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Response of NPK and organic manures on growth and yield of carrot (*Daucus carota* L.) CV. Nantes

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Abstract
A field study was investigated on the Experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur during 2017-18 to study the Response of NPK and Organic Manures on Quality and Commercial Yield of Carrot (*Daucus carota* L.) cv. Nantes. The seed of carrot were sown in the mid November with a spacing of 30×10 cm. The experiment was laid out in Randomized Block Design with twelve treatments replicated thrice. The maximum height of plant (95.14cm) at 40, 60, 80 DAS was observed with the application of 100%NPK (T_2) and minimum (79.39cm) was found under control treatment (T_1) i.e. without application of fertilizer. The maximum length of leaves (65.39cm) was observed with the application 100%NPK (T_2) and minimum (58.01cm) was found under control treatment (T_1) i.e. without application of fertilizer. The maximum number of leaves per plant (22.00) was observed with the application of 100%NPK (T_2) and minimum (16.33) was found under control treatment (T_1) i.e. without application of fertilizers. The maximum fresh weight of leaves per plant (132.15g) was observed with the application of 75%NPK+VC (T_4) and minimum (119g) was found under control treatment (T_1) i.e. without application of fertilizers. The maximum fresh weight of plant (g) (200.13g) was observed with the application of 100% NPK (T_2) and (170.33g) was found under control treatment (T_1) i.e. without application of fertilizers. The maximum dry weight of plant (g) (30.24g) was observed with the application of 100%NPK (T_2) and minimum (27.13g) was observed under control treatment (T_1) i.e. without application of fertilizers. Application of 75%NPK+VC (T_4) recorded maximum length of root (28.64 cm) while it was minimum (21.62cm) under the control treatment (T_1) i.e. without application of fertilizers. The maximum diameter of root (5.44cm) was recorded with the application of 75%NPK+VC (T_4) while it was minimum (3.33 cm)was observed under control treatment (T_1) i.e. without application of fertilizers. The maximum fresh weight of root (122.93g) was recorded with the application of 75%NPK+VC (T_4) while it was minimum (102.86g)was observed under control treatment (T_1) i.e. without application of fertilizers. The maximum dry weight of root (9.65g) was recorded with the application of 75%NPK+VC (T_4) while it was minimum (4.94)was observed under control treatment (T_1) i.e. without application of fertilizers. Highest root yield) (2.32 kg/plot) was observed with the application of 75%NPK+VC (T_4) while it was lowest (0.80 kg/plot) was observed under control treatment (T_1) i.e. without application of fertilizers. Highest root yield (232.21 q/ha) was observed with the application of 75%NPK+VC (T_4) while it was lowest (80 q/ha) was observed under control treatment (T_1) i.e. without application of fertilizers.

Keywords: vermicompost, farm yard manure, poultry manure, b: c ratio, NPK, total soluble solid, net income

Introduction
The carrot is originated in Asia and belonging to the family Umbelliferae, genus *Daucus* and species *carota* with chromosome no 2n=18 (X=9). The carrot is an annual (root production) and biennial (seed production). Initially the roots were long and thin and either purple or yellow in colour. The stem are small plate like structure, leaves are rosette of leaves arise from the stem. The inflorescence of carrot is 'Compound Umbel' and the edible part of carrot is modified root (Conical form) which develops in soil. The root type is tap, root length varying from 15-35 cm. botanically "modified root" (Conical form) which developed in the soil carrot has vertical root system. The fruit type of carrot is schizocarp and seed are spiny and one gram seed have 500-1000 seed (Singh and Bahadur, 2015) [11].

Carrot roots contain sucrose 10 times higher than that of glucose or fructose. It also contains abundant amounts of nutrients such as protein, carbohydrates, fibre and sodium (Ahmad *et al.*, 2014) [1]. The foliage of carrot is used as forage particularly feeding horses & cattles. Carrot fleshy roots are used as vegetables for salads, soups and are also steamed or boiled in other vegetable dishes. Besides food value different parts of carrot can be used for different medicinal purposes due to its wide range of pharmacological effects. Roots are also used for preparation of delicious dishes such as gajar halwa and carrot jam. The roots in the form of disc and slices can be dehydrated. Carrot juice is a rich source of carotene and is sometimes used for coluoring butter and other food items (Vanangamudi *et al.*, 2006) [14].

