Standardization of Organic production systems forLettuce and Pokchoi in Nilgiris

Abstract

An experiment was conducted to standardize the cultivation of Lettuce (*Lactuca sativa*) and Pokchoi under organic production system at Horticultural Research Station, Ooty during 2022-23. These exotic vegetables are grown for salad purpose for different dishes and consumed as raw in most of the Indian and European cuisine. The consumption of these exotic crops has increased considerably and farmers cultivate the crop on everyday harvest basis. The organic farming practices will help the farmers to fetch good remuneration as well to produce and practice Good Agricultural Practices so as to feed the consumers. An experimental field trial was conducted at Wood house farm of Horticultural research station in Lettucevar. Green and Pokchoi var. Chacko. A total of five treatments *viz.*, T_1 – Control , T_2 – Recommended dose of fertilisers, T_3 – organic package followed by farmers, T_4 - Package of practices based on recommendations of NOFRC (Nammazhvar Organic Farming Research Centre, TNAU, Coimbatore) and T_5 - Modified Package of practices based on recommendations of NOFRC were imposed with four replications. The results revealed that Lettuce and Pokchoi grown under modified organic package of practices (Green manuring and biofumigation with mustard + FYM @ 25 tonnes per ha + top dressing vermicompost @ 2 tonnes per ha + 3% panchagavya foliar spray +2 kg each of *azospirillum* + phosphobacteria + potashbacteria+ AM fungi) + need based application of biocontrol agents+ organic weedicide (vinegar 10% + common salt 5%) recorded significance with regard to morphological and yield parameters. Organic cultivation of Lettuce and Pokchoi plants proved significance when compared to cultivation with inorganic fertilizers and recorded a fresh weight of 176.3 g and 230.6 g respectively. The leaf quality of Lettuce and Pokchoiwas also superior for use as salad and the organic production system thus can be popularized as a means of environmental sustainability.

Key words: Lettuce, Pokchoi, organic production, bio-inputs, higher yield.

Introduction

Nilgiris District is part of the Western Ghats forming an important area of tropical rain forests in India. The area under temperate vegetable crops in Nilgiris District is about 4099 ha

per season. The annual production of temperate vegetables in Nilgiris is about 96,714 metric tonnes per annum and the productivity is23.59 metric tonnes/ha (Crop survey report of Nilgiris District, 2022). Since hill horticultural vegetable crops fetches profitable income throughout the year, vegetable crops are cultivated in Nilgiris in all seasons of the year. Among the vegetable crops, exotic vegetables are grown in an area of 500 ha. Lettuce (*Latuca sativa*) and Pok Choi (*Brassica rapa* sp. *Chinensis*) are the important exotic vegetables grown in the Nilgiris District in the mid and lower elevationsof the hills. The total crop duration is around 75 – 80 days. Almost all the exotic vegetables are grown for use as fresh and salad vegetables as well asconsumed as raw in most of the Indian and European cuisine. The consumption of these exotic crops has increased considerably and farmers cultivate these crops in a staggered manner for regular supply. Kowsalya *et al*., (2023) has also studied the importance of biofertilizers in vegetable production in Nilgiris hills.

Organic farming is considered a best farming practice which yields healthy food and achieves long term sustainability with lesser pollution to environment by avoiding hazardous inorganic chemicals (Mishra*et al*.,2013). One of the best organic inputs suited for organic farming practices are biofertilizers. Biofertilizersplay an imperative role in maintaining long term soil fertility and sustainability by fixing atmospheric nitrogen, mobilizing various micro and macro nutrients in the soil, thereby increasing their availability as well as efficiency (Mahdi *et al*., 2010). Biofertilizers are beneficial microbes-based fertilizers and are ecofriendly with low-cost input which when applied to soil promotes specific biochemical activity in rhizosphere. Biofertilizers are the preparations containing specific strains of microorganisms which can boost the microbiological processes *viz,* nitrogen fixation, phosphate solubilisation or mineralization, excretion of plant growth promoting substances and cellulose or lignin biodegradation in soil. The other important organic inputs are vermicompost and panchagavya. Vermi compost is nutrient rich, with microbiologically-active organic amendment which results from the interactions between earthworms and microorganisms by the breakdown of organic matter (Kaur *et al*., 2015).Panchagavya enhances the productivity by increasing the growth of roots, stems, branches and leaves and related parameters like root length, stem length, number of branches, number of leaves, leaf area index, chlorophyll content, oil content, protein content and other quality parameters finally contributing to the overall high yield and yield attributes (Kumar and Singh, 2020).

