PLANT SCIENCE TODAY
Vol 12(sp4): 1-7
https://doi.org/10.14719/pst.8475

eISSN 2348-1900

RESEARCH ARTICLE

# Weed management approaches on weed growth, productivity and profitability of summer green gram (*Vigna radiata* L.)

**Rounak Das, Subhaprada Dash* & Ankita Priyadarshini**

Department of Agronomy, Faculty of Agricultural Sciences, Siksha 'O' Anusandhan, Deemed to be University, Bhubaneswar 751 029, India

*Correspondence email - subhapradadash@soa.ac.in

Received: 24 March 2025; Accepted: 16 August 2025; Available online: Version 1.0: 05 November 2025

**Cite this article:** Rounak D, Subhaprada D, Ankita P. Weed management approaches on weed growth, productivity and profitability of summer green gram (*Vigna radiata* L.). Plant Science Today. 2025; 12(sp4): 1-7. https://doi.org/10.14719/pst.8475

## Abstract

Green gram is an important pulse crop in India. Its cultivation is affected due to several biotic and abiotic factors, which have reduced the yield significantly. Among these factors, weed infestation is a prominent challenge that can lead to significant reductions in productivity. A field experiment was conducted with ten weed management treatments to evaluate the weed growth, yield and economics of green gram during summer, 2022. Ten treatments were evaluated, including techniques such as stale seedbed, pendimethalin at 750 g $ha^{1}$, imazethapyr at 75 g $ha^{-1}$ and hand weeding. The dominant weeds in the experimental area were *Digitaria sanguinalis, Poa annua and Melochia corchorifolia*. The lowest biomass and density of weeds were achieved with two-hand weeding, which was comparable to treatments involving pendimethalin *fb* imazethapyr and stale seedbed *fb* imazethapyr. Among the weed management practices, the lowest value of weed index was recorded in pendimethalin *fb* imazethapyr (4.95 %), followed by stale seedbed technique *fb* imazethapyr (7.26 %), whilst it was the highest under weedy check (60.34 %). The maximum seed yield was noted in the hand weeding treatment (10.70 q $ha^{-1}$), which was followed by pendimethalin *fb* imazethapyr (10.17 q $ha^{-1}$) and stale seedbed *fb* imazethapyr (9.92 q $ha^{-1}$). Pendimethalin *fb* imazethapyr also fetched the highest net return ₹ 39335 $ha^{-1}$) and B:C (2.14) and at par with stale seedbed *fb* imazethapyr (₹ 37240 $ha^{-1}$ and 2.07). The study concluded that pendimethalin or stale seedbed with imazethapyr provided effective weed management and enhanced productivity and profitability in summer green gram.

**Keywords:** aqueous leaf extract; *Calotropis*; green gram; integrated weed management

## Introduction

Pulses are an essential group of leguminous crops that serve as a major source of plant-based protein in the Indian diet. They play a vital role in sustainable agriculture by enriching soil fertility through biological nitrogen fixation. Among the various pulse crops, green gram (*Vigna radiata* L.), commonly known as moong, holds a prominent place due to its short duration, adaptability to different agro-climatic conditions and high nutritional value. It is rich in protein, dietary fiber, vitamins and minerals, making it a key component in combating malnutrition. During 2021-22, the total area under pulses in India stands at 31.03 million ha, with a total production of 27.69 mt. The average productivity is about 892 kg $ha^{-1}$. Green gram contributes substantially to the pulse basket, especially in *kharif* and summer seasons across several states, including Rajasthan, Maharashtra, Andhra Pradesh and Odisha.

In the state of Odisha, green gram is primarily grown after the rice harvest, while irrigated fields are suitable for summer cultivation. The incorporation of early-maturing varieties allows farmers to expand their cropping options by cultivating green gram in summer. Despite its adaptability, several biotic and abiotic factors negatively impact green gram yields, with weed competition being a prominent challenge that can lead to significant reductions in productivity (1). Weed infestation affects green gram, particularly during its initial growth stages, which are critical for establishment. The crop reaches approximately 70-80 % of its growth within the first 20-40 days post-sowing, hence it is essential to ensure minimal weed presence during this period (2). Effective weed management is crucial to prevent yield losses and the initial slow growth of green gram necessitates two rounds of hand weeding for control, although this method can be labour-intensive and costly (3). The adoption of herbicides has risen as a necessary strategy to combat weeds and reduce their detrimental effects. While herbicides simplify weed management for farmers (4-6), their overuse raises environmental concerns, warranting the exploration of eco-friendly alternatives to chemical weed control (7).

The challenge lies in identifying sustainable practices that can take the place of conventional pesticides while effectively managing weed populations (8, 9). Implementing an integrated weed management that combines multiple control methods can significantly alleviate weed pressure (10-12). The stale seedbed technique is an effective preventive measure wherein weeds are encouraged to germinate and are controlled before crop sowing, thereby reducing the weed seed bank. Additionally, utilizing natural herbicides or those with allelopathic properties can further enhance weed management efforts (2, 13). It is imperative to develop and implement comprehensive and sustainable weed management practices tailored to the unique challenges faced during green gram cultivation. By focusing on diverse and integrated strategies, it is possible to minimize weed threats while promoting environmental stewardship and enhancing agricultural productivity (14). With this in consideration, the current experiment was conducted to assess the integrated weed management practices to mitigate the weed challenges in green gram cultivation, emphasizing sustainable approaches that ensure long-term productivity and environmental health. We hypothesize that applying a moderate rate sequential herbicide or herbicide with a non-chemical method of weed control will deliver superior weed control, while reducing labour demand and chemical inputs.

