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Research Communication

Efficacy of pyroxasulfone and its combinations against weeds in wheat (*Triticum aestivum*)

LAKHAN BHALSE[1], A.K. JHA[2], BADAL VERMA[3], SHIVANGI RAGHUWANSHI[4], MUSKAN PORWAL[5] AND M.P. SAHU[6]

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482 004

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) season of 2021–22 at the research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh to study the efficacy of pre-emergence herbicides against weeds in wheat (*Triticum aestivum* L.). The experiment was laid out in a randomized block design with 3 replications and 8 weed control treatments. Major weed flora in the experimental site, viz. *Medicago polymorpha* (L.) (28.97%) and *Cichorium intybus* (L.) (26.19%) were predominant in dicot weeds and in monocot weeds, *Phalaris minor* (17.82%) was dominant. The weedy check plot had the higher density and dry weight of weeds. Hand weeding (once) was done at 25 DAS (day after sowing) in wheat, reducing weeds density and dry weight to the maximum extent at 40 DAS with a weed control efficiency (WCE) of 92.8%, proving superiority over other treatments. Among the herbicidal applications, pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha significantly reduced the monocot and dicot weeds density and dry weight, followed by pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha. Pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha resulted in maximum values of growth parameters, viz. plant height (66.38 cm), number of tillers/m^2 (403.14) and yield attributing characters, viz. grains per earhead (51.00) and grain yield (5.65 t/ha) as compared to other herbicidal treatments.

Key words: Hand weeding, Herbicidal applications, Pre-emergence herbicides, Pyroxasulfone + metribuzin, Weed flora, Wheat

Wheat (*Triticum aestivum* L.) is an essential *rabi* season crop that plays a vital role in India's economy. It has a critical share in food bin with 36% share in the complete food grains which are produced from India, ensuring food and nourishment security (Sangwan *et al*., 2019). Wheat is grown on 223.40 million hectares, yielding 778.6 million metric tonnes worldwide. It is cultivated on 31.62 million hectares in India, producing 3420 kg/ha with a total production of 109.2 million metric tonnes (USDA 2021). In Madhya Pradesh, wheat is grown on 10.02 million hectares with total production of 16.52 million metric tonnes and yielding 3298 kg/ha (Anonymous 2021). Many variables influence wheat production, but one of the most severe reasons for low irrigated wheat yield is the infestation of weeds (Raghav *et al.*, 2023; Tanisha *et al.,* 2022). Weeding by hand or with animal-drawn equipment is not only inefficient but also quite costly due to increased labour and fuel costs (Jha *et al.,* 2011; Tomar *et al.,* 2023). Many herbicides, like sulfoslfuron, metribuzin, metsulfuron are used to control weeds in wheat. However, they have not shown to be very successful in managing all types of weeds. So, evaluating alternate herbicides for effective weed control in wheat became essential. Henceforth, present study was carried out to evaluate the performance of pre-emergence herbicides against weeds in wheat.

A field experiment was conducted during winter (*rabi*) season of 2021–22 at the research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. The experiment was laid out in a randomized block design (RBD) with 3 replications and 8 weed control treatments. Treatments applied during the field experimentation were pendimethalin at 1000 g *a.i.*/ha; pyroxasulfone at 127.5 g *a.i.*/ha; pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha; metribuzin at 300 g *a.i.*/ha; pendimethalin + metribuzin at 1250 + 280 g *a.i.*/ha; pyroxasulfone +

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[3]Corresponding author's Email: badalv82282@gmail.com

[1,4]M.Sc. Student, [2]Assistant Professor, [3,5]Ph.D. Scholar, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482 004; [6]Senior Research Fellow, ICAR-Directorate of Weed Research, Maharajpur, Jabalpur, Madhya Pradesh 482 004

metribuzin at 127.5 + 280 g *a.i*/ha as pre-emergence (3 DAS); hand weeding once at 25 DAS and weedy check. The research was carried out on clayey soil with a medium organic carbon content (0.61%), accessible nitrogen content (371 kg/ha), phosphorus content (17.1 kg/ha) and potassium content (296 kg/ha) and neutral in reaction (7.1 *p*H). A total 53.3 mm of winter rainfall was recorded during the crop growth period. The average weekly maximum temperature was 21 to 38.4°C, while the average weekly minimum temperature was 4.8 to 18.2°C. Certified seed of wheat variety 'JW 3382' with a high germination per cent was seeded at a rate of 100 kg/ha. Herbicides were sprayed with a Knapsack sprayer equipped with a flat fan nozzle. The significant differences between treatments were compared by critical difference at a 5% probability level.