Addition of organic amendments to the soil are found to increase porosity, structure stability index, field capacity, wilting point, and available water content resulting in increased yield of crops (Cercioglu, 2017). The organic farming practices will aid the farmers to get sustainable income by way of supply of healthy vegetables without any harmful residues.The Nilgiris district of Tamil Nadu inhabits diverse flora and fauna in its Western Ghats range of mountains. This environmentally important ecosystem of the district has felt the need for the practice of organic farming by avoiding exorbitant usage of chemical pesticides, fungicides and fertilizers. Hence, the present study was undertaken to standardize the organic production system of exotic leafy and salad vegetables *viz.*, Lettuce and pokchoiin Nilgiris district.

Materials and Methods

The experiment was conducted in Woodhouse farm of Horticultural Research Station,located in an elevation of 2535 m above msl in Ooty, The Nilgiris. The treatments were fixed with organic inputs along with package of practices as recommended by NOFRC (Nammazhvar Organic Farming Research Centre, TNAU, Coimbatore). The treatments comprised of T_1- Control (no chemical or organic amendments, no chemical pesticides / fungicides); T_2 - Standard package of practices (FYM 50 t/ha and NPK 50:30:30 kg/ha) for Lettuce and Pokchoi as recommended in TNAU Crop production guide 2020; T_3 - Package of practices followed by farmers for organic farming of Lettuceand Pokchoi (Panchagayva foliar spray + Neem oil + Humic acid soil application +organic herbicide available in the market) ; T_4 -Package of practices based on recommendations for organic production recommended by NOFRC (Green manuring + FYM @ 25 tonnes per ha + top dressing vermicompost @ 2 tonnes per ha + 3% panchagavya foliar spray + 2 kg each of azospirillum and phosphobacteria)+ need based application of biocontrol agents ; T_5 : Modified Package of practices based on recommendations for organic production recommended by NOFRC (Green manuring and biofumigation with mustard + FYM @ 25 tonnes per ha + top dressing vermicompost @ 2 tonnes per ha + 3% panchagavya foliar spray + 2 kg each of *azospirillum* + phosphobacteria + potashbacteria+ AM fungi) + need based application of biocontrol agents+ Organic weedicide (vinegar 10% + common salt 5%). The method of Panchakavya preparation as given in TNAU agritech portal was followed (www.agritech.tnau.ac.in).The experiment was laid out in RBD with five treatments and four replications. The experimental plot size was 1 m x1 m in raised

beds and seedlings of Lettuce var. Green, Pokchoi var. Chacko were planted at a spacing of 30x30 cm in raised beds. The number of propagules is 12 plants/$m^2$of raised bed.Observations were recorded on morphological characters, leaf yield, head yield and microbial count in soil. The data were statistically analyzed in WASP 2.0 software and interpreted with critical difference of mean values at 5% significance level.

Results and discussion

Morphological and yield characters

A significant effect was noticed with regard to the applicationof modified organic package of practice on the growth and yield of Lettuce and pokchoi plants (Tables 1 and 2). Lettuce plants imposed with treatment T_5 (Modified organic Package of practices based on recommendations of NOFRC) registered highest plant height (17.40 cm), plant spread (16.50 cm), number of leaves (18.4 per plant and 165.60 per m^2) and leaf length (15.40 cm) followed by the treatment T_2 (Standard POP crop production guide). Lettuce also recorded highest root length (12.60 cm) and plant fresh weight (176.3 g) in the treatment T_5 followed by T_2which recorded a root length of 12.0 cm and fresh weight of 164.0 g.

