~~Effect of pre-and post-emergence herbicide to control weeds for higher productivity of summer mungbean (*Vigna radiata*)~~

Comment [WU1]: Effect of pre- and post-emergence herbicide on weed growth and productivity of summer mungbean(*Vignaradiata*)

ABSTRACT:

The current study aimed to investigate the '~~Effect of pre-and post-emergence herbicide to control weeds for higher productivity of summer mungbean (*Vigna radiata*)~~' at Agronomy farm (Faridpur) K.N.I.P.S.S Sultanpur, Uttar Pradesh during *kharif*2022-2023. The research was conducted in randomized block design (RBD) with 8 treatments, viz. weedy check (W_0), one hand weeding at 15 DAS (W_1), hand weeding at 15 and 30 DAS (W_2), pendimethalin @ 0.75 kg a.i./ha as pre-emergence (W_3), quizalofop-ethyl @ 60 g /ha (20 DAS) (W_4), Imazethapyr @ 60 g /ha (20 DAS) (W_5), pendimethalin (PE) *fb*imazathapyr (20 DAS) (W_6), pendimethalin (PE) *fb*quizalofop ethyl (20 DAS) (W_7). Among all the treatments, growth and yield attributes such as pods count/plant (38.17), seeds count pod^{-1} (8.66) and yield (12.89q/ha) were observed highest with Hand weeding at 15 and 30 DAS.Furthermore, the concurrent use of pre- and post-emergence herbicides, exemplified by combinations like pendimethalin (PE) followed by imazathapyr at 20 DAS and pendimethalin (PE) followed by quizalofop ethyl at 20 DAS, yielded outcomes similar to those achieved through manual weeding.

Comment [WU2]: Check the title

Formatted: Font: Italic

Comment [WU3]: include

Keywords: Mungbean; Growth parameters, Yield attributes and Yield

1. INTRODUCTION

Mungbean (*Vignaradiata* L.) which is also known as green gram is classified in the Order Leguminosae. It is an important pulse and protein rich crop in the world. The crop plays a vital role in human diet by meeting protein requirements and improving fertility status of the soil. This crop is indispensably important to use as a rotational crop. Another important character of this crop is its earliness to maturity and that can give reasonable yield even in the low rainfall areas. its short maturity duration makes the crop ideal for catch cropping, intercropping and relay cropping. In addition, the forage remaining from mungbean after the pods has been picked and threshed is highly important for animal feed. The nutritive value of mungbean lies in its high and easily digestible protein, and contain approximately 25-28% protein,1.0% oil, 3.5-4.5% fiber, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis (Gowda *et al*., 2015).

There are number of constraints that limit the production of mungbean like weeds, insect infestations, shattering, difference in pod maturity and indeterminate growths. Weed infestation is one of the major factors limiting the yield of Mungbean. Uncontrolled weeds may reduce mungbean yield as much as 50-90% compared with weed free (Khaliq *et al*., 2002)). Furthermore, although the magnitude of loss varies with the intensity and type of weed flora, Khan *et al*. (2011) reported that weeds cause 30-50% losses in the grain yield of mungbean and the critical period of crop-weed competition in mungbean varies from 15-30 days after sowing (DAS). The conventional practice to remove weeds in mungbean fields in is hand weeding and it is too tedious and labour intensive. Now days, labour availability is notorious issues. The labor availability is decreasing from time to time, where the production cost is increasing from time to time. Generally, the current study has several advantages on; production cost reduction, labor minimization, productivity increment and it minimizes the duration of fieldwork. Therefore, this work was ~~is~~ designed ~~objective~~ to evaluate pre and post emergence herbicides on controlling grassy and broad leaf weeds in mungbean.

Formatted: Font: Italic

Formatted: Font: Italic

Effective herbicide at appropriate rate may prove as an effective weed control method and replace conventional methods of weed control. But little information is available regarding the herbicide's that is actually suitable for either pre-sowing or post-sowing application in mungbean. Therefore, the present research work was carried out to find out the suitable herbicides for controlling weeds associated with mungbean by pre- or post-sowing application and to evaluate the relative efficacy of herbicides on growth, yield and profitability of mungbean.

