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Bio efficacy of Pinoxaden on Weed Flora and Yield of Wheat (*Triticum aestivum* L.)

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ABSTRACT: Heavy weed infestation has become a significant concern in boosting and maintaining wheat productivity. Weeds reduce wheat yield by 25-40%. Effective weed control is essential for increasing wheat productivity, necessitating a detailed analysis of weed flora. Thus, weed management through a proper combination of herbicides can be an option to effectively manage complex weed flora without crop injury. Therefore, a field study was conducted at Agricultural Research Farm, AICRP on Wheat, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, during the *Rabi* season of 2021. The experiment comprised five post-emergence herbicides application (pinoxaden at 40 g *a.i.*/ha, pinoxaden at 45 g *a.i.*/ha, pinoxaden at 90 g *a.i.*/ha, clodinafop propargyl at 90 g *a.i.*/ha, sulfosulfuron at 25 g *a.i.*/ha) along with weed-free and weedy check treatments. The crop was infested with *Phalaris minor, Cichorium intybus, Medicago denticulata* and *Avenaludoviciana*. The results showed that weed management practices significantly influenced grassy, broad-leaved weeds, weed density and dry weight, and pinoxaden at 90 g *a.i.*/ha effectively controls all types of weeds. However, Growth parameters and yield attributes (plant height, number of tillers/m^2, grains/earhead) and grain yield were recorded highest with the post-emergence application of pinoxaden at 45 g *a.i.*/ha and found most remunerative than other treatments.

Keywords: Pinoxaden, Post-emergence herbicide, Weed flora, Weed management practices, Wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the staple food crop of the world, and it largely contributes to India's food security. Wheat is grown on 223.40 million hectares, producing 778.6 million metric tons worldwide. In India, it is produced in an area of 31.62 million hectares with a production of 109.2 million tons and productivity of 3420 kg per hectare (USDA, 2021). In Madhya Pradesh, wheat is grown in a 10.02 million hectares area with a production of 16.52 million metric tons and productivity of 3298 kg per hectare (Anonymous, 2021).

Both types of grassy and broad-leaf weeds are seriously plaguing the wheat crop. Depending on the quantity and kind of weeds present in a region, weeds that emerge among crop seedlings are harmful and, if not eliminated in the early stages of crop growth, may result in yield reductions of between 10% and 40%. Wheat cultivation best suits soils with a clay loam or loam texture, good structure, and a moderate water-holding capability.

Controlling weeds is now a crucial part of raising agriculture production. Weeding by hand or using machinery driven by animals is ineffective and relatively expensive, owing to higher labour and fuel expenses. Applying herbicides appropriately is the only practical and economical technique to manage weeds under these circumstances (Fayad *et al*., 1998). There are now various chemical herbicides on the market that effectively control weeds in wheat. Numerous herbicides, like sulfosulfuron, Metribuzin, Metsulfuron, and many others, are used in wheat to control weeds. However, they have not been proven to be highly effective in managing all types of weeds, so evaluating alternate herbicides for effective weed control in wheat became crucial.

In the most significant cereal-producing countries in the world, pinoxaden has been researched in field trials over the past few years. A brand-new herbicide called pinoxaden was made available after it was found to reduce wheat's composite weed flora successfully. However, there is no information regarding its efficacy for the Kymore Plateau and Satpura Hill region of Madhya Pradesh. Henceforth, experimentation was undertaken to test the bio-efficacy of pinoxaden for controlling complex weed flora in wheat for maximizing production.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Farm, AICRP on wheat, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, situated on the banks of the Narmada River in the state of Madhya Pradesh. The climate of Jabalpur is marked typically as sub-tropical and sub-humid, featured by hot, dry summers and cool, dry winters. It has been classified as the "Kymore Plateau and Satpura Hills" agro-climatic zone. The present investigation was carried out during the *Rabi* season 2021 in a randomized block design, replicated thrice. The treatments were pinoxaden at 40 g *a.i.*/ha, pinoxaden at 45 g *a.i.*/ha, pinoxaden at 90 g *a.i.*/ha, clodinafoppropargyl at 90 g *a.i.*/ha, sulfosulfuron at 25 g *a.i.*/ha, hand weeding (25 DAS) and unweeded control. Jabalpur region soil is broadly classified under the vertisol soil order, which is black with medium to deep depth. The texture of the soil was clay in the experiment field. It was medium in organic carbon (0.62%), available nitrogen (371 kg N/ha), and phosphorus (17.2 kg P_20_5/ha) but high in available potassium (297 kg K_2O/ha). The soil was nearly neutral in the reaction (7.2 pH), and the concentration of soluble salts (0.31 ds/m) was below the harmful limit. Treated seeds of wheat variety MP 3382 were sown uniformly in lines with the seed rate of 100 kg/ha at a row spacing of 20 cm. Post-emergence herbicides were sprayed by mixing the exact amount of herbicides in a measured amount of water at a rate of 500 liters per hectare with the help of a knapsack sprayer. As per the recommendation, all the agronomic practices were followed throughout the crop growth period. Data about weed count and dry weight were subjected to square root transformation ("x+0.50). Yields were harvested from the net plot. Treatment-wise economics was computed based on prevalent market price.

