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Effect of nitrogen and phosphorus on growth and yield of radish (*Raphanus sativus* L.) CV. Pusha chetki under shade net condition

Aruna Lakra, Devi Singh, VM Prasad, Deepanshu and Mohd Shabi

Abstract
The present investigation entitled "Effect of Nitrogen and Phosphorus on growth and yield of Radish (*Raphanus sativus L.*) cv. Pusha chetki under shade net condition" was undertaken at Naini Agriculture Institute, Department of Horticulture, Sam Higgibottom University of Agriculture, Technology and Science, Allahabad during the year 2017. The experiment was laid out in RBD having ten treatments with control and 3 replications. On the basis of above findings it is concluded that the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) was recorded the best among in all the treatment in terms of growth and yield attributes and also with increased T.S.S. The T_9 was also recorded highest in terms of cost benefit ratio (10.10) under shade net condition.

Keywords: Nitrogen, phosphorus, growth, yield, quality and radish

Introduction
Radish (*Raphanus sativus* L.) is a member of the Brassicaceae family native to Europe or Asia. It is a popular root crop grown all over the world. In India, it is grown in one or the other part of the country throughout the year. It is grown for its young fleshy tuberous roots consumed mainly as salted vegetable, eaten as a grated salad. Radish is a cool season crop and divided broadly into two groups: European or temperate and Asiatic or tropical. Asiatic types produce roots and seeds under tropical climate, whereas, European types produce roots under sub tropical and tropical climate. However, seed production of European types is possible only under temperate conditions in hills since these require chilling temperature for seed production. The Asiatic varieties although are higher yielders yet poor in quality attributes, whereas, European varieties are small in size, mild in pungency, early in maturity and rich in quality parameters. Tripathi *et al.,* (2017) [1].

Nitrogen plays an important role in the building up of protoplasm and protein which induce cell division and initiate meristematic activities when applied in optimum quantity. Low nitrogen availability causes a decrease in cell size especially cell division (Akand *et al.* 2015) [2]. Nitrogen improves the absorption & respiration process in plant and activates vegetation. Radish plants with more leaves can give more root yield as compared to the plants having less leaves. Nitrogen is the main component of protein & chlorophyll.

It plays vital role in transferring energy with in plant cells, cell division, and formation of meristem tissue; promote root growth, flowering and development of seed and fruit. Deficiency of phosphorus leads to reddish or purple leaves, stems and branches, stunted top growth that results in low yield and ultimately poor quality of crops (Zeb *et al.* 2016). And also the Deficiency of Phosphorus limits the production of plant because the mobility of Phosphorus is low in soil and the root system. To explore its mobility in plant and its role in plant top development, 10 and 20 mg/l phosphorus in radish was applied. Fresh and dry matter increased with phosphorus application (Kezia and David 2013) [3].

Materials and Methods
The present investigation "Effect of Nitrogen and Phosphorus on growth and yield of Radish (*Raphanus sativus* L.) cv. Pusa chetki under shade net condition." was carried out in agro – climatic condition of Allahabad region during the Zaid season 2017. The experiment was laid out at vegetable Research Farm Department of Horticulture, College of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The tropical experimental field was uniform with good irrigation facilities. Experiment was laid out

in Randomized Block Design with 10 treatments in three replications. Observations were recorded at five randomly selected and labeled plants from each treatment and each replication for growth, yield and quality. Growth, yield and quality parameters of the following traits were recorded *viz.*, Plant height (cm) Number of leaves, Root diameter, Shoot length (cm), Root length (cm), Shoot weight (g), Root weight (g), Yield per plot (kg), Total root yield (q/ha) and Total soluble solid (^{0}Brix). The data on growth, yield and quality components were subjected to Fisher's method of analysis of variance (ANOVA), where the 'F' test was significant for comparison of the treatment means, CD values were worked out at 5% probability level.

Results and Discussion

Influence of nitrogen and phosphorus fertilizer, under study on vegetative growth under different treatment is described in table 1. The maximum plant height (20.53 cm) was observed in the treatment T_9 50 Kg Urea + 50 kg S.S.P followed by T_8 (20.27 cm) 35 kg Urea+ 35 kg S.S.P, T_7 (20.10 cm) 15 kg Urea + 15 kg S.S.P and minimum plant height (11.16 cm) was observed in Treatment T_0 (control). The maximum number of leaves per plant (14.13) was observed in the treatment T_9 50 Kg Urea + 50 kg S.S.P followed by T_8 (13.20) 35 kg Urea+ 35 kg S.S.P, T_7 (13.00) 15 kg Urea + 15 kg S.S.P and minimum plant height (8.13) was observed in Treatment T_0 (control). Diameter of root in radish was significantly affected with different treatments. Maximum diameter of root (3.57cm) was observed under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) which was followed by $T_8>T_7>T_5>T_4>T_2>T_3>T_1>T_6$ in descending order. Minimum diameter of root (2.25 cm) was recorded under the treatment T0 (control). Urea and S.S.P. as source of nitrogen and phosphorus, respectively, were found most effective in increasing the root diameter of radish. Length of shoot in radish was significantly affected with different treatments. Maximum length of shoot (22.43 cm) was observed under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P). It was significantly superior over other treatments. Rest of the treatments were in a order of $T_8>T_7>T_3>T_1>T_2>T_6>T_5>T_4$. Minimum length of shoot i.e. 15.10 cm was observed under the treatment T_0 (control) after harvesting. Urea and S.S.P as source of nitrogen and phosphorus, respectively, were found most effectively in increasing the shoot length of radish.