2. MATERIALS AND METHODS

The experiment was conducted at Agronomy farm (Faridpur) K.N.I.P.S.S Sultanpur, Uttar Pradesh during *kharif*2023. Treatments comprised five different doses of post and pre-emergence herbicides. Thus, treatments are - weedy check (W_0), ~~one~~hand weeding at 15 DAS (W_1), hand weeding twice at 15 and 30 DAS (W_2), pendimethalin @ 0.75 kg a.i./ha as 1 DAS ~~pre-emergence~~ (W_3), quizalofop-ethyl @ 60 g /ha (20 DAS) (W_4), Imazethapyr @ 60 g /ha (20 DAS) (W_5), pendimethalin (PE) *fb*imazathapyr (20 DAS) (W_6), pendimethalin (PE) *fb*quizalofop ethyl (20 DAS) (W_7). Weedy and weed free plots were also maintained to work out the weed control indices and yield loss due to weeds. The experiment was laid out in randomized block design (RBD) with three replications. Greengram variety Samrat was used

for the study which matured in 60 days. Greengram was sown 20-22 ~~July~~during experiment. Plant to plant distance was maintained ~10 cm in a row spacing of 30 cm. Recommended dose of fertilizer 20:60:40:20 kg NPKS/ha was applied through urea, diammonium phosphate, muriate of potash and agricultural grade sulphur at the time of field preparation. Data on yield and yield attributing characters were recorded from three randomly selected plants from each plot and seed yield was recorded from the net plot. The cost of all type of variable was included to calculate the cost of cultivation and returns. Economic analysis with respect to gross margin was calculated to evaluate the profitability of different treatments.

Comment [WU4]: IN JULY??..IN TITLE YOU MENTION SUMMER THEN HOW JULY COME

Comment [WU5]: CHECK THE RECOMMENDED..I THINK FOR GREENGRAM 20:40:20:20 ITS ENOUGH..IF THE SOIL FERTILITY STATUS IS OK.

3. RESULT AND DISCUSSION

3.1 Effect on growth attributes

The data related to growth attributes of mungbean as affected by different pre and post-emergence herbicides is presented in Table 1.

3.1.1. Plant height (cm)

Among all ~~the pre- and post-emergence herbicide~~ treatments ~~used in summer mungbean.~~ h~~H~~and weeding twice ~~at 15 and 30 DAS~~ recorded highest plant height which was significantly higher than the weedy check, pendimethalin @ 0.75kg ~~a.i~~/ha as pre-emergence, quizalofop-ethyl @ 60 g/ha (20 DAS), imazathapyr @ 60 g/ha (20 DAS) and one hand weeding at 15 DAS, but was at par with pendimethalin (PE) *fb*imazathapyr~~(20 DAS)~~ and pendimethalin (PE) *fb*quizalofop ethyl ~~(20 DAS)~~. The hand weeding at 15 and 30 DAS is the most effective way to control weeds in summer mungbean. This is because hand weeding removes weeds from the field before they have a chance to compete with the mungbean crop for water, nutrients, and sunlight which allowed the mungbean plants to grow without competition from weeds. The other herbicide treatments were not as effective as hand weeding at controlling weeds. pendimethalin is a pre-emergence herbicide that only controls weeds that have not yet emerged from the soil. quizalofop-ethyl and imazathapyr are post-emergence herbicides that control weeds that have already emerged from the soil. However, combination of these pre- and post-emergence herbicides are as effective as hand weeding at controlling of weeds.Singh *et al*. (2015a) observed that utilizing two sessions of manual weeding led to increased plant height in mungbean when compared to both the weedy check and various herbicide treatments administered during both pre and post emergence.

