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Short communication

Evaluation of Agrometeorological Indices and Yield Response of Greengram Varieties to Varied Sowing Windows

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Greengram (*Vigna radiata* L.) is an important short-duration pulse crop in India, valued for its rapid growth, nitrogen-fixing ability, adaptability to diverse agro-climatic conditions, and high (20–25%) protein content (Meena *et al.*, 2025). Due to its short life cycle, the crop is highly sensitive to weather variations and its growth and yield are greatly influenced by environmental conditions at different stages. Sowing time plays a crucial role in determining crop exposure to temperature, solar radiation and photoperiod, which directly affect phenological development and yield formation. Under late *rabi* conditions, greengram often faces fluctuating temperatures, limited moisture availability and terminal heat stress, especially with delayed sowing, leading to reduced crop duration and productivity.

Agrometeorological indices such as growing degree days (GDD), photothermal units (PTU), and heliothermal units (HTU) help in understanding crop weather relationships by integrating temperature, day length and sunshine hours. These indices are useful in assessing crop phenology and yield response, while varietal differences in thermal requirements further influence crop performance under different sowing windows. However, limited information is available on the agrometeorological behaviour of greengram varieties under late *rabi* conditions of the Southern Agro-Climatic Zone of Andhra Pradesh. Therefore, the present study was undertaken to evaluate agrometeorological indices and yield response of greengram varieties under different sowing windows to identify suitable combinations for improved productivity.

Experimental Site

The present study was designed and conducted during the late *rabi* season of 2024-25 at the dryland farm of S.V. Agricultural

College Farm, Tirupati, India, located at a latitude of 13.5° N and a longitude of 79.5° E, at an altitude of 182.9 m above mean sea level. A total of 44.6 mm of rainfall was received in 4 rainy days.

The soil of the experimental site was sandy loam in texture and neutral pH. The organic carbon content was low, while available nitrogen was medium and higher levels of available phosphorus and potassium. The soil analysis was done from the random samples collected from the experimental field (0-30 cm depth) before the initiation of the experiment, following standard procedures (Jackson, 1973; Piper, 1950; Walkley & Black, 1934; Subbiah & Asija, 1956; Olsen *et al.*, 1954).

Experimental detail

The experimental field was thoroughly ploughed and levelled, and plot sizes of 5 × 6 m² were prepared. The crop was sown in line sowing with a spacing of 30cm x 10 cm, using a seed rate of 12 kg ha⁻¹, with fertiliser doses of 20 kg N and 50 kg P₂O₅ ha⁻¹ applied in the form of urea and single super phosphate, respectively. The entire dose of fertilisers was applied basally at the time of sowing. The experiment consists of twelve treatment combinations with three sowing windows *viz.*, S₁: IInd Fortnight of December (Dec 29), S₂: Ist Fortnight of January (Jan 11) and S₃: IInd Fortnight of January (Jan 27) and four varieties, *viz.*, LGG 607 (V₁), LGG 630 (V₂), LGG 574 (V₃) and IPM-2-14 (V₄), were tried sown in a split-plot design and replicated three times with sowing windows as main plot and varieties as L in subplots pot treatments.

Weather data

The daily weather data collected from the Meteorological Observatory of S.V. Agricultural College, Tirupati and aggregated

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to obtain weekly averages as per standard standard meteorological week (SMW). The processed data are presented in Table 1. The agrometeorological indices such as growing degree days (GDD), heliothermal units (HTU), and photothermal units (PTU) were computed as follows:

$$\text{Growing Degree Days (}^{\circ}\text{C day)} = \sum \frac{(T_{\max} + T_{\min})}{2} - T_b \quad (\text{Nuttonson, 1956})$$

$$\text{Heliothermal units (}^{\circ}\text{C day hour)} = \sum \text{GDD} \times \text{BSH} \quad (\text{Rajput, 1980})$$

$$\text{Photothermal units (}^{\circ}\text{C day hour)} = \sum \text{GDD} \times \text{day length} \quad (\text{Gudadhe et al., 2013})$$

where, T_{\max} and T_{\min} are the daily maximum and minimum temperatures ($^{\circ}\text{C}$), T_b is the base temperature below which the crop cannot thrive (Kiran & Bains, 2007). For *rabi* greengram, 10°C was considered as the base temperature (T_b) given by Narcico *et al.*, (1992).

Observations recorded

Data on plant height and number of branches plant⁻¹ were recorded from five randomly selected and tagged plants. Total dry matter accumulation and Leaf area index (Watson, 1952) was determined through destructive sampling as per standard procedure. The leaf area was measured using LI-COR-LT-300 leaf area meter per unit land area.

Statistical analysis

The data on growth parameters, seed and haulm yield were recorded at harvest, tabulated and statistically analyzed as suggested by Panse & Sukhatme (1985) and a critical difference (CD) was calculated at 5% level of significance for comparing treatment means.