## Materials and methods

### Weather

The present experiment was conducted in the research farm located at 20°15.666'N latitude and 85°40.513'E longitude, at an altitude of 58 m above MSL. The climate was characterized as warm sub-humid, featuring mild winters and hot summers, with peak rainfall during the southwest monsoon from June to October. A total of 41.1 mm of rainfall was recorded during the crop growing season in 2022, with the highest daily rainfall of 40.0 mm occurring in the 8$^{th}$ meteorological standard week and the lowest daily rainfall of 1.1 mm in the 7$^{th}$ week (Fig. 1). The maximum temperature peaked at 40.7 °C in the 17$^{th}$ week, while the minimum temperature ranged from 15.3 °C to 27.5 °C during the same period. Evapotranspiration rates increased over the weeks, culminating in a maximum of 5.1 mm per day during the 17$^{th}$ week (Fig. 1).

### Soil

The experimental area exhibited uniform topography and normal fertility status. Soil samples collected from depths of 0-15 cm revealed sandy loam texture, with various chemical properties assessed, including pH (5.86), electrical conductivity (4.2 dS m$^{-1}$) and organic carbon content (0.47 %). The determined available nutrients were 205.6 kg ha$^{-1}$ nitrogen, 18.43 kg ha$^{-1}$ phosphorus and 106.6 kg ha$^{-1}$ potassium. Over the four years, the experimental field was predominantly cultivated with rice during the *kharif* season, while pulses were also grown occasionally.

### Experimental details

The experiment was conducted in a randomized block design with a total of 10 treatments such as - stale seedbed (SSB) at 15 days before sowing (DBS), pendimethalin at 750 g ha$^{-1}$ at 1 day after sowing (DAS), imazethapyr at 75 g ha$^{-1}$ at 20 DAS, SSB at 15 DBS *fb* pendimethalin at 750 g ha$^{-1}$ at 1 DAS, SSB at 15 DBS *fb* imazethapyr at 75 g ha$^{-1}$ at 20 DAS, pendimethalin at 750 g ha$^{-1}$ at 1 DAS *fb* imazethapyr at 75 g ha$^{-1}$ at 20 DAS, aqueous leaf extract of *Calotropis gigantea* at 10 % concentration at 1 DAS, aqueous leaf extract of *Calotropis gigantea* at 20 % concentration at 1 DAS, two hand weeding at 15 and 30 DAS, weedy check, repeated across 3 replications. The green gram variety used in this study was *Virat*, which was sown at a rate of 25 kg ha$^{-1}$ on February 15, 2022. Planting density was recommended with a 25 cm row spacing and a north-south orientation. Fertilizer application was carried out at a rate of 20-40-20 kg ha$^{-1}$, with urea providing nitrogen, SSP providing phosphorus and MOP providing potassium.

### Treatment imposition

Herbicides were applied at specific doses utilizing a knapsack sprayer with a flat fan nozzle at appropriate growth phases of development. Before sowing, an irrigation was applied 15 days earlier in the stale seedbed to facilitate weed germination, followed by shallow harrowing to control the emerging weeds. After being thoroughly cleaned, fresh *Calotropis gigantea* leaves were allowed to air dry at room temperature in the shade. Subsequently, the air-dried leaves were subjected to oven drying for complete moisture removal. The dried leaves were then ground using a clean mortar and pestle to create a fine powder. This powder was soaked in 1000 mL of distilled water for 48 hr at room temperature in order to create solutions with concentrations of 10 % and 20 % w/v. After this step, the solution was filtered and refrigerated at or below 4 °C for later use. Additionally, manual weeding was conducted twice, at intervals of 15 and 30 days post-sowing, to ensure optimum growth conditions for the summer green gram.

### Observation and data collection

Yield attributes of green gram were meticulously measured by selecting ten samples at random. The 1000 seed weight was assessed by counting a sample of 1000 seeds using a digital seed counter and weighing them. Finally, seed yield were quantified,

