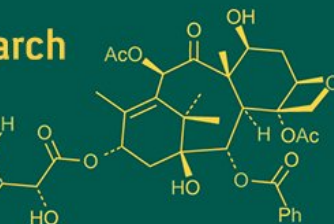
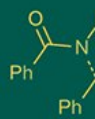


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Influence of sowing windows and foliar application of plant growth regulators on growth and seed yield of green gram (*Vigna Radiata* (L.) Wilczek)

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Abstract

A field experiment was conducted during the *kharif* season of 2025 at the Agricultural Research Station, Hanumanamatti, University of Agricultural Sciences, Dharwad, to study the influence of sowing windows and foliar application of plant growth regulators on the growth and seed yield of green gram. The experiment was laid out in a factorial randomized block design with three replications, comprising three sowing windows, namely the second fortnight of June, the first fortnight of July and the second fortnight of July and four foliar sprays, namely control, salicylic acid, naphthalene acetic acid and thiourea, forming twelve treatment combinations. Sowing during the second fortnight of June recorded significantly higher plant height, relative chlorophyll content, number of branches per plant, number of pods per plant, seed yield per plant and seed yield per hectare, compared with the lowest values recorded with delayed sowing during the second fortnight of July. Among the growth regulators, foliar spray of salicylic acid recorded the highest plant height, branches per plant, pods per plant and seed yield, on par with thiourea, against the lowest values recorded in the untreated control. The interaction between sowing windows and growth regulators was non-significant for all the parameters studied, although the combination of sowing during the second fortnight of June with salicylic acid spray recorded the numerically highest seed yield among all twelve treatment combinations, while the combination of delayed sowing with the untreated control recorded the lowest. The results indicated that timely sowing during the second fortnight of June, combined with foliar application of salicylic acid at the pre-flowering and pod formation stages, is the most favourable practice for realizing higher growth and seed yield of green gram under the agro-climatic conditions of northern Karnataka.

Keywords: Green gram; growth regulators; salicylic acid; seed yield; sowing window

Introduction

Pulses occupy a vital position in ensuring global food and nutritional security, being rich sources of protein, vitamins and minerals besides improving soil health through biological nitrogen fixation. Green gram is a short-duration, warm-season pulse crop belonging to the family Fabaceae, widely grown across the rainy, winter and summer seasons in India, which contributes nearly seventy per cent of world production. India produced about 4.24 million tonnes of green gram from 5.9 million hectares during 2024-25, while Karnataka contributed 2.42 lakh tonnes from 5.67 lakh hectares at a modest productivity of 659 kilograms per hectare ^[1].

Sowing window is among the most critical agronomic factors governing crop establishment, growth, phenology and yield, since timely sowing ensures optimum utilization of soil moisture, temperature and photoperiod for vigorous vegetative growth and efficient reproductive development. In Karnataka, green gram is generally sown from the second fortnight of June to the second fortnight of July depending on the onset of monsoon; however, increasingly erratic rainfall has frequently delayed sowing, exposing the crop to unfavourable conditions and considerable yield variation ^[2].

Foliar application of plant growth regulators has emerged as a complementary strategy to mitigate the adverse effects of delayed sowing and climatic stress. Salicylic acid enhances chlorophyll content, photosynthetic efficiency and reproductive efficiency under stress ^[3]; naphthalene acetic acid promotes cell elongation and reduces flower abscission; and thiourea improves nitrogen metabolism and early vigour under moisture stress. Despite the individual

benefits reported for sowing time and growth regulators, information on their combined influence on the growth and seed yield of green gram under the agro-climatic conditions of northern Karnataka remains limited.

In view of this, the present investigation was undertaken to assess the influence of different sowing windows and foliar application of plant growth regulators on the growth and seed yield of green gram.