Among all the weeds, dicot weeds were dominant over monocot weeds. The major weed flora observed in the experimental field in association with the wheat were *Medicago polymorpha* (L.) (28.97%), *Cichorium intybus* (L.) (26.19%), followed by *Chenopodium album* (L.) (16.10%) and *Anagallis arvensis* (L.) (10.92%) in dicot weeds. While, among monocot weeds, *Phalaris minor* (17.82%) was dominant.

The total weed density at 40 DAS varied significantly due to different weed-management practices in wheat. A weed-free check treatment showed the lowest density of monocot and dicot weeds, while the highest weeds density was recorded in the weedy check (Table 1). Among the weed-management practices, a significantly lower density of total weeds was observed in hand-weeding at 25 DAS (3.05/m^2). However, it was at par with pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha (4.12/m^2) followed by pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha. Pre-emergence application of herbicides inhibited the growth of newly germinated weed seeds or seedlings. Thus, it significantly reduced the total weed population during the initial periods of crop growth (Meena *et al*., 2019; Rani *et al*., 2021).

The total weed dry weight at 40 DAS was recorded minimum in the weed-free check, while the highest total dry weight was in the weedy check (Table 1). Among the different weed management treatments, hand weeding treatment recorded the lower dry matter of all the weed species compared to weedy check at 40 DAS, which recorded the highest values in respect of these parameters. In herbicidal treatments, application of pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha significantly reduced the dry matter of all the weed species (4.46 g/m^2), being statistically at par with pendimethalin + pyroxasulfone at 1250+127.5 g *a.i.*/ha (5.05 g/m^2). This was mainly due to better control of weed growth from germination to harvesting, resulting in lower dry weight of weeds.

Different weed-management treatments exerted their remarkable effect on weed control efficiency (Table 1). The range of weed control efficiency (WCE) among different weed-management practices varied between 53.0 and 92.8% over the weedy check. The highest WCE at 40 DAS was recorded under hand weeding treatment (92.8%), followed by the application of pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha (86.9%) and pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha. These outcomes are in line with the results of Punia *et al*., (2020) and Lakra *et al*., (2022).

Various growth parameters and yield attributes, viz. plant height, number of tillers/m^2 and grains/earhead plays a vital role in increasing the productivity of wheat crop,

Table 1. Effect of different weed control treatments on total weed density, dry weight and weed control efficiency in wheat

Treatment	Weed density (no./m^2) 40 DAS	Weed dry weight (g/m^2) 40 DAS	Weed-control efficiency (%) 40 DAS
Pendimethalin at 1000 g *a.i.*/ha	7.15 (50.73)	8.40 (70.06)	53.0
Pyroxasulfone at 127.5 g *a.i.*/ha	5.68 (31.79)	6.77 (45.42)	69.5
Pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha	4.58 (20.48)	5.05 (25.07)	83.2
Metribuzin at 300 g *a.i.*/ha	6.73 (44.82)	7.93 (62.41)	58.1
Pendimethalin + metribuzin at 1250 + 280 g *a.i.*/ha	4.70 (21.58)	5.26 (27.24)	81.7
Pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha	4.12 (16.45)	4.46 (19.47)	86.9
Weedy check	10.84 (116.99)	12.23 (149.23)	0.0
Hand weeding (One)	3.05 (8.85)	3.34 (10.70)	92.8
SEm±	0.07	0.08	-
CD (P=0.05)	0.21	0.25	-

Square root (X+0.5)-transformed values; values in the parentheses are original values; DAS - days after sowing

Table 2. Effect of different weed-control treatments on growth parameters, yield attributes and yield of wheat

Treatment	Plant height (cm) (60 DAS)	Number of tillers/m^2 (60 DAS)	Number of grains/ earhead	Grain yield (t/ha)	B:C Ratio
Pendimethalin at 1000 g *a.i.*/ha	61.2	378.0	40.0	4.83	2.67
Pyroxasulfone at 127.5 g *a.i.*/ha	61.3	383.5	43.0	5.01	2.57
Pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha	63.8	394.1	47.0	5.62	2.72
Metribuzin at 300 g *a.i.*/ha	59.1	374.1	39.0	4.58	2.58
Pendimethalin + metribuzin at 1250 + 280 g *a.i.*/ha	63.1	391.1	45.0	5.05	2.69
Pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha	66.3	403.1	51.0	5.65	2.80
Weedy check	52.8	352.1	33.0	2.80	1.74
Hand weeding (One)	69.9	412.9	55.0	5.72	2.64
SEm±	0.82	2.82	0.96	52.95	-
CD (P=0.05)	2.48	8.54	2.92	160.60	-

DAS - days after sowing

which were favourably influenced by the weed management treatments (Table 2). Significantly, a higher value of all said parameters were recorded under weed-free (hand weeding at 25 DAS), while a lower values were recorded in the weedy check treatment. Amongst different herbicidal treatments, pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha resulted in higher values of plant height (66.3 cm), number of tillers/m^2 (403.1) and grains/earhead (51.0) followed by pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha.

