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Sumit Kumar
Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana, India

VPS Panghal
Assistant Scientist, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Anil Kumar
Principal Scientist (Agronomy), Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar, Haryana, India

Shiv Kumar
Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
VPS Panghal
Assistant Scientist, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Effect of organic manures and natural farming on growth, growth indices and yield and of carrot

Sumit Kumar, VPS Panghal, Anil Kumar and Shiv Kumar

Abstract
The experiment was carried out at Research farm of Deen Dayal Upadhyaya Centre of Excellence for Organic Farming of CCS Haryana Agricultural University, Hisar during the *rabi* season 2022-23 under organic system cultivation without using any chemicals to study the effect of organic manures and natural farming on growth, yield and quality of carrot. The experiment was laid out in RBD with eight treatments and three replications. Three different organic manures such as FYM, vermicompost, poultry manure alone and along with biofertilizers (*Azatobacter* and PSB) was applied. Treatment of cow based bio-formulations (Ghanajeevamrit and Jeevamrit) and control was also included as treatment where no fertilizer and manure were used. The study revealed significant improvements in almost all growth attributes and growth indices by combined application of organic manures along with biofertilizers. Among different combinations, vermicompost+ biofertilizer surpassed all other treatments by giving maximum plant height, fresh root and shoot weight, dry root and shoot weight, root length, shoot length, root diameter, root yield (283.4 qha^{-1}), shoot yield (183.0 qha^{-1}), total sugar, reducing sugar, non-reducing sugar, TSS, Absolute growth rate and crop growth rate. Also, the gross return (Rs. 425100 ha^{-1}), net return (Rs. 232873 ha^{-1}),), and BC ratio (2.21) during the experiment. It was also observed during the study that control treatment showed lowest findings among all the treatments.

Keywords: Carrot, cow based bio-formulations, growth indices, organic manures

Introduction
Carrot (*Daucus carota* L.) is one of the earliest known vegetable crop, member of the Apiaceae family having chromosome number 2n=18 (Grzebelus *et al.*, 2011) [6]. It is a popular root crop around the world and grown as a temperate and tropical root crop. In India, it is grown as a cool-season vegetable crop as most favourable temperature range is 15 to 20 °C (Singh and Karmakar 2015) [14].

India is the second largest producer of vegetables in the world, following China, with a total production of 189.5 million metric tones from the area of 10.3 million hectare, while, carrot production was 18.75 lac metric tones from an area of 1.06 lac hectare during the year 2019-20. In Haryana, production of vegetable was 61.13 lac metric tonnes from an area of 3.84 lac hectare (Anonymous, 2022) [1].

Carrots are known as vitaminized foods with moisture (84 to 95%), protein (0.6 to 2.0%), fat (0.2 to 0.7), carbs (9.58 to 10.6%), sugars (5.4 to 7.5%), and fibre (0.6 to 2.9%) (Raees-ul and Prasad 2015) [11]. A rise in the popularity of organic vegetables has been observed recently because of their higher nutrients and zero chemical residues. Moreover, yield, quality and quantity of carrot crop is improved while using organic manures like vermicompost, FYM, poultry manure and biofertilizers, which not only lessen reliance on chemical fertilisers but also increase soil fertility (Chumyani *et al.*, 2012) [3].

In organic farming, higher soil fertility and optimum pest control is achieved through the use of crop rotation, organic manure, biofertilizers, cultural techniques, and bio-pesticides along with other cultural, physical and mechanical methods (Ganesh *et al.*, 2021) [5]. The availability of soil micronutrients is greatly influenced by improved agricultural practises such as soil organic amendments and soil water management. Addition of local organic inputs, such as dung, biofertilizers, crop residues, etc., maintains soil health and nutrient availability (Dhaliwal *et al.*, 2021) [4]. Natural farming is a cutting-edge method of agriculture because all the inputs (insect repellents, fungicides, and pesticides) are made of natural and locally accessible inputs. There is absence in the need for synthetic fertilisers and industrial pesticides and use of cow based bio-formulations (Ghanajeevamrit and Jeevamrit) making it a low input, climate resilient, and low cost farming system (Laishram *et al.*, 2022) [9].

