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Roopali Patel
Rajmata Vijayaraje Scindia Krishi
Vishwa Vidyalaya, Madhya
Pradesh, India

Vandna
Assam agricultural University,
Jorhat Assam, India

Effect of different level of nitrogen on growth yield and quality of Raddish (*Raphanus Sativus* L) under Gwalior Region of Madhya Pradesh

Roopali Patel and Vandna

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Abstract

Radish (*Raphanus sativus* L.), a member of the Cruciferae family, is cultivated as both an annual and biennial herbaceous crop. Owing to its short duration, optimizing the use of plant growth regulators (PGRs), especially gibberellic acid (GA₃), plays a crucial role in enhancing root quality and yield. Nitrogen, an essential macronutrient, is integral to the synthesis of proteins, nucleic acids, chlorophyll, and key enzymes. While nitrogen deficiency leads to poor crop performance and reduced quality, its excessive application can negatively impact yield and produce quality. In light of this, a field experiment was conducted to evaluate the effect of different nitrogen levels in combination with gibberellic acid on the growth, yield, and quality of radish. The study was laid out with three nitrogen levels, and the results indicated that the application of 120 kg N/ha, when supplemented with GA₃, significantly improved plant growth parameters, root yield, and quality traits. This treatment also recorded the highest gross and net returns along with the best benefit-cost (B:C) ratio compared to the other treatments. Thus, the combined application of 120 kg N/ha and gibberellic acid proved to be the most effective in optimizing radish productivity and profitability.

Keywords: *Raphanus sativus*, Radish, different level of Nitrogen

Introduction

Radish (*Raphanus sativus* L.) is an important root and leafy vegetable belonging to the family Cruciferae. It is cultivated as both an annual and biennial crop and is widely grown in tropical and temperate regions of the world. Radish is consumed not only for its edible roots but also for its tender leaves and shoots, which are used as salad greens and cooked vegetables (Alam *et al.*, 2010) [2]. Traditionally valued for its medicinal properties, the juice of radish leaves is used as a diuretic and laxative, and its roots are known to help alleviate liver, gall bladder, urinary, and digestive disorders (Sankari *et al.*, 2006) [50].

As a low-cost and nutritious vegetable, radish is a valuable food source for economically weaker populations. It is rich in carbohydrates, proteins, and essential vitamins such as A and C (Bakhsh *et al.*, 2006) [6]. In India, radish is cultivated over approximately 0.17 million hectares, yielding a total production of 2.4 million tonnes (Anon., 2015).

Among the essential macronutrients, nitrogen plays a crucial role in plant growth and metabolic functions. It is a key component of proteins, nucleic acids, chlorophyll, and enzymes. Deficiency of nitrogen leads to poor plant vigor, reduced yield, and diminished produce quality (Hussain *et al.*, 1997) [12]. To enhance crop productivity and nutrient use efficiency, nitrogen fertilization is widely practiced across the globe (Eugenius *et al.*, 2011) [47]. Its proper management is critical for achieving optimal yield and quality in radish cultivation. Furthermore, the form and dosage of nitrogen applied influence the nitrate content in radish roots. Use of ammonium-based fertilizers such as ammonium sulfate or amide forms like urea has been shown to reduce nitrate accumulation compared to nitrate-based sources. According to Kowalska *et al.* (2006) [24], the application of nitrogen must be optimized not only to maximize yield but also to ensure superior quality of the produce. Therefore, understanding the appropriate nitrogen levels and combinations with growth regulators is essential for successful radish production.

Corresponding Author:
Roopali Patel
Rajmata Vijayaraje Scindia Krishi
Vishwa Vidyalaya, Madhya
Pradesh, India

Materials and Methods

The present field experiment was conducted at the Research Farm of the College of Agriculture, Gwalior, Madhya Pradesh. The region receives an average annual rainfall of approximately 751.5 mm, and the climatic conditions are suitable for radish cultivation during the Rabi season.

The experimental layout followed a Randomized Block Design (RBD) with three replications. The study comprised three nitrogen application levels: 80 kg/ha, 100 kg/ha, and 120 kg/ha. Each treatment was randomly assigned within each block to reduce experimental error.

All recommended agronomic practices, including land preparation, sowing, irrigation, weeding, and pest management, were uniformly applied across all plots. Nitrogen treatments were applied at specified levels as per the treatment schedule, and other nutrients were provided as per the standard package of practices to ensure uniformity.

Results and Discussion

Growth Parameters

Application of nitrogen significantly influenced the growth parameters of radish. The tallest plants were observed with 120 kg N/ha, recording plant heights of 3.36 cm, 16.70 cm, 42.93 cm, 51.49 cm, and 62.54 cm at 10, 20, 30, 40, and 50 days after sowing (DAS), respectively. Similarly, the highest number of leaves per plant (4.27, 7.06, 10.09, 10.98, and 14.00 at corresponding growth stages) was also recorded at the same nitrogen level. This treatment was significantly superior to the other nitrogen levels tested.

