Advances in Bioresearch
Adv. Biores., Vol 17 (4) April 2026: 01-05

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.17.4.15

Advances in Bioresearch

ORIGINAL ARTICLE

Effect of different Pre- and Post-emergence Herbicides on Productivity and Profitability of wheat crop (*Triticum aestivum* L.)

Rahul Dhankar* and Amarnath Singh
School of Agricultural Sciences, GD Goenka University, Sohna, Gurugram, India 122103.
Corresponding Author ID: rahul.dhankar61@gmail.com

ABSTRACT
A field experiment was conducted during the rabi seasons of 2023–24 and 2024–25 at the Crop Research Farm, School of Agricultural Sciences, GD Goenka University, Sohna, Haryana, to evaluate the effect of different pre- and post-emergence herbicides on productivity and profitability of wheat (Triticum aestivum L.). The experiment was laid out in a Randomized Block Design with thirteen treatments and three replications. Herbicide treatments significantly influenced wheat yield and economic returns. Among treatments, T_{11} (pendimethalin 1500 g ha^{-1} fb one hand weeding) recorded the highest grain yield (3822.25 and 3977.37 kg ha^{-1}), straw yield (5706.87 and 5754.53 kg ha^{-1}), and biological yield (9529.12 and 9731.90 kg ha^{-1}), and remained statistically at par with T_8 (carfentrazone ethyl 20 g ha^{-1} + sulfosulfuron 25 g ha^{-1}). The weed-free treatment (T_{12}) produced the highest yield, whereas the weedy check (T_{13}) resulted in the lowest yield due to severe weed competition. Economic analysis revealed that T_8 recorded the highest net return (₹ 70,182 and ₹ 78,821 ha^{-1}) and benefit:cost ratio (1.77 and 1.96), followed by T_{10} and T_9. Although the weed-free treatment recorded the highest gross returns, its higher cost of cultivation resulted in comparatively lower profitability. The weedy check recorded the lowest gross and net returns as well as B:C ratio.
Keywords: *Wheat, herbicides, weed management, productivity, profitability, benefit–cost ratio, integrated weed management*

Received 22.02.2026 Revised 25.03.2026 Accepted 18.04.2026

How to cite this article:
Rahul D and Amarnath S. Effect of different Pre- and Post-emergence Herbicides on Productivity and Profitability of wheat crop (*Triticum aestivum* L.). Adv. Biores., Vol 17 (4) April 2026: 01-05.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops globally and plays a central role in food and nutritional security. It is consumed as a staple food by a large proportion of the world's population and contributes a major share of dietary energy through carbohydrates and proteins. In India, wheat is cultivated on about 31.83 million hectares with a production of 113.29 million tonnes during 2023–24 [1]. Despite its high yield potential, actual productivity is often constrained by several biotic and abiotic factors, among which weed infestation is one of the most serious limitations.

Weeds are a major biological constraint in wheat production systems as they compete with the crop for light, nutrients, water, and space, particularly during the early growth stages. Among the various biotic constraints affecting wheat production, infestation of *Phalaris minor* (locally known as *"gulli danda"*) has emerged as a serious problem in north-western India [2; 3; 4]. In severely infested, unmanaged fields, yield losses ranging from approximately 25% to 66% have been reported, depending on weed density, species composition, and duration of infestation [5;6; 7]. The weed flora in wheat fields is diverse and typically includes dominant grassy weeds such as *Phalaris minor* and *Avena ludoviciana*, along with broad-leaved weeds like *Chenopodium album* and *Rumex dentatus*. Effective management of these weeds is essential for sustaining higher wheat productivity. Uncontrolled weed growth can cause severe yield losses, and in extreme cases, grain yield reduction may reach up to 80%, or even lead to complete crop failure under severe infestation conditions [8; 9; 10].

Due to intense weed competition, weed management in wheat remains a major challenge for both researchers and farmers. Traditional weed control practices such as hand weeding and hoeing are labour-intensive, time-consuming, costly, and may sometimes cause mechanical injury to the crop [11]. In comparison, chemical weed control offers a more efficient and practical alternative under present-day farming conditions.

Considering the complex and dynamic weed flora in wheat ecosystems, there is a continuous need to evaluate herbicides with broad-spectrum activity for effective weed suppression [12]. The use of herbicides helps in minimizing yield losses by reducing weed competition, saving labour and management costs, and ultimately improving crop productivity and profitability [13].