Materials and Methods

Initial soil samples were collected randomly from several field locations in a zig-zag pattern at 0-15 cm of soil depth before crop sowing with a hand auger. A combined sample was ground and passed through a 2 mm sieve and thereafter put away in the polythene pack for further analysis. The chemical analysis of soil samples for texture, pH, EC, available N, P, K and organic carbon, was done by standard methods as outlined by Antil. However, organic manures (FYM, PM and VC) were collected from the Deen Dayal Upadhyaya Centre of Excellence for Organic Farming CCS HAU, Hisar, and incorporated into the field before sowing of crop. Before analysis, the manure's samples were air-dried, ground and passed through a 2 mm sieve. Digestion (with the di-acid mixture) is the main step followed, thereafter; standard methods were adopted for analysis purpose. For plant height, root length, shoot length meter scale was used and vernier calliper was used for measuring the root diameter. For measuring the fresh weight and dry weight of root and shoot digital balance was used.

Experimental design and field management

The experiment was carried out at Research farm of Deen Dayal Upadhyaya Centre of Excellence for Organic Farming of CCS Haryana Agricultural University, Hisar during the *rabi* season 2022-23 under organic system of cultivation without using any chemicals is located at 29°8'20" N latitude and 75°42'04" E longitude at an elevation of 213 metre above mean sea level (MSL) in the sub-tropics of the country and characterized by semi-arid climatic zone. The soil of experimental field was sandy loam in texture containing 157, 15.70 and 364.00 kg ha^{-1} available nitrogen, phosphorus and potassium, respectively in 0-15 cm soil depth with EC 0.78 dS m^{-1}, pH 7.80 and organic carbon content 0.67 per cent. The treatment combinations were setup as per recommended dose of Nitrogen for carrot crop in that is 60 kg ha^{-1}. The experiment was laid out in a randomized block design (RBD) with three replications and 8 treatment combinations. Seed of carrot cultivar Punjab carrot 161 was sown in net plot of 4.5m × 4.0m on 16 October, 2023.

The treatments were

T_1: RDN through FYM
T_2: RDN through vermicompost
T_3: RDN through poultry manure
T_4: RDN through FYM + biofertilizers*
T_5: RDN through vermicompost + biofertilizers*
T_6: RDN through poultry manure + biofertilizers*
T_7: cow-based bio-formulations (Ghanajeevamrit and Jeevamrit)
T_8: control.
(**Azotobector* + PSB)

Whereas, organic manures i.e., FYM, vermicompost, poultry manures and biofertilizers applied @ 9210, 3157, 2143 kg ha^{-1} and 50 ml each of *Azatobecter* and PSB for seed treatment. Cow based bio-formulations (Ghanajeevamrit and Jeevamrit) was applied @ 250 kg Ghanajeevamrit + 250 FYM kg/ha and 125 litre Jeevamrit in three split doses at 20, 40 and 60 DAS @ 5%, 10% and 10%, respectively.

Nutrient composition of organic manures is depicted in table 1.

Table 1: Available NPK content (%) in organic manures

Sr. No.	Organic Manure	Nitrogen (N) (%)	Phosphorous (P) (%)	Potassium (K) (%)
1.	FYM	0.65	0.42	0.84
2.	Poultry manure	2.80	1.59	1.72
3.	Vermicompost	1.89	0.85	0.96

Data collected

Data on growth, yield, quality parameters *viz.*, plant height (cm), fresh weight of root, fresh weight of shoot, dry weight of root, dry weight of shoot (g/plant), chlorophyll content in leaves at 30, 60 and 90 DAS, whereas root length (cm), shoot length (cm), root diameter (cm), root shoot ratio, forking % and root and shoot yield (q/ha), absolute growth rate and crop growth rate were taken from the ten tagged plants. Growth indices *viz.*, CGR was calculated from the dry weight of plant and AGR was from the height of plants at 30, 60 and 90 days intervals.