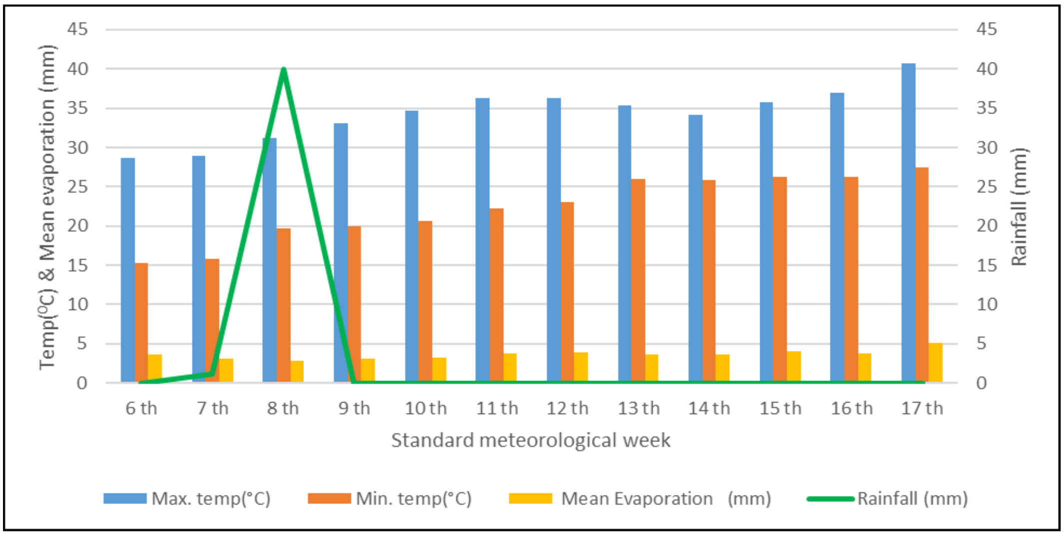


**Fig. 1.** Mean weekly rainfall, evaporation, maximum and minimum temperature during the crop growth period (2022).

with the seed weight recorded from threshed and cleaned produce of the designated area, converted to quintals per hectare (q ha$^{-1}$). Species-wise identification of weeds in the experimental field was conducted using authenticated sources, categorizing them morphologically into grasses and broad-leaved types. Weed density was measured by counting the number of weeds per square meter at 30 DAS using a quadrat of 0.25 m$^2$ to derive detailed category-wise data. For weed dry weight, samples were collected and processed by drying above-ground parts in a hot air oven to constant weight. The weed control efficiency (WCE) was computed based on the reduction of weed dry weight achieved by different control methods compared to unweeded checks, expressed as a percentage (15). Unlikely, the weed index (WI) reflects the gain in crop yield attributed to effective weed control methods, representing the crop yield in treated plots as a percentage of the yield from weed-free conditions (16). The net monetary return was calculated after deducting all the expenditures from the gross return. It was obtained by subtracting the cost of cultivation from gross return. Dividing the gross return by the cost of cultivation, B: C ratio was obtained.

### Statistical analysis

The experimental data were analyzed using the analysis of variance method, employing Fisher's "F" test at a probability level of 0.05 to assess significance. Data with wide variation and zero values in weed density and biomass were square root transformed for normalization before analysis (17). The statistical analysis was carried out using the GRAPES.

## Results and Discussion

### Weed flora

The experimental field exhibited infestation from eight distinct weed species categorized into two groups: two monocot and six dicot species, spanning across six families at 30 DAS. In the weedy check plots, all eight species were present. The seven dominant weed species identified in the experimental field are presented in Table 1. In green gram cultivation, a significant presence of *Digitaria sanguinalis* and *Poa annua* was observed among grasses, while *Melochia corchorifolia*, *Grangea maderaspatana* and *Aeschynomene afraspera* emerged as the broadleaf weeds throughout the crop growth period (3).

### Weed density and biomass

The densities and biomass of all weed categories were the maximum under the weedy check plots, which exhibited a preponderance of grasses (56.03 %), followed by broadleaved weeds (43.97 %) at 30 DAS. Among the weed management practices, minimum density and biomass of grasses and broadleaved weeds were recorded in the hand weeding (HW) treatment, which was at par with the application of pendimethalin at 750 g ha$^{-1}$ *fb* imazethapyr 75 g ha$^{-1}$ and stale seedbed technique *fb* imazethapyr 75 g ha$^{-1}$ (Table 2). The succeeding foremost treatment was imazethapyr application, which was at par with the stale seedbed *fb* pendimethalin in decreasing the weed growth (Table 2). If properly integrated, the stale seedbed method, a cultural approach, can increase weed control while reducing herbicide applications and total production costs (9). Medium infestation of total weeds was found in the treatment stale seedbed *fb* imazethapyr 75 g ha$^{-1}$ at 30 DAS. Among the sole applications, imazethapyr 75 g ha$^{-1}$ was effective in keeping the grasses, broadleaved weeds density and biomass under ETL, which was followed by the application of pendimethalin, stale seedbed and aqueous leaf extract of *Calotropis gigantea* at 20 % concentration. Post-emergence application of imazethapyr at 50 g ha$^{-1}$ delivered a statistically significant suppression of overall weed infestation and biomass compared to the untreated control (18). Pendimethalin *fb* imazethapyr was used because it significantly reduces weed biomass and density, improving weed control. Pendimethalin suppressed initial weed flushes by inhibiting root/shoot emergence at pre-sowing and early

**Table 1.** Floristic composition of weeds in the experimental site

| Botanical name | Family | Common name |
|---|---|---|
| | **Grasses** | |
| *Poa annua* L. | Poaceae | Annual meadow grass |
| *Digitaria sanguinalis* (L.) Scop. | Poaceae | Large crabgrass |
| | **Broadleaved weeds** | |
| *Melochia corchorifolia* L. | Sterculiaceae | Chocolate weed |
| *Aeschynomene afraspera* L. | Fabaceae | Joint vetch |
| *Cassia tora* L. | Fabaceae | Sickle pod |
| *Croton sparsiflorus* Morong | Euphorbiaceae | Wild chilli |
| *Mitracarpus hirtus* (L.) DC. | Rubiaceae | Girdle pod |
| *Coldenia procumbens* L. | Boraginaceae | Creeping coldenia |