In recent years, the application of both pre- and post-emergence herbicides, either alone or in combination as tank mixtures, has become increasingly popular among farmers [14]. However, information regarding the compatibility, effectiveness, and appropriate application timing of such herbicide combinations remains limited. Therefore, there is a need to evaluate suitable herbicides and their application strategies to ensure efficient and sustainable weed management in wheat.

MATERIAL AND METHODS

A field experiment entitled "Effect of different pre- and post-emergence herbicides on productivity and profitability of wheat (*Triticum aestivum* L.)" was conducted during the rabi seasons of 2023–24 and 2024–25 at the Crop Research Farm, School of Agricultural Sciences, GD Goenka University, Sohna, Haryana, India. The experimental site is located at 28.26° N latitude and 77.06° E longitude at an elevation of 237 m above mean sea level. The area experiences a semi-arid subtropical climate characterized by cool winters and hot summers.

The soil of the experimental site was sandy loam in texture with a slightly alkaline reaction (pH 7.58). It was low in organic carbon (0.40%) and available nitrogen (192.5 kg ha^{-1}), medium in available phosphorus (15.4 kg ha^{-1}), and medium in available potassium (248.0 kg ha^{-1}). The experiment was laid out in a Randomized Block Design (RBD) with thirteen treatments, each replicated three times.

The treatment structure included various herbicide options comprising pre-emergence and post-emergence applications, along with weed-free and weedy check plots. The treatments were: T_1: Pyroxasulfone 105 g ha^{-1} (PRE), T_2: Pyroxasulfone 127.5 g ha^{-1} (PRE), T_3: Pyroxasulfone 150 g ha^{-1} (PRE), T_4: Pyroxasulfone 127.5 g ha^{-1} + Pendimethalin 1500 g ha^{-1} (PRE), T_5: Pyroxasulfone 127.5 g ha^{-1} fb Pinoxaden 50 g ha^{-1}, T_6: Pyroxasulfone 127.5 g ha^{-1} + Pendimethalin 1500 g ha^{-1} fb Pinoxaden 50 g ha^{-1}, T_7: Pyroxasulfone 127.5 g ha^{-1} fb Clodinafop-propargyl 60 g ha^{-1}, T_8: Carfentrazone-ethyl 20 g ha^{-1} + Sulfosulfuron 25 g ha^{-1}, T_9: Mesosulfuron methyl + Iodosulfuron methyl sodium 14.4 g ha^{-1}, T_{10}: Clodinafop-propargyl 60 g ha^{-1} + Metsulfuron methyl 4 g ha^{-1}, T_{11}: Pendimethalin 1500 g ha^{-1} fb one hand weeding at 30 DAS, T_{12}: weed free, and T_{13}: weedy check.

The wheat variety HD-2967 was sown during the second fortnight of November in both years using a seed rate of 100 kg ha^{-1} with a row spacing of 20 cm. A recommended fertilizer dose of 120:60:25 kg $N:P_2O_5:ZnSO_4$ ha^{-1} was applied to wheat. Herbicide applications were carried out using a knapsack sprayer equipped with a flat-fan nozzle, maintaining a spray volume of 500 L ha^{-1} for pre-emergence treatments and 400 L ha^{-1} for post-emergence applications.

Observations on yield and economics were taken at post-harvest stage. The recorded data were statistically analyzed using analysis of variance (ANOVA) appropriate for the Randomized Block Design (RBD) as per [15]. Treatment differences were tested using the F-test, and means were compared using the critical difference (CD) at 5% level of significance.

RESULT AND DISCUSSION

Yield

The different weed management treatments exerted a significant influence on grain yield, straw yield, biological yield, and harvest index during both years of the study. The weedy check (T_{13}) was included only as a reference treatment to quantify yield losses under complete weed infestation conditions, as commonly emphasized in weed competition studies [16].

Pooled analysis indicated that the maximum grain yield was obtained with treatment T_{11} (3822.25 and 3977.37 kg ha^{-1} during 2023–24 and 2024–25, respectively), which was statistically comparable with T_8 (3934.92 and 4095.13 kg ha^{-1}). The higher yield under T_{11} can be associated with improved crop growth conditions, reduced weed pressure, and more efficient utilization of applied nutrients, which ultimately enhanced assimilate production and its effective allocation towards grain development [17].

