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Producing organic vegetables for better health

In recent years, major emphasis is given for commercial exploitation of vegetable crops as they are nutritionally rich, high-yielding and provide a valuable source of income. The study revealed that organic production of vegetable is economically-feasible and viable, besides it also improves quality, taste and flavour through increased dry-matter content, vitamin C, phenolic compounds and protein content. The soil heath is improved through increased organic carbon content, microbial activity and availability of nutrients and water.

VEGETABLES are important constituents of Indian diet as they are rich source of carbohydrate, proteins, vitamins, minerals, glucosinolates, antioxidants and fibre. The indiscriminate use of chemicals in modern intensive agriculture concerns the contamination of foods with agro-chemicals and also pollution of environment, soil and water. This made us to think about alternate forms of agriculture to produce food devoid of contaminants. Besides, in the present era of global warming and climate change, the face of agriculture has to be more environment friendly, hence the main emphasis should be for development of production technologies which are sustainable in long run. Organic agriculture is one among the broad spectrum of production methods that are supportive of the environment and restricts the use of synthetic inputs.

ORGANIC VEGETABLE PRODUCTION

In view of growing awareness of health and environment issues, there has been a paradigm shift and interest to adopt organic vegetable production systems, as a result, organic farming especially of vegetables is gaining momentum across the world and emerging fast as an attractive source of rural income generation. Organic products are increasingly preferred in developed countries and in major urban centers in India. There is high demand for organic food in domestic and international market which is growing around 20-25% annually; as a result the area under organic farming has been increasing consistently.

Initiatives at IIVR

It is pertinent that scientific study on organic production of vegetables to ascertain the productivity potential, economic feasibility and likely benefits of organic farming in terms of improved nutritional quality of produce and soil health are undertaken. The IIVR, Varanasi, took a lead in this direction and a permanent manurial trial on organic production of vegetables was initiated.

In the study different organic manures applied to supply plant nutrients to the vegetable crops include farmyard manure (FYM), vermicompost, NADEP compost, poultry manure, green manure, biofertilizers (*Rhizobium*, *Azotobacter*, Phosphorous Solubilizing Bacteria), Jeevaamrit and Panchagavya. In the field trials conducted at research farm of IIVR on organic farming had three source of bulky manure (FYM, Vermicompost and poultry manure) applied at three rates (FYM @ 10, 20, 30 tonnes/ha, vermicompost @ 5, 7.5 and 10 tonnes/ha and poultry manure @ 2.5, 5.0 and 7.5 tonnes/ha) for supplying nutrients to different crops along with different bio-inoculants. A separate block was assigned for conventional system of vegetable production for making valid comparison. Different plant protection materials used in organic farming include neem oil/ neem seed kernel extract, *Trichoderma*, Jeevaamrit and Panchagavya.

Crop planted in organic field

Crop productivity

The productivity of vegetables in organic farming is less in initial years, but it increases progressively under organic farming equating the yields under conventional inorganic farming during third to fourth year. In winter season tomato, cabbage and pea, the comparable yield to conventional system is achieved during third year in organic farming. However, in summer and rainy season cowpea, comparable yield is recorded only in fourth year of consecutive organic farming. Similarly, in rainy season

okra crop comparable fruit yield is achieved only in fourth year. The application of poultry manure @ 7.5 tonnes/ha or 20-30 tonnes/ha FYM or 7.5-10 tonnes/ha vermicompost can ensure 28-35% higher yield compared to conventional system. Even mixture of different organic sources such as FYM @ 10 tonnes/ha+vermicompost @ 3.5 tonnes/ha or FYM @ 10 tonnes/ha+ poultry manure @ 2.5 tonnes/ha along with the bioinoculation with *Azotobacter* and PSB were equally effective and produced yield comparable to conventional inorganic system in tomato, cabbage, pea, cowpea and okra crop.

There is reduction in average cost of cultivation in organic system due to use of farm derived inputs. Besides, use of botanical and biopesticides for insect pest and disease management resulted in considerable reduction in variable cost. Thus, combination of low-cost inputs and more yield with premium price makes organic vegetable production equally/more profitable than conventional system. Several studies on organic agriculture at other places have also shown the feasibility and profitability of commercial organic farming.

Soil health

The analysis of soil sample collected from 0-15 cm depth reveal that regular addition of organic manure improves soil fertility and quality. The loss of nutrient in organic manure is less due to its slow release. Higher P-use efficiency is noted in organic soils due to slow rate of release and fixation of phosphate ion in organic soils. Organic carbon build-up is noticed in organically fertilized fields. On an average, in organic field there is 39% increase in organic carbon and 22.3% increase in soil carbon stock of soil compared to conventional system over a period of only three years. The carbon sequestration is 301.1 kg/ha/year under organic farming, while it is only 42.6 kg/ha/year under conventional system in cabbage.