Materials and Methods

A field experiment was conducted during *kharif* 2025 at the Agricultural Research Station, Hanumanamatti, University of Agricultural Sciences, Dharwad (14°47' N, 75°37' E; 650 m above mean sea level), situated in the Northern Transitional Zone (Zone 8) of Karnataka, India. The experiment comprised two factors: three sowing windows, namely D1- second fortnight of June, D2- first fortnight of July and D3- second fortnight of July; and four foliar sprays of plant growth regulators, namely S1- control (water spray), S2- salicylic acid at 150 ppm, S3- naphthalene acetic acid at 75 ppm and S4- thiourea at 250 ppm, applied twice at the pre-flowering and pod formation stages. The experiment was laid out in a factorial randomized block design with twelve treatment combinations replicated thrice, with a net plot size of 3.0 × 2.8 m. Green gram cultivar DGGV 2 was sown at a spacing of 30 × 10 cm, with a fertilizer dose of 25:30:0 kilograms N:P:K per hectare. Plant height and relative chlorophyll content were recorded on five randomly tagged plants using a chlorophyll meter at 30 and 60 days after sowing, with plant height recorded additionally at harvest and the number of branches per plant was recorded at harvest. The number of pods per plant and seed yield per plant were recorded on the same tagged plants and seed yield per hectare was computed from the net plot yield. The data generated were statistically analysed following the method described by Panse and Sukhatme [4].

Results and Discussion

Plant height, relative chlorophyll content and number of branches per plant were significantly influenced by sowing windows and foliar application of plant growth regulators, while their interaction remained non-significant for all three parameters (Table 1, Fig. 1). Among sowing windows, significantly higher plant height was recorded with the second fortnight of June (D1) (32.27, 56.00 and 63.22 cm at 30 days after sowing, 60 days after sowing and at harvest, respectively), which was on par with the first fortnight of July (D2) (27.58, 53.93 and 60.45 cm, respectively), while lower plant height was recorded with the second fortnight of July (D3) (26.86, 51.08 and 58.06 cm, respectively). Similarly, higher chlorophyll content was recorded with D1 (35.59 and 55.83 at 30 and 60 days after sowing, respectively), on par with D2 (33.29 and 52.57, respectively), while lower chlorophyll content was recorded with D3 (32.38 and 51.75, respectively). The number of branches per plant was also higher with D1 (5.47), against the lowest with D3 (4.17). Timely sowing ensures favourable soil moisture, temperature and photoperiod for vigorous vegetative growth, whereas delayed sowing exposes the crop to declining moisture and rising temperature, restricting cell division, chlorophyll synthesis and branching. These findings were consistent with Rao *et al.* [5] in greengram and Singh *et al.* [6] in mungbean.

Plant height at 30 days after sowing was not significantly influenced by growth regulators, but at 60 days after sowing

and at harvest, significantly higher plant height was recorded with salicylic acid at 150 ppm (S2) (56.83 and 63.59 cm, respectively), on par with thiourea at 250 ppm (S4) (53.64 and 61.53 cm, respectively), while lower plant height was recorded with the control (S1) (51.33 and 57.91 cm, respectively). Chlorophyll content at 60 days after sowing was higher with S2 (56.39), on par with S4 (54.08), against the lowest with S1 (50.96). The number of branches per plant was highest with S2 (5.06), on par with S4 (4.79), against the lowest with S1 (4.39). Salicylic acid, being an important signalling molecule, enhances chlorophyll content, photosynthetic efficiency and cell elongation, corroborating Singh and Jambukiya [7] and Reddy and Singh [8] in greengram. Among the twelve treatment combinations, the interaction of the second fortnight of June sowing with salicylic acid spray (D1S2) recorded the numerically highest plant height (65.93 cm), chlorophyll content (59.35 at 60 days after sowing) and branches per plant (5.87), while the combination of delayed sowing with the untreated control (D3S1) recorded the lowest values for these parameters (Table 1, Fig. 1).

