

Original Research Article

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Soil Nutrient Status, NPK Uptake and Viable Bacterial Count as Influenced by Different Organic Nutrient Sources in European Carrot

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ABSTRACT

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A study was undertaken to assess the effect of organic nutrient sources on soil nutrient status, NPK uptake and viable bacterial count in European carrot. The experiment was conducted at Organic Block of Experimental Farm, Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, (HP) in the Rabi season of 2017. The experiment was laid out in Randomized Complete Block Design (RCBD) Factorial with sixteen treatments in three replication. Treatments comprised combination of four levels of organic manure and organic liquid formulations. The results revealed that combined application of vermicompost 5 t/ha + Jeevamrit – drenching @ 5 % + Panchgavya – spray @ 3 % exhibited significant higher values for soil nutrient status and NPK uptake. Highest viable bacterial count was also obtained under this treatment. Therefore, vermicompost along with Jeevamrit and Panchgavya can be recommended for sustainable production of carrot and to nourish soil fertility under mid-hills condition of Himachal Pradesh.

Introduction

Carrot (*Daucus carota* L.) belongs to family Umbelliferae and is an important root vegetable grown throughout the world. It is grown during spring, summer and autumn in temperate regions and during winter in tropical and subtropical climates. In India, it is grown in almost all parts of the country, both in plains and as well as in hills. It is native to Afganistan (Rubatzky and Yamaguchi, 1999). It is used as salad and cooked vegetable. Carrot in combination with other vegetables can produce especially healthful, tasty and refreshing drinks. Carrot contains appreciable

amount of carotene, thiamine, protein, calcium and riboflavin. It can play an important role to protect the night blindness in children providing vitamin-A. Being an antioxidant, a combination of carrot and orange juice also reduces the oxidation of low-density lipoproteins in habitual cigarette smokers (Abbey *et al.*, 1995). Maintenance of soil fertility is a prerequisite for long term sustainable agriculture. Modern conventional farming uses chemical fertilizers to stimulate crop production resulting in decline in soil structure and soil aggregation, decrease in water infiltration and an increase in soil salinity and soil bulk density. Moreover, the

use of inorganic fertilizers has been associated with human health problems and environment degradation (Arisha and Bardisi, 1999). Organic manures supply the required nutrients, improve soil structure, increase microbial population and at the same time maintain the quality of crop produce (Wong *et al.*, 1999, Nehra *et al.*, 2001 and Suresh *et al.*, 2004).

Organic manure can serve as a substitute to mineral fertilizers (Naeem *et al.*, 2006). Several authors have reported the importance of organic manure as a source of nutrients and a means of soil rejuvenation (Adeleye *et al.*, 2010). Considering the above facts the present study was undertaken to investigate the potential use of organic nutrient sources on soil nutrient status, NPK uptake and viable bacterial count in carrot.

Materials and Methods

The investigation was carried out at Experimental Farm of the Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during Rabi season (September – December) of 2017. The experimental site is located at an altitude of 1270 meters above mean sea level lying between latitude of 30°54' North and longitude of 77°5' East and falls under mid hill zone of Himachal Pradesh.

The layout of experimental field was laid down in Randomized Complete Block Design (RCBD) Factorial with three replications comprising of sixteen treatment combinations of two factors - Factor I: organic manure (M) and Factor II: organic liquid formulations (L). The details of treatments combination is given in Table 1. Seeds of carrot cv. Early Nantes were sown in the raised plots of size 2.25 m² on 15th September, 2017. Seeds were sown in lines at a row spacing of 30 cm and later on thinned to 10 cm spacing between the plants,

thus accommodating 75 plants per plot. The organic manures (vermicompost and well rotten farm yard manure) were applied at the time of land preparation. Jeevamrit 5 per cent (as soil drench) and Panchgavya @ 3 per cent (as foliar spray) were applied at 20, 40, 60 days and 30, 50, 70 days after sowing of seeds respectively. The observations were recorded on available NPK content in soil (kg/ha) (before and after termination of experiment), viable bacterial count (cfu/g) and NPK uptake by plant (kg/ha). The observed data were statistically analyzed and the treatments were tested at 5 per cent level of significance as per procedure described by (Panse and Sukhatme, 2000) under the Randomized Complete Block Design (RCBD) Factorial. The analysis of the soil was done before planting and it was found that soil was rich in organic matter and having pH, EC and OC values of 7.29, 0.43 dSm⁻¹ and 1.05 per cent, respectively. The available N, P and K content and viable bacterial count was recorded to be 370.00, 43.00 and 270.92 kg/ha and 86.90 × 10⁵ cfu/g, respectively.

Soil analysis

Soil samples from 0-15 cm depth were collected from all the plots separately and were air dried, crushed, passed through 2 mm sieve and stored in cloth bags for chemical analysis like available NPK. Available N was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956) and available phosphorus was determined by Olsen's method (Olsen *et al.*, 1954) using spectrophotometer. Available potassium was determined by ammonium acetate method using flame photometer (Mervin and Peech, 1951). For estimation of viable bacterial count one gram soil mixture was taken in 9 ml of sterilized water blank and the soil suspension was diluted in 10 fold series. Then, microbial count was determined by spread plate technique on different media as described by (Subba Rao, 1999).

