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Effect of nitrogen levels and boron on growth, yield and quality of Radish (*Raphanus sativus* L.) Cv. Pusa Reshmi

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Abstract

A field experiment, entitled "Effect of nitrogen levels and boron on growth, yield and quality of Radish (*Raphanus sativus* L.)" was carried out at Horticulture research farm of AKS University, Sherganj Satna (M.P.) during Rabi season of 2018-19. The experiment was laid out in Randomized Block Design with twelve treatments and three replication. The treatment comprises of application of T₁-nitrogen @ 0 kg/ha + Boron @ 0 kg/ha, T₁-nitrogen @ 0 kg/ha + Boron @ 10 kg/ha, T₃- nitrogen @ 0 kg/ha + Boron @ 20 kg/ha, T₄- nitrogen @ 40 kg/ha + Boron @ 0 kg/ha, T₅- nitrogen @ 40 kg/ha + Boron @ 10 kg/ha, T₆- Potassium @ 40 kg/ha + Boron @ 20 kg/ha, T₇- nitrogen @ 80 kg/ha + Boron @ 0 kg/ha, T₈ - nitrogen @ 80 kg/ha + Boron @ 10 kg/ha, T₉ - nitrogen @ 80 kg/ha + Boron @ 20 kg/ha, T₁₀- nitrogen @ 120 kg/ha + Boron @ 0 kg/ha, T₁₁- nitrogen @ 120 kg/ha + Boron @ 10 kg/ha, T₁₂- nitrogen @ 120 kg/ha + Boron @ 20 kg/ha the variety 'Pusa reshmi' was used for the study. The observations on growth yield and quality parameters were recorded, the results of present study indicated that the, there were significant differences in growth, yield and quality of radish due to different treatments. The maximum plant height (38.71cm), plant spread (72.18) number of leaves (17.17), fresh weight of leaf (182.78 g), dry weight of leaves (32.85 g), leaf area (1212.94) leaf area index (4.15) root length (29.25 cm), root diameter (5.04 cm), root to shoot ratio (2.39) average yield gm. per plant (175.35), root yield kg per plot (40.22 Kg), root yield quintal per hectare TSS (10.25%), ascorbic acid (28.15%), and B:C ratio (1.95) were observed in the treatment T₁₁ (nitrogen@ 120 kg/ha + Boron @ 10 kg/ha). Hence, considering the positive effects of the different levels of nitrogen and boron it can be concluded that, the application of nitrogen @ 120 kg/ha and boron @ 10 kg/ha was found to be beneficial for radish crop grown under Satna (M.P.) condition.

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

Introduction

Radish (*Raphanus sativus* L.) is a member of Cruciferae or 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 country throughout the year. It is grown for its young fleshy roots consumed mainly as salted vegetable and eaten as a grated salad. Good quality pickle is also prepared from radish roots.

Radish is a popular vegetable in both tropical and temperate regions. It is cultivated under glass for early production but large scale production in the field is more common. Radish is one of the most ancient vegetable. Inscription on the inner wall of pyramid show that radish was an important vegetable in Egypt about 2000 B.C Certain remark of Herodotus reveal that it was cultivated about 2700 B.C (Beaker 1962). It spread to china about 500 B.C and to japan A.D 700 (Shirks 1957).

Radish is probably a native to Europe or Asia (Thompson and Kelly 1957). It was very popular among the ancient Egyptians and greeks.it seems to have been reached England in about 1548 and in America in 1629. As it found growing wild in the Mediterranean regions, so many peoples regards its origin to be somewhere in south west Europe. The most popular part for eating is the napiform taproot, although the entire plant is edible and the tops can be used as a leaf vegetable Radish is also used in salad. Unripe fruits (siliqua) are also edible and cooked as vegetables.

India is the second largest producer of radish in the world and occupies 211(000) ha area with a production in 3074 (000) metric tonnes in 2017-18 (3rd Advance Est.), and west Bengal is a leading state in area 40.95 ('000hectares) and production of 502.05 ('000) metric tonnes. Haryana is the leading state in production 470.66 MT and productivity of 22.4 metric tonnes/ha followed by Punjab, Bihar, Assam, Chhattisgarh, Odisha and Andhra Pradesh, In Madhya Pradesh the crop occupies 3.14 ('000) hectare area with the production of 47.00

(‘000) metric tonnes and (source: Horticultural Statistics Division, DAC&FW).The present experiment have been designed to assess the “Effect of nitrogen levels and boron on growth, yield and quality of Radish (*Raphanus sativus* L.)” at AKS University Satna (M.P.) during Rabi season of 2018.

