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Impact of different levels of Phosphorus, Sulphur and FYM on soil properties, yield attributes and nutrient uptake by carrot (*Daucus carota L.*) cv. Deep red

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Abstract
The carrot (*Daucus carota L.)* Cv. Deep red crop is grown worldwide and used as fresh vegetables. Carrot requires favourable to organic and inorganic fertilizers. An experiment was carried out at Central Research Farm of Soil Science, Sam Higginbottom Institute of Agriculture & Sciences, Allahabad, during winter season of 2015-2016 to know the "Impact of different levels of Phosphorus, Sulphur and FYM on soil properties, yield attributes and nutrient uptake by carrot (*Daucus carota L.)*". cv. Deep red". The experiment was laid out in Randomised Block Design (RBD) with three replicates for each treatment. Each plot size was of 4m². The crop was applied with recommended dose of fertilizer i.e., N.P and K. Application of organic manure i.e., Farm Yard Manure and inorganic fertilizers i.e., SSP for P and Sulphur powder was available for S has significantly Influenced the growth and yield of carrot. Based on the above research work, it is concluded that application of phosphorus @ 40 kg/ ha(100%) + Sulphur @ 44 kg/ha(100%) followed by FYM @ 15 & 10 t/ha (100% & 50%) i.e., the treatment T_9(RDF 100% +FYM 10 t /ha) and T_8(RDF 100% +FYM 05 t /ha) was found more beneficial and significantly improved growth parameters and root yield of Carrot grown under Allahabad Agro-climatic conditions. This treatment also showed maximum gross return, net return and benefit: cost ratio i.e. (1: 4.02) respectively. These findings are based on one year research trial to sustains more work to be needed for the same.

Keywords: *Daucus carota*. Phosphorus. Sulphur. FYM. Yield attributes

1. Introduction

Carrot (*Daucus carota L.*) is an important vegetable and is being consumed all over the world. The fleshy roots are eaten raw in salads, boiled or steamed in vegetable dishes and also used with other vegetables in the preparation of soup. Carrot is most popular amongst the root crops, because it is a rich and cheapest source of carotene, a precursor of vitamin A. It belongs to the family Umbelliferae having chromosome no 2n=18. It is also rich in iron, thiamine, riboflavin, ascorbic acid and niacin. The carrot roots contain sucrose several times higher than glucose or fructose. The glucose and fructose sugar in carrot roots are usually found in ratio of 1:1.

Green carrot leaves are highly nutritive, rich in protein, minerals and vitamins. Consumers' choice to eat carrots is often based on perceptions of carrots quality that include organoleptic, sensory and nutritional factors (Rubatzky *et al.* 1999). Carrots are increasing consumed due to their quality characteristics such as flavour compounds, sugars, dry matter (DM) contents and their perceived health benefits related to their vitamins, minerals, and fiber (Alasalvar *et al.* 2001; Quilitzsch *et al.* 2005).

In addition to its role as a nutrient store, organic fertilizer i.e., FYM improves soil structures, stimulates soil biological activity and enhance the solubility of phosphorus applied as fertilizer in the soil (Stevenson and Ardakani, 1972) [2]. Organic fertilizers are critical in enhancing soil fertility (Kaack *et al.*, 2002; Ashraf *et al.*, 2004) [3, 4]. Amount of Sulphur absorbed by crops is generally 9-15% (one-tenth to one- seventh) of the nitrogen uptake.

Phosphorus plays an important role in energy transformation and metabolic process of plants. The deficiency P disturbs the nitrogen metabolism and also results in increased accumulation of free reducing sugars, suggesting an involvement of P in carbohydrates metabolism. P in soils almost exclusively occurs as orthophosphates ions. Sulphuris an essential secondary plant nutrient. S is gaining importance for crop production in the balanced fertilization programme. Sulphur occurs in soils as both organic and inorganic forms. Sulphur is involved in the metabolic and enzymic processes of all living organisms.

Farm yard manure is a decomposed mixture of Cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to the cattle. Farm Yard Manure helps to improve and conserve the fertility of soil. FYM imparts dark colour of the soil and thereby help to maintain the temperature of soil. The activity and population of beneficial soil organisms increased on application of FYM in soil. FYM is one of the oldest manure used by the farmer is growing crops because of its early availability and presence of almost all the nutrient required by plant. The composition of FYM is 1.13% N, 1.25%P, 1.30%K and 2.26% Zn (Katyayan, 2010).