Number of pods per plant, seed yield per plant and seed yield per hectare differed significantly due to sowing windows and growth regulators, while their interaction was non-significant for all three parameters (Table 2, Fig. 2). Significantly higher number of pods per plant was recorded with the second fortnight of June (D1) (24.91), followed by the first fortnight of July (D2) (21.90), while lower pods per plant was recorded with the second fortnight of July (D3) (21.20). Similarly, higher seed yield per plant and per hectare was recorded with D1 (7.91 g and 908.26 kg per hectare, respectively), followed by D2 (7.02 g and 763.10 kg per hectare, respectively), while lower values were recorded with D3 (6.52 g and 664.63 kg per hectare, respectively). Early sowing, coinciding with better vegetative growth and photosynthetic efficiency, favoured translocation of photosynthates towards reproductive sinks, resulting in higher pod set and seed yield, corroborating Rao *et al.* [5] and Bobade *et al.* [9] in greengram.

Among growth regulators, significantly higher number of pods per plant was recorded with salicylic acid at 150 ppm (S2) (23.93), on par with thiourea at 250 ppm (S4) (22.90), while lower pods per plant was recorded with the control (S1) (21.63). Similarly, higher seed yield per plant was recorded with S2 (7.63 g), on par with S4 (7.39 g), while lower seed yield per plant was recorded with S1 (6.62 g), and seed yield per hectare was also higher with S2 (815.14 kg per hectare), on par with S4 (782.69 kg per hectare) and naphthalene acetic acid at 75 ppm (S3) (777.59 kg per hectare), against the lowest value with S1 (739.22 kg per hectare). Improved reproductive efficiency, reduced flower and pod drop, and better partitioning of photosynthates under salicylic acid application account for this response, corroborating Bhadrar *et al.* [10] in greengram and Yadav *et al.* [11] in mungbean. Among the twelve treatment combinations, the highest number of pods per plant (25.81), seed yield per plant (8.46 g) and seed yield per hectare (953.59 kg) were recorded with the combination of the second fortnight of June sowing and salicylic acid spray (D1S2), while the lowest values (20.12 pods, 6.10 g and 625.96 kg per hectare) were recorded with the combination of delayed sowing and the untreated control (D3S1) (Table 2, Fig. 2).

Table 1: Effect of sowing windows and foliar application of plant growth regulators on plant height, relative chlorophyll content and number of branches per plant of green gram cv. DGGV 2

Treatments	Plant height (cm)			Relative chlorophyll content		Number of branches per plant at harvest
	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	
Date of sowing (D)						
D1: Second fortnight of June	32.27	56	63.22	35.59	55.83	5.47
D2: First fortnight of July	27.58	53.93	60.45	33.29	52.57	4.53
D3: Second fortnight of July	26.86	51.08	58.06	32.38	51.75	4.17
S.Em.±	0.79	1.12	1.23	0.85	1.1	0.09
C.D. at 5%	2.34	3.31	3.63	2.49	3.26	0.27
Foliar spray of plant growth regulators (S)						
S1: Control	27.79	51.33	57.91	31.67	50.96	4.39
S2: Salicylic acid @ 150 ppm	29.6	56.83	63.59	34.86	56.39	5.06
S3: Naphthalene acetic acid @ 75 ppm	28.83	52.87	59.27	33.99	52.09	4.65
S4: Thiourea @ 250 ppm	29.39	53.64	61.53	34.49	54.08	4.79
S.Em.±	0.91	1.29	1.42	0.98	1.28	0.1
C.D. at 5%	NS	3.83	4.2	NS	3.75	0.31
Interactions (D × S)						
D1S1	30.57	53.8	59.83	32.1	52.51	5.13
D1S2	33	59	65.93	36.95	59.35	5.87
D1S3	32.9	54.8	61.8	36.55	55.18	5.4
D1S4	32.6	56.4	65.3	36.77	56.27	5.47
D2S1	26.6	51.1	58.43	31.6	50.92	4.13
D2S2	27.93	57.2	63.93	34.31	55.28	4.87
D2S3	27.1	52.9	58.6	33.47	51	4.5
D2S4	28.7	54.5	60.83	33.77	53.08	4.63
D3S1	26.2	49.1	55.47	31.31	49.47	3.92
D3S2	27.87	54.3	60.9	33.31	54.55	4.43
D3S3	26.5	49.3	57.4	31.96	50.09	4.05
D3S4	26.87	51.63	58.47	32.93	52.9	4.27
Mean	28.9	53.67	60.58	33.75	53.38	4.72
S.Em.± (D × S)	1.58	2.24	2.46	1.7	2.21	0.18
C.D. at 5% (D × S)	NS	NS	NS	NS	NS	NS