Statistical analysis

The mean values of the parameters and LSD were calculated using one factor analysis in OPSTAT software developed by CCS HAU, Hisar.

Result and Discussion

Application of organic manures and cow-based bio-formulations significantly influenced growth, yield and quality attributes and also influenced the growth indices *i.e.*, absolute growth rate and crop growth rate. The results obtained from the present investigation are presented in table 2 to 4. The plant height of carrot was recorded highest (9.20, 37.33 and 56.67 cm), fresh weight of root (0.04, 14.30 and 52.80 g/plant), fresh weight of shoot (0.60, 20.67 and 41.87 g/plant), dry weight of root (0.014, 2.47 and 5.73 g/plant) and dry weight of shoot (0.08, 3.60 and 5.77 g/plant) at 30, 60 and 90 DAS with application of vermicompost along with the seed treatment of biofertilizers (*Azotobector* + PSB) which was superior over the control treatment.

Plant height was at par with the treatments T_4, T_2, T_1 and T_6 at 30 DAS, with treatments T_4, T_2, T_1 at 60 DAS and with T_4, T_2 at 90 DAS. Fresh weight and dry weight of shoot and root were recorded maximum in T_5 which was at par with the treatments T_4 and T_2 at 30 and 60 DAS but treatment T_1 was also at par with the treatment T_5 at 90 DAS in fresh weight of root, 30 and 60 DAS in dry weight of root. The beneficial effects of applying vermicompost and FYM may be attributed to the increased effectiveness of nutrient uptake and the provision of all essential nutrients in a balanced amount due to their slow release occurring at the stage of root development characterised by increased root thickness, fresh root weight, and dry matter accumulation after cessation of root growth. This result agrees with the finding of Rani and Malla Reddy (2007) [12], Yadav *et al.* (2022) [16], Kumawat *et al.* (2018) [7] and Kushwah *et al.* (2019) [8].

Growth indices

There was a sharp rise in the absolute growth rate and crop

growth rate from 0-30 DAS to 31-60 DAS, while it starts declining from 61-90 DAS. The maximum absolute growth rate between 0-30, 31-60 and 61-90 DAS was recorded in T_5 (3.07 cm day^{-1}) which was significantly higher than other treatments except T_4, T_2 and T_1. But at 0-30 DAS treatment T5 was also at par with treatment T_6. However, the minimum value of absolute growth rate was recorded in control treatment in which no external input was applied. The maximum crop growth rate between 0-30 DAS was recorded in T_5, T_4 and T_2 (0.08 g m^{-2} day^{-1}), which was significantly higher than other treatments except T_1, T_3 and T_6. At 31-60 and 61-90 DAS, maximum CGR (5.53 and 5.03 g m^{-2} day^{-1}) was recorded with T_5, which was at par with treatment T_2 and T_4 but also with treatment T_1 at 31-60 DAS. However, the minimum crop growth rate was recorded in cow based bio-formulations and control treatments (0.06 g m^{-2} day^{-1}). The increased leaf area and availability of more photosynthetically active leaf area for a longer period of time resulted in higher dry matter production and increased availability of active leaves over time, which may be the reason for the higher growth indices. The results are in conformity with the findings of Tabitha *et al.* (2018) [15], Ngoroyemoto *et al.* (2019) [10] and Arya *et al*. (2017) [2] who have also reported similar results.