RESULTS AND DISCUSSION

Weed flora and weed density. The prominent weed species were viz. *Phalaris minor, Cichorium intybus, Medicago denticulata* and *Avena ludoviciana*. The relative density of monocot weeds was *Phalaris minor* (43.42%) and *Avena ludoviciana* (10.57%), while the relative density of dicot weeds was *Cichorium intybus* (25.48%) and *Medicago denticulata* (19.88%). In unweeded plots, the relative density of monocot and dicot weeds was 53.99% and 45.36%, respectively, indicating that monocot weeds dominate wheat at Jabalpur.

Weed control treatments caused a significant reduction in the weed density (number /m^2) over the weedy check at 60 DAS (Table 1). The data revealed that pinoxaden at 90 g *a.i.*/ha recorded the lowest density of all the monocot and dicot weeds significantly compared to all other herbicidal treatments. However, hand weeding was superior among all the weed control treatments and recorded the lowest weed density of all the weed types. At the same time, the density of all the dominant weeds was higher in unweeded plots. The least weed density in herbicide treatments might be due to their phytotoxicity against diverse and disruptive weed flora. These findings were in harmony with Jaiswal *et al*. (2020). They reported that herbicides controlled grassy and broadleaf weeds very effectively in wheat and other crops.

Weed dry weight and weed index. Significant variation in weed dry weight existed between treatments (Table 2). At 60 DAS, lowest weed dry weight of grassy and broad-leaved weeds was recorded under the hand weeding treatment. At the same time, maximum dry weight was found under unweeded control. At this stage, the weed dry weight in all the herbicidal treatments was comparable. Among all the herbicides, the minimum weed dry weight of weeds was recorded under pinoxaden at 90 g *a.i.*/ha and found superior to other herbicidal treatments. These results agreed with the work of Rana *et al*. (2021); Kieloch *et al*. (2006).

The effect of different weed control treatments on weed index is presented in Table 2. The weed index ranged from 1.16 to 50.95 % under various treatments. However, unweeded control plots recorded higher weed index (50.95%) values than all post-emergence herbicidal treatments. The application of pinoxaden at 90 g *a.i*/ha resulted in a weed index of 19.88%.Similar findings were reported by Katara *et al*. (2015).

Effect on crop. A significant impact was noted due to different weed control treatments on plant height, the number of tillers/m^2, grains per earhead and grain yield (Table 3). At 60 DAS, among all the treatments, the weedy plots exhibited low-statured plants. Pinoxaden at 45 g *a.i*/ha produced somewhat taller plants (63.33 cm) than pinoxaden at 40 g *a.i*/ha and pinoxaden at 90 g *a.i*/ha. Under hand weeding, the plant reached its maximum height (72.05 cm). However, in unweeded control, it was lowest (61.67 cm). These results are in line with Kumar *et al*. (2022).

The number of tillers per m^2 changed dramatically according to the herbicidal treatment at 60 DAS. Compared to the unweeded control plots, the post-emergence application of all herbicidal treatments resulted in a significantly more number of tillers. Clodinafop Propargyl at 60 g *a.i*/ha gave the lowest number of tillers; however, it was raised when other doses were applied. Among herbicidal treatments, the application of pinoxaden at 45 g *a.i*/ha resulted in the highest number of tillers (357.8 tillers/m^2). While among all the weed control treatments, hand weeding treatment recorded the highest number of tillers (372.58 tillers/m^2).

Different weed control treatments resulted in significant differences in the grains/ear head. Compared to the unweeded control plots, the post-emergence application of all herbicidal treatments resulted in a significantly higher number of grains/ear head. Among all herbicidal treatments, pinoxadenat 45 g *a.i*/ha produced the most grains/ear head (51.24) and was comparable to

pinoxadenat 90 g *a.i*/ha. However, hand weeding recorded the highest grains/ear head (54.79). Less weed competition in the case of herbicidal treatment could be attributed to superior values of growth parameters, which in turn recorded the maximum values of grains/earhead. These results closely conform to the findings of Para *et al.* (2022).

