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Studies on the effect of integrated nutrient management on Yield attributing characters of radish (*Raphanus sativus L.*)

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Abstract: The experiment was carried out in the field of the Department of Horticulture, Janta College, Bakewar, Etawah (U.P.) during Rabi season of the year 2013-14. The layout of experimental field was laid down in Randomized Block Design with 9 treatments. These treatments randomized in three replications with total number of 27 plots. The observations were recorded for yield attributing characters of radish. Observations gathered with respect to increased over the length of roots (34.12 cm), diameter of root (3.43 cm), fresh weight of root (193.03 g), yield per plot of radish (5.06 kg) and root yield of radish (843.43 q/ha) was obtained with the treatment T_{8-} NPK + FYM + PSB (80:60:60 kg/ha) + (10t/ha) + (5kg/ha). Statistical analysis revealed that treatment T_{9-} NPK + FYM + *Azotobacter* +PSB (80:60:60 kg/ha) + (10t/ha) + (5kg/ha) + (5kg/ha) have increases the leaf: root length ratio (1.76) and treatment T_{6-} NPK + FYM (80:60:60 kg/ha + 10t/ha) have increases the leaf: root weight ratio (1.86) which is significantly higher over the rest of treatments. However, minimum values were obtained to control.

Keyword: NPK, FYM, *PSB*, *Azotobacter* and yield attributes of radish

Introduction

Among the root crop radish (*Raphanus sativus* L.) belongs to the family Brassicaceae, genus *Raphanus* and species *sativus* having chromosome number (2n=18). Radish is grown for its young tender tuberous root, which is consumed either cooked or raw and potential source of non-drying fatty oil suitable for soap making illuminating. In homeopathy, it is used for neurological problems, headache, sleeplessness and chronic diarrhea. The leafy top is very rich in minerals, particularly Ca and Fe. Radish leaves are excellent source of vitamins as 100 g, leaves contain 9570 I.U. vitamin-A, 0.18 mg thiamine, 0.35 mg riboflavin, 5.5 mg nicotinic acid and 16 mg ascorbic acid (Aykroyd, 1966). The characteristics pungent flavour of radish is due to the presence of volatile thiocyanates (trans-4-methyl-thiobutenyl, isothiocynate) and the colour of pink cultivar due to the presence of anthocynin pigments. Farmyard manure is conspicuous organic compost of an integrated nutrient supply system, which improves soil health and releases macro and micro nutrient. *Azotobacter* is free living nitrogen fixing bacteria, fixing nitrogen equivalent 30-40 kg /ha N_2 which increases 15-20 per cent yield and growth. Phosphate solubilizing bacteria play a significant role in solubilizing insoluble phosphate. As well as supplementary of chemical fertilizer like N, P and K given by Urea, DAP and Murate of potash. Sharma *et al*. (2003) obtained that maximum yield of root with investigated effect of integrated use of FYM and NPK on carrot cv. Nantes and Jayathilake *et al.* (2006) reported that integrated nutrient management with bio-fertilizer (*Azotobacter* and *Azospirillum*) on onion cultivation.

Materials and Methods

A field experiment entitled "Studies on the effect of integrated nutrient management on growth and yield attributes of radish (*Raphanus sativus L.*) cv. Kashi Sweta" was conducted during rabi season of 2013-14. The experiment was carried out in the field of the Department of Horticulture, Janta College, Bakewar, Etawah (U.P.). The layout of experimental field was laid down in Randomized Block Design with 9 treatments. These treatments randomized in three replications with total number of 27 plots. The details of experimental treatment plan employed in the present investigation was careid out as follow: T_{1-} Control, T_{2-} FYM (20t/ha), T_{3-} FYM + *Azotobacter* + PSB (10t/ha) + (5kg/ha) + (5kg/ha), T_{4-} FYM + *Azotobacter* (10t/ha) + (5kg/ha), T_{5-} NPK (80:60:60 kg/ha), T_{6-} NPK + FYM (80:60:60 kg/ha + 10t/ha), T_{7-} NPK + FYM + *Azotobacter* (80:60:60 kg/ha) + (10t/ha) + (5kg/ha), T_{8-} NPK + FYM + PSB (80:60:60 kg/ha) + (10t/ha) + (5kg/ha) T_{9-} NPK + FYM + *Azotobacter* +PSB (80:60:60 kg/ha) + (10t/ha) + (5kg/ha) + (5kg/ha). The observations revealed with respect to length of main root (cm) of five plants were measured meter scale from the point, where leaves arises to end point of root after harvesting, diameter of roots (cm) measured at the middle portion approximately 2.0 cm below the shoulder by a veneer calipers, leaf: root length ratio was derived by dividing leaf length with root length, leaf: root weight ratio was derived by dividing leaf weight with root weight and fresh weight of root (g) was recorded in each plant with the help of electronic balance. After harvesting and cleaning of root, weight of roots along with leaves taken for each plot by the electronic balance in term of Kilogram and total yield per hectare in quintal was calculated using the formula:-

$$\text{Yield (q/ha.)} = \frac{\text{Yield per net plot (kg)}}{\text{Net area of the plot (m}^2\text{)}} \times \frac{10000}{100}$$

The recorded data was subjected to analysis of variance appropriate to the randomized block design as given by (Chandel, 1984).