The application of herbicidal treatments resulted in a marked increase in weed control efficiency and yield attributes, which had significantly higher grain yields over the weedy check (Table 2). Pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha exhibited higher grain yield (5.65 t/ha), followed by pendimethalin + pyroxasulfone at 1250 + 127.5 g *a.i.*/ha and both treatments were at par with each other. Reduced competition for moisture, space, light and nutrients between crop and weeds along with effective suppression of weeds by these pre-emergence herbicides has helped in obtaining higher yield (Kumar *et al*., 2017; Singh *et al*., 2019). However, weedy check gave the lowest wheat grain yield due to severe competition from all types of weeds.

The minimum benefit cost (B:C ratio) ratio was found in weedy check treatment where weeds were not suppressed (Table 2). In the plot where pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha was used, the B:C ratio was found highest (2.80), followed by pendimethalin + pyroxasulfone at 1,250 + 127.5 g *a.i.*/ha (2.72).

It can be concluded that pyroxasulfone + metribuzin at 127.5 + 280 g *a.i.*/ha is the most suitable and effective weed management practice for achieving higher grain yield by reducing the weed growth throughout the critical crop period in wheat crop with higher net monetary returns.

REFERENCES

Anonymous. 2021. Annual Report 2021–2022, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of Madhya Pradesh.

Jha, A.K., Kewat, M.L., Upadhyay, V.B. and Vishwakarma, S.K. 2011. Effect of tillage and sowing management on productivity, economics and energetics of rice- wheat cropping system for Kamore Plataue and *Satpura hill zone of Madhya Pradesh. Indian Journal of Agronomy* **56**(1): 35–50.

Kumar, R., Singh, R.S., Jaidev and Kumar, M. 2017. Effect of herbicides on weeds, grain yield and soil health in wheat. *Indian Journal of Weed Science* **49**(1): 88–89.

Lakra, K., Pyare, Ram, Singh, Puneet Kumar, Verma, Sunil Kumar, Singh, Rajiv Kumar, Upadhyay, Kumar, Pravin and Tyagi, Vishal. 2022. Effect of irrigation schedule and herbicides application on growth and productivity of wheat (*Triticum aestivum*) in semi-arid environment. *Indian Journal of Agronomy* **67**(2): 129–136.

Meena, V., Kaushik, M.K., Dotaniya, M.L., Meena, B.P. and Das, H. 2019. Bio-efficacy of readi-mix *Science* **51**(4): 344–351.

Raghav, P., Jha, A.K., Badal, V., Rahul, K. and Richa, S. 2023. Bio-efficacy of pinoxaden as post-emergence herbicide against weeds in wheat crop. *Pollution research* **42**(1): 115–117.

Punia, S.S. Soni, J., Singh, S.K. and Kamboj, P. 2020. Management of herbicide resistant *Phalaris minor* in wheat. *Indian Journal of Weed Science* **52**(3): 237–240.

Sangwan, M., Hooda, V., Singh, J. and Duhan, A. 2019. Herbicidal weed management in dual purpose tall wheat. *Indian Journal of Agricultural Sciences* **89**: 141–144.

Rani, Sarita, Kumar, Suresh, Hooda, V.S. and Kumar, Satish. 2021. Bio-efficacy of metribuzin based herbicide mixtures on weeds and productivity of wheat. *Indian Journal of Agronomy* **66**(4): 407–412.

Singh, R.S., Kumar, R., Kumar, M. and Pandey, D. 2019. Effect of herbicides to control weeds in wheat. *Indian Journal of Weed Science* **51**(1): 75–77.

Tanisha, Nirala, Jha A.K., Badal Verma, Pushpendra Singh Yadav, Mahendra Anjna and Lakhan Bhalse. 2022. Bio efficacy of pinoxaden on weed flora and yield of wheat (*Triticum aestivum* L.). *Biological Forum–An International Journal* **14**(4): 558–561.

Tomar, D.S., Jha, A.K., Verma, B., Meshram, R.K., Porwal, M., Chouhan, M. and Rajpoot, A. 2023. Comparative efficacy of different herbicidal combinations on weed growth and yield attributes of wheat. *International Journal of Environment and Climate Change* **13**(8): 889–898.

USDA. 2021. World Agricultural Production, United States, Department of Agriculture, Foreign Agricultural Service, Circular Series. WAP 2–21. February 2021.