

Original Research Article

Effect of different levels of Inorganic Fertilizers with Vermicompost on Soil Parameters of Carrot (*DaucuscarotaL.*)

Abstract

The objective of study to show the effect of inorganic fertilizers sources with vermicompost on soil parameters of carrot. The experiment was laid out in randomized block design with three levels of NPK (0, 50 and 100 % NPK), and three level of Vermicompost (0, 50 and 100 % Vermicompost). The treatments were replicated three times and allocated random of each replication. The result shows that significant in pore space (%), water holding capacity, organic carbon and available NPK in depth wise findings. Treatment T₉ [NPK @ 100% + Vermicompost @ 100 %] has shown best in all parameters of soil compared to T₁ [(control) NPK @ 0% + Vermicompost @ 0 %]. Application of NPK and Vermicompost increased growth, yield of carrot and improved also physical and chemical properties of soil.

Key words: Carrot, Physico-chemical Properties, NPK and Vermicompost

Introduction

India is the second largest producer of vegetables in the world, after China. In India, vegetables are grown in 7.2 m ha with a production of 113.5 MT with productivity 15.9 t ha⁻¹. Carrot is most popular amongst the root crops, because it is a rich and the cheapest source of carotene, a precursor of vitamin A (28129 I.U.). It is also rich in iron, thiamine, riboflavin, ascorbic acid and niacin. The carrot roots contain sucrose several times higher than glucose or fructose. South western Asia, especially Afghanistan, is considered the primary Centre of carrot origin since the greatest morphological diversity is found here in this region (Nihad and Jessy, 2010). Carrot (*DaucuscarotaL.*) contains carotene, thiamine, and riboflavin in addition to energetic value and some therapeutic functions (Pant and Manandhar, 2007) as it enhances resistance against blood, eye (Pant and Manandhar, 2007) and other human diseases (Appiah *et al.*, 2015). Carrot production can be a beneficial enterprise for small-scale, resource-poor farmers because it is a short duration crop and high yields can be obtained per unit area (Ahmad *et al.*, 2005). Being rich in alpha

and Beta-carotene, it has special values as food. The carrot roots are rich in sucrose, having at least 10 times higher than glucose and fructose. The highest score for sweet taste is obtained in carrots grown at the lowest temperature, while bitter taste, terpenes and sugar have increasing values with increasing growth temperature. (Kurrey *et al.*, 2018).

Role of NPK and Vermicompost

Fertilizer and organic manure play an important role in increasing production, improving quality of vegetable and sustaining soil fertility. Organic manure contains all nutrients which are required for healthy growth of crop and help to improve physical, chemical and biological properties of soil. (Ola *et al.*, 2018). Nitrogen, Phosphorus and Potassium are among the common major nutrients, which are essential for the growth and development part of plant parts such as chlorophyll, amino acid, proteins and pigments. Nitrogen, Phosphorus and Potash influence vegetative and reproductive phase of crops. (Adeleye *et al.*, 2010).

Use of vermicompost has been advocated in integrated nutrient management (INM) system in vegetable crops. Vermicompost helps in reducing C/N ratio, increased humic acid content, cation exchange capacity and water-soluble carbohydrate. It also contains biological active substances such as plant growth regulators. Vermicompost is a source of micro and macro nutrients and acts as a chelating agent. Vermicompost is greatly humified through the fragmentation of parent organic materials by earthworms and colonization by microorganisms. (Singh *et al.*, 2013).

Methodology:

A field experiment conducted at the central research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the *Rabi* season 2022 growing carrot *Var. Pusa Vasuda* applied 3 levels of NPK and Vermicompost respectively 0 %, 50 % and 100 % including RDF for carrot = 100:60:50 kg ha⁻¹ experiment is lead to observe the physical and chemical parameters. In physical parameters like that bulk density, particle density, pore space and water holding capacity through method by 100 ml graduated measuring cylinder and process by Muthuvelet *et al.*, 1992.

