Plant Archives Vol. 26, Supplement 2, 2026 pp. 959-962 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.112

SOIL FERTILITY STATUS, YIELD AND PROTEIN CONTENT OF GREENGRAM AS INFLUENCED BY SOWING WINDOW AND VARIETIES

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(Date of Receiving : 21-02-2026; Date of Revision : 08-04-2026; Date of Acceptance : 26-04-2026)

ABSTRACT

A field experiment was conducted during late *rabi*, 2024–25 at dryland farm of S.V. Agricultural College, Tirupati, Andhra Pradesh, to evaluate the combined effect of sowing windows and varieties on growth, yield, protein content and post-harvest soil nutrient status of greengram. The experiment was laid out in a split-plot design with three sowing windows as main plots and four varieties as subplots and replicated thrice. The results from the present experiment concluded that sowing of greengram during II Fortnight of December significantly enhanced dry matter production (3411 kg ha^{-1}) and seed yield (874 kg ha^{-1}), recording 36.3% and 92.5% higher yield over crops sown during I and II Fortnight of January, respectively. Among varieties, LGG 630 produced the highest seed yield (819 kg ha^{-1}), which was 72.4% higher than LGG 574. Protein content was not significantly influenced by sowing windows and varieties. The study indicates that timely sowing during II Fortnight of December combined with LGG 630 is optimal for maximizing greengram productivity during late *rabi* season on Southern Agro-Climatic Zone of Andhra Pradesh.
Keywords **:** Greengram, sowing window, varietal response, yield and soil fertility.

Introduction

Greengram (*Vigna radiata* L.) is one of the most important pulse crops cultivated in India, valued for its high protein content, easy digestibility and short duration. It plays a crucial role in improving soil fertility through biological nitrogen fixation and serves as an integral component of sustainable cropping systems, particularly in rainfed and dryland agriculture. In India, greengram is widely grown during *kharif*, *rabi* and summer seasons, contributing significantly to nutritional security and soil health (Kumar *et al.*, 2015).

Among various agronomic factors, sowing time is a critical determinant of crop growth and productivity, as it governs the crop's exposure to prevailing environmental conditions such as temperature, solar radiation, and moisture availability. Optimum sowing time ensures proper synchronization between crop phenology and favorable climatic conditions, thereby enhancing biomass production, nutrient uptake and yield. In contrast, delayed sowing often results in shortened crop duration, reduced photosynthetic efficiency and exposure of reproductive stages to sub-optimal conditions, ultimately leading to yield reduction (Aswathi, 2016).

Varietal selection is another important factor influencing crop performance. Different greengram varieties exhibit significant variability in growth habit, biomass accumulation, nutrient uptake efficiency and yield potential (Tejaswini *et al.*, 2023 and Vignesh *et al.*, 2024). High-yielding varieties generally possess better source–sink relationships, enhanced physiological efficiency and superior nutrient utilization capacity, which contribute to higher productivity. However, such varieties may also lead to greater depletion of soil nutrients, thereby affecting soil fertility status in the long term.

Soil fertility, particularly the availability of major nutrients such as nitrogen (N), phosphorus (P) and potassium (K), plays a vital role in determining crop productivity. The interaction between crop growth and soil nutrient dynamics is complex, as higher biomass production and yield are often associated with increased nutrient uptake and removal from the soil. Therefore, understanding the effect of agronomic practices like sowing time and varietal choice on post-harvest soil nutrient status is essential for developing sustainable nutrient management strategies.

In recent years, there has been growing concern regarding the decline in soil fertility due to intensive cropping and inadequate nutrient replenishment. Hence, it is important to strike a balance between achieving higher productivity and maintaining soil health.

Therefore, the present investigation was undertaken to evaluate the effect of different sowing windows and greengram varieties on growth, yield, protein content and post-harvest soil nutrient status under sandy loam soils of Southern Agro-Climatic Zone of Andhra Pradesh. The findings of this study will help in identifying suitable sowing time and variety combinations for enhancing productivity while ensuring sustainable soil fertility management.

Material and Methods

Experimental site and soil characteristics

The field experiment was carried out during late *rabi* season of 2024-25 at the dryland farm of S.V. Agricultural College Farm, Tirupati, India (13.5° N latitude and 79.5° E longitude, at an altitude of 182.9 m above the mean sea level) in the Southern Agro-Climatic Zone of Andhra Pradesh). A total of 44.6 mm of rainfall was received in 4 rainy days. Soil samples were collected randomly from the experimental field at a depth of 0-30 cm before the initiation of the experiment and analyzed for their physicochemical properties following standard procedures. The soil of the experimental site was classified as sandy loam in texture and neutral in soil reaction. The organic carbon content was low, while available nitrogen was medium, phosphorus and higher levels of available potassium.