**Table 2.** Effect of weed management on weed growth, weed control efficiency (WCE) and weed index (WI) of summer green gram at 30 DAS

| Treatments | Weed density (No. m$^{-2}$) | | Weed biomass (g m$^{-2}$) | | WCE ( %) | WI ( %) |
|---|---|---|---|---|---|---|
| | Grass | BLW | Grass | BLW | | |
| $T_1$: SSB | 5.12 (25.91) | 3.24 (9.99) | 4.59 (20.64) | 2.79 (7.32) | 57.3 | 39.5 |
| $T_2$: Pendimethalin | 4.80 (22.58) | 3.11 (9.17) | 4.36 (18.56) | 2.71 (6.89) | 61.1 | 36.8 |
| $T_3$: Imazethapyr | 2.94 (8.23) | 1.86 (2.99) | 2.36 (5.10) | 1.46 (1.66) | 89.7 | 24.8 |
| $T_4$: $T_1$ *fb* $T_2$ | 3.24 (10.19) | 1.88 (3.07) | 2.76 (7.27) | 1.57 (1.96) | 85.9 | 26.7 |
| $T_5$: $T_1$ *fb* $T_3$ | 1.90 (3.11) | 1.64 (2.20) | 1.42 (1.53) | 1.19 (0.92) | 96.3 | 07.2 |
| $T_6$: $T_2$ *fb* $T_3$ | 1.66 (2.26) | 1.62 (2.13) | 1.31 (1.22) | 1.20 (0.95) | 96.7 | 04.9 |
| $T_7$: ALE of *Calotropis* @ 10 % | 5.57 (30.55) | 3.62 (12.71) | 5.41 (28.95) | 3.38 (10.95) | 39.1 | 51.0 |
| $T_8$: ALE of *Calotropis* @ 20 % | 4.94 (24.01) | 3.24 (10.04) | 4.53 (20.05) | 2.86 (7.68) | 57.7 | 43.1 |
| $T_9$: 2 HW | 1.39 (1.46) | 1.48 (1.71) | 1.01 (0.52) | 0.99 (0.49) | 98.5 | 00.0 |
| $T_{10}$: Weedy check | 6.17 (37.77) | 5.49 (29.64) | 6.18 (37.83) | 5.30 (27.69) | 0.0 | 60.3 |
| SEm(±) | 0.18 | 0.11 | 0.18 | 0.07 | - | - |
| CD(P=0.05) | 0.55 | 0.33 | 0.53 | 0.21 | - | - |

*Values in parentheses are original data. Which have been transformed through the square root transformation. BLW = Broadleaved weeds, SSB = Stale seedbed, ALE = Aqueous leaf extract, HW = Hand weeding seedling stages, while imazethapyr targeted later emerging weeds through ALS inhibition during early crop growth, thus extending residual control into mid-season (19). In the wheat crop, the stale seedbed produced a lower overall weed density than the conventional seedbed (20). The aqueous extract of *C. gigantea* was equally efficient as the stale seed bed approach and pre-emergence herbicide treatment at inhibiting the germination of grassy weeds. The phytotoxic action of the proteases found in *C. procera* extract was the cause of the plant's decreased dry weight (21). Because they may increase reactive oxygen levels, certain flavonoids have an allelopathic action that inhibits germination (22).

### Weed control efficiency

The weed control efficiency (WCE) of the two hand-weeding treatments was 98.5 % in managing weeds. WCE of all the weed management treatments was markedly higher over the weedy check at 30 DAS (Table 2). Among different sequential applications, pendimethalin *fb* imazethapyr registered the highest WCE (96.7 %) for managing grasses and broadleaved weeds and was very closely followed by stale seedbed *fb* imazethapyr (96.3 %) at 30 DAS (Table 2). Imazethapyr effectively controlled the complex weed flora, registering the highest WCE against total weeds (89.7 %) than the pendimethalin treatment (61.1 %) in the sole weed control category. Research indicates a similar observation from their previous study (3). Unweeded control resulted in the lowest WCE (23).

### Weed index

The weed index (%) was calculated by using grain yield and data presented in Table 1. i.e. the weed index (WI). It stated that all of the weed control methods had lower WI values than the weedy check (Table 2). Pendimethalin *fb* imazethapyr (4.95 %) had the lowest value of WI among the weed management practices, followed by SSB *fb* imazethapyr (7.26 %), while weedy check had the highest value (60.34 %). Application of imazethapyr registered the minimum WI (24.83 %) as compared to other sole weed control approaches in summer green gram (Table 2). Various doses of imazethapyr resulted in a minimum WI (24).

### Yield attributing parameters

The highest pods/plant, seeds/podwere observed in two HW, which remained statistically at par with pendimethalin *fb* imazethapyr and stale seedbed *fb* imazethapyr (Table 3). The stale seedbed technique, consisting of shallow tillage and herbicide, had the highest yield attributes and yield due to reduced weed growth (25). Likewise, the application of imazethapyr alone and the stale seedbed technique with pendimethalin also exhibited significant improvement in the number of pods per plant. The 1000 seed weight was found to be similar among all treatments. That was not varied significantly among the different treatment combinations under the study. Two HW produced the highest pods per plant, seeds per pod and seed yield (26). Except for 1000 seed weight, all yield characteristics were substantially lower in the weedy. The yield and yield-attributing parameters showed lower values in weedy treatments (27).