Excessive or under dose of N, P and K can affect the growth and yield of good quality carrot. Excess of nitrogen increases root splitting, which reduces marketable yield. It is considered that doses of nitrogen, phosphorus and potassium are important fertilizer variables for quality production of carrot. There are sufficient scope for increasing the yield of this crop by judicious application of manures & fertilizers. Optimum requirement of nutrients especially NPK is obviously needed. Nitrogen is one of the most important yield-limiting nutrients for plants. Carrot is a heavy feeder of nutrients, which removes 100 kg N ha^{-1}, 50 kg P_2O_5 $ha^{-1}$and 180 kg K_2O ha^{-1} and is very sensitive to nutrients and soil moisture (Sunanadarani and Mallareddy, 2007) [12].

In recent years use of organic manures like FYM, vermicompost and poultry manure for improving the productivity of crop and

maintaining soil fertility and productivity of soil is gaining prominence (Mahokar *et al*., 2007). Vermicompost is a rich source of micro and macro nutrients, vitamins, growth hormones and enzymes. FYM is not a good source of nutrients, which increase organic carbon content in the soil and improves soil physical properties. Poultry manure one of the components in integrated nutrient management highly used in production of vegetable crops. Carrot is a most important crop for healthy diet so it's needed to be available in high quality (Radices *et al*., 2002).

Materials and Methods

The present investigation was carried out at the Experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh, India during year 2017-18. Seed of carrot *cv.* Nantes were procured from Indian Institute of Vegetable Research (IIVR), Varanasi (U.P.). The climatic condition of Jaunpur is subtropical with three distinct seasons *i.e.*, winter, summer and rainy. The mean temperature is minimum 15-20 ^{0}C and maximum18-32 ^{0}C, maximum relative humidity 95% and minimum 55% with annual rainfall of 850-1100mm. The carrot seed of uniform size were transplanted 1-3 cm depth at a spacing of 30×10 cm. in mid-November. Farm yard manure, Vermicompost, Poultry Manure were applied in the concerned plots as per the treatment. The treatments *viz*., T_1- Control, T_2-100%NPK, T_3-75%NPK+FYM, T_4-75%NPK+VC, T_5-75%NPK+PM,T_6-50%NPK+FYM,T_7-50%NPK+VC, T_8-50%NPK+PM, T_9-25%NPK+FYM, T_{10}-25%NPK+VC, T_{11}-25%NPK+PM, T_{12}- FYM+VC+PM were evaluated in Randomized Block Design with three replications. The required quantity of organic manures as per treatments was applied at the time of land preparation. The seed of carrot sowing on the ridges were done. Other cultural practices like weeding, hoeing, irrigation, insect pest and disease management were done as and when required. The observations were recorded on five randomly selected plants from each treatment to assess the response of NPK and organic manures on quality and commercial yield character in carrot cv. Nantes. Quality characters [Root cracking (%), root forking (%), ascorbic acid (mg), total soluble solid (^{0}Brix) and yield plot^{-1} (kg) and yield/ha (qt) in carrot. The data recorded during the course of investigation were analyzed by analysis of variance (ANOVA) using the statistical program and the significance differences between the mean were tested against the critical difference at 5% probability level.

