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Effect of multi-nutrient fertilizer on growth and yield of green gram (*Vigna radiata* L.)

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Abstract
A field experiment was conducted on "Effect of multi-nutrient fertilizer on yield, nutrient uptake and quality of green gram. (*Vigna radiata* L.)" during *kharif* season of the year 2023-2024 at research farm, Department of Soil Science, College of Agriculture Latur. The experiment was laid out in randomized block design with three replications and ten treatments with variety of green gram BM-2003-2.
The results in a nutshell indicated that the growth and yield were significantly influenced by the application multi-nutrient fertilizer on green gram. The growth parameters *viz.,* plant height, number of branches, leaf area index, dry weight plant^{-1} and no. of nodules plant^{-1} were significantly increased with application of 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1} and found at par with treatment 75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.
Significantly higher grain yield ha^{-1} and straw yield ha^{-1} were recorded with application of 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1} and was found at par with application of 75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.

Keywords: Green gram, multi-nutrient fertilizer, growth and yield

Introduction
Greengram commonly known as 'Mungbean' or 'moong. It is generally grown as intercrop, mixed crop and sole crop in kharif and in Summer season. Amongst the grain legumes, it is one of the important conventional pulse crop in India. It ranks second to chickpea among the grain legumes from production point of view. Its seed is more palatable, nutritive, digestive and non-flatulent than other pulses grown in country. It contains 23.5% protein, 57-58% carbohydrates, 1.1% fat, 9.7% water, 3.3-3.8% fiber, 4-4.8% ash. As a vegetative protein, it is rich in vitamin B which is protective against the beriberi disease.
The pulses have high protein contents (average 20-25%). In addition to their value as food stuff, they are also important in cropping system. Green gram may be grown twice a year *i.e.* in *spring* and *autumn* season. This has opened avenues of intensifying crop production in the tribal dominated belt. Perhaps, because of these distinct features and higher economic returns, India is the world largest homeland of vegetarian and world leader in pulses production and import to provide protein supplement.
Multi-nutrient fertilizers contain two or more of the nutrients N, P and K and in some cases small amounts of sulfur, magnesium and trace elements like boron may be added. Calcium (Ca), magnesium (Mg) and sulphur (S) are essential plant nutrients which do play an important role in growth and development of plants. They are called "secondary" nutrients because plants require them in smaller quantities than nitrogen, phosphorous and potassium. On the other hand, plants require these nutrients in larger quantities than the micronutrients.

Materials and Methods
A field experiment was conducted at Departmental research farm of Soil Science, College of Agriculture, Latur during Kharif 2023-2024 on Green gram (variety BM-2003-2). The experimental soil was clayey in texture, moderately alkaline in reaction, low in content of organic carbon, available nitrogen, available phosphorous, medium in available potassium,

available sulphur, exchangeable calcium and exchangeable magnesium.

Latur district of Maharashtra state is situated between 18°05'-18°75' North latitude and between 76°25' to 77°25' East longitude on the Balaghat plateau with mean sea level height 633.85 meters and derived from Deccan trap rock, basaltic rich in Magnesium and dominated by smectite mineral. This area falls under the assured rainfall zone. The annual average precipitation is 750 to 800 mm. Most of the rains are received during July to October from the South-West monsoon. The rainfall pattern and temperature and humidity variation during the period of experimentation.

Table 1: Treatment details

T_1	Control
T_2	100% RDF
T_3	Multi-nutrient fertilizer @125 Kg ha^{-1}.
T_4	50% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.
T_5	75% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.
T_6	100% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.
T_7	Multi-nutrient fertilizers @187.5 Kg ha^{-1}.
T_8	50% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.
T_9	75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.
T_{10}	100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.

Result and Discussion

Growth Parameters

Plant height

The data regarding plant height was recorded at 30, 45 DAS and at harvest of crop are presented in table 2. and depicted in fig 1. It was evident from the results that the plant height was influenced due to application of multi-nutrient fertilizer at critical growth stages of crop. The highest plant height was recorded with treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) at 30 DAS (46.14 cm), 45 DAS (49.26 cm) and at harvest (54.61 cm) and was found at par with treatment T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) and significantly superior over rest of the treatments. The treatment T_1 (Control) recorded lowest plant height at 30 DAS (29.89 cm), 45 DAS (33.43 cm) and at harvest (45.18 cm) in green gram crop. The increase in plant height might be due to multi-nutrient fertilizer application along with RDF in green gram crop which helps in various enzymes that are responsible for driving many metabolic activities in crop and involved in the synthesis of chlorophyll and it is essential for the maintenance of chloroplast structure and function which helps in increasing plant growth.