### Seed yield

The highest productivity of seed (10.70 q $ha^{-1}$) was significantly recorded under two HW, which, however, was found to maintain statistically similar yield levels with pendimethalin *fb* imazethapyr (10.17 q $ha^{-1}$) and stale seedbed *fb* imazethapyr (9.92 q $ha^{-1}$) (Table 3). The stale seedbed technique effectively depletes the weed seed bank, ensuring a reduced weed infestation in the future and minimising crop-weed competition during the crop-growing period. Similarly, applying pendimethalin as a pre-emergence herbicide suppresses early weed growth by reducing both density and biomass. Combining these early weed control methods with the application of imazethapyr further enhances weed suppression, ultimately leading to improved yield in green gram cultivation. This sequential herbicide approach significantly enhanced weed control efficiency, leading to a notable increase in seed yield. Compared with $T_6$ treatment, the yield advantages under $T_9$ treatment ranged from 5.21 % in seed yield. Weeds are considered a major constraint in achieving higher productivity. One of the key intercultural activities to reach the potential yield of green gram is weed management throughout the crucial stages of crop growth. Because they occupy more area and face less competition from weeds for nutrients, water and light, green gram plants in less weed-competitive environments produced more pods and seeds than those grown in more weed-competitive environments.

The next best treatments, *viz.* imazethapyr (8.04 q $ha^{-1}$), which was at par with the integration of stale seedbed *fb* pendimethalin (7.84 q $ha^{-1}$). Compared to two HW treatments, pendimethalin applications resulted in a noticeably increased grain production (28, 29). Post-emergence application of imazethapyr registered maximum yield as compared to other sole methods of weed control. However, the sole application of pendimethalin, stale seedbed and 20 % leaf extract concentration of *C. gigantea* were comparable in registering higher yield (Table 3). Applying a 30 % concentration of

**Table 3.** Effect of weed management on yield attributes, yield and economics of green gram

| Treatments | Yield attributes | | | Seed yield | Net return | B: C ratio |
|---|---|---|---|---|---|---|
| | No. of pods $plant^{-1}$ | No. of seeds $pod^{-1}$ | 1000 seed wt (g) | (q/ha) | (Rs $ha^{-1}$) | |
| $T_1$: SSB | 21.00 | 5.47 | 38.05 | 6.47 | 13825 | 1.42 |
| $T_2$: Pendimethalin | 22.33 | 5.67 | 37.12 | 6.76 | 16210 | 1.49 |
| $T_3$: Imazethapyr | 26.67 | 6.23 | 37.09 | 8.04 | 25963 | 1.80 |
| $T_4$: $T_1$ *fb* $T_2$ | 26.00 | 5.97 | 36.11 | 7.84 | 21643 | 1.61 |
| $T_5$: $T_1$ *fb* $T_3$ | 29.00 | 7.80 | 38.62 | 9.92 | 37240 | 2.07 |
| $T_6$: $T_2$ *fb* $T_3$ | 29.67 | 8.07 | 38.00 | 10.17 | 39335 | 2.14 |
| $T_7$: ALE of *Calotropis* @ 10 % | 16.33 | 4.77 | 37.30 | 5.23 | 5704 | 1.18 |
| $T_8$: ALE of *Calotropis* @ 20 % | 20.33 | 5.17 | 37.13 | 6.08 | 11563 | 1.35 |
| $T_9$: 2 HW | 30.33 | 8.67 | 39.04 | 10.70 | 31959 | 1.70 |
| $T_{10}$: Weedy | 13.00 | 3.97 | 36.16 | 4.24 | 1.25 | 1.00 |
| SEm(±) | 0.95 | 0.40 | 0.94 | 0.27 | 1934.86 | 0.06 |
| CD(P=0.05) | 2.82 | 1.18 | NS | 0.79 | 5748.8 | 0.17 |

NB: SSB = Stale seedbed, ALE = Aqueous leaf extract, HW = Hand weeding

*Calotropis gigantea* leaf extract as a pre-emergence spray, followed by HW at 40 DAS, proved to be non-toxic to cotton. This weed management approach effectively enhanced cotton yield under irrigated conditions (30). The aqueous leaf extract of *Calotropis*, on the other hand, has been shown to have allelopathic qualities, such as reducing yield and inhibiting germination. In summer green gram, the seed yield was negatively connected with rising weed biomass and density (2).

## Economics

Among weed management treatments, pendimethalin *fb* imazethapyr fetched the highest net return (₹ 39335 $ha^{-1}$) and B:C ratio (2.14) and remained at par with stale seed bed technique *fb* imazethapyr (₹ 37240 $ha^{-1}$ and 2.07) (Table 3). Herbicide technology has revolutionised weed management by providing a cost-effective and efficient alternative to traditional hand-weeding. From the outset, it has enabled crops to establish a strong start, reducing competition from weeds and improving overall yield potential. In green gram cultivation, herbicide application proved to be more economical than manual weeding while ensuring effective weed control. Post-emergence application of imazethapyr+imazamox at 50 g $ha^{-1}$ yielded the highest net returns and B:C ratio, closely followed by imazethapyr+pendimethalin at 1000 g $ha^{-1}$ (31). Across various weed control strategies, the use of herbicides-whether applied individually or in combination-consistently outperforms untreated plots in terms of financial gains and cost-effectiveness (32). The maximum benefit was achieved by applying an integrated weed management approach to reduce the diverse weed flora (33).

