

# Assessment of Post-Emergence Herbicides for Improving the Yield of Mungbean [*Vigna radiata* (L.) Wilczek]

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**Abstract** - Mungbean (*Vigna radiata* L. Wilczek) is an important pulse crop contributing to food, nutritional security, and soil fertility through biological nitrogen fixation. However, weed infestation remains a major constraint limiting its productivity. A field experiment entitled “Assessment of Post-Emergence Herbicides for Improving Growth and Yield of Mungbean” was conducted during the kharif season of 2025 at Vivekananda Global University, Jaipur, Rajasthan, to evaluate the efficacy of different post-emergence herbicides. The experiment was laid out in a Randomized Block Design with eight weed management treatments and three replications. Results revealed that post-emergence herbicides significantly reduced weed density and weed dry matter compared with the weedy check. Among the treatments, fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> recorded the most effective weed control, followed by sodium acifluorfen + clodinafop-propargyl @ 210 g ha<sup>-1</sup>. Superior weed suppression resulted in improved crop growth, yield attributes, and yield. Fomesafen + fluazifop-p-butyl produced the highest grain yield (1254 kg ha<sup>-1</sup>), stover yield (2094 kg ha<sup>-1</sup>), and biological yield (3347 kg ha<sup>-1</sup>) among herbicidal treatments, closely followed by sodium acifluorfen + clodinafop-propargyl. The enhanced performance was attributed to broad-spectrum control of both grassy and broad-leaved weeds, reducing crop–weed competition during critical growth stages. The study concluded that fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> is an effective post-emergence herbicide option for improving weed management, growth, and productivity of mungbean under semi-arid conditions of Rajasthan.

**Keywords:** Mungbean, post-emergence herbicides, weed management, fomesafen, fluazifop-p-butyl, grain yield, productivity.

## INTRODUCTION

Pulses are an important component of food and nutritional security, particularly in developing countries, owing to their high protein content, affordability, and role in improving soil fertility. Among pulse crops, mungbean [*Vigna radiata* (L.) Wilczek] is one of the most important grain legumes cultivated in tropical and subtropical regions. It is valued for its short duration, adaptability to diverse agro-climatic conditions, and rich nutritional composition, containing about 24–26% protein along with essential vitamins and minerals. Being a leguminous crop, mungbean contributes to sustainable agriculture through biological nitrogen fixation and improvement of soil health.

India is the largest producer and consumer of mungbean, with an area of approximately 5.5 million hectares and production of about 3.8 million tonnes during 2024–25. Rajasthan is the leading state in terms of area and production. Despite its significance, mungbean productivity remains low compared with its potential due to several biotic and abiotic constraints, among which weed infestation is one of the most serious yield-limiting factors. Owing to its slow initial growth and short stature, mungbean is highly susceptible to weed competition during the early growth stages. Uncontrolled weed infestation can cause yield losses ranging from 30 to 80%, particularly during the critical crop–weed competition period of 20–40 days after sowing.

Conventional weed management through hand weeding is effective but often constrained by labour scarcity, high cost, and untimely operations. Consequently, herbicide-based weed control has emerged as a practical and efficient alternative. Recent advances in herbicide technology have introduced effective post-emergence molecules such as fomesafen and propaquizafop, which provide broad-spectrum weed control at low application rates with reduced environmental impact. However, the effectiveness of these herbicides under specific agro-climatic conditions requires systematic evaluation to identify suitable and economical weed management options for mungbean cultivation.

## MATERIAL AND METHODS

A field experiment entitled “Assessment of Post-Emergence Herbicides for Improving Growth and Yield of Mungbean [*Vigna radiata* (L.) Wilczek]” was conducted during the kharif season of 2025 at the Agricultural Research Farm, Vivekananda Global University (VGU), Jaipur, Rajasthan, India.