A comparable trend was recorded for straw yield, where T_{11} produced 5706.87 and 5754.53 kg ha^{-1}, remaining statistically at par with T_8 (5870.48 and 5922.19 kg ha^{-1}). In line with this, biological yield also reached its highest level under T_{11} (9529.12 and 9731.90 kg ha^{-1}), which was statistically similar to T_8 (9805.40 and 10017.32 kg ha^{-1}). These observations corroborate earlier findings reported in similar weed management studies [18].

The harvest index exhibited only marginal variation among treatments; however, slightly higher values were recorded under T_{11} (40.11 and 40.87%) and T_8 (40.13 and 40.88%). This indicates improved efficiency in the partitioning of photosynthates towards economic yield under effective weed control conditions [19].

The weed-free treatment (T_{12}) produced the highest grain yield (4110.00 and 4275.94 kg ha^{-1}), highlighting the yield potential of wheat under complete weed suppression. In contrast, the weedy check (T_{13}) recorded the lowest grain yield (2045.02 and 2128.61 kg ha^{-1}), straw yield (3101.13 and 3166.94 kg ha^{-1}), and biological yield (5146.16 and 5295.54 kg ha^{-1}), clearly reflecting the severe reduction in crop productivity under uncontrolled weed competition [20, 21].

Overall, it may be concluded that treatments T_{11} was most effective and T_8 was statically at par among all herbicidal options, showing consistent superiority in yield enhancement over other treatments, confirming the importance of efficient weed management in wheat.

Table 1: Effect of different pre- and post-emergence herbicides on yield of wheat

Tr. No.	Treatments	Yield (kg ha^{-1})							
		Grain yield		Straw yield		Biological yield		Harvest index (%)	
		2023-24	2024-25	2023-24	2024-25	2023-24	2024-25	2023-24	2024-25
T1	Pyroxasulfone 105 gm/ha	2907.37	2937.23	4393.80	4445.75	7301.17	7382.98	39.92	40.28
T2	Pyroxasulfone 127.5 gm/ha	2928.30	3062.14	4400.34	4457.17	7328.64	7519.31	39.96	40.32
T3	Pyroxasulfone 150 gm/ha	2979.30	3100.43	4472.52	4509.92	7451.83	7610.35	39.98	40.74
T4	Pyroxasulfone 127.5 gm/ha + Pendimethalin 1500 g/ha	3672.84	3823.12	5505.22	5550.62	9178.06	9373.74	40.02	40.78
T5	Pyroxasulfone 127.5 g/ha fb pinoxaden 50 g/ha	2967.93	3088.52	4457.57	4494.84	7425.50	7583.36	39.97	40.73
T6	Pyroxasulfone 127.5 g/ha + Pendimethalin 1500 g/ha (PRE) fb pinoxaden 50 g/ha (PoE)	3702.26	3852.68	5535.01	5581.19	9237.27	9433.87	40.08	40.84
T7	Pyroxasulfone 127.5 gm/ha fb Clodinafop propargyl 60g/ha	3024.78	3147.62	4537.23	4575.22	7562.01	7722.83	40.00	40.76
T8	Carfentrazone ethyl 20g/ha + Sulfosulfuron 25 g/ha (TM)	3822.25	3977.37	5706.87	5754.53	9529.12	9731.90	40.11	40.87
T9	Mesoulfuron Methyl + iodosulfuron methyl sodium 14.4 g/ha (TM)	3693.50	3843.92	5530.34	5576.30	9223.84	9420.22	40.05	40.80
T10	Clodinafop propargyl 60g/ha + metsulfuron Methyl 4g/h (RM)	3695.67	3845.82	5528.18	5574.30	9223.85	9420.12	40.07	40.82
T11	Pendimethalin 1500 g/ha fb one hand weeding	3934.92	4095.13	5870.48	5922.19	9805.40	10017.32	40.13	40.88
T12	Weed Free	4110.00	4275.94	6130.29	6181.86	10240.29	10457.80	40.14	40.89
T13	Weedy Check	2045.02	2128.61	3101.13	3166.94	5146.16	5295.54	39.74	40.20
SE(m)±		0.12	103.54	132.35	181.89	173.40	285.37	--	--
LSD (P=0.05)		0.38	302.21	386.31	530.89	506.13	832.94	--	--

