by flea beetles and cucumber beetles.
- Applying row cover to parthenocarpic cucumbers, zucchinis or other vegetables that do not need pollination to fruit can greatly reduce insect damage.

Date of planting.

- Many vegetable insects will have peak populations throughout the growing season.
- Avoid high populations of insects by adjusting the planting date. For eg; Cutworms, aphids and root maggots tends to be more severe during early in the spring and decline severity as temperature increases and rainfall decreases.

Benefits of organic farming:

1) Consumer Benefits

- **Nutrition:** Organically grown food is superior in mineral contents than grown by conventional methods.
- **Poison free:** They are free from contamination with health harming chemicals such as pesticides, fungicides and herbicides.
- **Keeping quality:** Due to natural nourishment, structural and metabolic integrity of their cellular structure is superior to those conventionally grown. Thus, organically grown vegetables can be stored longer and do not mould and rot rapidly.

2) Grower Benefits

- **Healthy soil:** Organic gardening enhance the fertility, productivity and also improves the balance of the soil.
- **Weed competitiveness:** There is considerably less weed competition in organically grown crops as several cultural practices keeps the weed population under control apart from adding soil fertility.
- **Drought resistance:** Organically grown plants show more drought tolerance.
- **Added value:** There is a market of consumers who recognise the greater food value of organic produce and are willing to pay premium prices for it.

Limitations:

- **Lack of organic alternatives:** Some pest problems are easily controlled by organic alternatives whereas, others are controlled either with difficulty or have no reliable organic controls. These crops are mostly avoided by organic gardeners or they must be willing to take risk from significant losses.
- **Climatic effect:** Climate vary regionally and annually with altitude, nearness to bodies of water, slope of land etc. These differences also affect plant susceptibility to problems and limit the effectiveness organic control. An organic control measure that works well one year may not work well the following year because of this climatic variation.
- **Cost of organically grown vegetable:** Organic vegetables are generally more expensive than traditionally grown vegetables. As organic sources of nutrients or organic pest control measures are more expensive. Marketable yields are frequently less with organic production as compared to traditional
- **Sources of nutrients and organic matter:** Organic production frequently relies on manure, organic material and nutrients that are generally brought in from outside the growing area. These resources are limited and may restrict the expansion of organically grown vegetables.
- **Time:** Requires greater interaction between farmers and his crop observation and timely intervention and weed control are required. Single farmer can produce more crop using traditional and industrial method than solely by organic methods.
- **Skill:** Requires considerable skill to farm organically. Careful observation, greater understanding and farming know-how is needed in the system.

National Standards for Organic Vegetable Management

- **Conversion Period:** The time between the start of organic management and certification of crops is known as conversion period. It is of three years.
- **Choice of crop and varieties:** GMO's, transgenic plants are not allowed to grow under organic farming system
- **Fertilizer policy:** Synthetic fertilizer and synthetic growth regulator is prohibited.
- **Zero budget natural farming:** Unique chemical method that relies on agro-ecology is promoted.



- **Ministries working for implementation of organic policies are:** Ministry of Agriculture and Ministry of Commerce and Industry.

Need and importance of certification in organic gardening

The certification ensures that all the raw materials used and the product itself was produced through organic farming means. In order to oversee such certifications, the National Standards for Organic Productions was established in India in 2000. This ensure that the products are:

- Free from pesticides.
- Have zero chemical fertilizers.
- Synthetic plant hormones have not been applied.

‘*Jaivik Kheti*’ portal is available for marketing of organic products in India.

Two Types of Certification Systems:

1) Third Party Certification:

- For the export of organic products to foreign countries *i.e.*, international level.
- Logo should have the brand name of ‘India Organic’.

2) Participatory Guarantee System:

For supply of organic products to domestic markets (Within India)

- Are of two types:
 - **PGS India Green:** It shows product obtained from under conversion field.
 - **PGS India Organic:** It shows product obtained is fully organic after conversion period.

Conclusion

Organic Farming has the twin objective of sustainability of the system and safety of the environment. In order to achieve these two goals, some rules and standards have been developed and should be followed strictly. There is very little scope for change and flexibility. Thus, the Organic Farming does not require best use of options available rather the best use of options that have been approved. These options are usually more complex and less effective than the conventional system. With ever increasing population having huge requirements of vegetables and availability of organic resources, pure organic farming is not possible in India; rather some specific area can be diverted to organic farming for export of high-quality vegetable crops. Thus, as a whole under Indian condition, only partial switching to organic farming of export-oriented vegetable crops can be possible in recent times.