Impact of sowing windows and varieties on growth attributes of greengram

The maximum plant height was recorded with the early sown crop (S_1 : December 26), which was significantly higher than all other sowing windows, as presented in Table 2. This might be due to favourable climatic conditions, which supported better vegetative growth and photoperiodic conditions. There was a linear decline in all the growth parameters with a delay in sowing. Number of branches plant⁻¹ followed a similar trend, with S_1 recording higher branching compared to S_3 . The crop sown on December 26 recorded the highest leaf area index, which was significantly higher than that of the January 11 and it was statistically at par with the January 27 sown crop. With the delay in sowing, dry matter production was reduced. Similar results were reported by Ahmed *et al.*, (2023). Similarly, Bankar *et al.*, (2020) revealed that all the biometric observations, plant height, number of functional leaves, number of branches, dry matter in *kharif* greengram, were significantly highest in D_1 24th MW (16th June).

Among the genotypes, LGG 630 was the tallest, whereas LGG 574 was the shortest in height (Table 1). The number of branches plant⁻¹, and leaf area index were least in LGG 574. The variation in leaf area index among different varieties was also observed by Gill

et al., (2018), Ali *et al.*, (2021). The dry matter accumulation was also higher in the case of LGG 630 than in the other varieties. The above results were in accordance with the findings of Mondal & Sengupta, (2019) and Ram & Dixit, (2001). Sriharsha *et al.*, (2025) recorded that cultivar LGG-603 significantly recorded the highest plant height and leaf area index at all the growth stages (30, 60 and at harvest).

Agrometeorological indices under different sowing windows

Agrometeorological indices of greengram increased with a delay in sowing (Table 3). Greengram sown on January 27 (S_3) accumulated higher GDD (1241.8 $^{\circ}\text{C}$ days), PTU (15801.8 $^{\circ}\text{C}$ day hour) and HTU (11893.4 $^{\circ}\text{C}$ day hour), followed by January 11, and December 26, during the entire crop growth period of greengram from emergence to maturity, compared to the crop sown on December 26 (S_1). This may be due to a progressive increase in temperature under delayed sowing. Crop sown on January 27 took a longer duration for the maturity (80 days) due to slow accumulation of thermal units and also due to increased vegetative and reproductive phase duration. Early sown crop (December 26) accumulated more thermal units within a shorter period of time and also quicker completion of phenophases. Similar effects of sowing windows on thermal indices have been reported earlier by Jena *et al.*, (2024) and Ram *et al.*, (2016). Similarly, Kumar *et al.*, (2020) also reported that early sowing (1 February) of greengram recorded the lowest agrometeorological indices, which were progressively increased under delayed sowing.

Agrometeorological indices under different varieties

Among the varieties, LGG 574 accumulated higher GDD (1213.3 $^{\circ}\text{C}$ days), PTU (14187.2 $^{\circ}\text{C}$ day hour), and HTU (10413.4 $^{\circ}\text{C}$ day hour) at all the stages of greengram (Table 3). This strongly suggests that LGG 574 is a late-maturing, long-duration variety that requires greater thermal time and solar radiation to complete its life cycle. Conversely, LGG 630 accumulated comparatively fewer thermal units to complete developmental stages, indicating it was an early maturing variety (72 days) with better adaptability across different sowing windows. Furthermore, delayed sowing specifically on the January 27 crop resulted in an increased accumulation of thermal units during the flowering and pod formation stages. For a short-day crop like greengram, this led to delayed floral initiation and extended vegetative growth. Such prolonged exposure to elevated temperatures and radiation during reproductive stages can induce terminal heat stress, ultimately compromising crop productivity, as reported by Sabaridheepa *et al.*, (2022).

Impact of sowing window and varieties on yield

Seed and haulm yield of greengram were significantly influenced by sowing window and varieties (Table 3). The crop sown on December 26 recorded the highest seed (874 kg ha⁻¹) and haulm yield (2083 kg ha⁻¹). There was a significant decrease in seed and haulm yield with a delay in sowing. Early (December 26) sown crop received the optimum environmental conditions required for better crop growth. The delay in sowing from December 26 to January 11 and January 27 decreased the seed yield of greengram by about 26.6 % and 48.05%, and haulm yield by about 27.17% and 43.40%,

Table 1: Standard week-wise meteorological data during the crop growth period of greengram during the late *rabi* season of 2024-25

Standard week	Date and month	Maximum temperature (°C)	Minimum temperature (°C)	Sunshine hours (hour day ⁻¹)	Day length (hour day ⁻¹)
52	24 Dec-31 Dec	28.6	18.9	5.1	11
1	1 Jan-7 Jan	29.2	13.9	6.9	11
2	8 Jan-14 Jan	27.7	16.4	3.1	11
3	15 Jan-21 Jan	28.5	16.0	5.6	11
4	22 Jan-28 Jan	29.8	12.8	8.7	11
5	29 Jan-4 Feb	32.9	14.2	9.0	11
6	5 Feb-11 Feb	32.8	14.2	8.7	11
7	12 Feb-18 Feb	34.3	13.4	9.4	11
8	19 Feb-25 Feb	34.1	15.9	9.2	11
9	26 Feb-4 Mar	34.7	18.8	7.6	11
10	5 Mar-11 Mar	35.4	16.6	8.4	11
11	12 Mar-18 Mar	36.6	19.1	9.2	12
12	19 Mar-25 Mar	36.0	20.9	8.1	12
13	26 Mar-1 Apr	38.3	18.4	9.1	12
14	2 Apr-8 Apr	36.7	21.7	7.6	12
15	9 Apr-15 Apr	38.3	21.5	8.1	12
16	16 Apr-22 Apr	39.1	23.5	7.6	12

