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Effect of sowing date and weed management on growth and yield of Green gram (*Vigna radiata* L. Wilczek)

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Abstract

A field experiment was conducted during the *kharif* season of 2024 at the Agronomy Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, to study the effect of sowing dates and weed management practices on growth and yield of green gram (*Vigna radiata* L. Wilczek). The experiment was laid out in a split-plot design with three sowing dates as main plot treatments [15 June (S₁), 25 June (S₂) and 5 July (S₃)] and five weed management practices as sub-plot treatments, replicated three times. Growth parameters, yield attributes and yield were recorded and statistically analyzed. Plant population at 30 DAS and harvest was not significantly affected by sowing dates or weed management practices. However, plant height, number of branches per plant and dry matter accumulation were significantly influenced by both factors. Early sowing on 15 June recorded significantly higher growth parameters, followed by sowing on 25 June, whereas delayed sowing on 5 July resulted in inferior growth. Among weed management practices, the weed-free treatment recorded the highest growth parameters. Early sowing on 15 June produced the maximum seed yield (922 kg ha⁻¹), straw yield (2645 kg ha⁻¹) and biological yield (3567 kg ha⁻¹). Among weed management practices, the weed-free treatment recorded the highest seed yield (1002 kg ha⁻¹). Interaction effects were significant for seed, straw and biological yields, indicating that early sowing combined with effective weed control resulted in maximum productivity of green gram under semi-arid conditions.

Keywords: Green gram, sowing dates, weed management, pendimethalin, imazethapyr, yield

1. Introduction

Green gram (*Vigna radiata* L.) is an important pulse crop of India owing to its short duration, nutritional richness and ability to improve soil fertility through biological nitrogen fixation (Chaudhari *et al.*, 2016; Musyoka *et al.*, 2020) [5, 12]. It is widely grown under rainfed conditions, particularly in semi-arid regions such as Rajasthan, which accounts for nearly 65 per cent of the total green gram area in the country (Anonymous, 2025) [2]. Despite its significance, productivity remains low due to erratic rainfall, poor soil fertility and sub-optimal agronomic practices (Saravanan *et al.*, 2013) [18]. Among agronomic factors, sowing date plays a crucial role in determining growth, phenology and yield of mung bean. Timely sowing ensures favourable synchronization of vegetative and reproductive stages with temperature and moisture regimes, whereas delayed sowing exposes the crop to heat stress, moisture deficit and increased pest and disease incidence, leading to yield reduction (Rathore *et al.*, 2010; Chauhan and Williams, 2018) [17, 6]. Proper sowing time has been reported to enhance nodulation, biomass accumulation and assimilate partitioning in mung bean (Godara *et al.*, 2024) [8]. Weed infestation is another major constraint, especially during the early growth stages when mung bean is a weak competitor. Weeds competing during the critical period of 15–30 days after sowing can cause yield losses ranging from 25 to 100 per cent (Malik *et al.*, 2005; Nath *et al.*, 2017) [11, 14]. Integrated weed management practices combining cultural and chemical methods are therefore essential to minimize weed competition, improve resource use efficiency and enhance mung bean productivity under rainfed conditions (Khaliq *et al.*, 2002; Bueren *et al.*, 2002) [9, 4].

2. Materials and Methods

A field experiment entitled “Effect of Sowing Date and Weed Management on Growth and Yield of Green gram (*Vigna radiata* L. Wilczek)” was carried out during the kharif season of 2024 at the Agronomy Research Farm, School of Agriculture, Suresh GyanVihar University, Jaipur, Rajasthan. The experiment was laid out in a Split plot Design with 15 treatments and three replications to minimize experimental error (Panse and Sukhatme, 1985) [15]. The green gram variety used for the study was ‘K-851, sown at a spacing of 30 cm × 10 cm using a seed rate of 12 kg ha⁻¹. The experimental layout followed the random allocation of treatments as per the method of Fisher and Yates (1963). Biometric observations were recorded from five randomly selected and permanently tagged plants in each plot. Growth parameters such as plant population per metre square were assessed. Plant height (cm), number of branches per plant and dry matter accumulation (g plant⁻¹) were recorded at 30 DAS, and harvest. Dry matter was measured by oven-drying samples at 70 °C until constant weight. For yield estimation, seed yield was recorded from the net plot and converted to kg ha⁻¹. Straw yield was calculated by subtracting the seed yield from the biological yield. All collected data were subjected to appropriate statistical analysis to interpret treatment effects.

