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Organic Vegetable Cultivation

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Abstract

Present day agricultural practices are posing a serious threat to the human population due to unscrupulous use of chemical fertilizers and pesticides. Conventional agricultural practices wherein large quantities and unscrupulous use of chemical fertilizers and pesticides are no longer safer as it directly enter the food chain. Hence, organic cultivation of vegetables is gaining momentum among the growing population. Organic practices rely on crop rotations, crop residues, plant and animal manures, growing of legume and green manure crops and biological control of pests and diseases. It aims to combine tradition, innovation and science in a balanced proportion to utilize the environment in safer manner and maintain ecological balance. Organic cultivation assures protection of the environment and plays a major role on the economy of a nation. Sustainable production of organic vegetables needs to be ensured to fetch premium price in the domestic as well as international markets. Organic farming has shown expansion in the recent years in the European countries offering scope for a better price in the international market.

Keywords: organic farming, sustainability, feasibility, certification

1. Introduction

In the recent past, organic cultivation of vegetables is gaining increasing importance due to increased awareness among the growing population on the food safety and quality. This may be attributed to the fact that conventional agricultural practices wherein large quantities and unscrupulous use of chemical fertilizers and pesticides are no longer safer as it directly enter the food chain. There are innumerable health hazards posed by the conventionally grown crops due to the presence of higher pesticide residues, heavy metals and also genetically modified organisms. In cereals and pulses where the moisture level is maintained around eight per cent, the presence of pesticide residue is very minimum and has been found to disappear over a period of time due to storage, whereas in the case of vegetables and fruits the moisture level is more than 90 per cent and the availability of pesticide residue is maximum and the produce is to be consumed within a reasonable time because of the perishable nature. Organic cultivation besides protecting the environment, has a greater socio economic impact on a nation. However, the true impact lies necessarily on the sustainable food production which can go a long way on the environmental stability and economic vulnerability of a nation. The International Federation of Organic Agriculture and Movements (IFOAM) has suggested principles to enhance biological cycles in the farming system, enhance soil fertility, reduce pollution, evade the application of chemical fertilizers and pesticides, conserve genetic diversity, consider socio-economic impact of food production and produce high quality

food in sufficient quantity [1]. The National Organic Programme implemented by USDA Organic Food Production Act (OFPA, 1990) has specified guidelines on cultivation of crops organically to be acceptable as organic.

Organically produced vegetables contribute more than 20% of the total share of vegetables in some of the European countries. On the contrary, the market share of organic vegetables is meager in tropical and subtropical countries and hence is exported. Due to increasing awareness of organically grown vegetables, countries like Brazil, Argentina and China have turned towards organic farming.

2. Importance of organic farming

Vegetable crops when grown organically produce lesser yield. However due to its nutritive quality and storage attributes they are valued well than conventionally grown vegetables. Organoleptic studies have shown that vegetables like tomato and potato tastes better when grown organically. Likewise, the fruits had a better taste, flavor, texture and juicier when compared to conventionally grown ones. Similarly, organically grown okra and carrots were found to possess better quality attributes like taste, flavor and sugar content than those grown conventionally.

Excessive nitrate intake is posing a serious threat to human health. Leafy vegetables, in particular, accumulate more nitrates followed by root vegetables and potato. Studies have confirmed that organically produced vegetables like potato, carrot, cabbage beetroot, celery, leak, parsley and lettuce contain lesser levels of nitrates and higher levels of vitamin C content when compared to conventionally grown vegetable crops. Similarly, it has been found in studies that organically grown vegetables accumulate higher content of total sugars, minerals like phosphorous and magnesium and phenolic compounds in vegetables like carrot, potato, spinach, brinjal, lettuce and cabbage. Organically grown vegetables like sweet pepper and brinjal exhibited higher levels of phenolic compounds, peroxidase and capsidol activity offering resistance to diseases.

3. Status of organic vegetable production

During the past few decades, there is increasing concern on the food safety which in turn is drawing attention of the farmers, researchers and policy makers on the alternate production systems like organic cultivation. Organic farming is estimated to be growing at a rate of 30% a year worldwide in response to the market needs [2]. The demand for certified organic produce, particularly vegetables is presently exceeding the supply, thus fetching premium market price. Globally, the agricultural production system is undergoing a rapid transformation since there is a rise in demand for healthier and environmentally safer food. A larger proportion of growers are now shifting to organic production practices to meet the increasing consumer demands.