Yield attributes

The maximum root length (27.20 cm), shoot length (55.90 cm), root diameter (3.07 cm), root yield and shoot yield (283.4 and 138.0 q/ha) were obtained with the treatment with the application of vermicompost along with the seed treatment of biofertilizers which was at par with treatments T_2 and T_4 whereas, the minimum was recorded with the treatment T_8 in which no external organic manures were applied. The ratio of root and shoot was taken on length basis and recorded in the range of 0.49 to 0.56 (table 5). The root shoot ratio was found non-significant recorded among the different treatments. Forking % was recorded maximum (10.62%) with the treatment T_3 which was statistically at par with the treatments T_6, T_4 and T_1 whereas, the minimum percentage of the forked roots was recorded in control (T_8). Due to favourable soil conditions, increased photosynthesis rates and adequate availability of major and micronutrients, vermicompost and FYM along with biofertilizers resulted in improved growth and yield characteristics of carrot. The results were in accordance with the findings of Rani *et al*. (2016) [13], Kumawat *et al.* (2018) [7] and Kushwah *et al*. (2019) [8].

Table 2: Effect of organic manures and natural farming on periodic changes in plant height, fresh weight, dry weight of root and shoot

Treatments	Plant height (cm)			Fresh root weight (g/plant)			Dry root weight (g/plant)			Fresh shoot weight (g/plant)			Dry shoot weight (g/plant)			Absolute growth rate (cm day^{-1})			Crop growth rate (g/m^2/days)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	0-30 DAS	31-60 DAS	61-90 DAS	0-30 DAS	31-60 DAS	61-90 DAS
T_1	8.93	34.60	52.87	0.03	12.20	49.67	0.013	2.13	5.27	0.44	17.60	36.73	0.06	3.40	4.90	0.30	0.86	0.61	0.07	5.05	4.29
T_2	8.97	35.80	54.73	0.03	13.33	52.07	0.014	2.40	5.47	0.52	19.67	39.40	0.07	3.53	5.47	0.30	0.89	0.63	0.08	5.41	4.63
T_3	8.03	33.33	50.93	0.02	10.67	47.00	0.013	2.00	4.97	0.40	15.47	35.33	0.06	2.47	4.07	0.27	0.84	0.58	0.07	4.07	4.23
T_4	9.10	36.27	54.67	0.04	13.13	51.80	0.013	2.30	5.43	0.52	18.53	39.20	0.07	3.53	5.10	0.30	0.91	0.61	0.08	5.33	4.35
T_5	9.20	37.33	56.67	0.04	14.30	52.80	0.014	2.47	5.73	0.60	20.67	41.87	0.08	3.60	5.77	0.31	0.94	0.65	0.08	5.53	5.03
T_6	8.87	33.87	51.00	0.03	11.40	47.07	0.013	2.07	5.13	0.45	17.20	35.80	0.06	3.03	4.57	0.30	0.83	0.58	0.07	4.65	4.26
T_7	7.93	32.13	50.40	0.03	10.60	44.53	0.013	1.80	4.77	0.40	14.03	29.93	0.06	2.33	3.87	0.26	0.82	0.59	0.06	3.76	4.17
T_8	7.87	31.13	48.40	0.02	9.93	36.87	0.012	1.73	4.10	0.36	12.60	25.00	0.05	1.73	3.47	0.26	0.78	0.58	0.06	3.15	3.80
SEm (±)	0.32	1.02	0.98	0.003	0.44	1.08	0.001	0.12	0.17	0.04	0.95	1.40	0.01	0.16	0.26	0.01	0.03	0.04	0.01	0.21	0.32
CD at 5%	0.99	3.12	2.96	0.01	1.35	3.30	N.S.	0.38	0.51	0.12	2.91	4.28	0.01	0.48	0.80	0.03	0.09	0.04	0.01	0.63	0.71

Table 3: Effect of organic manures and natural farming on root length, shoot length, root shoot ratio, root diameter, root forking, root yield, shoot yield, cost of cultivation, gross return, net return and BC ratio