3. Results and Discussion

3.1 Growth Parameters

3.1.1 Plant Population

Plant population of green gram at 30 DAS and at harvest was not significantly influenced by different sowing dates and weed management practices (Table 4.4). However, numerical variations were observed among treatments. Among sowing dates, the maximum plant population was recorded in S₁ (15 June) with 31.9 plants m⁻² at 30 DAS and 25.9 plants m⁻² at harvest, while the minimum was observed in S₃ (5 July) with 31.2 and 24.1 plants m⁻², respectively. Weed management practices also did not exert a significant effect on plant population. The weed-free treatment (W₂) recorded the highest plant population (32.6 plants m⁻² at 30 DAS and 27.1 plants m⁻² at harvest), whereas the lowest population was observed under the weedy check (W₁). The interaction effect between sowing dates and weed management practices on plant population was statistically non-significant at both stages.

3.1.2 Plant Height

Plant height was significantly influenced by sowing dates and weed management practices at both 30 DAS and harvest (Table 4.5). Early sowing on 15 June (S₁) resulted in significantly taller plants (17.54 cm at 30 DAS and 60.06 cm at harvest), followed by sowing on 25 June (S₂). Delayed sowing on 5 July (S₃) produced the shortest plants at both stages. Among weed management practices, the weed-free treatment (W₂) recorded the maximum plant height (19.10 cm at 30 DAS and 62.87 cm at harvest), followed by the sequential application of pendimethalin (PE) + imazethapyr (PoE) (W₃) and post-emergence application of imazethapyr (W₄). The minimum plant height was observed in the weedy check (W₁), attributed to severe weed competition. The interaction effect between sowing dates and weed management on plant height was non-significant.

3.1.3 Number of Branches per Plant

The number of branches per plant was significantly affected by sowing dates and weed management practices at both observation stages (Table 4.6). The highest number of branches

was recorded under early sowing on 15 June (S₁), followed by S₂, whereas delayed sowing (S₃) resulted in the minimum number of branches. Weed-free treatment (W₂) produced significantly higher number of branches per plant at both 30 DAS and harvest, followed by the sequential herbicide treatment (W₃) and post-emergence imazethapyr (W₄). The lowest branching was observed in the weedy check (W₁). The interaction effect between sowing date and weed management on number of branches per plant was statistically non-significant.

3.1.4 Dry Matter Accumulation

Dry matter accumulation of green gram was significantly influenced by sowing dates and weed management practices at both 30 DAS and harvest (Tables 4.7a and 4.7b). Early sowing on 15 June (S₁) recorded the maximum dry matter accumulation, followed by sowing on 25 June (S₂), while the minimum was observed under delayed sowing on 5 July (S₃). Among weed management practices, the weed-free treatment (W₂) recorded the highest dry matter accumulation, followed by the sequential application of pendimethalin + imazethapyr (W₃) and post-emergence imazethapyr (W₄). The weedy check (W₁) consistently recorded the lowest dry matter accumulation. The interaction between sowing date and weed management was significant at harvest, indicating better utilization of resources under early sowing combined with effective weed control.

The present findings align with earlier research on green gram and other pulse crops. Subbulakshmi (2021) [20], Ranjan *et al.* (2022) [16] and Charan *et al.* (2024) [7] reported that early sowing improves plant height, branching, and biomass due to favorable climatic conditions and extended vegetative growth. Regarding weed management, the effectiveness of pendimethalin followed by imazethapyr has been documented by Yadav *et al.* (2015) [21], Punia *et al.* (2017) and Kumar *et al.* (2018) [10], who found that sequential herbicide application provides broad-spectrum and sustained weed control, resulting in improved crop growth and biomass production.