The water-holding capacity and hydraulic conductivity of soil in organic fields is significantly improved as compared to conventional system. The soil moisture content is 25-27% higher and relatively uniform in 0-45 cm depth of soil profile in organic system compared to conventional system in tomato and cabbage crop. The soil moisture content varied from 11.56 to 12.26 cm in 0-45cm depth of soil in organic field while it ranges from 9.1 to 9.78 cm in conventional system. Regular organic addition (manures, roots and other leaf biomass, etc) has the largest effect in soil organic carbon.

Organic farming does help in restoring effective micro organisms in the soil and thus improves soil fertility and health. Microbial activity measured in terms of dehydrogenase activity, alkaline phosphatase and microbial biomass carbon were higher in organic soils by 32, 26.8 and 22.4% respectively, compared to conventional system in cabbage and tomato crop. The higher microbial activity in organically fertilized plots helps in nutrient transformation and increased availability of these nutrients to the plants. In general increase in microbial biomass carbon in organic manure added soils was due to increased availability of substrate carbon that stimulates microbial growth but a direct effect from microorganism added through the compost is also possible.

Vegetable Quality

The quality, taste and flavour improve in organic farming, mainly through increased dry matter, vitamin C, protein content and quality, decreased free nitrates in vegetables, decreases storage losses and disease. In organically-produced vegetables, 17-25% higher vitamin-C content is present compared to conventional system. In organically-grown cabbage, tomato and cowpea, vitamin C content increases by 17, 35 and 36%, respectively, and protein content in cowpea improves by 30%, while lycopene content in tomato improves by 39%. Similarly, total phenolic compounds are also improved by 44% in organically-produced cabbage. Organic farming also improves physical attributes of vegetables. The organically produced cowpea, okra, cabbage, and tomato have better colour, lustre and texture.

Disease and Pest Management

The incidence and damage by *Helicoverpa* in tomato fruit is less under organic farming compared to conventional farming. In organic fields, lower pod damage is noted in cowpea, while in cabbage lowest DBM and head borer population is recorded. The number of predators, viz. spiders in cowpea and Coccinellids in cabbage are significantly higher in organic fields. Different components of farming acts complementary and supplementary to each other, encouraging natural predators and parasites to act positively thereby, reducing the incidence of pest and diseases under organic farming. However, incidence of DBM and aphid population per plant is effectively controlled by application of 4% neem seed kernel extract in cabbage. Similarly, decomposed mixture of cow dung, cow urine, curd and wild tulsi reduced DBM and aphid population in cabbage.

Preparation of neem seed kernel extract

FUTURE INITIATIVES

Vegetable crop generally produces a lot of biomass. The biomass are being recycled to produce vermicompost and NADEP compost on the farm itself as per the principles of organic farming for utilization in organic production of vegetables. Study is initiated on the production of crop based NADEP compost and vermicompost through recycling of crop residues. The quality parameters of these on-farm products and their response on different crops is being studied.

Plantation of perennial trees such as Gliricidia on the

Vermicomposting unit

boundary of organic block and neem tree in the residue management block is done to create diversity of flora and fauna. Till now, organic production of individual vegetable crops was undertaken. Now, cropping system based organic production system is undertaken. Vegetable crops that are biological nitrogen fixers and are potent source for capturing nitrogen freely available in atmosphere are grown as main, inter or green manure crop in the cropping systems. Creation of biodiversity of flora and fauna is the key component in organic system. Therefore, enhancing cropping intensity and encouraging crop diversification through inclusion of different components of vegetables as per climate and soil is initiated. Vegetable crops are being grown in the organic block as per the standard norms of National Programme on Organic Production so that vegetable produced meets the defined standard and could be certified by any accredited agency covered under National Advisory Committee of department of agriculture and cooperation**.** A number of initiateves at government level to promote organic farming in the country is being taken. National programme on organic farming (NPOF) provides necessary support for area expansion under certified organic farming

SUMMARY

Organic farming, especially of vegetables is gaining momentum worldwide due to increasing awareness and concern on adverse effects of indiscriminate use of chemical fertilizers and pesticides and machinery on food quality, soil health, human health and environment. The organic farming system has strong potential for building climate resilient food system in the face of uncertainties through farm diversification and building soil fertility with organic residues. Certified organic vegetable products offer high income options for farmers and therefore can serve as promoters for eco-friendly farming practice worldwide.

For further interaction, please write to:

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