Biological Forum – An International Journal **15(8): 278-281(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Impact of Herbicides on Yield and Economics of Clusterbean

Hitesh Borana*, Ishwar Singh, U.N. Shukla and Moola Ram
Department of Agronomy, Agriculture University, Jodhpur (Rajasthan), India.

(Corresponding author: Hitesh Borana)*
(Received: 03 June 2023; Revised: 21 June 2023; Accepted: 23 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: Managing weeds in clusterbean by cultural practices, time consuming, expensive and laborious. These techniques are time-consuming and financially demanding, they are effective. The utilization of selective pre-emergence herbicides like pendimethalin and its ready mixed form, is a common practice for early-stage weed control, however this allows weeds to emerge at later stages, particularly in the case of clusterbean. Hence, the current study was designed and executed during the *kharif* season at the Agricultural Research Station, Mandor, Jodhpur, Rajasthan, India, during the rainy season of 2018. The primary objective of this study was to assess the impact of herbicides application on the yield and economics of clusterbean. The experimental design employed was a randomized block design (RBD) with three replications. The experiment consisted of ten treatments, designated as follows: W_1 - weedy check, W_2 - weed-free, W_3 - pendimethalin at 750 g/ha as pre-emergence (PE), W_4 - imazethapyr at 40 g/ha (early post-emergence), W_5 - pendimethalin + imazethapyr at 750 g/ha (PE), W_6 - imazethapyr + imazamox at 50 g/ha (early post-emergence), W_7 - pendimethalin at 750 g/ha (PE) + 1 hand weeding (HW) at 25 days after sowing (DAS), W_8 - imazethapyr at 40 g/ha (early post-emergence) + 1 HW at 35 DAS, W_9 - pendimethalin + imazethapyr at 750 g/ha (PE) + 1 HW at 25 DAS, and W_{10} - imazethapyr + imazamox at 50 g/ha (early post-emergence) + 1 HW at 35 DAS. Among the various treatments, significantly higher seed yield was obtained with the application of imazethapyr + imazamox at 50 g/ha combined with one hand weeding at 35 DAS. This treatment also resulted in the highest net return (₹ 49,693/ha) and benefit-cost ratio (B:C ratio) of 3.23. Similarly, positive outcomes in terms of net return and B:C ratio were achieved with the combination of imazethapyr + imazamox at 50 g/ha + 1 HW at 35 DAS followed by imazethapyr at 40 g/ha + 1 HW at 35 DAS. These findings underscore the positive impact of certain herbicidal treatments on clusterbean yield and economic parameters.

Keywords: Clusterbean, net return, profitability and yield.

INTRODUCTION

Clusterbean (*Cyamopsis tetragonoloba*), commonly known as "Guar," derives its name from the Sanskrit word "Gowahaar," meaning "cow food." It is a drought-tolerant crop grown in India's semi-arid and arid regions, particularly in the State of Rajasthan. Rajasthan accounts for a significant portion of India's clusterbean cultivation, with an area of 2.39 million hectares, producing 1.0 million tones and yielding 419 kg/ha of clusterbean (Anonymous, 2021-22). Clusterbean is valuable for nitrogen soil enrichment, able to fix around 4% of nitrogen content. Clusterbean serves various purposes such as vegetable consumption, green fodder, green manure, and seed production. The seeds contain a significant gum content (28-33%), finding utility in various industries including textiles, paper, petroleum, pharmaceuticals, food processing, cosmetics, mining explosives, and oil drilling, thus contributing to foreign exchange earnings (Sharma *et al.*, 2017; Kumawat *et al.*, 2017). The crop's growth is hindered by weed competition, especially in marginal and rain-fed areas. The clusterbean crop's critical period of weed competition has been identified as spanning between 20 and 30 days after sowing (DAS). Beyond this timeframe, the persistence of weeds leads to significant yield reductions ranging from 47% to 92%, as evidenced by previous studies (Punia *et al.*, 2011; Patel *et al.*, 2005; Bhadoria *et al.*, 2000). Yield losses of up to 53.7% have been observed due to weed infestations (Saxena *et al.*, 2004). Effective weed management is essential and research has shown that weed control alone can increase seed yield by 68% (Yadav, 1998). The crop cultivation period experienced excessive rainfall, leading to an accelerated microbial breakdown of applied herbicides, including pendimethalin, imazethapyr and imazamox. Interestingly, irrespective of the dosage and timing of application, these herbicides did not exhibit any detrimental effects on the subsequent *rabi* crop, as highlighted in a study by Punia *et al.* (2017). While pre-emergence application of herbicides like fluchloralin and pendimethalin has been effective, arid conditions and winds can limit their efficiency (Punia *et al.*, 2011). Post-emergence herbicides have been tested, including a combination of imazethapyr and imazamox, which have shown promise in controlling a broad spectrum of weeds in legume crops (Sangwan *et al.*, 2016; Sharma *et al.*, 2017). Post-emergence application of imazethapyr 75 g/ha is very effective against broad leaved weeds and sedges, but less efficient to control grasses (Sondhia *et al.*, 2015). Comprehensive evaluation of various doses and combinations of imazethapyr, imazethapyr + imazamox (Odyssey), quizalofop-ethyl, fenoxapropp-ethyl, and pendimethalin revealed no persistent repercussions on the growth, developmental progression, and ultimate yield of the subsequent wheat crop, as indicated by a study conducted by Manhas and Sidhu (2014). Application of herbicide mixtures featuring various modes of action is a strategy to effectively suppress a wide range of weed species, reducing their populations to acceptable levels. Through the utilization of well-designed herbicide mixtures that are both economically viable and more practical than alternative weed management approaches, the expenses associated with weed control can be minimized, subsequently enhancing returns on investment. Given this scenario, the development of advanced post-emergence herbicide combinations becomes crucial for proficiently managing diverse weeds in clusterbean crop. Given these findings, the current study aimed to evaluate the impact of herbicides on clusterbean yield and economic factors. The investigation focused on assessing the effectiveness of post-emergence herbicides, particularly imazethapyr and imazamox, to enhance clusterbean productivity and weed management.

