

Good Agriculture Practices in Vegetable Crops: Sustainable Agriculture

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Introduction:

These days, people are more worried about what they eat, how it impacts their health, and the safety and quality of the goods they consume. The role of vegetables in human nutrition and health through their provision of antioxidants like vitamin A, C, and E that are important in neutralizing free radicals (oxidants) known to cause cancer, cataracts, heart disease, hypertension, stroke, and diabetes has been the subject of public health advocacy in recent years, contributing to an increase in awareness of the nutritional and health benefits of vegetables worldwide. Thus, eating more veggies aids in the fight against malnutrition and hidden hunger. Additionally, vegetables are a source of raw materials for the nearby processing sector. With trade in agriculture and horticulture going global, harmonizing local production systems with the standards and requirements

of international markets can be achieved through the implementation of GAP standards. In addition to improving the yield and quality of the products, GAP standards also have environmental and social dimensions. Good Agricultural Practices are defined as “practices aimed at improving the quality, safety, and sustainability of food and agricultural products while maintaining environmental, economic, and social sustainability.”

A voluntary set of standards for produce farmers to grow foods and crops with a lower risk of microbial contamination linked to foodborne illnesses on their farms has been developed by producer associations, the food industry, non-governmental organizations, and the government. The FDA's Guide on Minimizing Microbial Food Safety Hazards for Fresh Produce served as its foundation. In addition to supporting sustainable agriculture,

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putting GAP into practice helps achieve global and national environmental and social development goals. It has been shown that putting GAP into practice promotes eco-friendly agriculture and the best possible use of resources including water, fertilizer, and pesticides. Its social component would be safeguarding the health of agricultural laborers from the inappropriate use of pesticides and chemicals.

Need of Good Agriculture Practices in Vegetable:-

In contrast to other food crops, the majority of the vegetables are succulent and invite a variety of pest insects. Certain pesticides that are used to manage them have long-lasting toxic effects and are harmful to the ecosystem. Furthermore, some of them do not break down and enter the body when the produce are consumed. As a result, aware consumers in industrialized nations like the USA and Europe are starting to demand food that is grown organically. The improvement of soil structure and micronutrient availability is the main advantage of employing organic manures for vegetable cultivation. The most urgent problems with regard to agriculture sustainability include soil loss (together with soil fertility), rising water demands from agricultural practices, and environmental pollution from the extensive use of agrochemicals. Biodiversity loss due to land

use change and emission of greenhouse gasses from agricultural activities are also causes for concern.

A new problem is ahead of us: how can we feed nine billion people on less land, water, and energy while maintaining soil fertility and natural resources? Technological advancements are necessary to fulfill future needs, but in order to effectively address sustainability, we also need to address critical socioeconomic challenges including population growth, unequal access to resources, and access to education. If we want to protect our ecosystem—the soil and its health—for future generations, our society might need to adjust some of its "values" and paradigms.

Good Agriculture Practices:-

Good Agriculture Practices as per FAO comprise of sequence of activities and choices in the production process including pre-planting measures, production measures and post-harvest measures.

1. Pre-Planting Measures

Site selection: - Crop rotation, past manure treatments, and cropping history should all be taken into consideration when choosing a piece of land or site for the cultivation of fruits and vegetables. The field needs to be far from barnyards, pastures, and animal houses. It is the responsibility of farmers to ensure that runoff or drift from

livestock waste does not end up in the produce fields.

Seed and seedlings: - Look for varieties which are pest and disease resistant, heat resistant and GM-free. Keep seeds in sealed containers and store in a cool and dry place. Sowing date clearly influences the soil temperature and soil water availability experienced by germinating seeds and as a consequence, manipulating the sowing dates could be an efficient practice to help crops better escape abiotic or biotic stresses. Sowing date is also known to affect the level of damage resulting from insect pest attacks and the ability of plants to compensate for this damage.

Manure application: - Sustainable crop production depends upon the rational use of chemical fertilizers along with organic manures for better soil health. Owing to the constant production of crops from the soil, the latter is being depleted gradually of its nitrogenous and other nutrients. Reduce the amount of mechanical movement in fields by planting cover crops, green manure crops, or compost, and applying other organic materials including agricultural residues on a regular basis.