Organic cultivation has a significant role to play in maintaining the soil fertility by boosting the microbial flora of the soil. This can substantially lead to increase in yield, plant composition as well as nutritional quality.

Organic treatments resulted in higher carrot root production compared to conventional treatments [3]. The yield of cabbage and tomato grown under organic practices yielded better than that grown under conventional system [4]. Similar results were obtained in cucumber [5]. Better results in terms of fruit yield in vegetables could be attributed to the fact that organic amendments of soil changed the soil dynamics as well as the plant composition and nutritional quality. Organic

inputs can proportionately increase the microflora which in turn facilitates production of substances such as citrate and lactate which combine with soil minerals to increase the availability of mineral nutrition to the plant roots [6].

Besides increasing the soil fertility status, the nutritional quality of organically grown vegetables has been found to be appreciable. Higher levels of iron and magnesium were recorded in vegetable crops like carrot, beetroot, lettuce, kale, leek, turnip, onion, celery and tomato when grown organically [7]. Vitamin C holds an important place in the daily recommended diet due to its higher antioxidant properties. Hence, the focus of many research experiments has been on the vitamin C content in organically grown vegetables.

Experiments on tomato, celery and kale have shown higher vitamin C content when they are grown under organic practices than when grown under traditional systems of cultivation [7]. On an average, the vitamin C content of organically grown vegetables is 27% more when compared to the conventionally grown vegetables [6]. Likewise, the vitamin C content in organically grown leafy vegetables was found to be higher compared to that grown with chemical inputs [8]. Plant system responds to chemical fertilizer by increasing the production of proteins rather than carbohydrates since chemical fertilizers are rich sources of nitrogen. However, vitamin C production is the outcome of carbohydrate production and hence more quantum of vitamin C is expected to be produced with increased quantities of organic manures which have lesser nitrogen content and thereby lesser protein production and more of carbohydrate production.

4. Feasibility of organic practices

Organic farming implies application of composted plant residues and animal manures and growing legume crops as cover crop to meet the nutrient requirement of the crop. Soil fertility status is also enhanced by adopting practices like crop rotation, sequential cropping and also by minimizing the plowing activities. These techniques have a profound impact in maximizing the carbon sequestration in lands where organic practices are followed. On the contrary, in lands where conventional farming practices are adopted increased tillage operations lead to depletion in the organic matter accompanied by greater loss in mineral composition of the soil. The annual sequestration rate has been found to increase substantially by upto 3.2 tons of CO₂/ha/year by organic farming practices [9] which has a direct implication in reducing the green house gases.

With the unpredictable climatic condition in the present day, organic farming which can increase soil water retention capacity can go a long way in fighting the drought situation. Increased carbon retention in the soil helps in withstanding climatic challenges as well as soil erosion.

Organic farming requires 28–32% lesser energy compared to the traditional farming practices as this cuts down the cost on fertilizers, pesticides and machinery [10].

Organic agriculture can potentially lower the green house gas emission [11]. The estimated quantum of green house gas emission due application of chemical fertilizers is 1000 million tonnes annually. Organic farming can by and large reduce the Green House Gas emission by sequestering carbon into soil.

5. Sustainability of organic farming

The global human population is projected to expand to 9.3 billion by 2050. Hence, sustainable production needs to be addressed to meet the increasing food

requirements of the human population. Sustainable agriculture provides a potential solution to enable agricultural systems to feed a growing population within the changing environmental conditions. For successful organic farming maintaining soil health by addition of organic residues is imperative. However, it may not be feasible because of continuous sourcing of the crop residues/organic matter which has become scanty in recent times. Soil health is not only maintaining the carbon content in the soil but also maintaining a balance between carbon and nitrogen which is the most important factor that determines the nutrient availability besides the population dynamics of the microflora in the soil. Unlike conventional agriculture which involves usage of harmful chemical fertilizers and pesticides, organic farming sustains, maintains and enhances the quality of ecosystem. Though the plant absorbs nutrient in the simpler forms of nutrients similar to inorganic fertilizers, the source of nutrients is important factor to be considered in any organic farming practices. In the global market, vegetables grown organically fetch higher price because of its quality consideration and long term storability compared to inorganic green vegetables.