## EXPERIMENTAL SITE AND SOIL

The experimental field was characterized by a sandy loam soil, slightly alkaline in reaction (pH 8.10) and non-saline (EC 0.12 dS m<sup>-1</sup>). The soil was low in organic carbon (0.17%) and available nitrogen (165 kg ha<sup>-1</sup>), while medium in available phosphorus (22 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and potassium (310 kg K<sub>2</sub>O ha<sup>-1</sup>). Composite soil samples (0–30 cm depth) were collected before sowing and analyzed using standard procedures.

### Climate

The experimental site falls under a semi-arid climatic zone. During the crop season, a total rainfall of 521.5 mm was received in 23 rainy days. Mean maximum and minimum temperatures ranged from 29.2–36.7°C and 20.6–25.3°C, respectively, with relative humidity varying from

45.2 to 87.4%.

### Experimental Design and Treatments

The experiment was laid out in a Randomized Block Design (RBD) with eight weed management treatments replicated thrice. The treatments consisted of:

1. Weedy check
2. Weed-free
3. Imazethapyr 10% SL @ 55 g ha<sup>-1</sup> (20 DAS)
4. Pendimethalin 30% EC + Imazethapyr 2% EC @ 800 g ha<sup>-1</sup> (20 DAS)
5. Imazethapyr 35% + Imazamox 35% WG @ 70 g ha<sup>-1</sup> (20 DAS)
6. Propaquizafop 2.5% + Imazethapyr 3.75% ME @ 33.3 + 50 g ha<sup>-1</sup> (20 DAS)
7. Acifluorfen sodium 16.5% + Clodinafop-propargyl 8% EC @ 140 + 70 g ha<sup>-1</sup> (20 DAS)
8. Fomesafen 11.1% + Fluazifop-p-butyl 11.1% SL @ 220 g ha<sup>-1</sup> (20 DAS)

Each treatment was randomly allocated to plots measuring 6.0 m × 4.5 m (gross) and 5.4 m × 3.9 m (net).

## CROP ESTABLISHMENT AND MANAGEMENT

Mungbean variety GM-7 was sown on 14 July 2025 at a spacing of 30 cm × 10 cm using a seed rate of 15 kg ha<sup>-1</sup>. A basal fertilizer dose of 15 kg N and 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> was applied through urea and single super phosphate. Seeds were treated with carbendazim (2 g kg<sup>-1</sup> seed), monocrotophos (3 ml kg<sup>-1</sup> seed), and *Rhizobium* culture before sowing. The crop was grown under rainfed conditions and standard agronomic practices were followed throughout the season. Post-emergence herbicides were applied at 20 days after sowing (DAS) using a knapsack sprayer fitted with a flat-fan nozzle. Weed-free plots were maintained manually throughout the crop growth period.

## OBSERVATIONS RECORDED

### Weed Parameters

- Weed density (no. m<sup>-2</sup>) at 30 DAS, 45 DAS, and harvest
- Weed dry matter accumulation (g m<sup>-2</sup>)
- Weed control efficiency (WCE, %)
- Weed index (WI, %)

### Crop Growth Parameters

- Initial and final plant population
- Plant height (cm)
- Dry matter accumulation (g plant<sup>-1</sup>)

- Number of branches plant<sup>-1</sup>

#### Yield Attributes and Yield

- Number of pods plant<sup>-1</sup>
- Number of seeds pod<sup>-1</sup>
- Grain yield (kg ha<sup>-1</sup>)
- Stover yield (kg ha<sup>-1</sup>)
- Biological yield (kg ha<sup>-1</sup>)

### ECONOMIC ANALYSIS

Economic parameters including cost of cultivation, gross returns, net returns, and benefit-cost ratio (B:C) were calculated using prevailing market prices of inputs and outputs.

#### Statistical Analysis

The experimental data were analyzed using analysis of variance (ANOVA) appropriate for the Randomized Block Design following the procedure of Panse and Sukhatme (1985). Weed density and weed dry matter data were subjected to square-root transformation  $\sqrt{(x + 0.5)}$  before analysis. Treatment means were compared using the critical difference (CD) test at the 5% level of significance.