### Relationship among the weed, crop growth and yield

The grass and broad-leaved density and biomass were negatively correlated with the growth parameters, such as plant height, dry matter accumulation (DMA). Similarly, the weed growth was also negatively correlated with the yield attributing and yield of green gram (Fig. 2). The grassy weed population strongly affected the dry matter accumulation (-1.0) and plant height (-0.99). Unlike weed growth, there was a positive correlation among yield, yield attributing and all the growth parameters measured in green gram (Fig. 2). A strong positive correlation was observed between stover yield and pods $plant^{-1}$, i.e. 0.99. The relation of the number of pods $m^{-2}$ and seeds $pod^{-1}$ was 0.915 and 0.934 with the seed yield of summer green gram, respectively (3). Furthermore, the traits such as plant height, DMA and number of branches were positively and significantly correlated to yield, highlighting the relevance of these characteristics in selecting for productivity (2).

## Conclusion

The application of pendimethalin at 750 g $ha^{-1}$ or stale seedbed followed by the post-emergence application of imazethapyr at 75 g $ha^{-1}$ has shown promising effectiveness in managing diverse weed flora in green gram cultivation during the summer season. Economic analysis of green gram exhibited maximum net return and highest B:C ratio under pendimethalin at 750 g $ha^{-1}$ *fb* imazethapyr at 75 g $ha^{-1}$, which was statistically at par with the application of stale seed bed *fb* imazethapyr at 75 g $ha^{-1}$. This

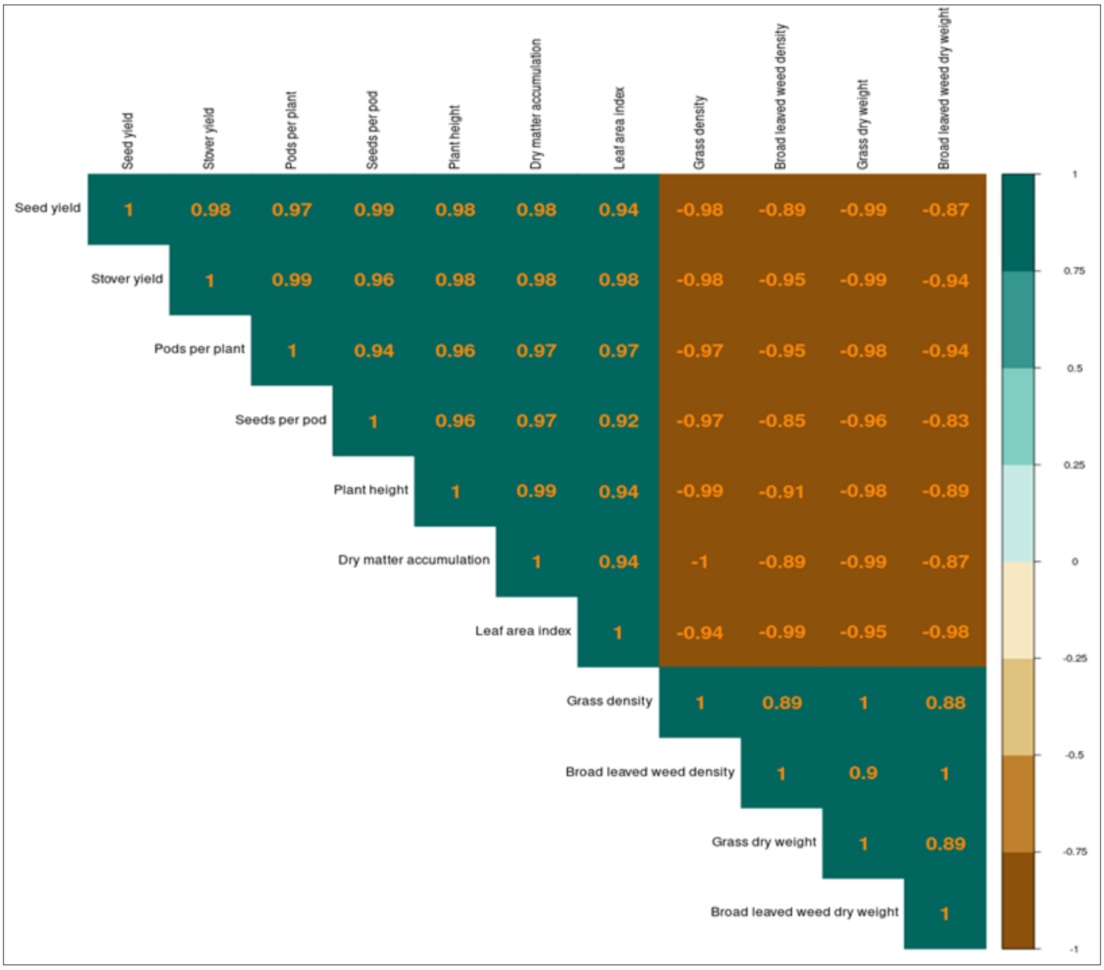


**Fig. 2.** Relationship among the weed growth, yield, yield attributing and growth parameters in summer green gram.

weed management approach not only aids in controlling weed populations but also contributes to improved crop productivity. Future research ought to prioritize the strategic optimization of both herbicidal as well as cultural weed management practices and their combinations. Furthermore, there lies significant potential in the exploration of integrated weed management practices.