Number of branches (plant^{-1})

Branching is a crucial aspect of crop growth, bearing the plants pods and ultimately increasing crop yield. The information regarding effect of multi-nutrient fertilizer application on number of branches plant^{-1} at critical growth stages are shown in table 2 and illustrated in fig 1.

The findings showed that the application of secondary nutrients along with potassium might have significant impact on the number of branches plant^{-1} in green gram. The maximum number of branches plant^{-1} were observed in the treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) at at harvest (12.29) and was found at par with treatment T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}) and significantly superior over rest of the treatments. While minimum number of branches plant^{-1} were observed in treatment T_1 (Control) at 30 DAS (3.02), 45 DAS (5.35) and at harvest (7.89). The multi-nutrient fertilizer contains potassium. So, application of K increased the availability of nitrogen and phosphorus which resulted in better plant growth and increases the number of branches plant^{-1}.

Table 2: Effect of application of multi-nutrient fertilizer on growth parameter of green gram

Treatments	Plant Height	Number of Branches (Plant^{-1})	Dry Matter Production (g plant^{-1})	Root nodules
T_1: Control	45.18	7.89	9.13	13.28
T_2: 100% RDF	47.36	9.22	10.84	15.35
T_3: Multi-nutrient fertilizer @125 Kg ha^{-1}.	47.34	8.39	9.21	14.33
T_4: 50% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	48.61	9.72	11.05	17.93
T_5: 75% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	48.57	9.47	10.42	19.32
T_6: 100% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	54.39	9.92	11.32	18.63
T_7: Multi-nutrient fertilizers @187.5 Kg ha^{-1}.	48.04	8.17	9.36	18.15
T_8: 50% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	53.55	10.56	11.08	18.22
T_9: 75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	53.96	11.84	11.86	19.75
T_{10}: 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	54.61	12.29	12.16	20.33
SE (m) ±	0.28	0.16	0.18	0.27
CD at 5%	0.83	0.48	0.54	0.82

Dry matter content (g plant^{-1})

The data regarding dry matter content g plant^{-1} was recorded at different growth stages of green gram is presented in table 2. and depicted in fig 1.

The higher dry matter was observed with the treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) at 30 DAS (5.10 g plant^{-1}), at 45 DAS (7.81 g plant^{-1}) and at harvest (12.16 g plant^{-1}) and was found at par with treatment T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) and significantly superior over rest of the treatments. Further data revealed that, the treatment T_1 (Control) produced lower dry matter content g plant^{-1} at 30 DAS (2.91), at 45 DAS (5.48) and at harvest (9.13) in green gram.

This might be due to superiority of calcium and magnesium in maintaining higher nutrient concentration in the rhizosphere. which in turn encourage vegetative growth of plants. Hence due to high vegetative growth the dry matter content gets increased.

Nodulation

Data tabulated on effect of multi-nutrient fertilizer application on number of nodules plant^{-1} at flowering stage (45 DAS) of green gram presented in table 2. The maximum number of nodules plant^{-1} was obtained under the treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) which was (20.33) respectively over control and was found at par with treatment T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg

ha^{-1}.) and significantly superior over rest of the treatments. The minimum number of nodules plant-1 was obtained under the treatment T_1 (Control) which was (13.28).