Green manuring a practice of ancient origin- is defined as the use of undecomposed green plant material, grown in situ or cut and brought in for incorporation to improve soil

productivity. The species commonly used for green manuring are of the Leguminosae with *Crotalaria juncea* (sunhemp) and *Sesbania aculeate* (Dhaincha) being the most popular in India, and *Vicia spp.*, *Trifolium spp.* and *Astragalus sinicus* in cooler climates. Biofertilizers which are formulations of bacteria, blue green algae or fungi helps in sustainable agriculture production either by providing plants with fixed nitrogen, available P or by other plant growth promoting substances. If necessary, liming can be used to rectify acidic soil, whereas sulphur can be used to repair alkaline soil. Saline soil can be remedied if needed by leaching soil, removing surface soil, and using fewer agrochemicals.

Table: - Major Biofertilizer and target crops

Biofertilizer	Target Crops
Rhizobium	Leguminous crops
Azotobacter	Potato, onion, tomato, brinjal and others
Phosphate solubilizing microorganisms	All
Potassium solubilizing microorganisms	All
Plant Growth Promoting Rhizobacteria (PGPR)	All
<i>Arbuscular mycorrhiza</i>	Nursery raised crops and orchard trees

Manure storage and sourcing: -

Apply fertilizers at the appropriate time and at the necessary level. Make use of aged and well-composted manure and organic

fertilizers. Fertilizers should be stored in a clean, dry, and protected area. For harvested veggies, never use used or empty fertilizer bags.

Timely application of manure: -

All planned vegetable should receive a manure application at the end of the growing season, ideally when the soils are warm, not saturated, and cover-cropped. When applying manure at the beginning of a season, it is best to do so two weeks prior to planting, ideally on forage or grain crops.

2. Production Measures

Irrigation water quality: -

Water is essential for horticultural production, both in terms of quantity and quality. One of the most important factors limiting crop productivity is the presence of high soluble salts in irrigation water. When water comes into contact with the edible part of the product, both before and after harvest, the quality of the water becomes especially crucial. For its intended purpose, all agricultural water must be safe and of a sufficient hygienic quality. Agricultural water quality varies widely and is largely influenced by its source. Municipal water is regarded as low risk, groundwater is moderately risky, and surface water has the highest likelihood of contamination. Wells that are erected, positioned, sealed, and maintained correctly will contribute to the provision of high-quality

water. Applications of water should always be appropriate for the intended use, whether it be for the crop or during post-harvest handling. Irrigate fields early in the morning, late in the evening or at night. Avoid uneven application of water.

The parameters characterizing irrigation water quality can be divided into three categories:

- ❖ **Physical:** temperature, suspended solids (soil particles, impurities etc.)
- ❖ **Chemical:** gaseous substances, pH, soluble salts, hardness, sodium and chloride concentration etc.
- ❖ **Biological:** algae, bacteria, various micro-organisms

Irrigation methods: -

Proper irrigation is the soul of agriculture. For getting a healthy crop, farmers have to irrigate their land in the right way. The edible parts of most crops should not be directly wetted, so whenever possible, the drip irrigation method should be used to lower the risk of crop contamination. A drip irrigation system works by directing water through a channel and into special drip pipes that have producers positioned at different distances from each other. Water flowed directly through the producers and into the soil near the roots. Water use efficiency is maximized and plant disease levels may be decreased with this method.

Field sanitation and animal exclusion: -

In order to stop plant or human pathogens from spreading, farmers should avoid wet fields. Before entering fields, tractors that were utilized for handling manure should be thoroughly cleaned. It is not advisable to let pets or poultry run loose in agricultural areas, particularly in the days leading up to harvest.

Pest Management: -

Maintenance of crop health is essential for successful farming for both yield and quality of produce. Use following prevention and control method to control insect and pest: -

Prevention method: -

In prevention method some of the cultural control practices are use i.e. choosing crops with less pest issues, choosing the ideal planting period to prevent insect peaks, utilizing resistant cultivars, and engaging in crop rotation; destroy old crop residue; before planting, get rid of weeds and continue to control them while crops are in the field. This helps keep a variety of insect pests under control, such as slugs, crickets, cutworms, false chinch bugs, and vegetable weevils. Border crops can be used like taller non-host border crops like maize, sorghum and pearl millet as a barrier for whitefly. Whereas trap crops attract pest species away from the cash crop to be protected and into a specific area where they can be destroyed.

