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Effect of various NPK nutrient doses on the growth of different greengram [*Vigna radiata* (L.)] varieties

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Abstract

Greengram [*Vigna radiata* (L.)] is the most important and extensively grown crop in India. It mainly contributes in enhancing soil fertility through nitrogen-fixing properties. The experiment was conducted to assess the supply of NPK nutrients but in an optimum or balanced manner which promotes chemical fertilizers to help in enhancing the greengram production and productivity. However, the experiment was conducted in Split Plot design with three main plot and three sub-plot factors and total treatment combinations were nine and each treatment replicated thrice. The main plot consists of three greengram varieties, IPM 02-3, IPM 410-3 and PDM-139. Further, each main plot is divided into three sub-plots consists of three different recommended doses of fertilizers viz., 75%, 100% and 125% RDF respectively where, 100% RDF consist of 25:50:30 NPK Kg ha⁻¹ and the study revealed that the greengram variety “IPM 02-3” performs better on growth parameters. Among doses, 125% RDF of NPK performs better regarding growth attributes viz., Plant height (cm), plant dry matter (g plant⁻¹), number of branches (plant⁻¹), Leaf Area Index and root nodule count (plant⁻¹).

Keywords: Greengram, NPK, growth attributes, IPM 02-3, fertilizers etc.

Introduction

India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world (Source: FAO in INDIA, 2022). Production of greengram in different states of India is distributed in Rajasthan, Maharashtra, Odisha, Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu, Bihar, Gujarat, Uttar Pradesh, Jharkhand etc. and In Uttar Pradesh, area and production of greengram is 0.038 million ha. and 0.14 lakh Mt. simultaneously, productivity is 3.58 q ha⁻¹ in 2021-22 (Source: <https://agricoop.nic.in/>). Greengram [*Vigna radiata* (L.)] is the most important and extensively grown crop in India. Greengram belongs to the family Leguminosae and subfamily Papilionaceae. It is small annual plant growing upto height of 30-100 cm. It is a self-pollinated, short duration and drought tolerant crop. It fits well in our existing crop rotation and can be grown twice in a year, both in spring and autumn seasons, in irrigated as well as rainfed areas (Ahmad *et al.*, 2003) ^[1]. It is a good source of carbohydrates (60-62%), proteins (20-24%), fibers (4.0%), fats (1.0%), riboflavin, thiamine and vitamins C (Ascorbic acid) but deficient in methionine and cysteine. Due to leguminous crop this crop has capacity to fix the atmospheric nitrogen (30-40 Kg N ha⁻¹) with the help of bacterium called Rhizobium. Being a short duration crop it can fit well in many intensive crop rotations.

Characteristics of Nitrogen, Phosphorus and Potassium (NPK)

Nitrogen plays a crucial role in increasing crop yield through atmospheric nitrogen fixation. Application of nitrogen can induce rhizobia formation and promotes the growth of strong greengram seedlings, during the early growth period mung bean can't effectively fix atmospheric nitrogen because very few or no rhizobia is formed. The optimum supply of nitrogen and phosphorus influenced the growth and yield of greengram (Rathod and Gawande, 2012) ^[14]. Phosphorus is second most important element which is involved in various functions of growth and metabolism of greengram. It has been recognized as one of the important

elements in plant nutrition (Dotaniya *et al.*, 2014)^[6]. Phosphorus helps in enhancing reproductive capacity of pulse crops due to which increased yield is obtained. Potassium is the third essential nutrient for plant growth. Plant requires large quantity of potassium which not only helps in improving the crop yield but also quality of the crop. Hence, potassium fertilizers help in producing higher value products and therefore in a greater return to farmers. It is a prime factor in deciding market value of greengram and enhances the income of farmers just by improving the quality of produce. Nitrogen, Phosphorus and Potassium are the most important elements for the growth and development of greengram and also plays a crucial role in higher yield and significantly affect many other greengram traits (Yin *et al.*, 2018)^[18]. To supply these nutrients, application of various fertilizers is to be done but in an optimum or balanced manner which promotes chemical fertilizers to help in enhancing the greengram production and productivity.

Materials and Methods

Experimental Site

The experiment was conducted at the University Research Farm, Banda University of Agriculture and Technology, Banda, 210001 (U.P.) during *kharif* season in 2022. The experimental site is situated between latitude 25°31'00" and 28°7'00" North and longitudes 80°20'00" and 41°9'00" East and having an altitude of 119 m above sea level. This region falls under Agro-climatic zone- VIII (Central Plateaus & Hills Region) of Uttar Pradesh. The climatic conditions of Bundelkhand are characterized by hot and semi-arid climate.