3.1.2. Plant dry weight (g/plant)

Among the various pre- and post-emergence herbicide treatments applied to summer mungbean, hand weeding at 15 and 30 DAS resulted in the highest plant dry weight (g/plant). This was significantly greater than the weedy check, one hand weeding at 15 DAS,pendimethalin @ 0.75kg a.i/ha as pre-emergence, quizalofop-ethyl @ 60 g/ha (20 DAS) and imazathapyr @ 60 g/ha (20 DAS). However, it was on par with the combination of pendimethalin (PE) followed by imazathapyr (20 DAS) and pendimethalin (PE) followed by quizalofop ethyl (20 DAS).The higher plant dry matter in hand weeding and combined pre- and post-emergence herbicide treatments, as opposed to sole pre-emergence or post-emergence applications, stems from the comprehensive weed control these practices offer. Hand weeding ensures precise elimination of weeds, minimizing competition for resources and allowing mungbean plants to allocate more energy to growth. The combined herbicide approach targets weeds at different stages, providing continuous control throughout the crop's growth. In contrast, relying solely on pre-emergence herbicides may leave gaps in weed control, and a post-emergence-only approach might allow early weed competition. The superior plant dry matter in hand weeding and combined herbicide treatments underscores the importance of effective weed management strategies for optimizing mungbean growth.Mirjha*et al*., (2013) also reported that hand-weeding at 20 and 40DAS recorded maximum shoot dry weight and dry weight/plant in mungbean.

3.2 Effect on yield attributes

The data related to yield attributes of mungbean as affected by different pre- and post-emergence herbicides was presented in Table 1 and 2.

3.2.1. No. of pods/plant

Among all the treatments ~~the pre- and post-emergence herbicide to control weeds for higher productivity of summer mungbean,~~ hand weeding at 15 and 30 DAS resulted in maximumnumber of pods/plant. This was significantly greater than the weedy check, ~~one~~ hand weeding at 15 DAS,pendimethalin @ 0.75kg ~~a.i~~/ha as pre-emergence, quizalofop-ethyl @ 60 g/ha (~~20 DAS)~~ and imazathapyr @ 60 g/ha ~~(20 DAS)~~. However, it was on par with the combination of pendimethalin (PE) followed by quizalofop ethyl ~~(20 DAS)~~, pendimethalin (PE) followed by imazathapyr~~(20 DAS)~~ and imazathapyr @ 60 g/ha ~~(20 DAS)~~.The higher number of pods per plant in hand weeding and combined pre- and post-emergence herbicide treatments,

compared to sole pre-emergence or post-emergence applications in mung beans, is attributed to reduced weed competition and enhanced plant development. Hand weeding ensures precise weed removal, minimizing competition for nutrients and space, while combined herbicide treatments provide consistent weed control throughout the crop's growth. In contrast, relying solely on pre-emergence herbicides may lead to weed resurgence, and a post-emergence-only approach might allow early weed interference, both negatively impacting pod production. Effective weed management strategies, particularly hand weeding and combined herbicide applications, are crucial for maximizing pod yield in mungbean crops.Singh *et al*., (2015)and Madukwe*et al*. (2012)also reported similar findings.

3.2.2. Length of pod (cm)

Hand weeding twice at 15 and 30 days after sowing (DAS) proved to be the most effective method for enhancing the pod length in summer mungbean, surpassing the impact of various pre- and post-emergence herbicides. The observed pod length was significantly higher compared to the weedy check, as well as treatments involving a single hand weeding at 15 DAS pendimethalin as a pre-emergence herbicide at a rate of 0.75 kg ~~a.i~~/ha and imazathapyr at 60 g/ha ~~(applied at 20 DAS)~~. The results were comparable to treatments combining pendimethalin followed by quizalofop ethyl at 20 DAS, pendimethalin followed by imazathapyr at 20 DAS, imazathapyr at 60 g/ha at 20 DAS, and quizalofop-ethyl at 60 g/ha at 20 DAS.The increased length of mung bean pods in hand weeding and combined pre + post-emergence herbicide application, compared to only pre- or post-emergence treatments, is attributed to reduced weed competition, comprehensive weed control throughout the growth cycle, and minimized stress on the plants. The selective nature of post-emergence herbicides further contributes to optimal pod development.Singh*et al*. (2022) also reported that that weed free recorded the longest pod length, highest no. of pods per plant, no. of seeds per pod and test weight which was at par with pendimethalin (PE) fb one HW.