This might be due to better root growth and favorable condition available for infection of bacteria to form nodules due to sufficient availability of secondary nutrients

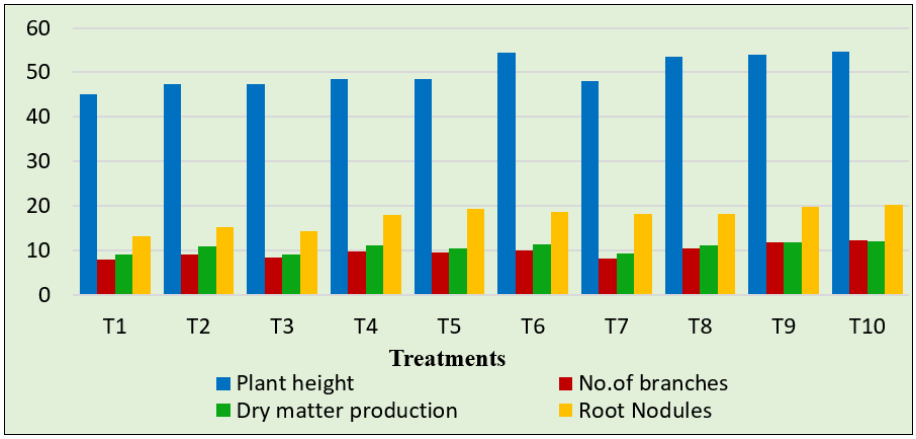

Fig 1: Effect of application of multi-nutrient fertilizer on growth parameter of green gram

Leaf area (cm^2 plant^{-1})

The leaf area cm^2 plant^{-1} was increased at high rate between 30 DAS to harvest and it was maximum at harvest. Data presented in table 3. and depicted in fig. 2.

The highest leaf area cm^2 plant^{-1} at 30 DAS (551.22), 45 DAS (599.00) and at harvest (673.34) was recorded with treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) and was found at par with T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) and significantly superior over rest of the treatments in green gram.

The lower leaf area cm^2 plant^{-1} was recorded with treatment T_1 (Control) at 30 DAS (342.96), 45 DAS (454.41) and at harvest (462.68). This might be due to increased metabolic activity by increased supply of nutrients, more dry matter accumulation in leaves helped the photosynthetic area to remain active for longer period.

Table 3: Effect of multi-nutrient fertilizer application on leaf area (cm^2 plant^{-1}) of green gram.

Treatments	Leaf area (cm^2 plant^{-1})		
	30 DAS	45 DAS	At Harvest
T_1: Control	342.96	454.41	462.68
T_2: 100% RDF	467.80	518.33	546.78
T_3: Multi-nutrient fertilizer @125 Kg ha^{-1}.	447.48	475.30	493.12
T_4: 50% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	450.19	527.85	557.35
T_5: 75% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	533.25	520.89	578.67
T_6: 100% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	538.20	542.67	598.93
T_7: Multi-nutrient fertilizers @187.5 Kg ha^{-1}.	447.51	470.56	507.18
T_8: 50% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	495.78	535.77	591.62
T_9: 75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	534.57	575.63	646.84
T_{10}: 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	551.22	599	673.34
SE (m) ±	18.43	10.63	10.63
CD at 5%	54.76	31.59	31.59

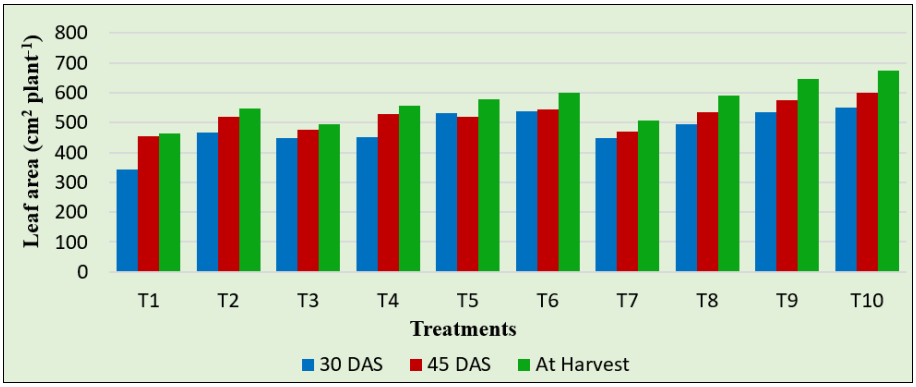

Fig 2: Effect of application of multi-nutrient fertilizer on Leaf Area of green gram

Yield parameters

The data on effect of multi-nutrient fertilizer on seed yield and straw yield of green gram are presented in table 4 and depicted in fig 3.