Control Method

Yellow sticky plates are useful for controlling insects, and yellow sticky traps are a useful tool for managing whiteflies. The majority of pheromone traps attract males, who are oblique signs of possible pest issues. Furthermore, females have the potential to attract males more successfully than traps when they are nearby. Additionally useful for tracking the population's level of pesticide resistance are pheromone traps. Use predator and parasitoid of devastating insect to biological control.

Chemical control

1. Use pesticides only when the number of pests is high enough to result in financial losses.
2. Purchase and use pesticides only that are registered.
3. When there is a lot of rain and strong winds, avoid using pesticides.
4. Respect the withholding period—that is, the interval between applying a pesticide and harvesting—as specified on the pesticide label.
5. Pesticides should be kept in their original containers and keep them tightly closed in a cool, well-ventilated location.
6. Do not recycle or re-use pesticide containers for other usage.
7. Avoid repeating the same group of chemicals again and again, hence different

chemicals may be rotated so that the insect pests do not develop resistance.

Harvesting

Harvest when the fruit is fully grown. Harvest in the early morning or late afternoon, when the temperature is at its lowest. When packing or storing, harvested produce should, if needed, be thoroughly cleaned with clean water and any excess water removed. Both before and after handling produce, wash your hands with soap. While harvesting, avoid eating, drinking, and smoking. Always maintain packing, storage, and tool/equipment areas neat and orderly.

Pre-cooling and cold storage: -

Vegetables should be promptly cooled after harvesting in order to prevent pathogen growth and preserve quality. The refrigeration room shouldn't be filled to capacity with items. If the produce is intended for long-term storage, the cold chain should be kept intact until it reaches the cold storage. When pre-cooling with ice, it should be ensured that ice is made from potable water.

Packaging material: -

The packaging material should be free from chemical and microbial contaminations. It should not have contamination of rodent or bird excreta, etc.

Transportation of produce from farm to market: -

Major issue in vegetable is handling of crop after harvesting due to its perishable nature. Because vegetables are watery and succulent so chances of microbial pathogen attack is very high and quality of crop is reduced during transportation. Temperature plays a major role in contamination because growth of microorganism majorly depends on it. So, there is a need to maintain proper temperature to reduce the risk of contamination and pathogen attack. Some other factors are cleanliness of vehicle in which products are transported. For traceability norms, it must be ensured that each package leaving the farm can be traced to field of origin and date of packing.

Compliance for certification: -

The documentation of all the operations of production and post-production phases with suitable control points and remedial measures will ensure the compliance of certification requirements.

Challenges Associated with GAP: -

GAP implementation in farms benefits both produce farmers, and consumers. However, there are some drawbacks to the regulation, such as high costs and insufficient information and support services. Given this, GAP standards are constantly evolving to incorporate best practices that benefit farmers and improve food quality and safety, as well as agricultural environmental sustainability.

- ❖ Increase in production cost, like record keeping, residue testing, and certification facilitated the quality produce from chemical free or no use of chemical.
- ❖ Inadequate access to information and support services
- ❖ Small farmers are at risk of missing out on export markets unless they are adequately informed, technically prepared, and organized.
- ❖ Despite claims to the contrary, sometimes GAP standards fail to deliver all the social and environmental benefits claimed.

Conclusion

The agriculture sector in India is expected to grow faster in the coming years as a result of increased investments in agricultural infrastructure such as irrigation, cold chain, and value addition. Exports will be critical if India is to meet its targets, which will only be possible if GAP standards and certification mechanisms are institutionalized. Farmers have to opt for GAP for their produce to have access to new markets and meet safety demands consumers. Sustainable agricultural practices have a vital role to play in sustaining the growth and development of farming. Considering the fact that soil remains the most critical factor for production need to be sustain the production and maintaining the good health of soil. Adoption of these practices have