Materials & Methods

A field trail was laid out in randomized block design at Horticulture Research Farm of the department of horticulture, AKS University Satna (M.P.) during the winter season of 2018. There were four levels of nitrogen and three levels of borax (di-sodium tetraboret) viz, 0, 40, 80, 120, kg/ha 0, 10, 20, kg/ha of borax, replicated three times. The experimental plot soil was sandy loam, medium in fertility with a pH of 7.3. A radish variety commonly cultivated in this area and is known as Pusa Reshmi was selected for this study. A manurial dose consisting of 45q/ha vermicompost, P₂O₅ - 50kg/ ha, and 50kg/ha K₂O kg/ha was applied. Other cultural practises has been done as per recommended package of practises for radish.

Results & discussion

Data recorded on ancillary characters and yields of radish are presented in Table 1. It is clear from the data presented in Table 1 that different nitrogen and boron levels influenced the growth trails such as plant heights, plant spread, number of leaves, fresh weight of leaf, dry weight of leaf, leaf area, leaf area index, root length, and diameter of roots, root to shoot ratio fresh weight of roots (g/ plant⁻¹), average root yield (kg/

plot⁻¹), root yield (q/ h⁻¹) and ascorbic acid %, TSS % of radish significantly. (Nitrogen @120 Kg + Borax@10 Kg) at a rate per ha was found to be significantly superior regarding growth, yield and quality parameters as compared to control. However application of higher dose of Nitrogen and borax reduces the growth parameters considerably, in T₁₂, Treatments ie; 120kgnitrogen and 20kg borax. These results are in conformity of the findings of Skok (1941) ^[11], Maurya & Singh (1985) ^[7] Maurya K.R & Devi Bineeta (2015) ^[6] and Maurya & Maurya (2015) ^[8] Similar results were also obtained by White and Stevens (1941) ^[12] in case of radish, table beet and cauliflower. The data on growth, yield and quality parameters are presented in (Table 1.1, 1.2, 1.3, 1.4, growth parameter). (Table 2. yield parameter) and (Table 3. quality) these growth, yield and quality parameter were significantly higher under 120 Kg nitrogen and 10kg of borax per ha while lower in control. When dose of nitrogen and borax were increased beyond 10kg per ha the decreases growth, yield and quality parameter gradually decreases. It may be due to detrimental effect of higher doses. Kother (1963) ^[2] reported that plants well supplied with boron took up and stored more carbohydrate and nitrogen due to which per cent dry matter and protein increased in the roots and tops of radish. Gandhi & Mehta (1960) ^[4] also reported the similar results. Myszka (1958) ^[5] reported that Vitamin -C increased in vegetables due to application of judicious Does of boron and manganese. Yadav & yadav (2012) ^[13] Kumar *et al.* (1996) ^[4] also reported similar result.

Table 1.1: Effect of nitrogen levels and boron on plant height (cm) and plant spread (cm²) of Radish

Treatment	Plant height (cm)			plant spread (cm ²)		
	30 DAS	40 DAS	At maturity	30 DAS	40 DAS	At maturity
T ₁ 0Kg(N0) + 0Kg(B0) + PK	14.10	20.18	26.31	25.08	40.09	61.25
T ₂ 0Kg(N0) + 10Kg(B1) + PK	15.67	21.63	30.35	26.75	40.86	62.98
T ₃ 0Kg (N0) + 20Kg(B2) + PK	16.65	22.09	31.53	27.15	41.55	62.78
T ₄ 40Kg (N1) + 0Kg(B0) + PK	17.24	22.84	32.90	28.08	41.67	63.22
T ₅ 40Kg (N1) + 10Kg(B1)+PK	19.73	25.34	35.19	31.20	53.10	67.53
T ₆ 40 Kg (N1) + 20 K(B2) +PK	19.81	26.25	35.83	31.45	54.08	69.06
T ₇ 80Kg (N2) + 0Kg(B0) + PK	19.06	23.26	33.84	29.10	47.88	65.28
T ₈ 80Kg (N2) + 10Kg(B1)+PK	19.86	26.81	36.52	31.62	55.12	70.05
T ₉ 80 Kg (N2) + 20Kg(B2)+PK	20.50	27.94	36.72	33.96	55.18	71.08
T ₁₀ 120Kg (N3) + 0Kg(B0) +PK	19.34	24.43	34.69	30.96	51.08	66.75
T ₁₁ 120Kg(N3)+10Kg(B1) +PK	20.22	28.91	38.71	36.09	56.75	72.18
T ₁₂ 120Kg (N3)+20Kg(B2)+PK	20.15	28.61	37.91	33.95	56.09	71.22
SE m±	0.561	0.75	0.503	0.916	1.496	2.005
CD (P=0.05)	1.655	2.214	1.484	2.705	4.415	5.918