2. Material and Method

Field experiment was conducted to examine the effect of Phosphorus, Sulphur and FYM on yield attributes of carrot crop. Laboratory experiment was conducted to examine the physical and chemical properties of soil. The experiment was conducted at the Central Research Farm, Department of Soil Science, Allahabad School of Agriculture, (shiats), Allahabad, 211007 (U.P.) which is situated six km away from Allahabad city on the right bank of Yamuna river, the experimental site is located in the sub–tropical region with 25^0 57' N latitude, 81^0 57' E longitude and 98 meter above the mean sea level. All the necessary facility including labour were readily available in the department. Allahabad

The climate in this part of the country has been classified as semi-arid with both the extent of temperature during winter and summer. During December to January, the temperature may drop down to as low as 2˚C.The experiment was laid out in Randomised Block Design (RBD) with three replicates for each treatments. Each plot size was of 4m². The crop was applied with recommended dose of fertilizer i.e., NP and K. Application of organic manure i.e., Farm Yard Manure and inorganic fertilizers i.e., SSP for P and Sulphur powder was available for S has significantly Influenced the growth and yield of carrot. The treatment combination was laid out as T1-RDF 00% + FYM 00 t ha-1, T2-RDF 00% + FYM 05 t ha-1, T3-RDF 00% + FYM 10 t ha-1, T4-RDF 50% + FYM 00 t ha-1, T5-RDF 50% + FYM 05 t ha-1, T6-RDF 50% + FYM 10 t ha-1,T7-RDF 100% + FYM 00 t ha-1, T8-RDF 100% + FYM 05 t ha-1, T9-RDF 100% + FYM 10 t ha-1, respectively.

3. Result and Discussion

3.1 Plant height (cm)

At 30 DAS, treatment T9 (RDF 100% +FYM 10 t /ha) recorded maximum plant height (28.57cm) followed by treatment T_6(RDF 50% +FYM 10 t /ha) (28.00 cm) whereas, the minimum recorded was 18.53 cm with treatment T_1 (Control).The maximum plant height at 60 DAS recorded in treatment T_9 (RDF 100% +FYM 10 t /ha) was (48.43cm) followed by treatment T_8(RDF 100% +FYM 05 t /ha) with (47.60 cm) whereas, the minimum plant height obtained with T_1(control) was (31.30 cm).At 90 DAS, maximum plant height recorded with treatment T_9(RDF 100% +FYM 10 t /ha) was (74.17 cm) which was closely followed by ((74.10 cm) with treatment T_8(RDF 100% +FYM 05 t /ha) whereas, the minimum plant height obtained with T_1(control) was 50.51cm.These similar findings are also reported by Malik *et al*. (1973) and Hipps *et al.* (1978).

3.2 Number of leaves

At 30 DAS, the maximum no. of leaves have been recorded with the treatment T_9 (RDF 100% +FYM 10 t /ha) was 3.72 followed by treatment T_8 with 3.71 and the minimum recorded was (2.75) with the treatment T_1 (control). At 60 DAS, the maximum number of leaves have been recorded with the treatment T_8 (RDF 100% +FYM 10 t /ha) was 6.57 followed by treatment T_8 (RDF 100% +FYM 05 t /ha) with 6.34 and the minimum recorded was (4.63) with the treatment T_1 (control).

At 90 DAS, the maximum no. of leaves have been recorded with the treatment T_9 (RDF 100% +FYM 10 t /ha) was (9.40) followed by treatment T_8 (RDF 100% +FYM 10 t /ha) with 9.16 and the minimum recorded was 7.93 with the treatment T_1 (control). The results are in conformity with the findings of Lingaiah *et al.* (1992) **[7]**.

Tuber weight (g): The maximum root weight recorded was (87.16 gm) in treatment T_5 (RDF 50% +FYM 05 t /ha) followed by treatment T_4 (RDF 50% +FYM 00 t /ha) with (84.70 gm) and the minimum reported was (66.41gm) in treatment T_1 (Control). These results are in consonance with the findings of many workers (Pujari*et al.*, 1977; Rajgopal *et al.*, 1979; Lingaiah *et al*., 1992 and Parthasarathy, 1998) [7].

3.3 Tuber length (cm)

The maximum root length was (24.33 cm) recorded with treatment T_8 (RDF 100% +FYM 05 t /ha followed by treatment T_9 (RDF 100% +FYM 10 t /ha) with (21.87cm) whereas the minimum recorded was (17.00cm) with the treatment T_1 (Control).