DAS: Days after sowing; NS: Non-significant

Table 2: Effect of sowing windows and foliar application of plant growth regulators on number of pods per plant and seed yield of green gram cv. DGGV 2

Treatments	Number of pods per plant	Seed yield (g/plant)	Seed yield (kg/ha)
Date of sowing (D)			
D1: Second fortnight of June	24.91	7.91	908.26
D2: First fortnight of July	21.9	7.02	763.1
D3: Second fortnight of July	21.2	6.52	664.63
S.Em.±	0.46	0.17	15.19
C.D. at 5%	1.37	0.52	44.55
Foliar spray of plant growth regulators (S)			
S1: Control	21.63	6.62	739.22
S2: Salicylic acid @ 150 ppm	23.93	7.63	815.14
S3: Naphthalene acetic acid @ 75 ppm	22.21	6.97	777.59
S4: Thiourea @ 250 ppm	22.9	7.39	782.69
S.Em.±	0.53	0.2	17.54
C.D. at 5%	1.58	0.6	51.44
Interactions (D × S)			
D1S1	23.64	7.33	868.96
D1S2	25.81	8.46	953.59
D1S3	25.09	7.7	899.51
D1S4	25.09	8.18	910.97
D2S1	21.15	6.43	722.76
D2S2	23.03	7.54	795.58
D2S3	21.34	6.86	773.3
D2S4	22.09	7.26	760.76
D3S1	20.12	6.1	625.96
D3S2	22.94	6.89	696.25
D3S3	20.21	6.37	659.96
D3S4	21.53	6.72	676.34
Mean	22.67	7.15	778.66
S.Em.± (D × S)	0.92	0.35	30.38
C.D. at 5% (D × S)	NS	NS	NS