Table 1.2: Effect of nitrogen levels and boron on Number of leaves plant¹ of radish & fresh weight (g) plant⁻¹leaf of Radish

Treatment	Number of leaves plant ¹ of radish			fresh weight (g) plant ⁻¹ leaf		
	30 DAS	40 DAS	At maturity	30 DAS	40 DAS	At maturity
T ₁ 0Kg(N0) + 0Kg(B0) + PK	5.12	10.53	13.81	34.38	118.49	138.86
T ₂ 0Kg(N0) + 10Kg(B1) + PK	5.18	11.85	14.87	38.89	127.66	142.56
T ₃ 0Kg (N0) + 20Kg(B2) + PK	5.55	12.24	15.65	45.83	133.96	145.25
T ₄ 40Kg (N1) + 0Kg(B0) + PK	6.8	12.51	15.9	55.8	143.78	148.65
T ₅ 40Kg (N1) + 10Kg(B1) + PK	7.25	12.94	16.43	75.65	150.45	163.35
T ₆ 40 Kg (N1) + 20 K(B2) + PK	7.33	13.41	16.67	78.84	151.94	168.45
T ₇ 80Kg (N2) + 0Kg(B0) + PK	6.9	12.72	16.28	65.40	145.88	159.7
T ₈ 80Kg (N2) + 10Kg(B1) + PK	7.98	13.59	16.81	79.54	152.38	172.34
T ₉ 80 Kg (N2) + 20Kg(B2) +PK	8.68	13.74	16.92	81.08	153.49	176.78
T ₁₀ 120Kg (N3) + 0Kg(B0) + PK	7.10	12.82	16.38	72.34	148.47	161.89
T ₁₁ 120Kg(N3) + 10Kg(B1) +PK	8.89	13.93	17.71	89.58	155.98	182.78
T ₁₂ 120Kg (N3) +20Kg(B2) +PK	8.75	13.85	17.19	85.65	154.33	179.33
SE m±	0.05	0.288	0.488	2.092	4.364	4.86
CD (P=0.05)	0.146	0.849	1.44	6.174	12.883	14.347

Table 1.3: Effect of nitrogen levels and boron on Dry weight (g) plant⁻¹ leaf & leaf area (cm²) of radish

Treatment	Dry weight (g) plant ⁻¹ leaf of radish			leaf area (cm ²) of radish		
	30 DAS	40 DAS	At maturity	30 DAS	40 DAS	At maturity
T ₁ 0Kg(N0) + 0Kg(B0) + PK	6.20	14.12	22.89	471.27	651.70	716.14
T ₂ 0Kg(N0) + 10Kg(B1) + PK	6.40	16.48	25.81	497.53	697.62	836.58
T ₃ 0Kg (N0) + 20Kg(B2) + PK	7.65	18.98	27.85	487.88	797.71	847.12
T ₄ 40Kg (N1) + 0Kg(B0) + PK	7.88	19.08	27.92	580.98	869.38	932.42
T ₅ 40Kg (N1) + 10Kg(B1) + PK	9.66	20.10	29.95	585.12	893.22	1084.25
T ₆ 40 Kg (N1) + 20 K(B2) + PK	9.85	20.18	30.88	586.51	967.81	1154.06
T ₇ 80Kg (N2) + 0Kg(B0) + PK	8.90	19.65	28.18	584.19	886.86	945.95
T ₈ 80Kg (N2) + 10Kg(B1) + PK	9.98	21.35	31.25	587.55	972.15	1176.77
T ₉ 80 Kg (N2) + 20Kg(B2) + PK	10.25	21.65	31.48	589.22	986.52	1189.43
T ₁₀ 120Kg (N3) + 0Kg(B0) + PK	9.20	19.81	28.48	585.51	892.80	1020.29
T ₁₁ 120Kg(N3) + 10Kg(B1) + PK	10.60	22.95	32.85	593.26	1085.19	1212.94
T ₁₂ 120Kg (N3) + 20Kg(B2) + PK	10.45	21.90	31.95	590.33	1012.18	1204.23
SE m±	0.272	0.599	0.879	16.909	27.048	31.179
CD (P=0.05)	0.803	1.768	2.595	49.914	79.842	92.035

Table 1.4: Effect of nitrogen levels and boron on leaf area index (cm²) of radish of Radish