Comment [WU6]: No need tomention all time

3.2.3. No. of seeds~~grains~~/pod

Among the various pre- and post-emergence herbicides aimed at weed control to enhance the yield of summer mungbean, manual weeding performed at 15 and 30 days after sowing (DAS) resulted in the highest number of grains per pod. This was significantly superior to the weedy check and a single hand weeding at 15 DAS. However, the results were comparable to treatments

involving pendimethalin (PE) followed by quizalofop ethyl at 20 DAS, pendimethalin (PE) followed by imazathapyr at 20 DAS, imazathapyr at 60 g/ha at 20 DAS, and quizalofop-ethyl at 60 g/ha at 20 DAS.The higher number of grains per pod in mung beans with hand weeding and combined pre + post-emergence herbicide applications, compared to only pre- or post-emergence treatments, is due to reduced weed competition, prolonged weed control, and minimized stress on plants, allowing for optimal grain development.Singh *et al*., (2015a) also noted that employing two rounds of hand weeding resulted in a greater number of seeds per pod in mungbean compared to the weedy check and other herbicide treatments applied during both pre and post emergence.

3.2.4. 100-seed weight (g)

Among the various pre- and post-emergence herbicides employed to manage weeds and enhance the productivity of summer mungbean, manual weeding at 15 and 30 days after sowing (DAS) yielded the highest 100-seed weight (g). This outcome was notably superior to both the weedy check and a single hand weeding at 15 DAS. However, it was comparable to the combined effects of pendimethalin (PE) followed by quizalofopethyl at 20 DAS, pendimethalin (PE) followed by imazathapyr at 20 DAS, imazathapyr at 60 g/ha at 20 DAS, and quizalofop-ethyl at 60 g/ha at 20 DAS.The higher seed weight in mung beans with hand weeding and combined pre + post-emergence herbicide applications, compared to only pre- or post-emergence treatments, is attributed to reduced weed competition, prolonged weed control, and minimized plant stress during seed development, resulting in larger and heavier seeds.Singh *et al*., (2015a) also reported that two hand weeding gave the higher 100-seed weight (g) of mungbean than the weedy check and remaining pre and post emergence herbicide treatments.Awan *et al*. (2009) and Madukwe*et al*. (2012) also found similar results.

3.3 Effect on yield

The data related to yield of mungbean as affected by different pre- and post-emergence herbicides is presented in Table 2.

3.3.1. Grain yield (q/ha)

All the pre- and post-emergence herbicide treatments applied to summer mungbean had a significant impact on seed ~~grain~~ yield (Table 1). HW~~Manual~~ weeding at 15 and 30 days after sowing (DAS) resulted in the highest grain yield (q/ha). This was significantly greater compared

to the weedy check, as well as treatments involving pendimethalin at 0.75 kg a.i/ha as a pre-emergence herbicide, quizalofop-ethyl at 60 g/ha at 20 DAS, a single hand weeding at 15 DAS, and imazathapyr at 60 g/ha at 20 DAS. However, the observed effect was comparable to the combined treatments of pendimethalin (PE) followed by imazathapyr at 20 DAS and pendimethalin (PE) followed by quizalofop ethyl at 20 DAS.The higher grain yield in mung beans with hand weeding and combined pre + post-emergence herbicide applications, as compared to scenarios involving only pre-emergence or post-emergence herbicides, is primarily attributable to the synergistic effects of effective weed management. Hand weeding reduces weed competition, allowing mung bean plants to access essential resources for growth and yield. The combination of pre + post-emergence herbicides ensure continuous and comprehensive weed control throughout the crop's development, minimizing yield losses due to weed interference. This integrated approach reduces stress on the mung bean plants, optimizing conditions for increased grain production. Additionally, the selective nature of post-emergence herbicides targets weeds while sparing the crop, contributing to a higher overall grain yield.Singh *et al*. (2015b) also found that performing hand weeding twice was the most effective method for enhancing grain yield and implementing weed management strategies in garden pea crops. Weed free and two hand weeding treatments gave higher grain yield. Khan *et al*. (2011) and Kumar *et al*. (2017) also reported similar findings.