Treatments	Root length (cm)	Shoot length (cm)	Root shoot Ratio	Root diameter (cm)	Forking %	Root yield (q ha^{-1})	Shoot yield (q ha^{-1})
T_1	25.70	50.3	0.51	2.88	9.38	265.9	126.6
T_2	26.53	53.5	0.50	3.00	8.30	275.1	132.8
T_3	24.87	47.5	0.53	2.83	10.62	248.1	113.2
T_4	26.40	52.5	0.50	2.93	9.52	271.2	131.8
T_5	27.20	55.9	0.49	3.07	7.97	283.4	138.0
T_6	25.33	48.8	0.52	2.87	10.48	254.7	118.5
T_7	24.40	45.6	0.54	2.67	6.76	241.7	110.6
T_8	23.73	42.9	0.56	2.53	5.91	220.8	99.0
SEm (±)	0.56	1.39	0.1	0.03	0.71	7.5	3.0
CD at 5%	1.47	4.3	N.S	0.14	2.01	22.9	9.1

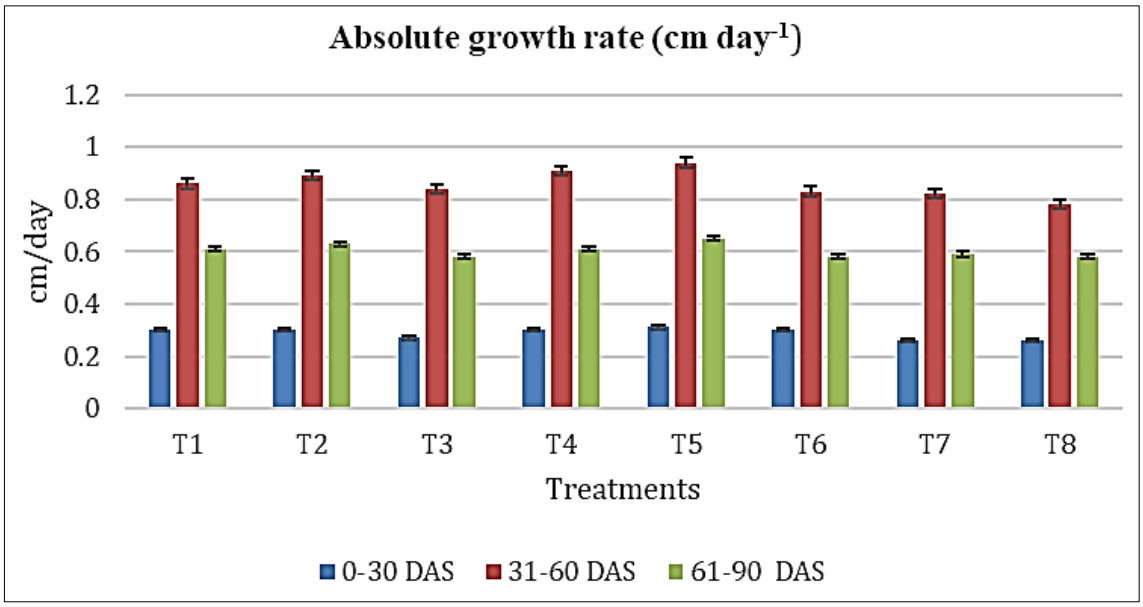

Fig 1: Effect of organic manures and natural farming on periodic changes in absolute growth rate