## Acknowledgements

We would like to express our gratitude to the Faculty of Agricultural Sciences, SOA, for giving us the opportunity to conduct the experiment in the Agricultural Research Station, Chattabar and use their well-equipped lab for analysis.

## Authors' contributions

RD executed the experiment and collected the data. SD conceptualised and supervised the experiment. SD and AP analysed the data and prepared the manuscript. All authors read and approved the final manuscript.

## Compliance with ethical standards

**Conflict of interest:** The authors do not have any conflict of interest to declare.

**Ethical issues:** None

## References

1. Patel TU, Patel AJ, Thanki JD, Arvadiya MK. Effect of land configuration and nutrient management on green gram (*Vigna radiata*). Indian J Agron. 2018;63(4):472–76.https://doi.org/10.59797/ija.v63i4.5682
2. Das R, Dash S, Priyadarshini A, Jena J, Subhadarshi S. Weed growth and productivity of green gram (*Vigna radiata* L.) under integrated weed management practices. Plant Sci Today. 2024;11:320–24. https://doi.org/10.14719/pst.3692
3. Patnaik PK, Dash S, Chowdhury MR, Das SP, Sar K, Pradhan SR. Weed growth and productivity of summer green gram (*Vigna radiata* L.) under sole and sequential application of herbicides. Res Crops. 2022;23:70–75. https://doi.org/10.31830/2348-7542.2022.011
4. Mesnage R, Szekacs A, Zaller JG. Herbicides: brief history, agricultural use and potential alternatives for weed control. Herbicides. 2021;1–20. https://doi.org/10.1016/B978-0-12-823674-1.00002-X
5. Mohanty T, Pattanaik P, Dash S, Tripathy HP, Holderbaum W. Smart robotic system guided with YOLOv5-based machine learning framework for efficient herbicide usage in rice *(Oryza sativa* L.) under precision agriculture. Comput Electron Agric. 2025;231:110032. https://doi.org/10.1016/j.compag.2025.110032
6. Jaiswal DK, Duary B, Rani SP, Dash S, Dhakre DS. Effect of herbicide and straw mulch on weed growth, productivity and profitability of wheat under different tillage practices in Eastern Indian J Weed Sci. 2023;55 (3):249–54. https://doi.org/10.5958/0974-8164.2023.00046.1
7. Priyadarshini A, Dash S, Jena J, Kusumavathi K, Pattanaik P, Holderbaum W. Review of the cutting-edge technologies for weed control in field crops. Int J Agric Bio. 2024;17(5):44–57. https://doi.org/10.25165/j.ijabe.20241705.9019
8. Dash S, Sarkar S, Tripathy HP, Pattanaik P, Patnaik S. Robotics in weed management: a new paradigm in agriculture. In: Proceedings of the International Conference on Electronic Information Technology and Smart Agriculture (ICEITSA); 2021; Huaihua, China. IEEE; 2021. p. 561–4. https://doi.org/10.1109/iceitsa54226.2021.00111
9. Dogan MN, Ünay A, Boz Ö, Ögüt D. Effect of pre-sowing and pre-emergence glyphosate applications on weeds in stale seedbed cotton. Crop Protection. 2009;28(6):503–7. https://doi.org/10.1016/j.cropro.2009.01.013
10. Duary B, Jaiswal DK, Dash S, Sar K, Patel N. Effect of tillage and pre-mix application of herbicides on weed growth and productivity of late-sown wheat. Indian J Weed Sci. 2021;53:188–90. https://doi.org/10.5958/0974-8164.2021.00035.6
11. Sangramsingh PK, Dash S. Sole and sequential application of herbicide and straw mulch on weed growth and productivity of direct-seeded rainfed rice (*Oryza sativa* L.). Bangladesh J Bot. 2021;50:671–77. https://doi.org/10.3329/bjb.v50i3.55847
12. Dash S, Duary B. Tillage and weed management effects on productivity of wheat under dry seeded rice-wheat system on lateritic soils of West Bengal. Indian J Weed Sci. 2020;52(4):326–30. https://doi.org/10.5958/0974-8164.2020.00065.9
13. Hota S, Dash S, Joshi UB. Sole and sequential application of herbicides and botanicals for weed management in summer sesame. Plant Sci Today. 2024;11:1022–27. https://doi.org/10.14719/pst.4122
14. Dash S, Chowdhury MR, Sar K, Jena J, Gulati JML. Integrated weed management in conservation agriculture: a review. Int J Curr Microbiol Appl Sci. 2020;9(8):11–24. https://doi.org/10.20546/ijcmas.2020.908.048
15. Mani VS, Mala ML, Gautam KC, Bhagavandas. Weed-killing chemicals in potato cultivation. Indian Farm. 1973;23(1):17–18.
16. Gill HS, Vijayakumar. Weed index–a new method for reporting weed control trials. Indian J Agron. 1969;14(1):96–98.
17. Gomez KA, Gomez AA. Statistical procedure for agricultural research. 2nd ed. New York: John Wiley and Sons; 2003.
18. Rani PB, Venkateswarlu E. Evaluation of pre and post emergence herbicides in green gram (*Vigna radiata* L.) during Kharif and Rabi seasons in the uplands of Krishna zone of Andhra Pradesh. Indian J Agric Res. 2022; 56(3):290–96. https://doi.org/10.18805/ijare.a-5724
19. Verma SK, Prasad SK, Kumar S, Singh SB, Singh RP, Singh YV. Effect of mulching and herbicides on weeds, yield and economics of green gram (*Vigna radiata* L.) grown under eight-year-old agri hortisystem. Res Crops. 2017;18:438–44. https://doi.org/10.5958/2348-7542.2017.00076.6
20. Kumari P, Saini JP, Kumar R, Chopra P, Sharma RP. Impact of seed bed manipulations and weed management practices on growth, yield and economics of wheat under organic conditions, Int J Curr Microbiol Appl Sci. 2019;8(8):2889–97. https://doi.org/10.20546/ijcmas.2019.808.333
21. Singh AN, Shukla AK, Jagannadham MV, Dubey VK. Purification of a novel cysteine protease, procerain B, from *Calotropis procera* with distinct characteristics compared to procerain. Process Biochem. 2010;45:399–406. https://doi.org/10.1016/j.procbio.2009.10.014
22. Kumar D, Kumar N, Akamatsu K, Kusaka E, Harada H, Ito T. Synthesis and biological evaluation of indolyl chalcones as antitumor agents. Bioorganic and Medicinal Chemistry Lette₹ 2010;20:3916–19. https://doi.org/10.1016/j.bmcl.2010.05.016
23. Chowdhury R, Dash S, Pradhan A. Weed management in direct-seeded rice-musterd-sesame crop sequence in lateritic soil of Birbhum, West Bengal Pestic Res J. 2021;33:43-51. https://doi.org/10.5958/2249-524x.2021.00037.6
24. Dash S, Teja KC, Duary B. Weed management in kharif blackgram with imazethapyr and other herbicides. In: National Seminar on "Recent Trends in Agriculture and Allied Sciences for Better Tomorrow, Visva-Bharati, West Bengal. 2016; p. 49.
25. Benvenuti S, Selvi, Mercati S, Cardinali, G, Mercati V, Mazzoncini M. Stale seedbed preparation for sustainable weed seed bank management in organic cropping systems. Sci Hortic. 2021;289:110453. https://doi.org/10.1016/j.scienta.2021.110453
26. Adhikary P, Patra PS. Effect of integrated weed management on