6. Organic certification

The body, CODEX Alimentarius of the Food and Agriculture Organization of the United Nations aims to protect the health of the consumers and ensure fair prices in the international market. Internationally, organic certification is underway to facilitate international trade between countries. One such body is International Federation of Organic Agriculture Movement (IFOAM).

USDA organic certification confirms that the farm complies with USDA organic regulations. Farms are certified by State or Private entities which have been accredited by USDA. Any farm that produces over \$5000 annually through organic sales needs to be certified.

Land utilized for organic vegetable production must not have used chemical fertilizers, pesticides, Genetically Modified Organisms (GMO's) for atleast 3 years prior to growing for organic purpose. Whole farm or part of a farm can be certified as organic. It is particularly important for vegetable growers to document the last date of application of prohibited chemicals, particularly when crops like, Lettuce or Spinach is grown.

7. Organic certification in India

Organic farming in India is showing steady increase. Farmers involved in organic farming are of three categories *viz.*, farmers of low input zones, traditionally doing organic farming, farmers who have shifted to organic farming as a result of realizing the ill effects of conventional farming and farmers who have ventured into organic practices to fetch premium price for their produce. In India, the National Programme on Organic Production (NPOP) has provided the regulatory framework while National Project on Organic Farming (NPOF) is involved in providing support for expanding the area under certified organic production [12].

8. Regulatory mechanism

The National Programme on Organic Production (NPOP) offers regulatory mechanism to acts for domestic and export markets. NPOP under Foreign

Trade Development and Regulation Act (FTDR) caters the export requirement and has been acclaimed by European Union, Sweden and USDA. Hence, any organic product certified by NPOP can be exported to Europe, Sweden and USA. Similarly, to meet the domestic demands, NPOP notified under Agriculture Produce Grading, Marketing and Certification Act (APGMC) comes to play lead role. Regulatory body of NPOP under FTDR is Agricultural and Processed Foods Export Development Authority (APEDA) under Ministry of Commerce and NPOP under APGMC Act is Agricultural Marketing Advisor (AMA) under Ministry of Agriculture. Accreditation of Certification and Inspection Agencies is being granted by a common National Accreditation Body (NAB) [12].

9. Need for certification

Certification ensures quality produce. “Certified Organic” serves as a product assurance to consumers. Certification necessarily aims to regulate and facilitate the sale of organic vegetables to consumers.

10. Certification process

In order to ensure certification by any agency, the producer has to satisfy the following criteria:

- Adherence of the organic standards as prescribed by the certification authority.
- The production practices and farm facilities have to comply with the norms and standards.
- Detailed documentation of the entire farming procedures adopted and farm facilities is required.
- Periodical inspection by the authorities concerned.

11. Product labeling

Organic legislation defines three levels of organic labelling in many countries. Products are given a “100% organic” label when the products are made entirely with certified organic ingredients. Products with the label “Organic” indicate 95% organic ingredients being used. The third label “made with organic ingredients” shows that a minimum of 70% of organic ingredients has been used.

12. Prospects and constraints of organic vegetable production

There is immense scope for organic production of vegetable crops in India since the agricultural sector has enormous organic resources like crop residues, livestock and other bio-products from agro industries. Organic farming is growing at a rapid pace among Indian farmers and entrepreneurs, particularly in rainfed and hilly areas where fertilizer consumption is less than 25 kg/ha/year [13].

Market development, particularly domestic sector continues to be one of the biggest challenges in organic farming. Lack of infrastructural facilities for post

production practices also poses a challenge as it sets a constraint in meeting the organic standards. Similarly the cost involved in certification process and the extensive documentation procedure is a major setback.

13. Conclusion

Organic agriculture is growing in many countries where there is self sufficiency in vegetable production. On the contrary in economically backward and developing world, feeding the population with adequate growing of vegetable assumes first priority.

The impediment to adopting organic cultivation practices in vegetable crops is the higher input cost. However, considering the environmental concerns and long-term sustainability of organic farming, the worthiness of the added costs has to be educated among the producers and entrepreneurs.

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