Layout of the experiment and treatments

The study was conducted using a split-plot design with three replications, wherein sowing windows were assigned to the main plots and varieties were assigned to the subplots. There are twelve treatment combinations and main plot treatments comprised of three sowing windows: S_1: II Fortnight of December, S_2: I Fortnight of January and S_3: II Fortnight of January. The subplot treatments included four varieties: V_1: LGG 607, V_2: LGG 630, V_3: LGG 574 and V_4: IPM-2-14. Uniform basal applications of nitrogen at 20 kg ha^{-1} and phosphorus at 50 kg P_2O_5 ha^{-1} were applied across all treatments to ensure balanced nutrient availability.

Observations Recorded

Collection of soil sample

Initial soil samples were drawn from 0 to 30 cm depth of the experimental field at random, shade dried and passed through 2 mm sieve.

Dry matter production

Observations on the growth and yield of greengram were recorded at harvest. Dry matter accumulation was determined by sampling plants from a designated area in each plot, oven-drying the samples at 65°C to a constant weight and converting the values to kg ha^{-1}. Dry matter was recorded at harvest to quantify biomass production throughout the crop growth period.

Seed yield

Seed yield was obtained from the net plot area, cleaned, sun-dried to a safe moisture level and converted to kg ha^{-1}. These observations collectively provided insights into the treatment effects on the growth, development and productivity of greengram.

Protein content

The seed obtained from net plot of each treatment were used to estimate the protein content. Nitrogen content in the seed was estimated by using the Micro Kjeldahl method (Association of Official Analytical Chemists, AOAC, 1960). After estimating the nitrogen content of the seed, it was multiplied by the factor 6.25 and the Resultant protein content was expressed in per cent.

$$\textbf{Protein (\%) = Nitrogen content (\%)} \times \textbf{6.25}$$

Statistical analysis

The data on dry matter production, seed yield, soil fertility status and seed protein content at harvest were recorded, which was tabulated and statistically analyzed and a critical difference (CD) was calculated at 5% level of significance for comparing treatment means.

Results and Discussions

Initial soil samples were drawn from 0 to 30 cm depth of the experimental field at random, shade dried and passed through 2 mm sieve. Results of the soil analysis of the experimental site revealed that the soil was sandy loam in texture, neutral in soil reaction, low in organic carbon (0.2 per cent) and available nitrogen (230 kg N ha^{-1}), medium in available phosphorus (25 kg P_2O_5 ha^{-1}), and high in available potassium. (250 kg K_2O ha^{-1}).

Post-Harvest Soil Available Nutrient Status

Post-harvest soil available nitrogen, phosphorus and potassium were significantly influenced by sowing window and varieties, whereas their interaction effect was found to be non-significant (Table 1 and Fig. 1).

A clear trend emerged across sowing windows tried, crop sown during II Fortnight of January (S_3) retained higher residual soil nutrients**,** while early sowing *i.e.*, II Fortnight of December (S_1) recorded lower post-harvest nutrient levels. The higher residual fertility under delayed sowing may be attributed to reduced biomass production and lower nutrient uptake. In contrast, early sowing promoted vigorous vegetative growth and higher dry matter accumulation, which led to increased nutrient uptake and consequently, reduced residual soil fertility.

This indicates a trade-off between productivity and residual nutrient status early sowing improved yield but depleted more soil nutrients, whereas delayed sowing conserved nutrients but reduced productivity. These results were in agreement with findings of Reddemma (2018), who reported that early sown greengram utilized more soil nutrients due to better growth conditions. Similarly, Gupta *et al*. (2024) observed that optimum sowing time enhances nutrient uptake efficiency, leading to depletion of available soil nutrients after harvest.

Varietal differences followed a similar pattern. LGG 574 maintained higher post-harvest soil nutrient levels**,** whereas LGG 630 recorded the lowest residual nutrients. This suggests that LGG 630 had higher nutrient uptake efficiency associated with its superior biomass and yield performance. Thus, LGG 630 excelled in productivity but depleted more nutrients, while LGG 574 conserved soil fertility at the cost of lower yield.