3.2 Yield attributes and Yield

The influence of sowing dates and weed management practices on seed yield, straw yield, biological yield and harvest index of green gram is presented in Tables 3 and 4. Sowing dates and weed management practices significantly affected seed, straw and biological yields, whereas harvest index remained statistically non-significant. Among sowing dates, early sowing on 15 June (S₁) produced the highest seed yield (922 kg ha⁻¹), straw yield (2645 kg ha⁻¹) and biological yield (3567 kg ha⁻¹), followed by sowing on 25 June (S₂). Delayed sowing on 5 July (S₃) resulted in the lowest seed (816 kg ha⁻¹), straw (2367 kg ha⁻¹) and biological yields (3183 kg ha⁻¹). Harvest index did not differ significantly among sowing dates, although numerically higher values were observed under early sowing. The results of the present study are supported by earlier findings in legumes and other kharif crops. Ambore *et al.* (2020) [1], Bankar *et al.* (2020) [3] and Charan *et al.* (2024) [7] reported that early sowing leads to higher seed and straw yields due to favorable climatic conditions and extended growth duration. Weed management practices exerted a significant influence on yield. The weed-free treatment (W₂) recorded the maximum seed (1002 kg ha⁻¹), straw (2852 kg ha⁻¹) and biological yields (3854 kg ha⁻¹), followed by the sequential application of pendimethalin (PE) + imazethapyr (PoE) (W₃) and post-emergence imazethapyr (W₄). The weedy check (W₁) consistently produced the lowest yields. The superiority of weed-free and sequential herbicide treatments

aligns with research conducted by Singh *et al.* (2014) ^[19], Chaudhary *et al.* (2016) and Muthuram *et al.* (2018) ^[13], who highlighted the importance of sustained weed control for maximizing yield in pulses.

Harvest index was statistically non-significant, but the numerical trend showed maximum HI in W₂ (26.00%) and minimum in W₁ (25.39%). The interaction of sowing date and weed management was significant for seed, straw and biological yields but non-significant for harvest index. Across all sowing dates, the maximum seed yield was recorded in the weed-free treatment (W₂), producing 1067 kg ha⁻¹ in S₁, 993 kg ha⁻¹ in S₂ and 945 kg ha⁻¹ in S₃. This was followed by W₅, the sequential application treatment, while W₄ and W₃ ranked next. Whereas, the minimum seed yield occurred in the weedy check (W₁) for all sowing

dates. The maximum straw yield was observed in W₂ across all sowing dates, followed by W₅. Next in order were W₄ and W₃, while the minimum straw yield was recorded in W₁ under all sowing conditions. Biological yield followed the same pattern. The maximum biological yield was consistently produced in W₂, followed by W₅, then W₄ and W₃. Whereas, the minimum biological yield occurred in W₁, with yields declining further under late sowing (S₃). Overall, the interaction results clearly show that the highest productivity was achieved under early sowing combined with effective weed control, especially the weed-free and sequential herbicide treatments. Conversely, delayed sowing under weedy conditions resulted in the lowest yields.

Table 1: Effect of sowing date and weed management on growth attributes of green gram

Treatment	Plant population (plants/m ²)		Plant height (cm)		Number of branches per plant		Dry matter accumulation (g/plant)	
	30 DAS	At harvest stage	30 DAS	At harvest stage	30 DAS	At harvest stage	30 DAS	At harvest stage
A. Main factor- Sowing date								
S ₁ -15 June	31.9	25.9	17.54	60.06	4.4	6.5	7.06	48.06
S ₂ -25 June	31.7	25.2	16.72	58.44	4.1	6.1	6.41	46.28
S ₃ -05 July	31.2	24.1	15.63	55.50	3.7	5.7	5.54	42.61
SEm±	0.45	1.09	0.34	0.84	0.12	0.09	0.17	0.70
C.D. @ 5%	NS	NS	1.35	3.28	0.47	0.34	0.68	2.74
B. Sub factor- Weed management								
W ₁ -Weedy check	30.6	22.9	13.58	52.03	2.7	4.8	4.23	32.62
W ₂ -Weed Free	32.6	27.1	19.10	62.87	5.1	7.2	8.15	53.87
W ₃ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE)	31.1	23.7	15.40	55.52	3.6	5.5	5.42	42.03
W ₄ -Imazethapyr @ 75 g a.i. ha ⁻¹ as post-emergence	31.6	25.1	16.64	57.70	4.2	6.1	6.25	47.63
W ₅ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE) + imazethapyr @ 75 g a.i. ha ⁻¹ (PoE) at 20-25 DAS	32.2	26.6	18.42	61.88	4.8	6.9	7.63	52.11
SEm±	0.71	1.09	0.43	1.37	0.15	0.15	0.22	0.60
C.D. @ 5%	NS	NS	1.27	4.00	0.43	0.44	0.64	1.76
Interaction A × B								
SEm±	1.24	1.88	0.75	2.37	0.25	0.26	0.38	1.04
C.D. @ 5%	NS	NS	NS	NS	NS	NS	NS	3.04