Results and Discussion

In this chapter, Endeavour has been made to exam pain the result of various sources of tables. Emphasis has been given on the statistical analysis in order to compare one treatment with another, so that the validity of treatment may be clarified with confidence. It is evident from data revealed in table-1 that:

Table-1: Studies on the effect of integrated nutrient management on yield attributing characters of radish cv. Kashi Sweta

Treatments	Length of root (cm)	Diameter of main root (cm)	Leaf: Root length ratio	Leaf: Root weight ratio	Fresh weight of root (g)	Yield kg per plot	Yield (q/ha)
T_1: Control	18.07	2.28	1.19	0.85	86.53	2.56	426.40
T_2: FYM	26.45	3.18	1.17	0.57	126.33	3.53	588.40
T_3: FYM+ Azotobacter+PSB	27.28	3.20	1.04	0.54	116.33	3.15	524.20
T_4: FYM + *Azotobacter*	29.49	2.99	0.95	0.49	125.8	3.35	558.80
T_5: NPK	29.41	3.23	1.27	0.95	169.73	4.93	822.46
T_6: NPK+ FYM	25.32	2.69	1.72	1.86	91.2	3.65	608.60
T_7: NPK+FYM+Azotobacter	27.10	2.81	1.37	1.39	106.93	4.09	681.20
T_8: NPK + FYM + PSB	34.12	3.43	1.48	1.29	193.03	5.06	843.43
T_9: NPK+FYM+Azotobacter+PSB	26.69	3.30	1.76	1.39	104.93	3.77	628.20
S. Em ±	1.53	0.25	0.25	0.51	36.59	0.97	161.40
CD at 5%	3.25	0.53	0.53	1.07	77.57	2.05	342.16

Length of root (cm): Among the yield parameters studied, the maximum length of root (34.12 cm) was observed with the application of NPK + FYM + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha) under T_8 followed by (29.49 cm) with T_4 (FYM + *Azotobacter* @ + 10 t/ha + 5 kg/ha) and T_5 (NPK @ 80:60:60 kg/ha),the minimum length of root was recorded under T_1 namely control (18.07cm).

Diameter of main root (cm): The maximum diameter of main root (3.43 cm) was recorded with the application of NPK + FYM + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha) under T_8 followed by (3.30 cm) with T_9 (NPK + FYM + *Azotobacter* + PSB @ 80:60:60 kg/ha + 10 t/ha + 5 kg/ha + 5 kg/ha) , while it was minimum diameter of main root recorded under T_1 namely control (2.28 cm).

Leaf: Root length ratio: The maximum leaf: root length ratio (1.76) was recorded with the application of fertilizer NPK + FYM + *Azotobacter* + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha + 5 kg/ha) under T_9 followed by (1.72) with T_6 (NPK + FYM @ 80:60:60 kg/ha + 10 t/ha). However it was minimum leaf: root length ratio recorded (0.95) under T_4 with the application of recommended dose of FYM + *Azotobacter* (10 t/ha + 5 kg/ha).

Leaf: Root weight ratio: The maximum leaf: root weight ratio (1.86) was recorded with the application of NPK + FYM (80:60:60 kg/ha + 10 t/ha under T_6 followed by (1.39) with T_9 (NPK + FYM + *Azotobacter* + PSB @ 80:60:60 kg/ha + 10 t/ha + 5 kg/ha + 5 kg/ha) and T_7 (NPK + FYM + *Azotobacter* @ 80:60:60 kg/ha + 10 t/ha + 5 kg/ha), while it was minimum leaf: root weight ratio recorded (0.49) under T_4 with the application of recommended dose of FYM + *Azotobacter* (10 t/ha + 5 kg/ha).

Fresh weight of root (g): The maximum fresh weight of root (193.03 g) was recorded with the application of NPK + FYM + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha) under T_8 followed by (169.73 g) with T_5 (NPK @ 80:60:60 kg/ha) and T_2 (FYM @ 20 t/ha), while it was minimum fresh weight (86.53 g) recorded under T_1 namely control.

Yield per plot (kg): The maximum yield (5.06 kg/plot) was recorded with the application of NPK + FYM + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha) under T_8 followed by (4.93 kg/plot) with T_5 (NPK @ 80:60:60 kg/ha) and T_7 (NPK + FYM + *Azotobacter* @ 80:60:60 kg/ha + 10 t/ha + 5 kg/ha), while it was minimum yield (2.56 kg/plot) recorded T_1 namely control.

Yield (q/ha): The highest yield (843.43 q/ha) was observed with the application of NPK + FYM + PSB (80:60:60 kg/ha + 10 t/ha + 5 kg/ha) under T_8 followed by (822.46 q/ha) with T_5 (NPK @ 80:60:60 kg/ha) and T_7 (NPK + FYM + *Azotobacter* @ 80:60:60 kg/ha + 10 t/ha + 5 kg/ha), while it was lowest yield (426.40 q/ha) recorded under T_1 namely control.

Integrated nutrient management supplies all essential elements of the plants in a proper amount it's promoting the growth of the plant which increased the vegetative growth and maintains the soil fertility and sustainability. They are nutrient increased length of main root (cm), diameter of roots (cm), leaf: root length ratio, leaf: root weight ratio and yield of radish. The results are in conformity with the findings of Thanunathan *et al*. (1997). Similar result is in consonance with the findings of the increase in bulb diameter and length may be attributed to solubilization of plant nutrients by addition of vermin-compost, FYM leading to increase uptake of NPK (Subbaiah *et al*., 1982). The result is in consonance with the findings of many workers (Pujari *et al*., 1977; Rajgopal *et al*., 1979; Lingaiah *et al*., 1992 and Parthasarathi, 1998).

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