Dry matter production and seed yield

Dry matter production and seed yield of greengram recorded at harvest and it was significantly influenced by both sowing window and varieties, while their interaction effect was sound to be non-significant (Table 2)**.**

Greengram sown during II Fortnight of December (S_1) produced significantly higher dry matter accumulation and seed yield compared to the I Fortnight of January (S_2) and II Fortnight of January (S_3) recorded the lowest values. The yield reduction under delayed sowing was mainly associated with shortened growth duration and exposure of reproductive stages to relatively less favorable temperature and radiation regimes. Higher dry matter accumulation with early sowing was recorded by the findings of Reddemma (2018) and Gupta *et al*. (2024).

Among the varieties, LGG 630 (V_2) consistently recorded superior dry matter production and seed yield of greengram, followed by LGG 607 (V_1) and IPM-2-14 (V_4)**,** while LGG 574 (V_3) recorded the lowest performance. The superiority of LGG 630 may be attributed to its higher genetic potential for photosynthesis, better source sink relationship and efficient translocation of assimilates to developing seeds. A similar genotypic variation in dry matter accumulation was also reported by Tejaswini *et al*. (2023) and Vignesh *et al*. (2024).

Protein Content

Seed protein content of greengram was not significantly influenced by sowing window and varieties as well as their interaction (Table 2) indicating that protein concentration remained relatively stable across different environmental conditions and genotypes, as also reported by Sen *et al*. (2016) and Dash *et al*. (2024).

Table 1 : Post-harvest soil available nutrient status of greengram as influenced by sowing window and varieties

Treatments	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
Main plots: Sowing window (3)			
S_1: II Fortnight of December (26 December)	204	21.8	187
S_2: I Fortnight of January (11 January)	217	21.9	228
S_3: II Fortnight of January (26 January)	231	23.8	259
SEm±	3.1	0.26	5.7
CD (P=0.05)	12	1.0	22
Sub plots: Varieties (4)			
V_1: LGG 607	210	21.7	212
V_2: LGG 630	196	19.9	188
V_3: LGG 574	244	25.4	262
V_4: IPM-2-14	223	23.0	236
SEm±	3.9	0.39	7.9
CD (P=0.05)	12	1.1	23

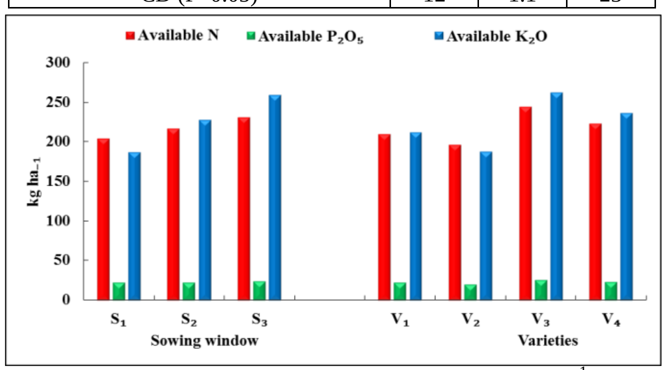

Fig. 1: Post-harvest soil available nutrient status (kg ha^{-1}) of greengram as influenced by sowing window and varieties.

Table 2: Dry matter production, seed yield and protein content of greengram as influenced by sowing window and varieties

Treatments	Dry matter production (kg ha^{-1})	Seed yield (kg ha^{-1})	Protein content (%)
Main plots: Sowing window (3)			
S_1: II Fortnight of December (26 December)	3411	874	23.3
S_2: I Fortnight of January (11 January)	2826	641	23.3
S_3: II Fortnight of January (26 January)	2466	454	23.1
SEm±	73.8	21.9	0.10
CD (P=0.05)	290	86	NS
Sub plots: Varieties (4)			
V_1: LGG 607	3077	720	23.2
V_2: LGG 630	3372	819	23.6
V_3: LGG 574	2285	475	23.1
V_4: IPM-2-14	2869	610	23.0
SEm±	86.7	30.0	0.25
CD (P=0.05)	258	89	NS

Although statistical differences were not observed, a slight trend was evident, greengram sown during II Fortnight of December (S_1) and I Fortnight of January (S_2) recorded higher protein content and II Fortnight of January (S_3) sown crop recorded lower protein content.

With respect to varieties, registered high protein content was registered with LGG 630 (V_2) and lower protein content was registered with LGG 574 (V_3) variety of greengram. The absence of significant variation suggests that protein content in greengram is largely governed by inherent genetic factors and remains less sensitive to moderate changes in sowing time.

Conclusion

The study concluded that timely sowing during II Fortnight of December along with LGG 630 variety of greengram resulted in significantly higher dry matter accumulation, seed yield and lower soil fertility status compared to other sowing windows during late *rabi* season on sandy loam soils of the Southern Agro-Climatic Zone of Andhra Pradesh.

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