Results and Discussion

Among the nutrient level T_2 (100%NPK) recorded the maximum value of plant height (15.41, 34.01, 58.83, 95.14) during the different stages followed by (14.88, 32.66, 58.00, 93.72) in T_4 (75%NPK+VC), (14.55, 31.75, 56.57, 91.51) in T_3 (75%NPK+FYM), (14.08, 31.63, 56.22, 90.44) in T_5 (75%NPK+PM) as well as (13.31, 30.22, 55.16, 85.39) in T_{10} (25%NPK+VC). While the minimum value of plant height was observed with T_1 (Control) (11.47, 25.85, 49.61, 79.39) at all the stages of crop growth. T_2 (100%NPK) (15.41, 34.01, 58.83, 95.14) significantly improved the plant height. The increase in height of plant by the use of vermicompost with integration of NPK may, be due to beneficial influence of nitrification inhibition properties of vermicompost in the soil. Besides, it may also be due to rapid elongation and multiplication of cell in the presence of adequate quantity of nitrogen. (Barman *et al*. 2014) [2], similar results were reported by (Bhattarai and Maharjan, 2013) [3] in carrot and (Mahokar *et al.*, 2007) in radish. Nutrient level had exerted significant effect on number of leaves during all the stages. Highest number of leaves were observed with T_2 (100%NPK) (5,14,20,22) followed by (4.00, 12.33, 19.33, 21.33) in T_4 (75%NPK+VC), (3.66, 10.00, 18.33, 20.33) in T_3 (75%NPK+FYM), (4.33, 10.33, 17.33, 19.33) in T_5 (75%NPK+PM) as well as (4.66, 9.66, 16.00, 18.33) in T_{10} (25%NPK+VC). While the minimum value of number of leaves was observed with T_1 (control) (4.33, 7.66, 15.00, 16.33) at all the stages of crop growth. Highest number of leaves in T_2 (100%NPK) (5.00, 14.00, 20.00, 22.00) due to slow release of nutrients through vermicompost thus enriching available nutrient pools of the soil that resulting in more number of leaves per plant (Bhattarai and Maharjan, 2013) [3]; similar findings have been reported by (Barman *et al.*, 2014) [2] in potato and (Suthar, 2009) [13] in garlic. Among nutrient level maximum length of leaves per plant was recorded with the nutrient level T_2 (100%NPK) (14.26, 25.25, 39.52, 65.39) followed by (13.95, 24.96, 39.33, 65.07) in T_4 (75%NPK+VC), (12.94, 24.12, 38.50, 64.02) in T_3 (75%NPK+FYM), (12.84, 23.95, 34.60, 63.53) in T_5 (75%NPK+PM) as well as (11.93, 23.12, 35.71, 62.02) T_{10} (25%NPK+VC). While, minimum length of leaves per plant was observed under nutrient level T_1 (Control) (10.33, 19.74, 28.67, 58.01). Highest length of leaves in T_2 (100%NPK) due to vermicompost provide the micronutrients such as zinc, copper, iron and manganese etc. in the adequate amount to the plant (Bhattarai and Maharjan, 2013) [3]. Similar findings have been reported by (Kumar *et al*., 2014) [6] in radish. The maximum fresh weight of leaves in T_4 (75%NPK+VC) is (132.15g) was observed with the application of (75%NPK+Vermicompost) followed by (132.15) in T_4 (75%NPK+VC), (131.93) in T_3 (75%NPK+FYM), (123.79) in T_5 (75%NPK+PM) and minimum (119.08g) in T_1 (control). Nutrient level indicated significant effect on fresh weight of plant at all stages. Maximum fresh weight of plant was observed with T_2 (100%NPK) (13.26, 65.62, 85.40, 200.13) followed by (12.51, 64.61, 84.39, 198.37) in T_4 (75%NPK+VC), (12.02, 62.37, 82.32, 192.61) in T_3 (75%NPK+FYM), as well as (10.60, 55.45, 75.42, 183.70) in T_{10} (25%NPK+VC). The minimum fresh weight of plant was observed with T_1 (Control) (7.51, 50.54, 70.56, 170.33) at all the stages of crop growth. Similar findings have been reported by (Suthar, 2009) [13] in garlic. Among the nutrient levels the maximum dry weight of plant was recorded with nutrient T_2 (100%NPK) (1.52, 9.52, 20.39, 30.24) followed by (1.46, 9.04, 20.02, 30.02) in T_4 (75%NPK+VC), (1.25, 8.52, 19.51, 29.51 in T_3 (75%NPK+FYM), (1.21, 8.14, 19.25, 29.25) in T_5 (75%NPK+PM), as well as (1.10, 8.60, 18.80. 12,28.53) in T_{10}(25%NPK+VC). Minimum dry weight of plant was recorded in case of nutrient level T_1 (Control) (0.88, 5.12, 15.48, and 27.13). Similar findings have been reported by (Suthar 2009) [13] in garlic.