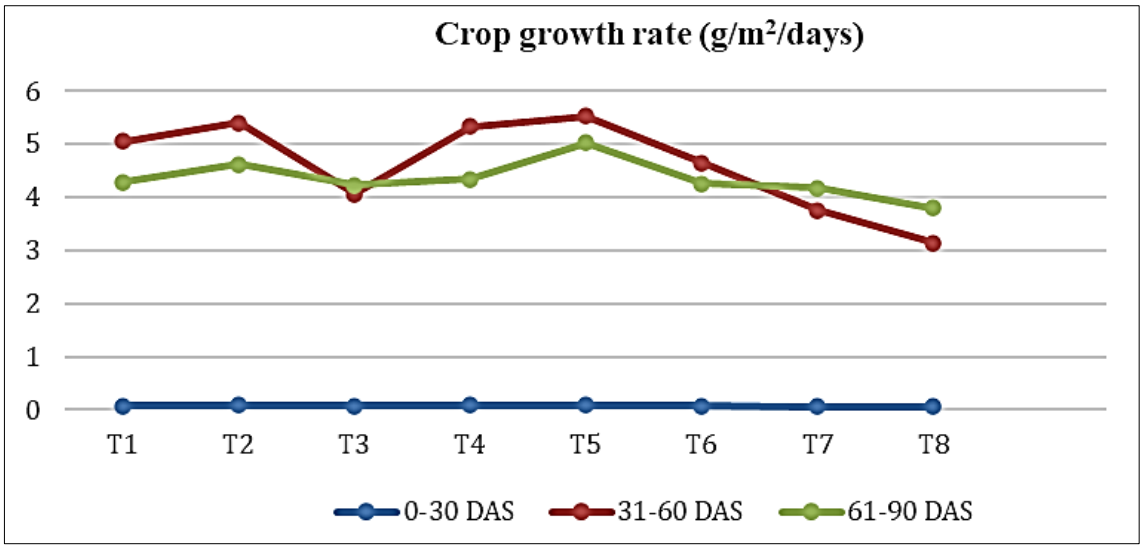

Fig 2: Effect of organic manures and natural farming on periodic changes in Crop growth rate