The maximum leaf length 3.07 cm, 11.66 cm, 29.49 cm, 35.67 cm, and 49.80 cm at 10, 20, 30, 40, and 50 DAS, respectively was again recorded under 120 kg N/ha. These results confirm the positive impact of nitrogen on vegetative growth in radish and are in agreement with the findings of Singh *et al.* (1990) [55], Yi *et al.* (1992) [59], Abdel (1996) [1], Pawar *et al.* (1997) [39], Singh and Rajodia (2001) [57], Dhariwal (2005) [10], Mukherjee and Roy (2006) [33], Jatav (2007) [15], and Karuppaiah *et al.* (2007) [17].

Yield and Yield Attributes

Increasing nitrogen levels significantly improved yield and yield components. The fresh weight of leaves per plant was highest (243.56 g) with 120 kg N/ha. Root length was also maximum (exact value not provided, but higher than 27.32 cm) under 120 kg N/ha, whereas the minimum (27.32 cm) was recorded under 80 kg N/ha.

The highest root dry weight (312.66 g) was observed with 120 kg N/ha, compared to the lowest (208.32 g) in the 80 kg N/ha treatment. Likewise, root diameter was greatest (6.18 cm) at the highest nitrogen level, whereas the lowest diameter (5.42 cm) was recorded under 80 kg N/ha.

In terms of overall yield, application of 120 kg N/ha resulted in the highest performance 480 g per plant, 32.17 kg per plot, and

579.03 q/ha. The yield attributes fresh weight of leaves, root length, root weight, root diameter, and yield per hectare were all significantly influenced by nitrogen levels.

The maximum yield (73.92 t/ha) was recorded with 120 kg N/ha. This increase in yield is attributed to enhanced vegetative growth, better foliage development, and increased photosynthetic activity, ultimately leading to higher carbohydrate accumulation in roots.

These findings are in agreement with previous studies by Mishra (1989) [32], Singh *et al.* (1990) [55], Deore and Bharud (1991) [35], Nirmal *et al.* (1994) [35], Pawar *et al.* (1997) [39], Shakada and Gajipara (1998) [48], Singh and Rajodia (2001) [57], Dhariwal (2005) [10], Karuppaiah *et al.* (2007) [17], Ganpathi *et al.* (2008) [11], and Pervez *et al.* (2004) [41]. Pervez *et al.* (2004) [41] specifically reported maximum root length at 200 kg N/ha, and Sounda *et al.* (1998) noted increased root diameter and higher marketable yield with increased nitrogen application. The improved performance under higher nitrogen could be due to enhanced plant vigor, better nutrient availability, and adoption of recommended agronomic practices.

Table 1: Plant height as influenced by different treatment of nitrogen level and at successive crop growth stages

Treatment	Plant Height at Different Growth Stages				
	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS
Nitrogen level					
N1	1.76	8.31	18.89	28.63	42.92
N2	2.97	16.01	37.19	47.53	58.24
N3	3.36	16.70	42.93	51.49	62.54
SEM +	0.065	0.226	0.826	0.863	0.756
CD@5%	0.195	0.679	2.478	2.589	2.267

Table 2: Number of leaves per plant as influenced by different treatment nitrogen level at successive crop growth stages

Treatment	Number of leaves at Different Growth Stages				
	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS
Nitrogen level					
N1	2.94	5.52	8.42	8.69	10.97
N2	3.46	5.83	9.59	10.75	12.04
N3	4.27	7.06	10.09	10.98	14.00
SEM +	0.157164	0.144739	0.23044	0.220846	0.300379
CD@5%	0.471199	0.433948	0.690891	0.662125	0.900577

Table 3: Length of leaves per plant as influenced by different treatment of Nitrogen level at successive crop growth stages

Treatment	Length of leaves at Different Growth Stages				
	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS
Nitrogen level					
N1	1.76	8.31	18.89	28.63	42.92
N2	2.16	8.87	19.95	32.50	45.43
N3	3.07	11.66	23.90	35.67	49.80
SEM +	0.127	0.26	0.542	0.824	1.070
CD@5%	0.383	0.793	1.626	2.472	3.210

Table 4: Length of root (cm), Fresh weight of roots (gm) Diameter of Root (cm) and Fresh weight of leaves (gm) as influenced by different treatment Nitrogen level at harvest

Treatment	Length of root (cm))	Fresh weight of roots (gm)	Diameter of Root (cm)	Fresh weight of leaves (gm)
Nitrogen level				
N1	27.32	208.32	5.42	150.78
N2	29.72	265.01	5.82	189.44
N3	34.74	312.66	6.18	8.471926
SEM +	0.711	12.99	0.078	8.471926
CD@5%	2.133	38.95	0.234	25.39996

Conclusion

Based on the present investigation, it can be concluded that the application of 120 kg N/ha resulted in the highest yield, gross and net income, and benefit-cost (B:C) ratio. This nitrogen level also significantly enhanced growth and yield parameters of radish compared to the other treatments. Therefore, 120 kg N/ha can be recommended as the optimum nitrogen dose for maximizing productivity and profitability in radish cultivation under the given agro-climatic conditions.

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