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Original Research Article

Interaction Effect of Planting Distance and Biofertilizers on Growth and Yield Attributes of Turnip (*Brassica rapa* L.) cv. Pusa Sweti under Garhwal Hills

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A B S T R A C T

A field experiment was conducted during *Rabi* season 2017-18 at Horticultural Research Centre, Chauras Campus and Department of Horticulture, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand to find out the interaction effect of planting distance and bio-fertilizers on growth and yield attributes of turnip under sub-tropical condition of Garhwal Himalaya. Nine treatment combinations were investigated. Treatments comprises three different planting distance: S_1 (10 cm x 40 cm), S_2 (15 cm x 40 cm) and S_3 (20 cm x 40 cm)), three biofertilizer: B_1 (*Azotobacter*), B_2 (*Azospirillum*) and B_3 (Control) in Factorial Randomized Block Design with three replications. Results revealed that the interaction of planting distance and biofertilizers showed significant effect on various characters. It was concluded that S_1B_1 (40 cm x 10 cm with *Azotobactor*) was observed superior for growth and yield characters while S_3B_2 (40 cm x 20 with *Azospirrilum*) was found superior in yield attributing of turnip.

Keywords

Growth and yield attributes, Biofertilizers, Planting distance and interaction

Introduction

Turnip (*Brassica rapa* L.) is a winter vegetable and herbaceous biennial in nature, comes under the family of brassicaceae. It is mainly grown for the hypocotyls and the swollen upper part of the root and lower part of the stem. It has a crisp white flesh and a zesty mustard-like flavor and a rapidly maturing crop. Its root is called underground modified root, which is napiform in shape. The stem is short at vegetative stage but elongated at the reproductive stage. It is well established in fertile and medium to heavy well drained soils are best suited to grow. Turnip can be grown in slightly acidic to saline soils. However, the optimum soil pH range is 6.0-7.0 (Choudhary, 2015). Determining spacing is one of the most important requirements of farming planning to realize maximum yield with an optimum quality. The bio-fertilizers are organic in origin and thus are absolutely safe. Organic fertilizers are made from materials derived from plant and animal residues. The positive effect of most commonly used organic fertilizers on crop production and soil fertility are dependent on the quality, rate, timing and method of application. The amount of nutrients and the type of elements available

from the specific organic fertilizer used is again dependent on the age, origin as well as climatic conditions such as temperature and rainfall (Grubinger, 1999).

Nitrogen favours the transformation of carbohydrates into proteins and promotes the formation of protoplasm. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs.

This leads to higher productivity (Patel *et al.*, 1992). Phosphorus is indispensable constituent of nucleic acid, phospholipids and several enzymes. It is also needed for the transfer of energy within the plant system and has beneficial effect on early root development, plant growth and quality of produce (Brady, 1974).

Materials and Methods

The experiment was conducted at Horticultural Research Centre, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand. Geographically, the Horticultural Research Centre is situated in Alaknanda valley which lies between $78^0$47'30" E longitude and $30^0$13'0"N latitude, right in the heart of Garhwal region at an elevation 540 m above MSL, in the lesser Himalayan region.

The climate of Horticultural Research Centre is humid sub-tropical with minimum and maximum temperature ranging between 7.5^0C to 25.8^0C and 17.7^0C to 40^0C, respectively during experimentation. Nine treatment combinations were investigated.

Treatments comprises three different planting distance: S_1 (10 cm x 40 cm), S_2 (15 cm x 40 cm) and S_3 (20 cm x 40 cm)), three biofertilizer: B_1 (*Azotobacter*), B_2 (*Azospirillum*) and B_3 (Control) in Factorial Randomized Block Design with three replications. Recommended package of practices were followed for weeding, fertilizer application and crop protection management to grow the crop.

Observations of different growth and yield attributes counted separately which were obtained randomly from five tagged plants and their averages were recorded. Crop was harvested manually.

Least significant difference at 5% level was used for finding the significant differences among the treatment means. The data obtained from selected plants were subjected to analysis of variance Panse and Sukhamate (1961).

Results and Discussion

In the present investigation different parameters *viz*. plant height (43.14 cm), number of leaves per plant (17.91), weight of fresh and dry leaf (197.26 & 11.86), diameter of root (93.67), were appreciably increased and found significant superior under B_1(*Azotobactor*) S_2 (40 cm x 10 cm), while the fresh and dry weight of root(179.6 & 20.96), yield per plot (12.30 kg), were found superior under S_3B_1 (40 cm x 20 cm and *Azospirrilum*) respectively.

These results are in according with those obtained by Charak *et al.,* (2006) and Bhusan *et al.,* (2010)

Study concluded that S_1B_1 (40 cm x 10 cm with *Azotobactor*) was observed superior for growth and yield characters while S_3B_2 (40 cm x 20 with *Azospirrilum*) was found superior in yield attributing of turnip (Table 1–3).

Table.1 Interaction effect on plant height and number of leaves of turnip

Treatment	Plant height (cm)		Number of leaves	
	30 DAS	45 DAS	30 DAS	45 DAS
S_1+B_1	11.83	32.04	11.83	17.91
S_1+B_2	9.2	38.97	9.2	16.74
S_1+B_0	10.77	41.98	10.77	12.02
S_2+B_1	8.93	28.40	8.93	14.86
S_2+B_2	9.67	32.59	9.67	14.10
S_2+B_0	14	27.00	14	14.79
S_3+B_1	11.5	32.36	11.5	17.44
S_3+B_2	10.83	36.37	10.83	16.44
S_3+B_0	12.97	37.37	12.97	15.98
SE(m)	1.35	0.87	0.47	0.86
CD (5%)	4.87	2.68	1.44	2.62

Table.2 Interaction effect on root diameter, whole plant weight and fresh and dry leaf weight of turnip

Treatment	Root diameter (mm)	Whole plant weight (g)	Freshleaf weight(g)	Dry leaf weight (g)
S_1+B_1	69.76	278.33	112.2	11.87
S_1+B_2	54.47	249.72	118.5	9.17
S_1+B_0	65.66	343.37	115.2	4.37
S_2+B_1	63.43	339.92	184.0	5.57
S_2+B_2	61.29	334.57	125.2	8.73
S_2+B_0	69.55	239.37	151.9	9.73
S_3+B_1	69.63	268.30	119.0	9.57
S_3+B_2	81.84	336.87	197.3	10.53
S_3+B_0	93.68	271.57	135.3	11.73
SE(m)	1.06	0.87	0.84	0.45
CD (5%)	3.23	2.64	2.55	1.37

Table.3 Interaction effect on fresh and dry root weight, yield per plot and TSS of turnip

Treatment	Fresh root weight (g)	Dry root weight (g)	Yield per plot (kg)	TSS (^{0}Brix)
S_1+B_1	179.70	15.30	5.08	6.73
S_1+B_2	115.63	17.50	6.40	8.47
S_1+B_0	119.13	16.43	6.28	7.77
S_2+B_1	103.03	16.63	2.78	10.40
S_2+B_2	111.83	18.93	8.42	10.30
S_2+B_0	89.93	12.07	5.67	6.43
S_3+B_1	124.90	16.90	4.47	9.33
S_3+B_2	131.83	19.00	4.70	6.03
S_3+B_0	122.57	20.97	12.30	6.93
SE(m)	1.52	0.59	1.49	2.04
CD (5%)	4.77	1.79	4.50	2.12

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