Similar results were obtained with regard to performance of Pokchoi plants. Pokchoi recorded highest plant height (27.97 cm), plant spread (18.0 cm), number of leaves per plant (12.50) and number of leaves per m^2 (112.5) in the treatment T_5 (Modified organic package of practices) followed by T_2 (Standard POP crop prod. guide) with a plant height (27.18 cm), plant spread (17.50 cm), number of leaves per plant (11.0)and per m^2(99.0). The leaf length of Pokchoi was also significantly highest in the treatment T_5 (26.0 cm) followed by T_2 (25.20 cm).

The significant effect of organic inputs on yield of vegetable crops has been previously reported by earlier workers. Ashraf *et al*. (2020) has reviewed the role of biofertilizers in vegetable production. The significant role of bioBiofertilizers are the important components in organic farming as they aid in maintaining soil fertility for longer time period. The beneficial microbes present in these fertilizers support the uptake of nutrients by plants. Increased curd size and yield in broccoli by application of 50% AM FUNGI and 50% Azospirillum and Azotobacter has been reported by Singh*et al*. (2014). Azospirillum's key effects consist of modifications in root morphology that eventually stimulates plant growth (FibachPaldi*et al*., 2011). Phosphobacteria have the ability to convert the insoluble form of phosphorus to a soluble form

and make it available to plant by releasing various organic acids. Phosphobacteriacan be applied in all vegetables through seed treatment, soil application or seedling dip. Plants with limited root systems would be the most benefitted by Phosphobacteria application (Abd ElLattief, 2016). AM fungi are inter-cellular and obligatory endosymbiotic that have a beneficial relationship with plant roots since it extends and contaminates within the root zone. The shallow root system of Pokchoi and Lettuce plants have proved effective in absorbing the benefits of the above organic fertilizers as discussed in the above results. The beneficial effects of azospirillum, azotobacter and phosphobacteria were also reported in Carrot(MogB, 2007), Radish (Shani *et al*., 2017) and Potato (Kumar *et al*., 2013). The beneficial effects of phosphate solubilising bacteria also gained supportive evidences in Onion as reported by Waghmode*et al*., (2010), in Asparagus by Palande *et al*., (2017) and cauliflower by Kachari *et al*., (2009).

A significant improvement in soil quality and productivity of potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*) and turnip (*Brassica campestris*) after the application of vermicompost was reported by (Ansari *et al*., 2008).Gopal *et al*., (2017) stated that the panchagavya (4%) spray showed significantly higher dry matter, leaf area index (LAI), number of pods, number of seeds, seed yield, straw yield and biological yield in black gram. Suchitra *et al*., (2017) observed that3% panchagavya spray resulted in the highest number of fruits (19)and fruit weight (30.67 mg/fruit) when compared with other treatments in *Abelmoschus esculentus*.

With regard to microbial population in rhizosphere a significant count was recorded as 246.10 CFU (x1000) and 228.60 CFU (x1000) under organic production systems of T_5 and T_4 treatments, while it was very minimal with regard to inorganic production system 2.9 CFU (x1000). The application of bio-inputs had proved beneficial in significantly improving the microbial rhizosphere of Lettuce and Pokchoi plants.

Conclusion

Modified organic Package of Practices (Green manuring and biofumigation with mustard + FYM @ 25 tonnes per ha + top dressing vermicompost @ 2 tonnes per ha + 3% panchagavya foliar spray+ 2 kg each of *azospirillum* + phosphobacteria + potashbacteria+ AM fungi) + need based application of biocontrol agentscan be recommended for organic production of Lettuce and Pokchoi. This can be a best alternative to the inorganic package of practice of in terms of improvement in soil healthand multifold increase in rhizosphere bioinoculant population.