Economics

Gross returns closely followed the pattern of yield performance across treatments. The highest gross return (₹ 1,17,989 and ₹ 1,27,955 ha^{-1} during 2023–24 and 2024–25, respectively) was obtained under the weed-free treatment (T_{12}), which was mainly due to maximum grain and straw production under complete absence of weed competition. Among herbicidal treatments, T_8 (Carfentrazone-ethyl 20 g ha^{-1} + Sulfosulfuron 25 g ha^{-1}) recorded consistently higher gross returns (₹ 1,09,757 and ₹ 1,19,046 ha^{-1}), followed by T_{10} (Clodinafop + metsulfuron @ 60 + 4 g ha^{-1}) with ₹ 1,06,174 and ₹ 1,15,169 ha^{-1}, and T_9 (Mesosulfuron methyl + Iodosulfuron methyl sodium) with ₹ 1,06,139 and ₹ 1,15,141 ha^{-1}. These results clearly indicate that effective post-emergence herbicide combinations were more efficient in enhancing economic returns through better weed suppression and improved yield realization. In contrast, the weedy check (T_{13}) recorded the lowest gross return (₹ 58,962 and ₹ 64,235 ha^{-1}), primarily due to severe yield reduction under uncontrolled weed infestation. Similar findings have been reported by [20 and 22], who observed that effective weed control substantially improves gross economic returns in wheat.

Net returns followed a trend similar to gross returns, reflecting the combined effect of productivity and cost of cultivation. The maximum net return was recorded under T_8 (₹ 70,182 and ₹ 78,821 ha^{-1}), followed by T_{10} (₹ 66,379 and ₹ 74,654 ha^{-1}) and T_9 (₹ 66,163 and ₹ 75,316 ha^{-1}). The higher profitability of these treatments can be attributed to efficient weed control leading to improved crop growth and higher economic yield. Although the weed-free treatment (T_{12}) recorded the highest gross return, its relatively higher cost of cultivation resulted in comparatively lower net returns (₹ 64,414 and ₹ 72,030 ha^{-1}). In contrast, the weedy check (T_{13}) registered the lowest net return (₹ 19,787 and ₹ 24,509 ha^{-1}), clearly indicating that uncontrolled weed growth drastically reduces profitability even under low input costs. Similar observations have been reported by [13 and 23], who emphasized that effective weed management significantly enhances net returns in wheat-based systems.

The B:C ratio, which represents economic efficiency, varied considerably among treatments. The highest B:C ratio was recorded under T_8 (1.77 and 1.96), followed by T_{10} (1.67 and 1.84) and T_9 (1.66 and 1.89), indicating superior economic performance of these herbicide combinations. These treatments were more efficient in converting investment into profitable returns due to sustained and broad-spectrum weed control. Integrated herbicide approaches such as T_4 and T_6 also recorded relatively higher B:C ratios (up to 1.69), suggesting that sequential and combined applications improve economic efficiency. In contrast, the lowest B:C ratio was observed under the weedy check (0.51 and 0.62), confirming that weed infestation severely reduces economic efficiency irrespective of lower input costs. Similar results have been reported by [24], who highlighted that uncontrolled weed growth significantly reduces benefit:cost ratio in wheat production systems.

Table 2: Effect of different pre- and post-emergence herbicides on economics of wheat

Tr. No.	Treatments	Economics					
		Gross return		Net return		B-C ratio	
		2023-24	2024-25	2023-24	2024-25	2023-24	2024-25
T1	Pyroxasulfone 105 gm/ha	83751	89091	43175	47615	1.06	1.15
T2	Pyroxasulfone 127.5 gm/ha	84228	91813	43353	49963	1.06	1.19
T3	Pyroxasulfone 150 gm/ha	85673	92944	44498	50718	1.08	1.20
T4	Pyroxasulfone 127.5 gm/ha + Pendimethalin 1500 g/ha	105574	114545	64174	71945	1.55	1.69
T5	Pyroxasulfone 127.5 g/ha fb pinoxaden 50 g/ha	85356	92600	44081	50250	1.07	1.19
T6	Pyroxasulfone 127.5 g/ha + Pendimethalin 1500 g/ha (PRE) fb pinoxaden 50 g/ha (PoE)	106348	115357	64548	72256	1.54	1.68
T7	Pyroxasulfone 127.5 gm/ha fb Clodinafop propargyl 60g/ha	86963	94338	45607	51888	1.10	1.22
T8	Carfentrazone ethyl 20g/ha + Sulfosulfuron 25 g/ha (TM)	109757	119046	70182	78821	1.77	1.96
T9	Mesoulfuron Methyl + iodosulfuron methyl sodium 14.4 g/ha (TM)	106139	115141	66163	75316	1.66	1.89
T10	Clodinafop propargyl 60g/ha + metsulfuron Methyl 4g/h (RM)	106174	115169	66379	74654	1.67	1.84
T11	Pendimethalin 1500 g/ha fb one hand weeding	112969	122555	68469	77329	1.54	1.71
T12	Weed Free	117989	127955	64414	72030	1.20	1.29
T13	Weedy Check	58962	64235	19787	24509	0.51	0.62