MATERIALS AND METHODS

A field study was conducted during the *kharif* season of 2018 at Agricultural Research Station, Mandor, affiliated with the Agriculture University, Jodhpur. The research station is located geographically between 26°15'N to 26°45'N latitude and 73°00'E to 73°29'E longitude, with an altitude of 231 meters above mean sea level, falling within the western dry region agro-climatic zone. The experimental setup utilized a randomized block design (RBD) with three replications. The study involved ten different treatments: W_1 - weedy check, W_2 - weed-free, W_3 - pendimethalin at 750 g/ha as pre-emergence (PE), W_4 - imazethapyr at 40 g/ha (early post-emergence), W_5 - pendimethalin + imazethapyr at 750 g/ha (PE), W_6 - imazethapyr + imazamox at 50 g/ha (early post-emergence), W_7 - pendimethalin at 750 g/ha (PE) + 1 hand weeding (HW) at 25 days after sowing (DAS), W_8 - imazethapyr at 40 g/ha (early post-emergence) + 1 HW at 35 DAS, W_9 - pendimethalin + imazethapyr at 750 g/ha (PE) + 1 HW at 25 DAS, and W_{10} - imazethapyr + imazamox at 50 g/ha (early post-emergence) + 1 HW at 35 DAS. For the experiment, the clusterbean variety RGC-1017 was planted in rows spaced 30 cm apart, with a seed rate of 15 kg/ha. The recommended nutrient doses of 10 kg N and 40 kg P_2O_5/ha were applied through urea and DAP and full doses of nitrogen and phosphorus were added as a basal application. All prescribed agricultural practices for the region were followed, excluding weed management. Pendimethalin and its combination with imazethapyr were applied as pre-emergence treatments within 2 DAS, while imazethapyr and its combination with imazamox were applied as early post-emergence treatments at 20 DAS. Herbicides were sprayed using a knapsack sprayer at a rate of 800 liters/ha. Hand weeding was conducted in designated plots at 25 and 35 DAS according to treatment specifications. Yields of both seeds and stover were measured from the designated net plot areas for each treatment. Economic assessments of the treatments were based on prevailing market prices. Thorough statistical analysis, including treatment means, standard error means, critical differences, and range of variation, were performed, and significance tests (F-tests) were conducted for each parameter. The collected biometric data were organized into tables and subjected to statistical analysis using standard methodologies for randomized block designs as suggested by Gomez and Gomez (1984).

Table 1: Initial soil parameters.

Sr. No.	Name of parameters	Value	References
1.	Available N (kg/ha)	174	(Subbiah and Asija 1956)
2.	Available P_2O_5 (kg/ha)	22	(Olsen, 1954)
3.	Available K_2O (kg/ha)	325	(Jackson, 1973)
4.	Bulk density (Mg/m^3)	1.77	(Richards, 1954)
5.	Particle density (Mg/m^3)	3.20	(Richards, 1954)
6.	Organic carbon (%)	0.13	(Jackson, 1973)
7.	Soil pH	8.2	(Richards, 1954)
8.	Electrical conductivity (dS/m)	0.12	(Richards, 1954)