Comment [WU7]: WHERE IS 2015a??

3.3.2.~~Straw yield (q/ha)~~

Comment [WU8]: Straw yield in moong bean???

Amongst the pre- and post-emergence herbicides and their combinations utilized for weed control and productivity enhancement in summer mungbean cultivation, hand weeding at 15 and 30 days after sowing (DAS) resulted in the highest straw yield (q/ha). This outcome exhibited significant superiority over both the weedy check and a single hand weeding at 15 DAS. However, it was comparable to the combined effects of pendimethalin (PE) followed by quizalofop ethyl at 20 DAS, pendimethalin (PE) followed by imazathapyr at 20 DAS, imazathapyr at 60 g/ha at 20 DAS, and quizalofop-ethyl at 60 g/ha at 20 DAS.The higher straw yield in mung beans with hand weeding and combined pre + post-emergence herbicide applications, compared to only pre- or post-emergence herbicides, is due to effective weed management. Hand weeding reduces weed competition, allowing mung bean plants to allocate more resources to straw production. The dual herbicide approach ensures prolonged weed control, minimizing interference during critical straw development stages. This integrated

strategy reduces plant stress and promotes healthier straw growth. The selective nature of post-emergence herbicides further contributes to the overall increase in straw yield.

3.3.3. Harvest index (%)

The data showed that harvest index in summer mungbean was influenced by various pre- and post-emergence herbicide treatments. The most effective treatments included hand weeding at 15 and 30 days after sowing (DAS), with the highest harvest index observed followed by combination of pendimethalin (PE) followed by imazathapyr at 20 DAS, quizalofop-ethyl at 60 g/ha at 20 DAS, imazathapyr at 60 g/ha at 20 DAS, and pendimethalin at 0.75 kg a.i/ha as a pre-emergence treatment, along with one hand weeding at 15 DAS. In contrast, the weedy check exhibited the lowest harvest index.The higher harvest index in mung bean with hand weeding and combined pre + post-emergence herbicide applications, compared to only pre- or post-emergence herbicides, is due to reduced weed competition, extended control, and minimized plant stress. Hand weeding allows more resources for seed and grain production, while the dual herbicide approach ensures thorough weed control throughout critical seed development stages. This integrated strategy promotes optimal conditions for a higher harvest index, with the selective nature of post-emergence herbicides contributing to the overall increase.Singh *et al*., (2015a) also reported that two hand weeding gave the highest harvest index than the weedy check treatment.Awan *et al*. (2009) and Madukwe*et al*. (2012) also reported similar observations.

CONCLUSION

The study found that hand weeding at 15 and 30 days after sowing significantly outperformed various herbicide treatments in promoting the growth and yield attributes of summer mungbean. This included increased plant height, plant dry weight, and yield-related parameters such as the number of pods per plant, pod length, grains per pod, 100-seed weight, seed~~grain~~ yield, ~~straw yield~~, and harvest index. The efficacy of hand weeding was attributed to its early elimination of weeds, reducing competition for essential resources. Additionally, the combination of pre- and post-emergence herbicides such as pendimethalin (PE) followed by imazathapyr at 20 DAS and pendimethalin (PE) followed by quizalofop ethyl at 20 DAS showed comparable results to hand weeding.

Table 1. Effect of weed management practices on growth and yield attributes of summer mungbean:

Symbol	Treatment	Plant height (cm)	Plant dry weight (g/plant)	No. of pods/plant	Pod length (cm)	No. of seedsgrains/pod
T1	Weedy check	37.56	9.17	31.36	6.11	6.98
T2	One hand weeding at 15 DAS	39.45	12.23	32.08	6.27	8.08
T3	Hand weeding at 15 and 30 DAS	48.87	16.01	38.17	7.14	8.66
T4	Pendimethalin @ 0.75kg a.i/ha as pre-emergence	40.43	13.69	33.06	6.36	8.21
T5	Quizalofop-ethyl @ 60 g/ha (20 DAS)	41.21	13.88	33.60	6.48	8.25
T6	Imazathapyr @ 60 g/ha (20 DAS)	42.40	13.99	36.83	6.85	8.34
T7	Pendimethalin (PE) *fb*imazathapyr (20 DAS)	45.67	15.94	37.79	7.08	8.53
T8	Pendimethalin (PE) *fb*quizalofop-ethyl (20 DAS)	43.20	15.55	37.15	7.00	8.42
	SEm (±)	1.90	0.60	1.31	0.24	0.15
	C.D. at 5%	5.68	1.79	3.94	0.72	0.45

Table 2. Effect of weed management practices on yield and harvest index of summer mungbean:

Symbol	Treatment	100-seed weight (g)	seedGrain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T1	Weedy check	5.35	10.08	21.03	32.35
T2	One hand weeding at 15 DAS	5.52	10.42	21.10	33.06
T3	Hand weeding at 15 and 30 DAS	6.44	12.89	23.87	35.07
T4	Pendimethalin @ 0.75kg a.i/ha as pre-emergence	5.71	10.59	21.32	33.19
T5	Quizalofop-ethyl @ 60 g/ha (20 DAS)	5.80	11.27	21.53	34.36
T6	Imazathapyr @ 60 g/ha (20 DAS)	5.94	11.48	21.95	34.34
T7	Pendimethalin (PE) *fb*imazathapyr (20 DAS)	6.30	11.83	22.35	34.61
T8	Pendimethalin (PE) *fb*quizalofop-ethyl (20 DAS)	6.02	11.75	22.32	34.49

	SEm (±)	0.25	0.47	0.90	-
	C.D. at 5%	0.74	1.40	2.70	-

References

Awan, F.K, Zahid, M.A. and Yaqoob, M. (2009). Weed management in mungbean [*Vignaradiata* (L.) R. Wilczek] using different methods and row spacing. *Pakistan Journal of Weed Science Research*; 15: 269–74.

Gowda, C. L., Chaturvedi, S., Gaur, P., Sameer Kumar, C. and Jukanti, A. (2015). Pulses research and development strategies for India.

Khaliq, A., Aslam, Z. and Cheema, Z. (2002). Efficacy of different weed management strategies in mungbean (*Vignaradiata* L.). *Int. J. Agric. Biol*, 4: 237-39.

Khan, R., Ullah, Rashid, A., Khan, M. and Sohail.(2011). Impact of various rates of pendimethalin herbicide on weed control, seed yield and economic returns in mungbean under rainfed conditions. *J. Agric. Res*, 49: 491-98.

Kumar, N., Hazra, K.K. and Nadarajan, N.N. (2017). Efficacy of pre- and post-emergence herbicides in rainy season greengram (*Vignaradiata*). Indian Journal of Agricultural Sciences; 87 (9): 1219–24.

Mirjha, P.R., Prasad, S.K., Singh, M.K., Paikra, R.H., Patel, S., & Majumdar, M.N. (2013). Effect of weed control measures on weeds, nodulation, growth and yield of mungbean (*Vignaradiata*). *Indian Journal of Agronomy*, 58, 615-617.

Singh, G., Kaur, H., Aggarwal, N., & Sharma, P. (2015a). Effect of herbicides on weeds growth and yield of greengram. *Indian Journal of Weed science*, 47, 38-42.

Singh, J., Chaudhary, D. R., & Kumar, S. (2015b). Effect of post-emergence herbicides on productivity and profitability of garden pea (Pisum sativum L.) in Lahaul valley of Himachal Pradesh. *Himachal Journal of Agricultural Research*, 41(2), 172-176.

Singh, K., Ram, H., Kumar, R., & Meena, R. K. (2022). Effect of Weed Management Practices on Weed Dynamics, Nutrient Depletion, Productivity and Profitability of Summer

Mungbean (*Vignaradiata*) under Zero Tillage Condition. *Legume Research: An International Journal*, 45(6).