REFERENCES

1. Department of Agriculture & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India.
2. Sidhu, H.S., Brar, A.S. & Singh, B. (2014) Herbicide resistance in wheat ecosystems of north-west India and its management. *Pest Management Science*, 70(12), 1805–1812.
3. Rasool, S., Hassan, G. & Khan, M.A. (2019) *Phalaris minor* infestation and herbicide resistance issues in wheat systems. *Weed Biology and Management*, 19(2), 85–92.
4. Singh, R.K., Chhokar, R.S. & Sharma, R.K. (2021b) Herbicide resistance in *Phalaris minor* and its management strategies in wheat. *Crop Protection*, 144, 105612.
5. Yadav, A. & Malik, R.K. (2005) Herbicide resistance and yield losses in wheat. *Weed Technology*, 19(4), 894–899.

6. Angiras, N.N., Kumar, S. & Rana, S.S. (2008) Weed dynamics and yield losses in wheat under different weed management practices. *Indian Journal of Weed Science*, 40(1–2), 1–6.
7. Nosratti, I., Mahmoodi, S., Rahimi, A. & Bagheri, H. (2017) Weed competition and yield loss assessment in wheat under different environmental conditions. *Crop Protection*, 95, 1–7.
8. Pandey, J., Singh, R.K. & Singh, V.P. (2000) Yield losses due to weeds in wheat and their management. *Indian Journal of Weed Science*, 32(1–2), 12–16.
9. Gopinath, K.A. & Kundu, S. (2008) Yield losses in wheat due to weed competition under different conditions. *Indian Journal of Agronomy*, 53(3), 195–199.
10. Kalita, H., *et al.,* (2014) Weed management in wheat and associated yield losses. *Indian Journal of Weed Science*, 46(3), 236–239.
11. Ram, H., Yadav, A. & Singh, R. (2011) Evaluation of weed control methods in wheat under irrigated conditions. *Indian Journal of Agronomy*, 56(3), 205–210.
12. Chopra, N.K., Chopra, N. & Singh, G. (2015) Evaluation of herbicide combinations for weed control in wheat. *Indian Journal of Agronomy*, 60(2), 254–259.
13. Singh, S., Kumar, R. & Yadav, A. (2018) Economic evaluation of weed control practices in wheat. *Journal of Agronomy*, 67(3), 210–218.
14. Jat, R.K. & Singh, S. (2021) Integrated weed management in wheat using herbicide combinations. *Journal of Crop and Weed*, 17(1), 1–10.
15. Gomez, K.A. & Gomez, A.A. (1984) *Statistical Procedures for Agricultural Research*. Wiley, New York.
16. Zimdahl, R.L. (2018) *Fundamentals of Weed Science*. 5th edn. Academic Press, USA.
17. Pandey, J., Singh, R.K. & Kumar, S. (2001) Weed competition and its effect on wheat yield and yield attributes. *Indian Journal of Agronomy*, 46(4), 603–607.
18. Singh, S., Chhokar, R.S. & Singh, R.K. (2013) Weed management effects on growth and yield of wheat. *Indian Journal of Agronomy*, 58(2), 198–202.
19. Donald, C.M. (1962) In search of yield. *Journal of the Australian Institute of Agricultural Science*, 28, 171–178.
20. Chhokar, R.S., Sharma, R.K. & Gill, S.C. (2014) Herbicide-resistant *Phalaris minor* and its management in wheat. *Weed Technology*, 28(3), 445–457.
21. Malik, R.K. (1996) Evolution of herbicide resistance in *Phalaris minor* in wheat. *Proceedings of Indian Society of Weed Science*, 19, 1–8.
22. Kumar, S., Singh, R. & Sharma, A. (2016) Effect of herbicides on weed control efficiency and productivity of wheat. *Indian Journal of Weed Science*, 48(2), 150–156.
23. Raj, A., Kumar, P. & Singh, S. (2020) Effect of weed control practices on economics and productivity of wheat. *Journal of Crop and Weed Management*, 16(1), 45–52.
24. Paighan, R., Singh, S. & Sharma, R.K. (2013) Economic analysis of weed management practices in wheat. *Indian Journal of Weed Science*, 45(2), 120–125.