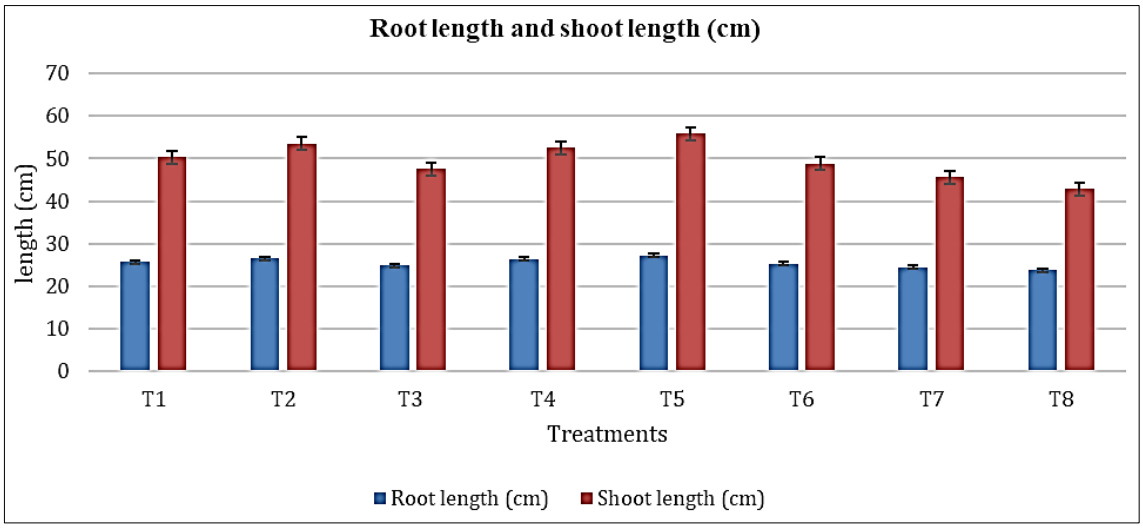

Fig 3: Effect of organic manures and natural farming on root and shoot length

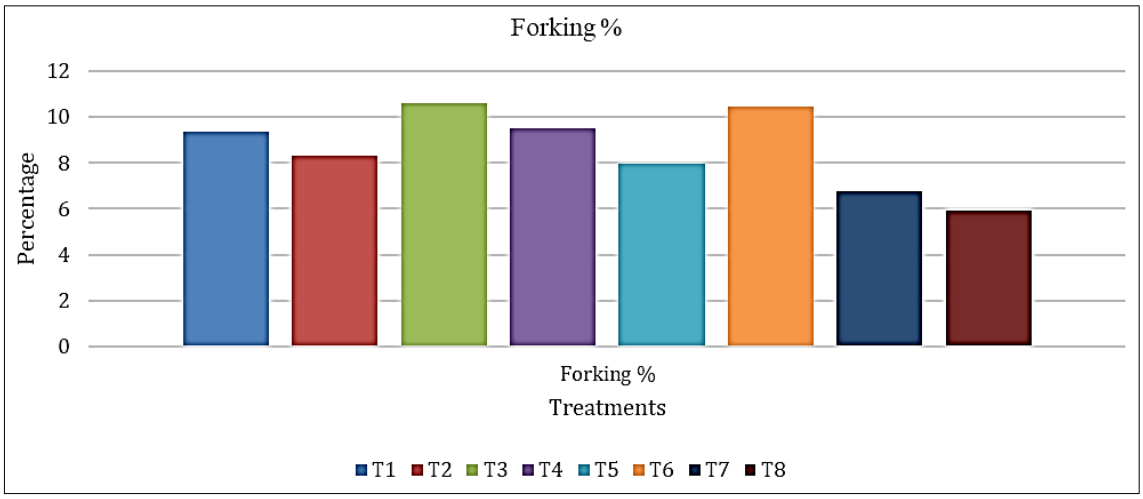

Fig 4: Effect of organic manures and natural farming on forking % at harvest

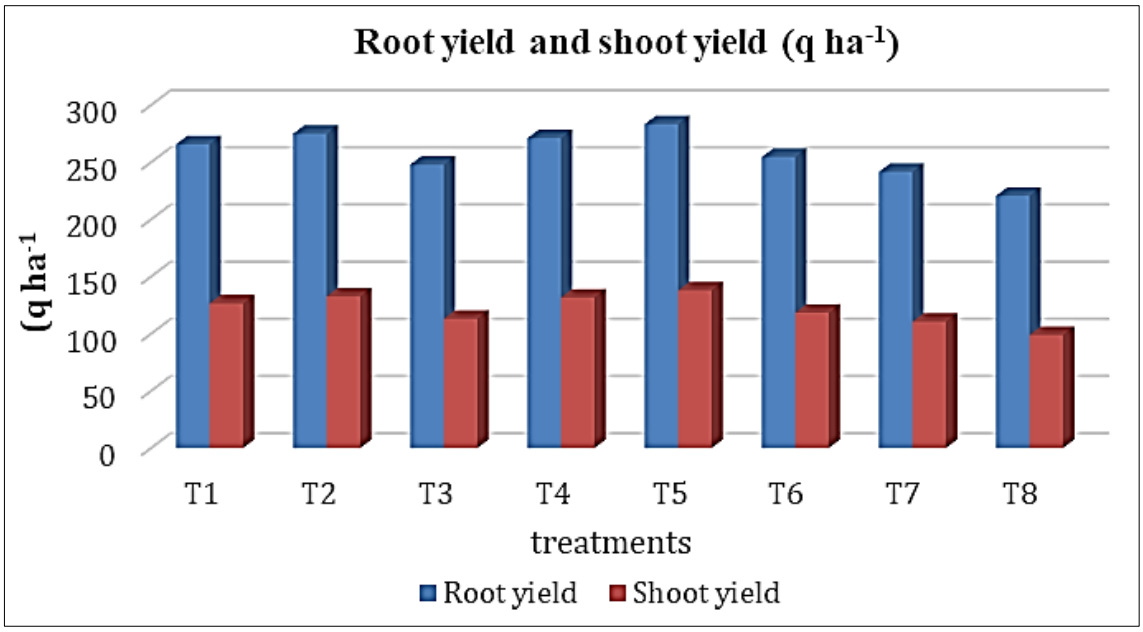

Fig 5: Effect of organic manures and natural farming on root yield and shoot yield.