The wheat grain yield was significantly affected due to the different weed control treatments. The maximum grain yield was recorded in hand weeding treatment. While the lowest wheat grain yield was recorded in the unweeded control plots (2804 kg/ha) due to the maximum infestation of weeds. However, among all the herbicidal treatments, maximum grain yield was observed with the application of pinoxaden at 45 g *a.i*/ha (5659 kg/ha), which was comparable to sulfosulfuron at 25 g *a.i.*/ha and superior to all other herbicidal treatments. The higher grain yield in herbicide-treated plots is due to better control of grassy and broad-leaved weeds. Thus, the crop was able to utilize the available resources more efficiently in wheat Qazizada *et al*. (2022).

Table 1: Effect of different weed control treatments on weed density in wheat at 60 DAS.

Treatment	Density of weeds (No./m^2)			
	Phalaris minor	***Avenaludoviciana***	***Cichoriumintybus***	***Medicagodenticulata***
Pinoxadenat 40 g *a.i.*/ha	2.72 (6.88)	2.94 (7.67)	3.57 (12.59)	3.96 (24.27)
Pinoxadenat 45 g *a.i.*/ha	2.55 (6.00)	2.81 (7.01)	3.54 (12.25)	3.94 (13.98)
Pinoxadenat 90 g *a.i.*/ha	2.24 (4.50)	2.73 (6.50)	3.54 (12.25)	3.95 (24.20)
Clodinafop Propargylat 60 g *a.i.*/ha	2.92 (8.00)	2.96 (7.84)	3.55 (12.32)	3.90 (24.82)
Sulfosulfuronat 25 g *a.i.*/ha	2.74 (7.00)	2.74 (6.56)	3.57 (12.39)	4.00 (24.48)
Hand weeding (25 DAS)	1.38 (1.40)	1.74 (2.04)	1.56 (1.85)	1.24 (1.04)
Unweeded control	6.06 (35.33)	3.31 (10.01)	3.66 (12.87)	4.05 (25.14)
CD (at 5%)	0.06	0.28	0.08	0.10

Table 2: Effect of different weed control treatments on weed dry weight at 60 DAS and weed index in wheat.

Treatment	Dry weight of weeds (g/m^2)				Weed index (%)
	Phalaris minor	***Avenaludovician a***	***Cichoriumintybus***	***Medicagodenticul ata***	
Pinoxadenat 40 g *a.i.*/ha	3.75 (13.55)	3.54 (11.65)	5.15 (26.66)	4.73 (22.05)	12.38
Pinoxadenat 45 g *a.i.*/ha	3.72 (13.23)	3.51 (11.37)	5.15 (26.66)	4.70 (22.00)	1.16
Pinoxadenat 90 g *a.i.*/ha	2.71 (6.84)	2.22 (3.96)	5.14 (26.62)	4.72 (22.03)	19.88
Clodinafop Propargylat 60 g *a.i.*/ha	4.52 (20.13)	3.68 (12.59)	5.16 (26.68)	4.71 (22.02)	11.65
Sulfosulfuronat 25 g *a.i.*/ha	3.78 (13.79)	3.70 (12.71)	5.18 (26.70)	4.73 (22.05)	1.78
Hand weeding (25 DAS)	2.50 (5.31)	2.12 (3.53)	1.28 (1.22)	1.74 (2.55)	-
Unweeded control	9.77 (95.98)	6.75 (45.11)	5.22 (26.76)	4.75 (22.09)	50.95
CD (at 5%)	0.07	0.25	0.09	0.03	-

Table 3: Effect of different weed control treatments on growth parameter, yield attributes and yield of wheat.

Treatment	Plant height (cm)	Number of tillers/m^2	Grains/ear head	Grain yield (kg/ha)
	60 DAS	**60 DAS**		
Pinoxadenat 40 g *a.i.*/ha	62.99	349.22	43.47	5017
Pinoxadenat 45 g *a.i.*/ha	63.33	357.89	51.24	5659
Pinoxadenat 90 g *a.i.*/ha	62.53	337.66	44.10	4588
ClodinafopPropargylat 60 g *a.i.*/ha	63.65	336.31	42.19	5055
Sulfosulfuronat 25 g *a.i.*/ha	63.68	340.11	44.01	5620
Hand weeding (25 DAS)	72.05	372.58	54.79	5722
Unweeded control	61.67	298.50	37.65	2804
CD (at 5%)	2.84	18.50	1.73	155.75

CONCLUSION

From the present study, it can be concluded that the application of pinoxaden at 90 g *a.i.*/ha is an effective herbicide for controlling complex weed flora in wheat crops. Although, pinoxaden at 45 g *a.i.*/ha recorded the highest growth parameters, yield attributes, and grain yield and gained higher net returns.

FUTURE SCOPE

This study could be helpful to the farmers for effective weed control through herbicides after proper validation of 2-3 years in the farmer's field. The study may be conducted to evaluate the residual effect of different herbicides on succeeding crops.

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Conflicts of Interest. None.

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