Treatment	leaf area index (cm ²) of radish		
	30 DAS	40 DAS	At maturity
T ₁ 0Kg(N0) + 0Kg(B0) + PK	1.52	2.13	2.95
T ₂ 0Kg(N0) + 10Kg(B1) + PK	1.69	2.18	2.98
T ₃ 0Kg (N0) + 20Kg(B2) + PK	1.79	2.20	3.01
T ₄ 40Kg (N1) + 0Kg(B0) + PK	1.82	2.28	3.05
T ₅ 40Kg (N1) + 10Kg(B1) + PK	1.98	3.15	3.61
T ₆ 40 Kg (N1) + 20 K(B2) + PK	2.08	3.18	3.65
T ₇ 80Kg (N2) + 0Kg(B0) + PK	1.89	3.10	3.09
T ₈ 80Kg (N2) + 10Kg(B1) + PK	2.10	3.22	3.70
T ₉ 80 Kg (N2) + 20Kg(B2) + PK	2.12	3.25	3.95
T ₁₀ 120Kg (N3) + 0Kg(B0) + PK	1.94	3.12	3.42
T ₁₁ 120Kg(N3) + 10Kg(B1) + PK	2.22	3.48	4.15
T ₁₂ 120Kg (N3) + 20Kg(B2) + PK	2.18	3.33	3.97
SE m±	0.059	0.088	0.104
CD (P=0.05)	0.174	0.261	0.308

Table 2: Yield parameter of radish as influenced by nitrogen and boron application.

Treatment	Root length	Root to shoot ratio	Root diameter	Root weight (g) plant ⁻¹	Yield (kg) plot ⁻¹	Yield q/h
T ₁ 0Kg(N0) + 0Kg(B0) + PK	25.18	1.68	3.75	112.80	25.12	380.60
T ₂ 0Kg(N0) + 10Kg(B1) + PK	26.1	1.89	3.85	135.40	27.22	412.42
T ₃ 0Kg (N0) + 20Kg(B2) + PK	26.12	1.90	3.89	140.75	29.24	443.03
T ₄ 40Kg (N1) + 0Kg(B0) + PK	26.28	1.93	4.56	145.80	30.12	456.36
T ₅ 40Kg (N1) + 10Kg(B1) + PK	27.12	2.05	4.86	156.67	33.10	501.51
T ₆ 40 Kg (N1) + 20 K(B2) + PK	27.95	2.09	4.9	158.76	34.18	517.87
T ₇ 80Kg (N2) + 0Kg(B0) + PK	26.75	1.95	4.79	155.80	30.88	467.87
T ₈ 80Kg (N2) + 10Kg(B1) + PK	28.09	2.18	4.94	162.83	35.44	536.96
T ₉ 80 Kg (N2) + 20Kg(B2) + PK	28.22	2.22	4.96	164.95	37.88	573.93
T ₁₀ 120Kg (N3) + 0Kg(B0) + PK	26.85	1.98	4.85	155.98	32.66	494.84
T ₁₁ 120Kg(N3) + 10Kg(B1) + PK	29.25	2.39	5.04	175.35	40.22	609.39
T ₁₂ 120Kg (N3) + 20Kg(B2) + PK	28.91	2.35	4.98	165.85	38.34	580.90
SE m±	0.816	0.062	0.139	4.621	0.994	14.197
CD (P=0.05)	2.408	0.183	0.411	6.174	12.883	44.973

Table 3.1: Effect of nitrogen levels and boron on Ascorbic acid (Mg/100g) & TSS % of radish

Treatment	Ascorbic acid (Mg/100g)	TSS of radish (%)
T ₁ 0Kg(N0) + 0Kg(B0) + PK	23.66	7.10
T ₂ 0Kg(N0) + 10Kg(B1) + PK	24.39	7.18
T ₃ 0Kg (N0) + 20Kg(B2) + PK	25.42	7.65
T ₄ 40Kg (N1) + 0Kg(B0) + PK	25.49	7.75
T ₅ 40Kg (N1) + 10Kg(B1) + PK	26.79	8.28
T ₆ 40 Kg (N1) + 20 K(B2) + PK	26.85	9.20
T ₇ 80Kg (N2) + 0Kg(B0) + PK	25.82	7.85
T ₈ 80Kg (N2) + 10Kg(B1) + PK	27.34	9.78
T ₉ 80 Kg (N2) + 20Kg(B2) + PK	27.65	9.82
T ₁₀ 120Kg (N3) + 0Kg(B0) + PK	26.75	8.25
T ₁₁ 120Kg(N3) + 10Kg(B1) + PK	28.15	10.25
T ₁₂ 120Kg (N3) + 20Kg(B2) + PK	27.91	9.98

SE m±	0.103	0.259
CD (P=0.05)	0.303	0.765

Conclusion

From the results obtained in the present investigation, it has been concluded that, the application of nitrogen @ 120 kg/ha and Boron @ 10 kg/ha proved to be best for cultivation of radish in Satna region of Madhya Pradesh for getting higher growth, yield and quality of radish.

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