Table 2: Growth attributes of greengram as influenced by sowing window and varieties during the late *rabi* season of 2024-25

Treatments	Plant height (cm)	Leaf area index	Number of branches plant ⁻¹	Dry matter production (kg ha ⁻¹)
Main plots: Sowing window				
S ₁ : 26 Dec	51.6	1.63	6.23	3411
S ₂ : 11 Jan	50.1	1.39	5.53	2826
S ₃ : 27 Jan	49.4	1.18	5.38	2466
SEm±	0.36	0.052	0.105	73.8
CD (P=0.05)	1.4	0.21	0.41	290
Sub plots: Varieties				
V ₁ : LGG 607	52.4	1.42	6.07	3077
V ₂ : LGG 630	54.7	2.06	6.52	3372
V ₃ : LGG 574	46.2	0.93	4.90	2285
V ₄ : IPM-2-14	48.3	1.19	5.37	2869
SEm±	0.48	0.059	0.138	86.7
CD (P=0.05)	1.5	0.18	0.43	258

respectively. This clearly indicated that delay in sowing caused substantial yield reduction, more severe in seed yield than haulm yield. The early sown crop maintained better agrometeorological indices, which helped in maintaining optimal thermal requirements for various plant processes, hence increasing the seed and haulm yields. The decrease in seed yield with delayed sowing was also supported by Khan & Malik (2001) and Ashwini *et al.*, (2021).

Among the varieties, LGG 630 recorded higher seed (819 kg ha⁻¹) and haulm yield (1887 kg ha⁻¹), indicating better adaptability and efficient utilization of available resources, whereas LGG 574 recorded the lowest. Sowing of greengram variety LGG 630 on December 26 was found to be the most suitable practice for achieving higher yield under sandy loam soils of the Southern Agro-Climatic Zone of AP under late *rabi* conditions. However, Subbulakshmi (2021) reported a decline in seed yield when sowing was delayed from the last week of September to the last week of

October. Similarly, Bobade *et al.*, (2018) observed that early sowing of greengram resulted in higher yields compared to later sowing dates. These results conformed with the findings Miah *et al.*, (2009). Differential yield potential due to different green gram varieties was reported by Bhise *et al.* (2010).

From the present study, it may be concluded that early sowing on December 26 showed better performance at all the phenophases of late *rabi* greengram. Further, the variety, LGG 630, may be recommended for higher productivity due to favourable agrometeorological conditions on sandy loam soils of the Southern Agro-Climatic Zone of Andhra Pradesh.

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Table 3: Agrometeorological indices, Seed yield, haulm yield and harvest index of greengram as influenced by sowing window and varieties during the late *rabi* season of 2024-25

Treatments	GDD (°C days)	PTU (°C day hour)	HTU (°C day hour)	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Harvest index (%)
Main plots: Sowing window (3)						
S ₁ : 26 Dec	946	11476	7707	874	2083	29.8
S ₂ : 11 Jan	1040	13207	9308	641	1517	26.5
S ₃ : 27 Jan	1242	15802	11893	454	1179	25.6
SEm±	–	–	–	21.9	53.8	1.49
CD (P=0.05)	–	–	–	86	211	NS
Sub plots: Varieties (4)						
V ₁ : LGG 607	1141	13319	9935	720	1666	28.2
V ₂ : LGG 630	790	13319	9298	819	1887	28.3
V ₃ : LGG 574	1213	14187	10413	475	1357	24.8
V ₄ : IPM-2-14	1159	13321	9298	610	1462	28.0
SEm±	–	–	–	30.0	67.4	1.54
CD (P=0.05)	–	–	–	89	200	NS

Table 4: Agrometeorological indices, Seed yield, haulm yield and harvest index of greengram as influenced by sowing window and varieties during the late *rabi* season of 2024-25

Treatments	GDD (°C days)	PTU (°C day hour)	HTU (°C day hour)	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Harvest index (%)
Main plots: Sowing window (3)						
S ₁ : 26 Dec	946	11476	7707	874	2083	29.8
S ₂ : 11 Jan	1040	13207	9308	641	1517	26.5
S ₃ : 27 Jan	1242	15802	11893	454	1179	25.6
SEm±	–	–	–	21.9	53.8	1.49
CD (P=0.05)	–	–	–	86	211	NS
Sub plots: Varieties (4)						
V ₁ : LGG 607	1141	13319	9935	720	1666	28.2
V ₂ : LGG 630	790	13319	9298	819	1887	28.3
V ₃ : LGG 574	1213	14187	10413	475	1357	24.8
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SEm±	–	–	–	30.0	67.4	1.54
CD (P=0.05)	–	–	–	89	200	NS

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