RESULTS AND DISCUSSION

A. Impact on Yield

The data analysis demonstrated significant impacts of different treatments on both seed and stover yields compared to the control, as outlined in Table 2. Among the various herbicidal treatments, the most notable seed yield (1180 kg/ha) and stover yield (3340 kg/ha) were achieved with the application of imazethapyr + imazamox at 50 g/ha combined with one hand weeding at 35 days after sowing (DAS). Similarly, imazethapyr at 40 g/ha along with one hand weeding at 35 DAS exhibited equally effective results. Both these treatments exhibited statistically superior performance compared to other treatments and were on par with plots maintained weed-free throughout the season. The seed yield showed a decline of 24.3% when imazethapyr + imazamox at 50 g/ha was applied without concurrent hand weeding at 35 DAS. This decline could be attributed to the sustained suppression of weeds from the application of herbicides at 20 DAS, which in turn allowed some remaining weeds to proliferate and compete with the crop plants during the critical phase of crop-weed competition. The subsequent hand weeding at 35 DAS managed to suppress these residual weeds, creating a weed-free environment during the critical crop period. Research by Singh *et al.* (2015) reported an 81.8% increase in clusterbean seed yield when herbicide application was combined with hand weeding. The better weed management and lack of competition for resources, resulted in favourable conditions for the crop plants, like increased availability of moisture, nutrients, light and other factors, led to better growth and higher dry matter production of plants, which in turn increased seed, stover and biological yields. These impacts led to increased yield numbers with yield attributes parameters (Shashidhar *et al.*, 2020). The enhancement in clusterbean yield components can be attributed to improved growth characteristics of the crop. These results align with the findings of Singh *et al.* (2015); Singh *et al.* (2016); Sharma *et al.*, (2017); Yadav and Mundra (2017) in the context of clusterbean.

B. Impact on Economics

The economic data collected across various components showed that gross returns were positively influenced by higher seed and stover yields. The highest net monetary return of ₹49,693/ha was achieved under imazethapyr + imazamox at 50 g/ha combined with one hand weeding at 35 DAS. The net return was superior to both treatments, weed-free check and imazethapyr at 40 g/ha + one hand weeding at 35 DAS, with a difference of ₹2,030 and ₹3,691/ha, respectively. Furthermore, the treatment imazethapyr + imazamox at 50 g/ha + one hand weeding at 35 DAS demonstrated the highest benefit-cost ratio (B:C) of 3.23, closely followed by imazethapyr at 40 g/ha + one hand weeding at 35 DAS with a ratio of 3.02. The B:C ratio reveals that sole application of herbicides did not comprehensively manage clusterbean crop weeds. However, when herbicide application was supplemented by hand weeding, the B:C ratio demonstrated notable improvement. These results are consistent with the conclusions drawn by Singh *et al.* (2015); Singh *et al.* (2016); Sharma *et al.*, (2017).

Table 2: Effect of different weed management treatments on seed and stover yield.

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)
Weedy check	210.0	641.0
Weed free	1237.0	3503.0
Pendimethalin at 750 g/ha (pre-em.)	694.0	2097.0
Imazethapyr at 40 g/ha (early post-em.)	713.0	2140.0
Pendimethalin + imazethapyr at 750 g/ha (pre-em.)	752.0	2257.0
Imazethapyr + imazamox at 50 g/ha (early post-em.)	893.0	2670.0
Pendimethalin at 750 g/ha (pre-em.) + 1 HW at 25 DAS	903.0	2711.0
Imazethapyr at 40 g/ha (early post-em.) + 1 HW at 35 DAS	1120.0	3240.0
Pendimethalin + imazethapyr at 750 g/ha (pre-em.)+ 1 HW at 25 DAS	975.0	2923.0
Imazethapyr + imazamox at 50 g/ha (early post-em.) + 1 HW at 35 DAS	1180.0	3340.0
S Em ±	44.23	106.02
CD (P=0.05)	131.44	315.03

Table 3: Effect of different weed management treatments on economics.

Treatments	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
Weedy check	19,833	10,500	-9,333	0.52
Weed free	27,783	75,446	47,663	2.71
Pendimethalin at 750 g/ha (pre-em.)	22,398	43,118	20,720	1.92
Imazethapyr at 40 g/ha (early post-em.)	21,393	44,212	22,819	2.06
Pendimethalin + imazethapyr at 750 g/ha (pre-em.)	22,554	46,630	24,076	2.06
Imazethapyr + imazamox at 50 g/ha (early post-em.)	20,942	55,312	34,370	2.64
Pendimethalin at 750 g/ha (pre-em.) + 1 HW at 25 DAS	23,723	55,998	32,275	2.36
Imazethapyr at 40 g/ha (early post-em.) + 1 HW at 35 DAS	22,718	68,720	46,002	3.02
Pendimethalin + imazethapyr at 750 g/ha (pre-em.) + 1 HW at 25 DAS	23,879	60,498	36,619	2.53
Imazethapyr + imazamox at 50 g/ha (early post-em.) + 1 HW at 35 DAS	22,267	71,960	49,693	3.23

CONCLUSIONS

Early post-emergence application of imazethapyr + imazamox at 50 g/ha + 1 HW at 35 DAS recorded higher seed yield and net return of clusterbean followed by imazethapyr at 40 g/ha + 1 HW at 35 DAS.