Length of root in radish was significantly affected with different treatments. Maximum length of root (19.95 cm) was observed under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P). It was significantly superior over other treatments. Rest of the treatments were in an order of $T_8>T_7>T_3>T_2>T_1>T_6>T_5>T_4$. Minimum length of root i.e. 13.33 cm was observed under the treatment T_0 (control) after harvesting. Urea and S.S.P as source of nitrogen and phosphorus, respectively, were found most effective in increasing the root length of radish.

Weight of shoot in radish was significantly affected with different treatments. Maximum weight of shoot (140.33 g) was observed under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P). It was significantly superior over other treatments. Rest of the treatments were in a order of $T_8>T_7>T_3>T_2>T_1>T_5>T_5>T_6$. Minimum weight of shoot i.e. 109.67 g was observed under the treatment T_0 (control) after harvesting. Urea and S.S.P as source of nitrogen and phosphorus, respectively, were found most effective in increasing the shoot weight of radish.

Weight of root in radish was significantly affected with different treatments. Maximum average weight of root (117.33 g) was noted under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) which was significantly superior over all other treatments. It was followed by $T_8>T_7>T_6>T_3>T_2>T_1>T_5>T_4$ in descending order. Minimum average weight of root (81.10 g) was observed under the treatment T_0 (control). Urea and S.S.P as source of nitrogen and phosphorus, respectively, were found most effective in increasing the root weight of radish. Treatments showed significant influence on root yield per plot (kg) in radish. Highest root yield per plot (10.43 kg) was recorded under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) which was significantly superior over all other treatments under study. It was followed by $T_8>T_7>T_3>T_2>T_1>T_6>T_5>T_4$ in descending order. Lowest root yield per plot (4.83 kg) was observed under the treatment T_0 (control). Urea, S.S.P and their combination (50 kg N through Urea +50 kg S.S.P) registered higher root yield per plot than all other treatment combination.

Treatments showed significant influence on root yield (q/ha) in radish. Highest root yield (695.56 q/ha) was recorded under the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) which was significantly superior over all other treatments under study. It was followed by $T_8>T_7>T_3>T_2>T_1>T_6>T_5>T_4$ in descending order. Lowest root yield (322.22 q/ha) was observed under the treatment T_0 (control). Urea and S.S.P were found appropriate source of nitrogenous and phosphatic fertilizer, respectively, and their combination T_9 (50 kg N through Urea + 50 kg P through S.S.P) emerged as superior over all other treatment combinations, for yield and yield attributing components of radish.

Highest total soluble solid content (5.0 ^{0}Brix) was determined with T_9 (50 kg N through Urea + 50 kg P through S.S.P) treatment with significant difference than other treatments. Rest of treatments has total soluble solids in descending order $T_8>T_7>T_3>T_2>T_1>T_6>T_5>T_4$ Minimum total soluble solid content (3.81 ^{0}Brix) was found in treatment T_0 (control). Urea, S.S.P and their combination T_9 (50 kg N through Urea + 50 kg P through S.S.P) registered higher total soluble solid content than all other treatment combination.

Table 1: Effect of nitrogen and phosphorus on growth, yield and quality of Radish (*Raphanus sativas* L.) under shade net condition.

Treatment Combination	Growth parameters						Yield parameters			Quality parameters
	Plant height (cm)	Number of leaves per plant	Root diameter (cm)	Shoot length (cm)	Root length (cm)	Shoot weight (g)	Root weight (g)	Root yield per plot (kg)	Root yield (q/ha)	TSS (^{0}Brix)
T_0 Control	11.16	8.13	2.25	15.10	13.33	109.67	81.10	4.83	322.22	3.81
T_1 Nitrogen (Urea) 15 kg ha^{-1}	19.27	10.00	2.73	20.30	17.00	121.33	90.33	7.00	466.67	4.37
T_2 Nitrogen (Urea) 35 kg ha^{-1}	19.57	10.27	2.82	20.00	17.30	123.00	91.32	7.23	482.22	4.37
T_3 Nitrogen (Urea) 50 kg ha^{-1}	19.20	10.27	2.76	20.47	17.43	125.70	93.20	7.37	491.11	4.40
T_4Phosphorus (S.S.P) 15 kg ha^{-1}	13.53	8.93	2.91	19.33	15.17	113.44	83.63	5.53	368.89	4.13
T_5 Phosphorus (S.S.P) 35 kg ha^{-1}	13.10	8.87	3.07	19.33	15.30	114.67	85.20	5.63	375.56	4.10
T_6Phosphorus (S.S.P) 50 kg ha^{-1}	15.10	8.87	2.33	19.37	15.43	112.67	93.23	5.83	388.89	4.07
T_7Nitrogen 15 + Phosphorus 15 kg ha^{-1}	20.10	13.00	3.13	22.15	19.10	135.00	97.00	8.43	562.22	4.44
T_8Nitrogen 35 + Phosphorus 35 kg ha^{-1}	20.27	13.20	3.37	22.30	19.23	137.41	102.67	9.33	622.22	4.55
T_9Nitrogen 50 + Phosphorus 50 kg ha^{-1}	20.53	14.13	3.57	22.43	19.23	140.33	117.33	10.43	695.56	5.00
F-test	S	S	S	S	S	S	S	S	S	S
S. Ed. (±)	0.09	0.10	0.10	0.10	0.07	4.58	0.90	0.11	7.14	0.05
C.D. at 5%	0.20	0.20	0.21	0.22	0.15	9.61	1.90	0.22	14.99	0.10

Conclusion

On the basis of above findings it is concluded that the treatment T_9 (50 kg N through Urea + 50 kg P through S.S.P) was recorded the best among in all the treatment in terms of growth and yield attributes and also with increased T.S.S. The T_9 was also recorded highest in terms of cost benefit ratio (10.10) under shade net condition.

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