NS: Non-significant

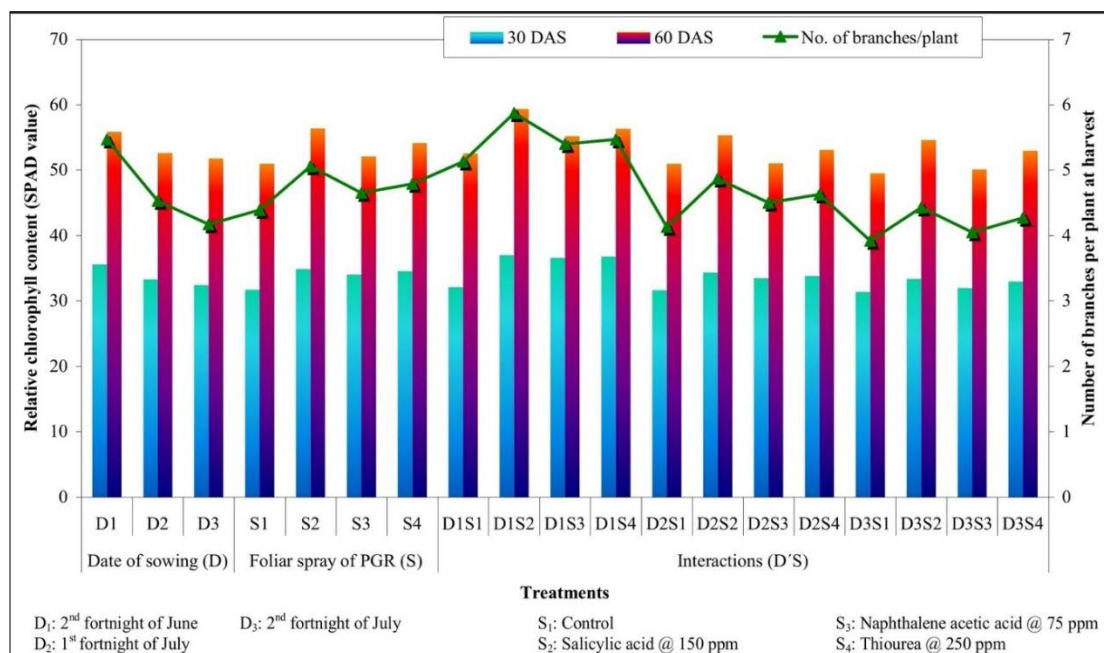


Fig 1: Effect of date of sowing and foliar application of plant growth regulators on relative chlorophyll content (SPAD value) and number of branches per plant at harvest of green gram cv. DGGV 2

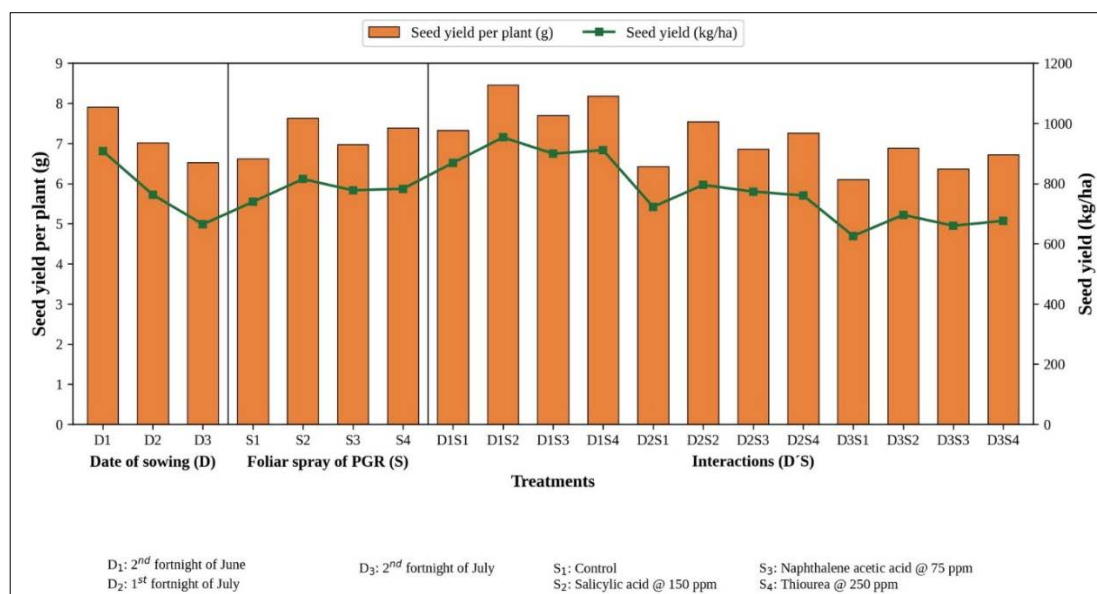


Fig 2: Effect of date of sowing and foliar application of plant growth regulators on seed yield per plant and seed yield per hectare of green gram cv. DGGV 2

Conclusion

Sowing of green gram cultivar DGGV 2 during the second fortnight of June, coupled with foliar spray of salicylic acid at 150 ppm at the pre-flowering and pod formation stages, was the most effective combination for realizing higher growth and seed yield. Hence, timely sowing during the second fortnight of June along with salicylic acid spray can be recommended to green gram growers of northern Karnataka for improving productivity.

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