### RESULTS

Table: Yield attributes of mungbean as influenced by different post- emergence herbicides

Treatments	No. of pods (Nos./plant)	No. of grains (Nos./pod)	1000- grains Weight (g)
Weedyc heck(W1)	26.42	7.81	37.08
Weed free(W2)	37.36	10.32	43.70
Imazethapyr(W3)	30.14	8.49	39.16
Pendi.+imaza.(W4)	31.22	8.91	39.56
Imaza. +imazmox. (W5)	32.17	9.01	39.82
Propa+imaze.(W6)	33.07	9.07	40.06
Acifluorfen+clodina. (W7)	34.55	9.41	41.55
Fomesafen+fluazifop(W8)	35.80	9.75	42.27
SEm±	0.39	0.10	0.45
CD (P=0.05)	1.17	0.30	1.35

## Yield

### Grain yield (kg/ha)

Grain yield is the outcome from an interaction between environment and genotypes. It is the most important parameter, which decides the efficiency and superiority of a particular treatment over other treatments. Data pertaining to grain yield of mungbean as influenced by application of different post-emergence herbicides are presented in Table 4.9 and depicted in Fig. 4.5.

It is quite evident from the data that significantly higher grain yield (1254 kg/ha) was recorded under the treatment that sprayed with fomesafen + fluazifop-p-butyl 220 g/ha (W8) significantly harvest huge tonnage of grain yield from mungbean followed by the second-best treatment sprayed with sodium acifluorfen + clodinafop-propargyl 210 g/ha (W7), which accounted with the production of 1191 kg/ha of mungbean during investigation. Both the treatments (W8 and W7) proved their significant superiority over rest of the treatments subjected to grain yield of mungbean during investigation. Similarly, treatment used ready-mixed application of herbicides *viz.*, propaquizafop + imazethapyr 33.3

+ 50 g/ha (W6) and imazethapyr + imazamox 70 g/ha (W5) also had great effect on grain yield (1132 and 1062 kg/ha), respectively and showed its superiority over weedy check (W1).

### Stover yield (kg/ha)

Data on stover yield pertaining to treatment variables *i.e.* application of post-emergence herbicides are shown in Table 4.9 and illustrated in Fig.4.5. The perusal of the data clearly indicated that application of post-emergence herbicides significantly influenced the stover yield of mungbean.

It is observed from the data that significantly higher stover yield of mungbean was produced under the treatments sprayed with fomesafen + fluazifop-p-butyl 220 g/ha (W8) and sodium acifluorfen + clodinafop-propargyl 210 g/ha (W7) with recorded stover yield of 2094 and 2009 kg/ha, respectively during the experimentation and also proved significant superiority over rest of the treatments including weedy check (W1). However, weed free plot (W2) significantly recorded highest stover yield (2118 kg/ha) as this treatment followed season long weeding, whereas lesser stover yield (1488 kg/ha) was produced under weedy check (W1) during field trial. Further glancing of data revealed that significant quantity of stover yield was associated with the treatments used propaquizafop + imazethapyr 33.3 + 50 g/ha (W6) and imazethapyr + imazamox 70 g/ha (W5), which recorded stover yield (1924 and 1821 kg/ha), respectively and showed its superiority over weedy check(W1).

### Biological yield (kg/ha)

The data on the biological yield of mungbean are presented in Table 4.9 and depicted in Fig.4.5. Various treatment variables *i.e.* application of post-emergence herbicides showed marked effect on biological yield of mungbean.

Among the different herbicidal treatments, significantly higher biological yield (3347 kg/ha) of mungbean was produced under post-emergence application of fomesafen + fluazifop-p-butyl 220 g/ha (W8) followed by the treatment sprayed with sodium acifluorfen + clodinafop-propargyl 210 g/ha (W7) which recorded biological yield of 3199 kg/ha. However, both the treatments (W7 and W8) showed significant superiority over rest of the treatments. It was observed that treatment used ready-mixed application of herbicides *viz.*, propaquizafop + imazethapyr 33.3 + 50 g/ha (W6) and imazethapyr + imazamox 70 g/ha (W5) also had great effect on biological yield (3055 and 2882 kg/ha), respectively and showed its superiority over weedy check (W1).

