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Deepak Gurjar
Vivekananda Global University, Jaipur, Rajasthan, India

Dr. Hemraj Jat
Vivekananda Global University, Jaipur, Rajasthan, India

Corresponding Author:
Deepak Gurjar
Vivekananda Global University, Jaipur, Rajasthan, India

Effect of Nitrogen Levels and Foliar Nutrition on Growth and Yield of Green Gram (*Vigna radiata* L. Wilczek)

Deepak Gurjar and Hemraj Jat

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Abstract
A field experiment was conducted during kharif 2025 at the Research Farm, Vivekananda Global University, Jaipur, Rajasthan, to evaluate the effect of nitrogen levels and foliar nutrition on the growth and yield of green gram (*Vigna radiata* L. Wilczek). The experiment was laid out in a factorial randomized block design with three replications comprising four nitrogen levels (0, 10, 20 and 30 kg N ha^{-1}) and four foliar spray treatments, viz., control, 2% urea spray at flowering stage, 2% urea spray at pod development stage and 2% urea spray at both flowering and pod development stages. Application of 30 kg N ha^{-1} significantly improved growth parameters, including plant height, number of branches, leaves, nodules, dry matter accumulation, leaf area, leaf area index, chlorophyll content and crop growth rate, and remained statistically at par with 20 kg N ha^{-1}. Among foliar treatments, two sprays of 2% urea at flowering and pod development stages recorded superior growth performance. Yield attributes and yields were also significantly influenced by nitrogen and foliar nutrition. The highest pod length (8.66 cm), pods $plant^{-1}$ (29.73), seeds pod^{-1} (11.59), test weight (39.20 g), grain yield (1185 kg ha^{-1}) and straw yield (2299 kg ha^{-1}) were obtained with 30 kg N ha^{-1}, while dual foliar application of 2% urea produced the highest values among foliar treatments. The study indicated that application of 20–30 kg N ha^{-1} coupled with two foliar sprays of 2% urea effectively enhanced growth and productivity of green gram.

Keywords: Green gram, nitrogen levels, foliar nutrition, urea spray, growth attributes, grain yield

Introduction
Green gram (*Vigna radiata* L. Wilczek) is an important pulse crop widely cultivated in Asian countries and ranks third among pulse crops in India, occupying nearly 8% of the total pulse area (Karthik *et al*., 2021) [10]. India accounts for a major share of global production, with Rajasthan being the leading state in area and production (Anonymous, 2022a; Anonymous, 2022b). Despite its importance as a rich source of protein and its ability to fix atmospheric nitrogen through symbiosis, the productivity of green gram remains low due to nutrient stress, moisture scarcity and inadequate nitrogen management (Parry *et al*., 2015) [15].

Nitrogen plays a vital role in plant growth and productivity as it is a major constituent of proteins, enzymes and nucleic acids (Anon., 2005). Although green gram is a leguminous crop, its nitrogen requirement during early growth stages largely depends on soil nitrogen availability until effective nodulation is established. Adequate nitrogen supply promotes leaf area development, dry matter accumulation and photosynthetic activity, thereby improving yield attributes and grain yield (Akram *et al*., 2004) [1]. Increased nitrogen levels have been reported to enhance crop growth rate, pod number and seed yield in mungbean (Razzaque *et al*., 2017) [17], whereas nitrogen deficiency adversely affects plant height, branching and pod development.

Foliar application of urea during reproductive stages provides a rapid and efficient source of nitrogen, particularly under dryland conditions where root uptake is restricted (Salisbury and Ross, 1985) [18]. Foliar nutrition improves photosynthetic efficiency, prolongs green leaf area duration and enhances seed development and yield (Gupta *et al*., 2011) [8]. Therefore, integrated use of basal nitrogen and foliar urea application may be an effective approach for improving the growth and productivity of green gram under semi-arid conditions.

Material and Methods

A field experiment entitled *"Agronomic Performance and Quality of Green Gram (Vigna radiata L. Wilczek) in Response to Nitrogen Levels and Foliar Nutrition"* was conducted during kharif 2025 at the Research Farm, Vivekananda Global University, Jaipur The experiment was laid out in a factorial randomized block design (FRBD) with three replications and 16 treatment combinations consisting of four nitrogen levels (0, 10, 20 and 30 kg N ha^{-1}) and four foliar spray treatments: control, 2% urea spray at flowering, 2% urea spray at pod development, and 2% urea spray at both flowering and pod development stages. Uniform doses of 30 kg P_2O_5 ha^{-1} and 20 kg K_2O ha^{-1} were applied at sowing. Green gram variety MH-421 was sown on 10 July 2025 at 30 cm × 10 cm spacing using a seed rate of 15 kg ha^{-1}. Standard agronomic practices including seed treatment, thinning, weeding, and plant protection were followed. Irrigation was not applied as the crop was grown under rainfed conditions. Observations were recorded on growth, yield attributes, yield, and quality parameters from five randomly selected plants per plot. Soil and plant analysis were carried out using standard laboratory methods. Data were statistically analyzed using ANOVA appropriate for factorial RBD.