3.4 Diameter of tuber (mm)

Maximum root diameter recorded was (34.50 mm) in treatment T_5 (RDF 50% +FYM 05 t /ha) followed by (34.29 mm) in treatment T_3 (RDF 00% +FYM 10 t /ha) whereas, the minimum recorded was 29.54 mm with the treatment T_1 (Control). These results are in consonance with the findings of many workers (Pujari *et al.*, 1977; Rajgopal *et al.*, 1979; Lingaiah *et al.*, 1992 and Parthasarathy, 1998) [7].

3.5 Plant dry weight (g)

Maximum plant dry weight was (22.85g) obtained with treatment T_8 (RDF 100% +FYM 05 t /ha) followed by (22.75g) with treatment T_9 (RDF 100% +FYM 10 t /ha) whereas the minimum was (16.43g) recorded with treatment T_1 (Control). These results are in consonance with the findings of many workers (Pujari*et al.*, 1977; Rajgopal *et al.*, 1979; Lingaiah *et al.*, 1992 and Parthasarathy, 1998) [7].

3.6 Plant fresh weight (g)

The maximum plant fresh weights recorded was (162.50gm) in treatment T_9 (RDF 100% +FYM 10 t /ha) followed by treatment T_8 (RDF 100% +FYM 05 t /ha) with (152.46 gm) and the minimum reported was (70.44gm) in treatment T_1 (Control). These results are in consonance with the findings of many workers (Pujari*et al.*, 1977; Rajgopal *et al.*, 1979; Lingaiah *et al.*, 1992 and Parthasarathy, 1998) [7].

3.7 Yield kg/plot

Maximum root yield per plot was (10.13kg) obtained with treatment T_9 (RDF 100% +FYM 10 t /ha) followed by (8.23 kg) with treatment T_8 (RDF 100% +FYM 10 t /ha) whereas the minimum was (5.10 kg) recorded with treatment T_1 (Control). These results are in consonance with the findings of many workers (Pujari*et al.*, 1977; Rajgopal *et al.*, 1979; Lingaiah *et al.*, 1992 and Parthasarathy, 1998) [7].

Table 1:- Effect of different levels of Phosphorus, Sulphur and FYM on soil properties and yield of Maize. (90 Day)

Treatment combination	Plant height (cm)	Numbers of leaves per plant	Tuber weight (g)	Diameter of tuber (mm)	Tuber length (cm)	Plant dry weight (gm)	Plant fresh weight (gm)	Yeild (kg per plot)	Cost benefit ratio
T1	50.51	7.93	66.41	29.54	17.00	16.43	70.44	5.10	2.78
T2	61.27	8.50	79.10	27.70	19.73	16.98	90.37	5.50	2.75
T3	68.83	8.30	80.91	34.29	21.33	17.78	102.89	6.93	3.20
T4	67.09	8.53	84.70	32.83	19.87	17.94	113.97	7.00	3.61
T5	60.57	8.70	87.83	34.50	20.33	18.92	122.98	7.03	3.34
T6	67.77	9.00	76.37	32.63	17.67	19.28	136.37	8.03	3.53
T7	68.40	9.16	76.43	33.33	20.80	22.15	141.80	8.23	3.26
T8	74.10	9.40	76.69	31.14	24.33	21.85	152.46	8.23	3.72
T9	74.17	10.13	76.24	29.88	21.87	22.75	162.50	10.13	4.00
Mean	76.9	9.99	79.53	32.55	22.82	23.50	176.09	10.01	4.01
F-test	S	S	S	S	S	S	S	**S**	
S. Em (±)	13.824	0.574	2.804	1.928	1.665	0.206	1.892	0.654	
C. D. at 5%	6.521	1.216	5.944	4.087	3.530	0.436	4.012	1.387	

4. Conclusion

Based on the above results, it is concluded that application of phosphorus @ 40 kg/ ha(100%) + Sulphur @ 44 kg/ha(100%) followed by FYM @ 15 & 10 t/ha (100% & 50%) i.e., the treatment T_9(RDF 100% +FYM 10 t /ha) and T_8(RDF 100% +FYM 05 t /ha) was found more beneficial and significantly improved growth parameters and root yield of Carrot grown under Allahabad Agro-climatic conditions. This treatment also showed maximum gross return, net return and benefit: cost ratio i.e. (1:4.02) respectively. These findings are based on one year research trial, to sustains more work to be needed for the same.

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