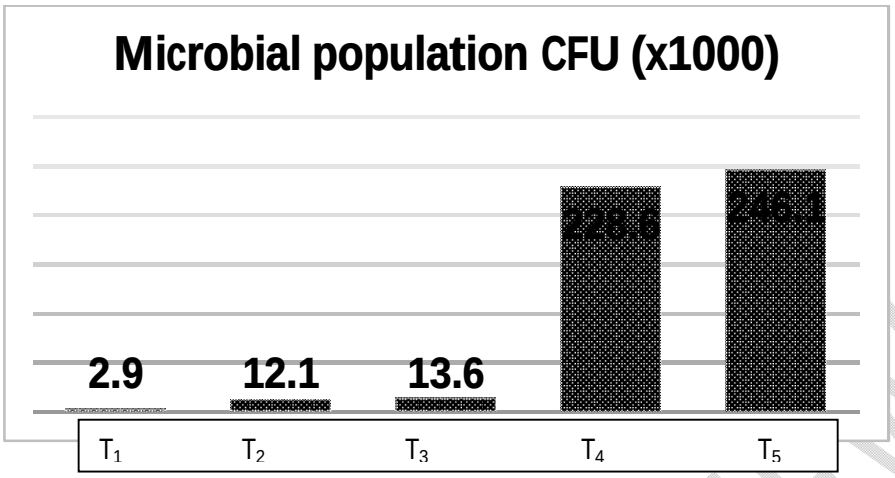
Table 1. Effect of Organic cultivation practices on morphological and yield parameters of Lettuce

Treatments	Plant height (cm)	Plant spread (cm)	No. of leaves	No. of leaves/m^2	Leaf length (cm)	Root length	Plant FW (g)	Plant DW (g)
T_1	13.5	13.6	14.5	130.5	11.7	9.7	148.0	26.7
T_2	16.5	15.0	17.8	160.2	14.1	12.0	164.0	40.0
T_3	15.5	14.0	16.2	145.8	13.4	11.6	158.7	35.0
T_4	16.0	14.8	17.0	153.0	13.9	11.8	162.3	37.0
T_5	17.4	16.5	18.4	165.6	15.4	12.6	176.3	48.3
Mean	15.78	14.78	16.78	151.02	13.7	11.54	161.86	37.4
S.Ed	0.023	0.023	0.028	0.29	0.028	0.02	0.177	0.15
CD (5%)	0.055	0.042	0.057	0.52	0.051	0.041	0.385	0.296

Table 2. Effect of Organic cultivation practices on morphological and yield parameters of Pokchoi

Treatments	Plant height (cm)	Plant spread (cm)	No. of leaves	No. of leaves/m^2	Leaf length (cm)	Root length (cm)	Plant FW (g)
T_1	22.48	12.5	9.0	81.0	20.5	11.2	220.4
T_2	27.18	17.5	11.0	99.0	23.92	13.16	228.48
T_3	24.63	16.4	10.0	90.0	23.0	12.6	226.0
T_4	26.32	17.0	11.0	99.0	24.9	13.0	225.0
T_5	27.97	18.0	12.5	112.5	25.2	13.8	230.6
Mean	25.71	16.28	10.7	76.3	26.0	15.2	240.4
S.Ed	0.039	0.039	0.025	0.77	0.042	0.028	NS
CD (5%)	0.079	0.08	0.05	1.375	0.08	0.056	

Fig.1 Rhizosphere microbial count as evidenced under organic farming



Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Table 3: Comparison of Lettuce and pokchoi under organic and inorganic production system

  T_5 T_2 Lettuce leafy vegetable	T_5:Green manuring and biofumigation with mustard + FYM @ 25 tonnes per ha + top dressing vermicompost @ 2 tonnes per ha + 3% panchagavya foliar spray + 2 kg each of *azospirillum* + phosphobacteria + potashbacteria+ AM) + need based application of biocontrol agents + + Organic weedicide (vinegar 10% + common salt 5%) T_2 :Standard package of practices (FYM 50 t/ha and NPK 50:30:30 kg/ha) for Lettuce and Pokchoi as recommended in TNAU Crop Production guide 2020
  T_5 T_2 Pokchoi leafy vegetable	