Plant analysis

The samples collected were immediately weighed and brought to the laboratory in paper bags. All the samples were washed in series, first with tap water, and then with 0.1 N HCl followed by distilled water. The washed samples were allowed to dry in air and subsequently in oven at 60°C till constant weight attained.

The dried samples were then grinded in a electric grinder and stored in butter paper bags for chemical analysis. For estimation of N, 1.0 g of plant material was digested in concentrated H₂SO₄ in the presence of a digestion mixture.

After digestion the N was determined by micro-kjeldahl method. For the estimation of P and K, 1.0 g of the plant sample was digested in 4:1 nitric acid and per chloric acid (HNO₃: HClO₄) mixture. In order to have complete transfer of the digestion material, three washings of the digestion flask were given with distilled water and volume was made to 100 ml. Potassium in the extract was determined by flame photometer and P was determined by Vanado-molybdate yellow colour method (Jackson, 1973).

Results and Discussion

Available NPK and NPK uptake

Application of different levels of organic manures, organic liquid formulations and their combinations significantly influenced the available NPK and NPK uptake (Table 2). The application of vermicompost (M₂) accounted for the maximum available nitrogen (367.94 kg/ha), phosphorous (59.50 kg/ha), potassium (352.09 kg/ha) and uptake of nitrogen (113.49 kg/ha), phosphorus (27.98 kg/ha) and potassium (108.68 kg/ha) as compared to control M₀. Among the liquid formulations,

maximum available nitrogen (367.52 kg/ha), phosphorous (61.98 kg/ha), potassium (354.07 kg/ha) and uptake of nitrogen (112.78 kg/ha), phosphorus (27.65 kg/ha) and potassium (107.02 kg/ha) were found in L₃ and were minimum in L₀.

The data on different combination divulged that maximum available nitrogen (387.56 kg/ha), phosphorus (71.58 kg/ha), potassium (366.90 kg/ha) and uptake of nitrogen (127.05 kg/ha), phosphorus (29.84 kg/ha) and potassium (120.31 kg/ha) were observed in M₂L₃ and were minimum in control (M₀L₀).

Increase in available N may be due to slow release of nutrients through organic manure and enriching available pool of nitrogen (Bharadwaj and Omanwar, 1994) or it might be due to the addition of nitrogen through vermicompost, Jeevamrit and Panchgavya and multiplication of soil microbes, which could convert organically bound N to inorganic form to the available pool of the soil.

The buildup of available P under these treatments may be due to release of organic acids during microbial decomposition of organic matter which might have helped in solubility of native phosphates thus increases the available phosphorus pool in the soil (Khan *et al.*, 1984).

Increase in available K could be attributed to the beneficial effect of organic matter in releasing K₂O due to the interaction of organic matter with clay and direct addition of K₂O to the available pool of soil. Further the increase in N, P and K uptake might be due to the enhancement of availability of nutrients in the soil (through application of enhancing the availability of nutrients). Similar findings were reported by Sharma *et al.*, (2009), Gore and Sreenivasa (2011), Prativa and Bhattarai (2011), Singh *et al.*, (2014) and Suklabaidya *et al.*, (2017).

Table.1 Details of treatments

Factor I: Organic manure (M): M₀ - No organic manure, M₁ - FYM @ 10 t/ha, M₂ - Vermicompost @ 5 t/ha, M₃ - FYM @ 5 t/ha + Vermicompost @ 2.5 t/ha

Factor II: Organic Liquid Formulation (L): L₀ - No organic formulation, L₁ - Jeevamrit (drenching @ 5 %), L₂ - Panchgavya (spray @ 3%), L₃ - Jeevamrit + Panchgavya (Drenching @ 5 % + spray @ 3 %)

Treatment No.	Treatment code	Treatments
T ₁	M ₀ L ₀	No organic manure + No organic formulations (control)
T ₂	M ₀ L ₁	No organic manure + Jeevamrit (drenching @ 5 %)
T ₃	M ₀ L ₂	No organic manure + Panchgavya (spray @ 3 %)
T ₄	M ₀ L ₃	No organic manure + Jeevamrit + Panchgavya (drenching @ 5 % + spray @ 3 %)
T ₅	M ₁ L ₀	FYM @ 10 t/ha + no organic formulations
T ₆	M ₁ L ₁	FYM @ 10 t/ha + Jeevamrit (drenching @ 5 %)
T ₇	M ₁ L ₂	FYM @ 10 t/ha + Panchgavya (spray @ 3 %)
T ₈	M ₁ L ₃	FYM @ 10 t/ha + Jeevamrit + Panchgavya (drenching @ 5 % + spray @ 3 %)
T ₉	M ₂ L ₀	Vermicompost @ 5 t/ha + no organic formulations
T ₁₀	M ₂ L ₁	Vermicompost @ 5 t/ha + Jeevamrit (drenching @ 5 %)
T ₁₁	M ₂ L ₂	Vermicompost @ 5 t/ha + Panchgavya (spray @ 3 %)
T ₁₂	M ₂ L ₃	Vermicompost @ 5 t/ha + Jeevamrit + Panchgavya (drenching @ 5 % + spray @ 3 %)
T ₁₃	M ₃ L ₀	FYM @ 5 t/ha + vermicompost @ 2.5 t/ha + no organic formulations
T ₁₄	M ₃ L ₁	FYM @ 5 t/ha + vermicompost @ 2.5 t/ha + Jeevamrit (drenching @ 5 %)
T ₁₅	M ₃ L ₂	FYM @ 5 t/ha + vermicompost @ 2.5 t/ha + Panchgavya (spray @ 3 %)
T ₁₆	M ₃ L ₃	FYM @ 5t/ha + vermicompost @ 2.5 t/ha + Jeevamrit + Panchgavya (drenching @ 5 % + spray @ 3 %)