Conclusion

Based on the experimental results it can be showed that the application of 100% RDN through vermicompost along with biofertilizers (*Azotobacter* and PSB) showed superior performance over other treatments which was at par with the treatments in which recommended dose of nitrogen was provided through vermicompost and RDN through FYM along with biofertilizers. In addition to enhancing soil health the application of organic based fertilizers can substitute the chemical fertilizers. So, the use of organic manures along with biofertilizers directly benefit to the farmers by reducing the cost of cultivation.

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Conflict of interest

Authors have cleared that there is no conflict of interest.

References

1. Anonymous. Area and Production of Horticultural Crops 2019-2020. Department of Agriculture and Farmer Welfare. Ministry of Agriculture and Farmer Welfare, Government of India; c2022. Agricoop.nic.in/en/statistics/horticulture.
2. Arya S, Kumar TR, Santhosh KR. Comparative study on the effect of fertilizers on agronomic and biochemical characters in Amaranthus sp, Indian Journal of Tropical Biodiversity. 2017;25(1):93-97.
3. Chumyani KS, Singh A, Singh V. Effect of integrated nutrient management on growth, yield and quality of tomato (*Lycopersicon esculentum*), Journal of Soil and Crops. 2012;22:5-9.
4. Dhaliwal SS, Sharma V, Mandal A, Naresh RK, Verma G. Improving soil micronutrient availability under organic farming, Advances in Organic Farming; c2021. p. 93-114.
5. Ganesh BM, Ahmad MA, Karthik S, Raju BJ. Organic insect pest management: a sustainable approach for the Indian Farming Community, Entomology; c2021. p. 127.
6. Grzebelus D, Baranski R, Spalik K, Allender C, Simon PW. Daucus Wild Crop Relatives: Genomic and Breeding Resources: Vegetables; c2011. p. 91-113.

7. Kumawat S, Soni A, Sharma D, Soni V. Effect of organic manures and fertility levels on yield attributes of carrot (*Daucus carota* L.) cv. Pusa Rudhira, International Journal of Chemical Studies. 2018;6(5):1613-1616.
8. Kushwah L, Sharma RK, Kushwah SS, Singh OP. Influence of organic manures and inorganic fertilizers on growth, yield and profitability of radish (*Raphanus sativus* L.), Annals of Plant and Soil Research. 2020;22(1):14-18.
9. Laishram C, Vashishat RK, Sharma S, Rajkumari B, Mishra N, Barwal P, *et al*. Impact of natural farming cropping system on rural households—Evidence from solan district of Himachal Pradesh, India. Frontiers in Sustainable Food Systems. 2022;6:174.
10. Ngoroyemoto N, Gupta S, Kulkarni MG, Finnie JF, Van SJ. Effect of organic biostimulants on the growth and biochemical composition of Amaranthus hybridus L, South African Journal of Botany. 2019;124:87-93.
11. Raees-ul H, Prasad K. Nutritional and processing aspects of carrot (Daucus carota)-A review. South Asian Journal of Food Technology and Environment. 2015;1(1):1-14.
12. Rani R, Malek MA, Robbani M. Effect of organic manures and mulching on growth and yield of carrot Journal of Agro forestry and Environment. 2016;10(1):155-160.
13. Rani SM, Malla RK. Effect of different organic manures and inorganic fertilizers on growth, yield and quality of carrot (*Daucus carota* L.). Karnataka Journal of Agricultural Scienc. 2007;20:686-88.
14. Singh BK, Karmakar P. Improved production technology for root crops, Improved production technologies in vegetable crops. IIVR training manual. 2015;59:120-133.
15. Tabitha K, Wilson T, Joseph PGO. Morphological Characteristics of Amaranthus cruentus and Amaranthus tricolor as Influenced by Integration of Organic and Inorganic Fertilizers in Kiambu County, Kenya. Asian Research Journal of Agriculture. 2018;8(1):1-18.
16. Yadav A, Jakhar RK, Kumari N, Yadav GN, Kant R, Sharma SL, *et al*. Response of organic manures and fertilizers on yield and quality of carrot under sandy soil condition. The Pharma Innovation Journal. 2022;11(4):1822-1827.