Table 2: Interactive effect of sowing date and weed management on weed dry weight in green gram (*Vigna radiata* L. Wilczek)

At harvest stage			
B. Sub factor- Weed management		A. Main factor- Sowing date	
		S ₁	S ₂
W ₁ -Weedy check		33.54	35.76
W ₂ -Weed Free		57.81	53.79
W ₃ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE)		44.00	42.54
W ₄ -Imazethapyr @ 75 g a.i. ha ⁻¹ as post-emergence		49.23	47.23
W ₅ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE) + imazethapyr @ 75 g a.i. ha ⁻¹ (PoE) at 20-25 DAS		55.70	52.10
SEm±		1.04	
C.D. @ 5%		3.04	

Table 3: Effect of sowing date and weed management on yield and harvest index of green gram (*Vigna radiata* L. Wilczek)

Treatment	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
A. Main factor- Sowing date				
S ₁ -15 June	922	2645	3567	25.83
S ₂ -25 June	878	2533	3412	25.73
S ₃ -05 July	816	2367	3183	25.61
SEm±	16.0	12.12	23.0	0.34
C.D. @ 5%	62.0	46.0	92.0	NS
B. Sub factor- Weed management				
W ₁ -Weedy check	722	2120	2842	25.39
W ₂ -Weed Free	1002	2852	3854	26.00
W ₃ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE)	812	2356	3168	25.63
W ₄ -Imazethapyr @ 75 g a.i. ha ⁻¹ as post-emergence	868	2505	3373	25.72

W ₅ -Pendimethalin @ 1 kg a.i. ha ⁻¹ (PE) + imazethapyr @ 75 g a.i. ha ⁻¹ (PoE) at 20-25 DAS	957	2743	3700	25.87
SEm±	10.0	23.0	24.0	0.30
C.D. @ 5%	30.0	66.0	70.0	NS
Interaction A × B				
SEm±	18.0	39.0	41.0	0.51
C.D. @ 5%	52.0	114.0	121.0	NS
C.V. (%)	3.53	2.69	2.11	3.46

Table 4: Interactive effect of sowing date and weed management on seed, straw and biological yield of green gram (*Vigna radiata* L. Wilczek)

Seed yield (kg ha ⁻¹)			
B. Sub factor- Weed management	A. Main factor- Sowing date		
	S ₁	S ₂	S ₃
W ₁ -Weedy check	787	756	623
W ₂ -Weed Free	1067	993	945
W ₃ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE)	827	810	798
W ₄ -Imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ as post-emergence	910	856	838
W ₅ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE) + imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ (PoE) at 20-25 DAS	1018	977	877
SEm±	18		
C.D. @ 5%	52		
Straw yield (kg ha ⁻¹)			
W ₁ -Weedy check	2294	2217	1850
W ₂ -Weed Free	3017	2830	2709
W ₃ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE)	2397	2351	2320
W ₄ -Imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ as post-emergence	2617	2471	2426
W ₅ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE) + imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ (PoE) at 20-25 DAS	2900	2798	2530
SEm±	39		
C.D. @ 5%	114		
Biological yield (kg ha ⁻¹)			
W ₁ -Weedy check	3081	2973	2473
W ₂ -Weed Free	4085	3823	3654
W ₃ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE)	3224	3161	3118
W ₄ -Imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ as post-emergence	3527	3327	3264
W ₅ -Pendimethalin @ 1 kg <i>a.i.</i> ha ⁻¹ (PE) + imazethapyr @ 75 g <i>a.i.</i> ha ⁻¹ (PoE) at 20-25 DAS	3918	3775	3407
SEm±	41		
C.D. @ 5%	121		

4. Conclusion

The present study clearly demonstrated that sowing date and weed management practices play a crucial role in determining the growth and productivity of green gram. Early sowing on 15 June resulted in superior plant growth, higher biomass accumulation and significantly greater seed, straw and biological yields compared to delayed sowing. Effective weed management, particularly the weed-free treatment and sequential application of pendimethalin followed by imazethapyr, markedly improved growth parameters and yield by minimizing crop-weed competition. Although plant population and harvest index were not significantly affected, their numerical trends favored early sowing and better weed control. The interaction effects further confirmed that early sowing combined with efficient weed management maximized green gram productivity. Therefore, timely sowing along with integrated and effective weed management practices is recommended for enhancing green gram yield under semi-arid conditions of Rajasthan.

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