Treatment Details & Experimental Design

The experiment comprises of two factor treatments conducted in Split Plot design with three main plot factors and three sub-plot factors. The total combination of treatments was nine and each treatment replicated thrice. The main plot consists of three greengram varieties i.e., IPM 02-3, IPM 410-3 and PDM-139. Further, each main plot is divided into three sub-plots consists of three different recommended doses of fertilizers *viz.*, 75%, 100%

and 125% RDF where, 100% RDF consist of 25:50:30 NPK Kg ha⁻¹.

Results and Discussion

Emergence count and final plant stand (m²)

Table 01. revealed that among varieties and fertilizers doses there was no significant effect were seen. Data concerning to interaction effect of greengram varieties and recommended dose fertilizers also didn't reach at the level of significance at both emergence and at final plant stand.

Table 1: Effect of doses and greengram varieties on emergence count and final plant stand (m²).

Treatments	Plant population (m ²)	
	Emergence count (15 DAS)	Final plant stand
Varieties		
IPM 02-3	32.67	32.00
PDM-139	31.78	31.00
IPM 410-3	32.56	31.11
S.Em±	0.82	0.61
CD (P=0.05)	NS	NS
CV (%)	7.65	5.80
Fertilizer doses		
75% RDF	31.89	31.11
100% RDF	32.56	31.33
125% RDF	32.56	31.67
S.Em±	0.95	1.13
CD (P=0.05)	NS	NS
CV (%)	5.07	6.23
Interaction effect	NS	NS

Plant height (cm)

Table 02. revealed that application of 125% RDF recorded highest plant height (42.08 cm) at 45 DAS. At 60 DAS, among doses 125% RDF had highest plant height (63.40 cm). At the time of harvest, 125% RDF had also highest plant height of (63.51 cm) although, their interaction effects were found to be non-significant. Results were seen similar to the findings of Sangeeta *et al.* (2014)^[15] and Ali *et al.* (2006)^[3].

Table 2: Effect of doses and greengram varieties on plant height (cm).

Treatments	Plant height (cm)			
	30 DAS	45 DAS	60 DAS	At harvest
Varieties				
IPM 02-3	21.91	40.60	61.94	62.51
PDM-139	21.47	40.57	61.78	61.64
IPM 410-3	21.66	40.53	61.83	61.78
S.Em±	0.45	0.74	1.04	1.08
CD (P=0.05)	NS	NS	NS	NS
CV (%)	6.16	5.44	5.04	5.21
Fertilizer doses				
75% RDF	21.13	38.86	58.87	59.56
100% RDF	21.61	40.76	63.28	62.88
125% RDF	22.30	42.08	63.40	63.51
S.Em±	0.71	1.39	2.16	1.85
CD (P=0.05)	NS	4.28	6.66	5.71
CV (%)	5.69	5.93	6.05	5.18
Interaction effect	NS	NS	NS	NS

Number of Branches (plant⁻¹)

Table 03. demonstrated that at 30, 45, 60 DAS and at harvest the varieties, fertilizer doses and their interaction differed insignificant. A perusal of result further indicated that among the

varieties, IPM 02-3 produces maximum number of branches plant⁻¹ but remained statistically comparable with other varieties. Among doses, 125% RDF had the maximum number of branches in comparison to other doses.

Table 3: Effect of doses and greengram varieties on number of branches (plant⁻¹).

Treatments	Number of branches (plant ⁻¹)			
	30 DAS	45 DAS	60 DAS	At harvest
Varieties				
IPM 02-3	1.69	2.22	3.70	3.82
PDM-139	1.57	2.00	3.44	3.60
IPM 410-3	1.62	2.13	3.48	3.81
S.Em±	0.05	0.07	0.08	0.06
CD (P=0.05)	NS	NS	NS	NS
CV (%)	8.66	10.12	6.78	5.19
Fertilizer doses				
75% RDF	1.53	2.07	3.51	3.54
100% RDF	1.67	2.11	3.54	3.83
125% RDF	1.68	2.18	3.57	3.86
S.Em±	0.08	0.13	0.20	0.18
CD (P=0.05)	NS	NS	NS	NS
CV (%)	8.37	10.36	9.90	8.19
Interaction effect	NS	NS	NS	NS

Plant Dry Matter (g plant⁻¹)

Table 04. revealed that among varieties, at 60 DAS significant effect were seen in which highest dry matter is found in IPM 02-3 with 9.91 g plant⁻¹ and at harvest also significant effect was founded with highest dry matter of 10.11 g plant⁻¹ in IPM 02-3. Among doses, at 60 DAS significant effect were seen with highest dry matter of 9.81 g plant⁻¹ with 125% RDF and at harvest significant effect was seen with 10.40 g plant⁻¹ in 125% RDF. These findings were closely related to the findings reported by Meena *et al.* (2006) [11] and Sengupta & Tamang (2015) [16].