FUTURE SCOPE

These findings are based on one season experimentation and needs to be validated through further experimentation to formulate a recommendation.

Acknowledgements. Authors are thankful to the Department of Agronomy, Agriculture University, Jodhpur, Rajasthan.
Conflict of Interest. None.

REFERENCES

Anonymous (2021-22). Directorate of Economics & Statistics. Final Estimates of Area, Production and Yield of Crops in Respect of Rajasthan State/U.T. for the Year 2021-22.

Bhadoria, R. B. S., Jain, P. C. and Tomar, S. S. (2000). Crop weed competition in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] under rainfed condition. *Indian Journal of Agronomy*, *45*(4), 737-739.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedure for Agricultural Research. John Willey and Sons, 2nd edition p329.

Jackson, M. L. (1973). Soil Chemical Analysis (II Edition). Prentice Hall of India Private Limited. New Delhi, India.

Kumawat, P., Kaushik, M. K, Meena, V. K, Chouhan, B. S, Meena, R. K. and Kumar, R. (2017). Effect of weed management and fertility levels on productivity of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]. *Legume Research, 40*(5), 884-889.

Manhas, S. S. and Sidhu, A. S. (2014). Residual effect of clusterbean herbicides on succeeding wheat crop. *Indian Journal of Weed Science*, *46*(3), 278-282.

Olsen, S. R. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA: Washington. Circular, 939.

Patel, B. D., Patel, R. B., Meisuriya, M. I. and Patel, M. V. (2005). Integrated weed management in clusterbean [*Cymopsis tetragonoloba* (L.) Taub.]. *National Biennial Conference,* ISWS, PAU, 154-156.

Punia, R., Punia, S. S., Sangwan, M. and Thakral, S. K. (2017). Efficacy of imazethapyr applied alone and its mixture with other herbicides in greengram and their residual effect on mustard. *Indian Journal of Weed Science, 49*(2), 151-155.

Punia, S. S., Singh, S. and Yadav, D. (2011). Bioefficacy of imzethapyar and chlorimuron-ethyl in clusterbean and their residual effect on succeeding rabi crops. *Indian Journal of Weed Science, 43*(2), 48-53.

Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soil. USDA Hand Book No. 60 Oxford & IBH Publication Company, New Delhi.

Sangwan, M., Singh S. and Satyavan. (2016). Efficacy of sequential application of imazethapyr + imazamox and propaquizafop in clusterbean (*Cyamopsis tetragonoloba*) in two texturally different soils. *Indian Journal of Agronomy, 61*, 519-52.

Saxena, A., Singh, Y. V. and Singh, R. (2004). Crop-weed competition in clusterbean in arid region. *Journal of Arid Legumes, 1*(1), 41-43.

Sharma, K., Rawat, G. S, Gaur, D. and Sharma, A. (2017). Effect of post-emergence herbicides on weed control, growth and yield of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] in M.P. *Agricultural Science Digest, 37***(**3), 179-184.

Shashidhar, K. S., Jeberson, M. S., Premaradhya, N., Singh, A. K. and Bhuvaneswari, S. (2020). Weed management effect in blackgram under acidic soils of Manipur. *Indian Journal of Weed Science, 52*(2), 147-152.

Singh, S. P, Yadav, R. S and Gupta V. (2015). Yield performance and nutrient uptake as influenced by integrated weed management in clusterbean. *Indian Journal of Weed Science, 47*(1), 82-84.

Singh, S. P, Yadav, R. S, Sharma V. (2016). Weed control in clusterbean through post-emergence herbicides. *Indian Journal of Weed Science, 48*(2), 202-205.

Sondhia, S., Khankhane, P. J., Singh, P. K. and Sharma, A. R. (2015). Determination of imazethapyr residues in soil and grains after its application to soybeans. *Journal of Pesticide Science,* D14-109.

Subbiah, B. and Asija, G. (1956). A rapid procedure for the estimation of available nitrogen in soils. *Current Science*, *25*, 259–60.

Yadav, R. K and Mundra, S. L. (2017). Weed management and sulphur nutrition in clusterbean for higher productivity and profitability. *Journal of Pharmacognosy and Phytochemistry, 6*(3), 06-08.

Yadav, R. S. (1998). Effect of weed removal in cluster bean (*Cyamopsis tetragonoloba*) under different rain fall situations in an arid region. *Journal of Agronomy and Crop Science, 181*, 209-214.

How to cite this article: Hitesh Borana, Ishwar Singh, UN Shukla and Moola Ram (2023). Impact of Herbicides on Yield and Economics of Clusterbean. *Biological Forum – An International Journal*, *15*(8): 278-281.