summer green gram under alluvial soil of West Bengal. Indian J Weed Sci. 2024; 56(1):39–45.

27. Dash S, Duary B, Sar K. Efficacy of fenoxaprop-p-ethyl and penoxsulam for weed management with special emphasis on *Echinochloa* spp. in transplanted summer rice. Indian J Weed Sci. 2021;53:78–80. https://doi.org/10.5958/0974-8164.2021.00011.3

28. Henery CBO, Ogtrop FV, Roche R, Tan DKY. Evaluation of pre-emergence herbicides for weed management and rice yield in direct-seeded rice in Cambodian lowland ecosystems. Farming Syst. 2023;1 (2):100018. https://doi.org/10.1016/j.farsys.2023.100018

29. Maji S, Reja H, Nath R, Bandopadhyay P, Dutta P. Herbicidal management in monsoon green gram (*Vigna radiata* (L.) Wilczek) and its effect on the following rapeseed (*Brassica campestris* L. var. Yellow Sarson) in the Indo-Gangetic plains of Eastern India. J Saudi Soc Agric Sci. 2020; 19(8):499–509. https://doi.org/10.1016/j.jssas.2020.09.003

30. Malarkodi N, Balasubramanian R. Integrated weed management with *Calotropis gigantea* leaf extract in cotton. Madras Agric J. 2014;101 (10/12):331–35. https://doi.org/10.29321/maj.10.001209

31. Mansoori N, Bhadauria N, Rajput RL. Effect of weed control practices on weeds and yield of blackgram, Legume Res. 2015;38(6):855–57. https://doi.org/10.18805/lr.v38i6.6736

32. Bahar FA, Dar SA, Lone AA, Ansarul HS, Alie BA, Dar ZA, et al. Effect of land configuration and weed management on mungbean productivity under temperate conditions of Kashmir, India. Int J Curr Microbiol Appl Sci. 2017;6(10):863–80. https://doi.org/10.20546/ijcmas.2017.610.103

33. Dash S, Priyadarshini A, Jena J, Behera SD, Shankar T, Palai JB, et al. Effect of herbicides and varying rates of straw mulching on weed dynamics, productivity and profitability of rice. Indian J Agron. 2024;69 (4):364–68. https://doi.org/10.59797/ija.v69i4.5537

## Additional information

**Peer review**: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

**Reprints & permissions information** is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

**Publisher's Note**: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Indexing**: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting



**Publisher information:** Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.