Maximum length of root recorded under the nutrient level T_4 (75%NPK+VC) (28.64) and it was followed by (26.96) in T_3 (75%NPK+FYM). Nutrient level T_1 (Control) recorded minimum length of root (21.62). The beneficial effect of combined application of organic manure (vermicompost or compost) and fertilizer might be attributed to the increased efficacy of inorganic fertilizers and supply of all the essential nutrients in a balanced

amount owing to their control release coinciding with the stage of root growth (Kumar *et al.* 2014) [6]. Similar findings have been reported by (Sunandarani and Malareddy, 2007) [13]. Nutrient level recorded significant effect on diameter of root of carrot. Maximum diameter of root of carrot was found under the nutrient level T_4 (75%NPK+VC) (5.44) followed by (5.26) in T_3 (75%NPK+FYM), (5.06) in T_7 (50%NPK+VC).While the minimum diameter of root of carrot was observed with T_1 (Control) (3.33). These findings are in agreement with those reported by (Kumar *et al*. (2014) [6] in carrot. Nutrient level indicated significant effect on fresh weight and dry weight of root. Maximum fresh weight and dry weight of root was observed with nutrient level T_4 (75%NPK+VC) (9.65) followed by (7.47) in T_3 (75%NPK+FYM), (8.45) in T_7 (50%NPK+VC). While the minimum fresh weight and dry weight of root was observed with T_1 (control) (4.94). This was attributed due to solubilizing effect of plant nutrients by the addition of vermicompost leading to increased uptake of NPK. Organic manure plays a direct role in plant growth as a source of all necessary macro and micro-nutrients in available forms during mineralization, improving physical and physiological properties of soil. Similar findings have been reported by (Kumar *et al.*, 2014) [6]. Yield of root of carrot significantly affected by nutrient level. The maximum yield of root recorded under the nutrient level T_4 (75%NPK+VC) (2.32 kg) followed by (1.96 kg) in T_3 (75%NPK+FYM), (1.96 kg) in T_7 (50%NPK+VC). While the minimum yield of root was observed with T_1 (control) (0.80 kg). Similar findings have been reported by (Rao *et al.*, 2009) in onion, (Barman *et al.*, 2014) [2] in potato, (Narayan *et al.*, 2014) in potato and (Kumar *et al*., 2014) [6] in carrot.

Table 1: Response of NPK and Organic Manures on Growth Attributes of Carrot (*Daucus carota* L.) cv. Nantes

Treatments	Plant height (cm.)	Number of leaves/plant	Length of leaves (cm.)	Fresh weight of leaves (g.)	Fresh weight of plant (g.)	Dry weight of plant (g.)
T_1	79.39	16.33	58.01	119.08	170.33	27.13
T_2	95.14	22.00	65.39	120.81	200.13	30.24
T_3	91.51	20.33	64.02	131.93	192.61	29.51
T_4	93.72	21.33	65.07	132.15	198.37	30.02
T_5	90.44	19.33	63.53	123.79	190.69	29.25
T_6	88.34	18.00	62.75	127.37	188.77	29.13
T_7	92.45	19.33	64.57	130.37	195.64	29.86
T_8	87.26	21.00	62.52	122.66	185.38	28.76
T_9	82.39	17.33	60.9	124.17	175.75	27.76
T_{10}	85.39	18.33	62.02	125.72	183.70	28.53
T_{11}	81.42	16.66	58.75	121.39	172.65	27.53
T_{12}	83.68	17.66	61.24	128.43	180.66	28.20
CD at 5%	0.421	1.553	0.196	0.509	0.437	0.057
SEM-+	0.143	0.526	0.066	0.172	0.148	0.019

Table 2: Response of NPK and Organic Manures on Yield Attributes of Carrot (*Daucus carota* L.) cv. Nantes

Treatments	Length of root (cm.)	Diameter of root(cm.)	Fresh weight of root (g.)	Dry weight of root (g.)	Root yield/ plot (kg.)	Root yield/ha (q.)
T_1	21.62	3.33	102.86	4.94	0.80	80.00
T_2	21.95	3.51	106.56	5.20	1.13	113.16
T_3	26.96	5.26	121.48	7.47	1.96	196.20
T_4	28.64	5.44	122.93	9.65	2.32	232.20
T_5	23.00	4.14	112.52	6.32	1.46	146.10
T_6	24.66	4.76	119.78	7.40	1.78	178.10
T_7	26.00	5.06	120.70	8.45	1.96	196.10
T_8	23.88	4.37	118.16	6.78	1.36	136.11
T_9	22.54	4.33	112.53	5.36	1.52	152.33
T_{10}	27.00	4.53	118.52	7.13	1.66	165.00
T_{11}	28.00	3.56	107.39	5.12	1.23	123.66
T_{12}	25.22	4.83	120.15	7.28	1.86	186.17
CD at 5%	0.628	0.412	0.357	0.115	0.017	0.796
SEM-+	0.213	0.139	0.121	0.039	0.006	0.270

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