In chemical parameters through method by- Soil pH – method given by (Jackson, M. L. 1958) through using digital pH meter, Soil EC (dSm⁻¹)-method given by (Wilcox, 1950) through using digital EC meter, Organic Carbon (%)- Wet oxidation method given by (Walkley and Black, 1947), Available Nitrogen (kg ha⁻¹)-Kjeldhal Method (Subbiah and Asija, 1956), Available Phosphorus (kg ha⁻¹)- Colorimetric method by using Jasper single

beam U.V. Spectrophotometer at 660 nm wavelength given by (Olsen *et al.*, 1954), Available Potassium (kg ha^{-1})- Flame photometric method by using Flame Photometer given by (Toth and Prince, 1949).

Table.1 Detailed Treatment Combination of Inorganic fertilizers with organic fertilizers

Treatment	Treatments Combinations
T1	NPK @ 0 % + Vermicompost @ 0 %
T2	NPK @ 0 % + Vermicompost @ 50 %
T3	NPK @ 0 % + Vermicompost @ 100 %
T4	NPK @ 50 % + Vermicompost @ 0 %
T5	NPK @ 50 % + Vermicompost @ 50 %
T6	NPK @ 50 % + Vermicompost @ 100 %
T7	NPK @ 100 % + Vermicompost @ 0 %
T8	NPK @ 100 % + Vermicompost @ 50 %
T9	NPK @ 100 % + Vermicompost @ 100 %

Result and Discussion

Physical Properties of Soil

Bulk density (Mg m^{-3})

The data presented in table.2 variation in bulk density (Mgm^{-3}) of soil after crop harvest as influenced by NPK and Vermicompost. The response in bulk density of soil was found non-significant due to levels of NPK and Vermicompost. The maximum bulk density of soil 1.23 Mgm^{-3} and 1.27 Mgm^{-3} at 0-15 cm and 15-30 cm was recorded in treatment T₁(NPK @ 0% + Vermicompost@ 0 %) and minimum 1.12 Mgm^{-3} and 1.15 Mgm^{-3} at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost@ 100 %) respectively. Similar result has been recorded by Singh *et al.*, 2020; Kunjet *et al.*, 2018; Ali *et al.*, 2016 and Kumar *et al.*, 2014.

Particle density (Mg m^{-3})

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The data presented in table.2 variation in particle density Mgm^{-3} of soil after crop harvest as influenced by NPK and Vermicompost. The response in particle density of soil was found non-significant due to levels of NPK and Vermicompost. The maximum particle density of soil 2.54 Mgm^{-3} and 2.56 Mgm^{-3} at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 2.36 Mgm^{-3} and 2.40 Mgm^{-3} at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Singh *et al.*, 2020; Kunjet *et al.*, 2018; Kumar *et al.*, 2014 and Ali *et al.*, 2016.

Percent pore space

The data presented in table.2 variation in percent pore space of soil after crop harvest as influenced by NPK and Vermicompost. The response in percent pore space of soil was found to be significant due to levels of NPK and Vermicompost. The maximum pore space of soil 48.74 % and 45.38 % at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 42.26 % and 40.45 % at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Kumar *et al.*, 2017; Hailu *et al.*, 2016; Sarma *et al.*, 2015 and Mehedi *et al.*, 2012.

Water holding capacity (%)

The data presented in table.2 variation in water holding capacity % of soil after crop harvest as influenced by NPK and Vermicompost. The response in water holding capacity % of soil was found to be significant due to levels of NPK and Vermicompost. The maximum water holding capacity of soil 46.70 % and 42.85 % at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 34.53 % and 31.40 % at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Kumar *et al.*, 2017; Hailu *et al.*, 2016; Sarma *et al.*, 2015 and Mehedi *et al.*, 2012.

Chemical Properties of Soil

Soil pH (1:2.5) w/v

The data presented in table.3 variation in pH of soil after crop harvest as influenced by NPK and Vermicompost. The response pH of soil was found non-significant due to levels of NPK and Vermicompost. The maximum pH of soil 7.20 and 7.25 at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) and minimum 6.75 and 6.82 at

0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) respectively. Similar result has been recorded by Kumar *et al.*, 2017 and Mehedi *et al.*, 2012.