Results and Discussion

Growth Parameters

The present investigation clearly indicated that nitrogen levels and foliar application of urea significantly improved the growth parameters of green gram, including plant height, number of branches, number of leaves, leaf area, leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR), chlorophyll content, nodulation and dry matter accumulation. Application of nitrogen up to 20–30 kg N ha^{-1} resulted in significant enhancement of vegetative growth, with maximum values generally recorded under N_4 (30 kg N ha^{-1}), closely followed by N_3 (20 kg N ha^{-1}). This improvement may be attributed to higher nitrogen availability, which enhances cell division, cell elongation and chlorophyll synthesis, thereby improving photosynthetic efficiency and biomass production. Similar findings were reported by Sultana *et al*. (2006) [24], Sharma and Abraham (2010) [19]. (2003), who observed increased vegetative growth in legumes with higher nitrogen levels.

Foliar application of urea, particularly S_4 (2% spray at flowering and pod development stages), significantly improved growth parameters over control and single-spray treatments. This may be due to rapid foliar absorption of nitrogen during critical growth stages, enhancing chlorophyll content, delaying senescence and improving metabolic activity. These findings are supported by Reddy *et al*. (2005), Deshmukh *et al*. (2008), Sritharan and Mallika (2005) and Singh *et al*. (2023) [16, 6, 13, 20], who reported improved growth in pulse crops due to foliar nitrogen application. The improvement in CGR, LAI and dry matter accumulation under higher nitrogen levels and foliar spray treatments is also supported by Karthik *et al*. (2021) [10], Parry *et al*. (2015) [15] and Gupta *et al*. (2011) [8], who reported enhanced assimilate production and better biomass partitioning with adequate nitrogen supply.

Yield Attributes and Yield

Yield attributes such as pod length, number of pods $plant^{-1}$, number of seeds pod^{-1} and test weight were significantly improved with increasing nitrogen levels and foliar application of urea. The maximum values were recorded under N_4 (30 kg N ha^{-1}), which remained statistically at par with N_3 (20 kg N ha^{-1}). This improvement may be due to better vegetative growth leading to higher photosynthate production and improved translocation towards reproductive structures. Similar results were reported by Srinivas *et al*. (2002), Choudhary *et al*. (2003) and Malik *et al*. (2003) [22, 5, 12], who observed enhanced yield attributes in mungbean with higher nitrogen application.

Foliar spray of urea (S_4) significantly improved yield attributes, particularly pod number and seed number per pod. This may be due to improved nitrogen availability during flowering and pod development stages, reducing flower and pod abortion and improving sink strength. Similar observations were reported by Ganapathy *et al*. (2008) and Limba *et al*. (2020) [7, 11], who found that foliar nitrogen application enhances reproductive efficiency in legumes.

Grain yield, straw yield and biological yield followed a similar trend, with maximum values recorded under N_4 and S_4 treatments. The increase in yield may be attributed to enhanced photosynthetic efficiency, better assimilate partitioning and improved source–sink relationship. These results are strongly supported by Mondal *et al*. (2011), Singh *et al*. (2022) and Jat *et al*. (2024) [14, 13, 9], who reported that foliar urea application improves yield formation during reproductive stages. Harvest index remained non-significant under both nitrogen levels and foliar sprays, indicating proportional increase in grain and straw yield. This finding is in agreement with Thummar *et al*. (2022) and Mandre *et al*. (2020) [25, 13], who also reported non-significant variation in harvest index under different nitrogen management practices.

Conclusion

Application of nitrogen significantly improved growth and yield of green gram, with the best performance observed at 20–30 kg N ha^{-1}. Foliar spray of 2% urea at flowering and pod development stages further enhanced crop performance. The combined effect of N_4 (30 kg N ha^{-1}) and S_4 treatment resulted in maximum growth, yield attributes and yield. Hence, 20–30 kg N ha^{-1} with 2% foliar urea spray at critical stages is recommended for higher productivity of green gram under the study conditions.

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