Table.2 Effect of organic nutrient sources on available NPK and NPK uptake

Particular	Avail N in soil (kg/ha)	Avail P in soil (kg/ha)	Avail K in soil (kg/ha)	Nitrogen uptake by plant (kg/ha)	Phosphorus uptake by plant (kg/ha)	Potassium uptake by plant (kg/ha)
Organic Manure (M)						
M ₀	311.43	49.86	326.18	97.20	22.34	91.60
M ₁	347.11	50.78	341.00	100.19	24.39	97.64
M ₂	367.94	59.50	352.09	113.49	27.98	108.68
M ₃	358.93	51.58	342.52	107.02	24.70	102.52
CD _{0.05}	0.48	2.14	0.49	2.61	1.39	0.16
Organic Liquid Formulations (L)						
L ₀	316.99	42.61	318.18	95.12	20.60	92.67
L ₁	353.50	57.04	347.90	106.84	26.28	101.59
L ₂	347.38	50.10	341.64	103.18	24.88	99.15
L ₃	367.52	61.98	354.07	112.78	27.65	107.02
CD _{0.05}	0.48	2.14	0.49	2.61	1.39	0.16
Interaction M × L						
M ₀ L ₀	296.89	38.53	310.88	90.58	15.05	88.17
M ₀ L ₁	311.16	54.89	332.19	98.04	24.99	93.50
M ₀ L ₂	298.47	49.95	327.35	96.17	23.78	89.33
M ₀ L ₃	339.20	56.04	334.29	104.05	25.53	95.42
M ₁ L ₀	308.21	42.11	316.90	90.95	20.49	91.74
M ₁ L ₁	355.91	54.20	342.20	102.93	25.43	98.87
M ₁ L ₂	354.36	47.97	351.07	98.94	25.12	97.39
M ₁ L ₃	369.97	58.84	353.84	107.93	26.53	102.55
M ₂ L ₀	341.23	45.79	324.34	100.64	25.25	95.67
M ₂ L ₁	374.91	65.44	361.75	117.20	28.93	110.03
M ₂ L ₂	368.07	55.22	355.40	109.09	27.89	108.72
M ₂ L ₃	387.56	71.58	366.90	127.05	29.84	120.31
M ₃ L ₀	321.67	44.02	320.58	98.30	21.64	95.12
M ₃ L ₁	372.04	53.59	355.49	109.18	25.76	103.99
M ₃ L ₂	368.64	47.27	332.75	108.51	22.75	101.17
M ₃ L ₃	373.34	61.44	361.27	112.07	28.68	109.80
CD _{0.05}	0.97	4.28	0.98	5.22	2.79	0.32

Table.3 Effect of organic nutrient sources on viable bacterial count

Treatments	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	T ₁₁	T ₁₂	T ₁₃	T ₁₄	T ₁₅	T ₁₆
Viable bacterial count ×10 ⁵ cfu/g soil	127.33	138.67	128.00	139.33	140.33	162.00	158.00	174.67	167.67	180.00	177.00	195.33	163.33	178.33	169.00	179.00

Viable bacterial count

Data regarding viable bacterial count are presented in Table 3. A perusal of data revealed that among different treatments viable bacterial count were highest (195.33×10^5) in M₂L₃ (vermicompost, Jeevamrit and Panchgavya) and lowest viable bacterial count (127.33×10^5) was recorded in M₀L₀. The increase in viable microbial count might be due to incorporation of organic manures which provide a conducive environment for microbial proliferation due to increased organic C, mineral N and total N content of soils.

It also may be due to the presence of macronutrients, essential micronutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA in Panchgavya which may provide nutrition to rhizosphere microorganisms and thus helped to increase their population (Natarajan, 2007). Present findings are in agreement with Kanan *et al.*, (2005) and Rana *et al.*, (2015). Shwetha (2007) reported similar result from combination of organic manure (vermicompost) and fermented organics (jeevamrit and panchgavya) in soyabean.

It can be concluded from the experiment, that combined application of vermicompost 5 t/ha + Jeevamrit – drenching @ 5 % + Panchgavya – spray @ 3 % was found optimum for available NPK, viable bacterial count and NPK uptake. Therefore, vermicompost along with Jeevamrit and Panchgavya can be recommended for sustainable production of carrot and to nourish soil fertility under mid-hills condition of Himachal Pradesh.

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