Soil Electrical Conductivity (dSm⁻¹)

The data presented in table.3 variation in electrical conductivity (dSm⁻¹) of soil after crop harvest as influenced by NPK and Vermicompost. The response EC of soil was found non-significant due to levels of NPK and Vermicompost. The maximum EC of soil 0.48 dSm⁻¹ and 0.55 dSm⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 0.35 dSm⁻¹ and 0.38 dSm⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Kumar *et al.*, 2017; Hailu *et al.*, 2016 and Sarma *et al.*, 2015.

Comment [o2]: ?

Organic Carbon (%)

The data presented in table.3 variation in organic carbon (%) of soil after crop harvest as influenced by NPK and Vermicompost. The response of OC of soil was found non-significant due to levels of NPK and Vermicompost. The maximum OC of soil 0.45 % and 0.41 % at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 0.37 % and 0.30 % at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Hailu *et al.*, 2016 and Sarma *et al.*, 2015.

Available Nitrogen (kg ha⁻¹)

The data presented in table.3 variation in available nitrogen (kg ha⁻¹) of soil after crop harvest as influenced by NPK and Vermicompost. The response of available nitrogen of soil was found significant due to levels of NPK and Vermicompost. The maximum available nitrogen of soil 318.42 kg ha⁻¹ and 310.06 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 292.35 kg ha⁻¹ and 285.23 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Anjaiah *et al.*, 2019; Devendra *et al.*, 2018; Kumar *et al.*, 2012 and Zakiret *et al.*, 2012.

Available Phosphorus (kg ha⁻¹)

The data presented in table.3 variation in available phosphorus (kg ha⁻¹) of soil after crop harvest as influenced by NPK and Vermicompost. The response of available phosphorus of soil was found significant due to levels of NPK and Vermicompost. The maximum available

phosphorus of soil 30.02 kg ha⁻¹ and 27.78 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 17.40 kg ha⁻¹ and 14.36 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Anjaiah *et al.*, 2019; Devendra *et al.*, 2018; Kumar *et al.*, 2012 and Zakir *et al.*, 2012.

Available Potassium (kg ha⁻¹)

The data presented in table.3 variation in available potassium (kg ha⁻¹) of soil after crop harvest as influenced by NPK and Vermicompost. The response of available potassium of soil was found significant due to levels of NPK and Vermicompost. The maximum available potassium of soil 198.24 kg ha⁻¹ and 195.62 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) and minimum 178.32 kg ha⁻¹ and 174.25 kg ha⁻¹ at 0-15 cm and 15-30 cm was recorded in treatment T₁ (NPK @ 0% + Vermicompost @ 0 %) respectively. Similar result has been recorded by Anjaiah *et al.*, 2019; Devendra *et al.*, 2018; Kumar *et al.*, 2012 and Zakir *et al.*, 2012.

Table.2: Variation in Bulk density (Mg m^{-3}), Particle density (Mg m^{-3}), Pore space(%)and Water holding capacity(%)of soil after crop harvest as influenced byInorganic Fertilizers with Vermicompost