## DISCUSSION

Weed density decreased progressively from 30 DAS to harvest, whereas weed dry matter increased with crop age due to the accumulation of weed biomass. In contrast, weed density continued to increase under the weedy check because no weed control measures were applied. The reduction in weed population at later stages may be attributed to the completion of the life cycle of early-emerging weeds and suppression of subsequent weed flushes by the developing crop canopy.

Application of post-emergence herbicides significantly reduced the density and dry matter of major weeds, including *Digera*

*arvensis*, *Phyllanthus niruri*, and *Dactyloctenium aegyptium*, at all observation stages. The treatment fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> (W8) recorded the lowest weed density and dry matter, followed by sodium acifluorfen + clodinafop-propargyl @ 210 g ha<sup>-1</sup> (W7). The superior performance of these treatments may be attributed to the combined control of broad-leaved and grassy weeds. Similar findings have been reported by Kadam et al. (2018) and Singh et al. (2014).

Fomesafen and sodium acifluorfen, belonging to the PPO-inhibitor group, effectively controlled broad-leaved weeds by disrupting photosynthesis and cell membrane integrity. Fluazifop-p-butyl and clodinafop-propargyl, ACCase inhibitors, selectively controlled grassy weeds by inhibiting fatty acid synthesis in susceptible species. The combined action of these herbicides resulted in broad-spectrum weed control and reduced crop-weed competition, thereby improving crop growth and productivity. Similar observations were reported by Kavadi et al. (2016), Rai et al. (2016), Nirala et al. (2016), and Haritha Vardhani et al. (2016). **Weed Control Efficiency and Weed Index**

Significant differences in weed control efficiency (WCE) and weed index (WI) were observed among the herbicidal treatments. The highest WCE and the lowest WI were recorded with fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> (W8), followed by sodium acifluorfen + clodinafop-propargyl @ 210 g ha<sup>-1</sup> (W7). Effective suppression of weeds by these treatments reduced crop-weed competition and consequently minimized yield losses, resulting in a lower weed index. Similar findings were reported by Jat and Singh (2021), Bhimwal et al. (2018), Yadav et al. (2022), and Singh et al. (2014).

The superior weed control achieved by ready-mix herbicides may be attributed to their effectiveness against both early and later-emerging weed flora, thereby providing season-long weed suppression and enhancing grain yield.

### GROWTH ATTRIBUTES

Weed management significantly influenced the growth of mungbean. The weed-free treatment (W2) recorded the highest plant population, plant height, and dry matter accumulation owing to the absence of crop-weed competition throughout the growing period. Conversely, the weedy check (W1) exhibited the lowest values for these parameters due to severe competition for nutrients, moisture, light, and space. Similar results were reported by Udhaya et al. (2023) and Chandolia et al. (2010).

Among herbicidal treatments, fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> produced superior growth attributes, which may be attributed to effective weed suppression during the critical crop-weed competition period. Reduced weed pressure enhanced resource availability and promoted photosynthetic activity, resulting in greater biomass accumulation and plant growth. These findings are in agreement with those of Chugh et al. (2017), Dhaker et al. (2009), and Jadhav et al. (2015).

### Yield Attributes

Yield attributes such as pods plant<sup>-1</sup> and test weight are directly influenced by crop growth and resource availability. Effective weed control improved these parameters by reducing competition and ensuring adequate supply of nutrients, moisture, light, and space during critical growth stages. Consequently, treatments providing better weed suppression, particularly fomesafen + fluazifop-p-butyl @ 220 g ha<sup>-1</sup> and sodium acifluorfen + clodinafop-propargyl @ 210 g ha<sup>-1</sup>, recorded superior yield attributes compared with the weedy check. The improvement in yield components ultimately contributed to higher grain yield of mungbean.

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