Table 4: Effect of doses and greengram varieties on plant dry matter (g plant⁻¹).

Treatments	Plant dry matter (g plant ⁻¹)			
	30 DAS	45 DAS	60 DAS	At harvest
Varieties				
IPM 02-3	4.42	9.05	9.91	10.11
PDM-139	4.07	7.91	8.72	9.12
IPM 410-3	4.42	7.99	9.43	10.00
S.Em±	0.17	0.28	0.19	0.17
CD (P=0.05)	NS	NS	1.15	1.05
CV (%)	12.02	10.19	6.04	5.30
Fertilizer doses				
75% RDF	4.10	8.06	8.53	9.07
100% RDF	4.22	8.36	9.72	9.77
125% RDF	4.59	8.53	9.81	10.40
S.Em±	0.28	0.43	0.40	0.57
CD (P=0.05)	NS	NS	1.23	1.75
CV (%)	11.35	8.94	7.42	10.09
Interaction effect	NS	NS	NS	NS

Leaf Area Index

Table 05. states that leaf area index at 45 DAS, among varieties significant effect were seen in which IPM 02-3 produces maximum LAI with mean of 3.77 the scrutiny of data further reported that among doses, effects were also significant in which 125% RDF produces maximum LAI with mean of 4.10 also the interaction effect of varieties and doses were found to be significant. Increment in LAI by applying various fertilizers was also reported by Singh *et al.* (2018) [17] and Akpan *et al.* (2016) [2].

Table 5: Effect of doses and greengram varieties on LAI at 45 DAS.

Treatment	LAI at 45 DAS			
	75% RDF	100% RDF	125% RDF	Mean
IPM 02-3	3.80	3.16	4.36	3.77
PDM-139	2.00	3.53	3.93	3.15
IPM 410-3	3.63	3.50	4.03	3.72
Mean	3.14	3.39	4.10	
Treatments	S.Em±	C.D. (P=0.05)	CV (%)	
Variety (V)	0.12	0.78	10.90	
Doses (N)	0.16	0.49	7.8	
Interaction of VxN	0.27	1.09		

Number of Root Nodules (plant⁻¹)

Table 06. reveals that at 45 DAS difference among varieties in root nodule count didn't seen. Different RDF doses had significant impact on greengram plants in which 100% RDF produces maximum root nodules i.e., 38 with IPM 02-3 also their interaction effect was found to be significant and Table 07. found that at 60 DAS, varieties, doses and their interaction were found to be significant in which variety IPM 02-3 had maximum number of root nodules with value of 27.33 with incorporation with 100% RDF. Similar finding was seen with Kumar *et al.* (2014) [10].

Table 6: Effect of doses and greengram varieties on root nodule count (plant⁻¹) at 45 DAS.

Treatment	Root nodule count plant ⁻¹ at 45 DAS			
	75% RDF	100% RDF	125% RDF	Mean
IPM 02-3	24.33	38.00	28.00	30.11
PDM-139	24.66	26.73	30.66	27.35
IPM 410-3	27.00	32.50	29.33	29.61
Mean	25.33	32.41	29.33	
Treatments	S.Em±	C.D. (P=0.05)	CV (%)	
Variety (V)	0.76	NS	7.94	
Doses (N)	1.05	3.22	6.24	
Interaction of VxN	1.81	7.11		

Table 7: Effect of doses and greengram varieties on root nodule count (plant⁻¹) at 60 DAS.

Treatment	Root nodule count plant ⁻¹ at 60 DAS			
	75% RDF	100% RDF	125% RDF	Mean
IPM 02-3	19.33	27.33	27.00	24.55
PDM-139	19.66	22.00	21.66	22.10
IPM 410-3	21.66	24.00	21.03	22.23
Mean	20.21	24.44	23.23	
Treatments	S.Em±	C.D. (P=0.05)	CV (%)	
Variety (V)	0.61	3.72	8.11	
Doses (N)	0.68	2.10	5.22	
Interaction of VxN	1.18	4.64		

Conclusion

The greengram variety IPM 02-3 performs better in comparison to other greengram varieties. Among doses, 125% RDF of NPK had recorded better performance regarding growth *viz.*, Plant height (cm), plant dry matter (g plant⁻¹), number of branches (plant⁻¹), leaf area index and root nodule count (plant⁻¹). The interaction of variety IPM 02-3 with 125% RDF of NPK among growth parameters *viz.*, Leaf area index at 45 DAS and root nodule count (plant⁻¹) at 45 & 60 DAS is found to be best in comparison to 75% and 100% RDF. Based on the above research, it is concluded that variety "IPM 02-3" with 125% recommended dose of fertilizer is found to be suitable for achieving maximum growth in greengram crop.

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