Seed yield

The seed yield of green gram ranged between 891.02 Kg ha^{-1} to 1397.42 Kg ha^{-1} The highest seed yield (1397.42 Kg ha^{-1}) was recorded in T_{10} (100% RDF + Multi-nutrient fertilizer @187.5

Kg ha^{-1}.) which was at par with T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) (1341.Kg ha^{-1}) and significantly superior over rest of the treatments. Whereas, the lowest seed yield (891.02 Kg ha^{-1}) was recorded in the treatment T_1 (Control) in green gram.

The nutrient combination with the secondary nutrients was found to be promising in obtaining the seed yields. The substantial increase in the growth of the plants leading to higher values of yield parameters might be the reason for higher seed yield in the combination treatments.

Straw yield

Data indicated that the application of multi-nutrient fertilizer markedly influence the straw yield in the range of (2066.24 Kg ha^{-1} to 2903.84 Kg ha^{-1}).

The maximum straw yield (2903.84 Kg ha^{-1}) was recorded in the treatment T_{10} (100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) which was found at par with treatment T_9 (75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.) i.e. straw yield (2808.83 Kg ha^{-1}) and significantly superior over rest of the treatments. Whereas, the lowest straw yield (2066. Kg ha^{-1}) was recorded in the treatment T_1 (Control).

Higher nutrient availability and uptake in the combined treatments probably had put forth lush growth of plants with regard to plant height, dry matter production and leaf area index proceeding to higher Straw yields.

Table 4: Effect of multi-nutrient fertilizer on grain yield (kg ha^{-1}) and straw yield (kg ha^{-1}) of green gram

Treatments	Seed Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
T_1: Control	891.02	2066.24
T_2: 100% RDF	1138.88	2373.93
T_3: Multi-nutrient fertilizer @125 Kg ha^{-1}.	1117.51	2382.48
T_4: 50% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	1129.65	2489.31
T_5: 75% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	1134.61	2418.8
T_6: 100% RDF + Multi-nutrient fertilizer @125 Kg ha^{-1}.	1170.93	2643.16
T_7: Multi-nutrient fertilizers @187.5 Kg ha^{-1}.	1047	2213.67
T_8: 50% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	1126.06	2666.66
T_9: 75% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	1341.87	2808.83
T_{10}: 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.	1397.42	2903.84
SE (m) ±	37.15	39.82
CD at 5%	110.37	118.31

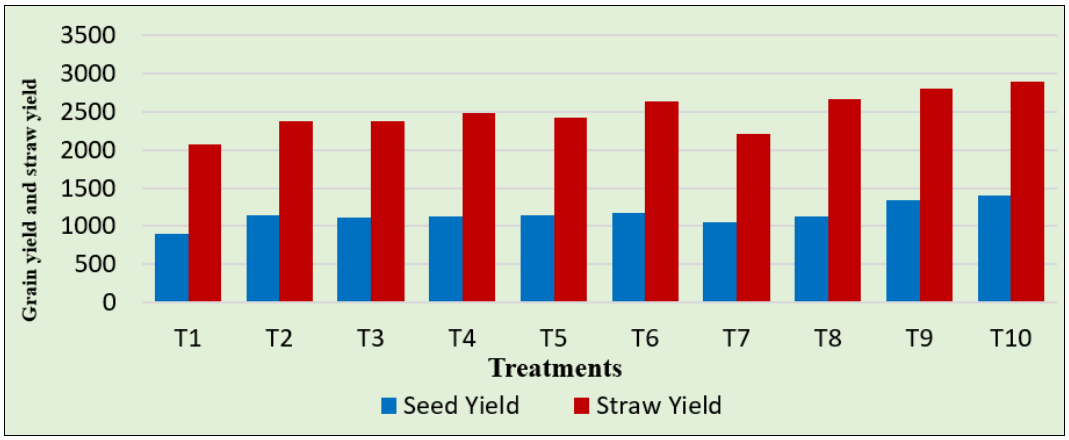

Fig 3: Effect of application of multi-nutrient fertilizer on Seed yield and Straw yield of green gram

Conclusion

1. Application of 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1} improves growth parameters like plant height, number of branches plant^{-1}, leaf area, dry matter content and number of root nodules in green gram.
2. Significantly seed yield ha^{-1} and straw yield ha^{-1} of green gram increased with the application of 100% RDF + Multi-nutrient fertilizer @187.5 Kg ha^{-1}.

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