Treatment		Bulk density (Mg m^{-3})		Particle density (Mg m^{-3})		Pore space(%)		Water holding capacity(%)	
		0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm
T ₁	NPK @ 0 % + Vermicompost @ 0 %	1.23	1.27	2.36	2.40	42.26	40.45	34.53	31.40
T ₂	NPK @ 0 % + Vermicompost @ 50 %	1.22	1.25	2.38	2.44	42.85	40.80	35.92	32.82
T ₃	NPK @ 0 % + Vermicompost @ 100 %	1.20	1.24	2.40	2.46	43.62	41.13	37.08	33.10
T ₄	NPK @ 50 % + Vermicompost @ 0 %	1.21	1.22	2.39	2.42	44.37	41.60	37.45	34.62
T ₅	NPK @ 50 % + Vermicompost @ 50 %	1.19	1.21	2.43	2.45	45.20	42.76	38.27	35.82
T ₆	NPK @ 50 % + Vermicompost @ 100 %	1.17	1.19	2.47	2.49	46.41	43.52	40.74	37.58
T ₇	NPK @ 100 % + Vermicompost @ 0 %	1.18	1.22	2.44	2.47	46.60	43.92	41.26	38.42
T ₈	NPK @ 100 % + Vermicompost @ 50 %	1.15	1.18	2.50	2.53	47.28	44.32	43.82	40.23
T ₉	NPK @ 100 % + Vermicompost @ 100 %	1.12	1.15	2.54	2.56	48.74	45.38	46.70	42.85
	F-Test	NS	NS	NS	NS	S	S	S	S
	S.Ed. (\pm)	-	-	-	-	0.78	0.56	0.55	0.46
	C.D. at 0.5%	-	-	-	-	1.60	1.15	1.12	0.94

Table.3: Variation in pH (1:2.5) w/v, electrical conductivity (dSm⁻¹), organic carbon (%), available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹) and available potassium (kg ha⁻¹) of soil after crop harvest as influenced by NPK and Vermicompost. Comment [o3]: Why determinate this range?

Treatment		Soil pH (1:2.5) w/v		Electrical Conductivity (dSm ⁻¹)		Organic Carbon (%)		Available Nitrogen (kg ha ⁻¹)		Available Phosphorus (kg ha ⁻¹)		Available Potassium (kg ha ⁻¹)	
		0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm	0 – 15 cm	15 – 30 cm
T ₁	NPK @ 0 % + Vermicompost @ 0 %	7.20	7.25	0.35	0.38	0.37	0.30	292.35	285.23	17.40	14.36	178.32	174.25
T ₂	NPK @ 0 % + Vermicompost @ 50 %	7.17	7.22	0.37	0.41	0.38	0.33	293.58	285.89	18.63	14.85	179.14	176.42
T ₃	NPK @ 0 % + Vermicompost @ 100 %	7.12	7.18	0.40	0.44	0.40	0.35	293.82	287.15	20.07	16.05	181.85	177.46
T ₄	NPK @ 50 % + Vermicompost @ 0 %	7.15	7.20	0.38	0.42	0.38	0.32	295.27	290.58	21.48	17.62	180.18	179.02
T ₅	NPK @ 50 % + Vermicompost @ 50 %	7.10	7.15	0.41	0.45	0.39	0.36	297.86	294.70	22.74	19.27	184.65	182.80
T ₆	NPK @ 50 % + Vermicompost @ 100 %	6.98	7.07	0.44	0.49	0.41	0.38	300.04	296.37	24.86	22.58	187.82	185.56
T ₇	NPK @ 100 % + Vermicompost @ 0 %	6.90	7.02	0.43	0.46	0.40	0.37	306.26	299.64	25.05	23.22	190.21	188.25
T ₈	NPK @ 100 % + Vermicompost @ 50 %	6.84	6.95	0.45	0.50	0.42	0.40	311.15	305.82	28.70	26.55	195.05	191.74
T ₉	NPK @ 100 % + Vermicompost @ 100 %	6.75	6.82	0.48	0.55	0.45	0.41	318.42	310.06	30.02	27.78	198.24	195.62
F-Test		NS	NS	NS	NS	NS	NS	S	S	S	S	S	S
S.Ed. (±)		-	-	-	-	-	-	2.21	1.80	0.80	0.65	1.25	1.05
C.D. at 0.5%		-	-	-	-	-	-	4.45	3.62	1.65	1.34	2.55	2.14

Conclusion

From trial it was concluded that the various level of inorganic fertilizers of NPK sources in the experiment gave the best result in the treatment T₉ (NPK @ 100% + Vermicompost @ 100 %) followed by treatment T₈, in T₉ the soil health parameters retained the suitable soil properties. Therefore, it can be recommended for farmers to obtain best combination Treatment (T₉) for higher farm income and sustainable agriculture.

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Comment [o4]: f

Comment [o5]: m

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