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Pyroxasulphone Herbicide and its Combinations effect on Weed Flora, Productivity and Profitability of Irrigated Wheat

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Abstract: This study was performed to the evaluation of herbicides application on weed interference and yield of wheat crop under irrigated condition and carried out in the Rabi season during 2022-23 at a research farm, College of Agriculture ,Gwalior RVSKVV. The experiment was designed as a Randomized Block Design with eight treatments and replicated thrice. Studied traits included plant height, no. of ear head, test weight, biological yield and seed yield, quality parameters and economics. Major weed flora in the experimental site, viz. *Phalaris minor* (L.) (20.16%) and *Eleusine indica* (L.) (26.19%) were predominant in in monocot weeds and dicot weeds *chenopodium album* (26.08%) and *Medicago denticulate* (25.30%) were dominant. The weedy, check plot had the higher density and dry weight of weeds. the herbicidal applications, Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} significantly reduced the weeds density and dry weight, followed by Clodinafop propargyl+ Metribuzin Pre mix PoE @ 600g ha^{-1}. Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} resulted in maximum values of growth parameters, viz. Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha-1 resulted in higher values of plant height (91.03.3 cm), Length of ear head (cm) (9.39), earhead/m2 (432), grains/earhead (36.15) and test weight (41.05) and grain yield (6010 kg ha^{-1}) followed by Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}. While maximum benefit cost ratio was found in Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1} (4.52) followed by Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} (4.32).

Keywords: weeds, yield, economics, weed control efficiency, weed index and wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop of the world and the second most important staple crop in country. To keep pace with the annual population growth rate of India, i.e. 0.97%, and to meet the future wheat de mand of India by 2050, i.e. 140 million tonnes, the productivity from present level of 3.3 t/ha to 4.7 t/ha and production of wheat by 46% have to be increased (Ramadas *et al*., 2019). The average loss in wheat yield caused by weeds is about 25-30%, (Chhokar *et al*., 2014). Weed management incur major input costs of production. Herbicide mixtures could be one of the strategies for controlling or delaying the emergence of cross resistance against these herbicides. It has been noted that sole reliance on herbicides with a single mode of action is also not advised because it has led to a change in how difficult it is to manage weeds and the quick evolution of multiple herbicide resistance, which poses a threat to wheat production. In using newly herbicides and its combination is a more feasible, cost-effective, and ideal strategy to reduce weed resistance and early weeds competition and crop production losses and control broad

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spectrum weed. So, keeping the above facts in view the present study has been taken.

METHOD AND MATERIALS

This research trial was operated at Agronomy Farm, College of Agriculture, RVSKVV, Gwalior during the *rabi* season of 2021-22. The region of the experimental site falls under the central zone of India and the soil of the research field was sandy clay loam in texture, slightly alkaline (pH 7.4) in reaction, low in organic carbon (0.46 %), nitrogen (180 kg ha-1) and medium in available phosphorus (12.5 kg ha-1) but high in potassium (200 kg ha-1). The experiment consisted of 13 treatments as given below in table no.1 which were laid out in randomized block design (RBD) and replicated thrice. The wheat 'NIAW- 3170' variety was sown on 20th November, 2022, The sowing was done using the normalized (adjusted considering 1000 grains weight as 38g) seed rate of 100kg/ha at a row to row spacing of 20 cm with 4-5 cm depth. After pre-sowing irrigation, total 5 irrigations were applied during the whole growing period. The recommended dose of phosphorous and potassium i.e., 60 and 40 kg ha^{-1} were applied through SSP and MOP as a basal dose. But the total recommended dose of nitrogen i.e., 120 kg ha^{-1} was provided through the urea fertilizer. In RDN, half nitrogen was applied basal and remaining half divided in to 2 equal splits were applied at tillering stage and the second at the jointing stage. Treatments applied during the field experimentation were pyroxasulfone at 127.5 g a.i./ha as a pre-emergence and early post- emergence (14 DAS); Pyroxasulfone + Metsulfurone@ 127.5 + 4g ha^{-1} (Tank mix) as a PE and early post- emergence (14 DAS); Metribuzin PE @ 300g ha^{-1}; Pyroxasulfone + Metribuzin (Tank mix) PE @ 127.5 + 280g ha-1; Clodinafoppropargyl +Metribuzin(Pre mix) PoE (31 DAS)@ 600gha-1 and weedy check. Herbicides were sprayed with a Knapsack sprayer equipped with a flat fan nozzle. Total dry weight of weeds was recorded at 60DAS. The weeds were up rooted from the sampling area of m2 each time and oven dried to a constant weight at 60-70 °C and the dry weight of weeds was expressed in g m-2. It is usually determined on the from weed dry biomass recorded from each treatment by utilising the formula suggested by Mani et al., (1973)

$$\text{Weed control efficiency} = \frac{X - Y}{X} \times 100$$

Were,

X = Dry matter production of weeds in unweeded plot.

Y = Dry matter production of weeds in treated plot

The weed index (WI) was calculated by using the following formula suggested by (Gill and Vijayakumar, 1969).

$$WI = \frac{X - Y}{X} \times 100$$

Were,

X = Yield from maximum weed free plot

Y = Yield from another treated plot

The Crop resistance index (CRI)was calculated by using the following formula. CRI was suggested by (Mishra and Mishra, 1997)

$$CRI = \frac{Crop\ dry\ weight\ in\ treated\ plot}{Crop\ dry\ weight\ in\ control\ plot} \times \frac{Weed\ dry\ weight\ in\ control\ plot}{Weed\ dry\ weight\ in\ treated\ plot}$$

HEI indicates the weed killing potential of a herbicide treatment ad its phytotoxicity on the crop. HEI was suggested by (Krishnamurthy et al., 1975)

$$HEI = \frac{Crop\ yield\ of\ treatment - Crop\ yield\ of\ control}{\frac{Crop\ yield\ of\ treatment}{\frac{Weed\ dry\ weight\ in\ treatment\ plot}{Weed\ dry\ weight\ in\ control\ plot}} \times 100} \times 100$$

The total grain yield of the net plot area under each treatment was recorded replication wise.Total produce to obtain grain yield of the respective plots and converted into yield/ha by multiplying the plot yield by conversion factor. Net monetary returns is

computed by subtracting cost of cultivation from gross returns. Monetary returns for different treatments were calculated with the help of prevailing market rates of produce and different inputs used in the experiments.

Net monetary returns (Rsha^{-1}) = Gross return –Cultivation cost.

B:C is the ratio of gross returns to cost of cultivation. It is expressed as returns per rupee invested.

Benefit cost ratio (Rsha-^{1}) = Gross return / Cost of cultivation

The significant differences between treatments were compared by critical difference at a 5% probability level.

RESULT AND DISCUSSION

The minimum total dry weight (10 g m-^{2}) of weeds at 60 DAS was significantly recorded in Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} and it was at par with Clodinafop propargyl+ Metribuzin Pre mix PoE @ 600g ha^{-1} to among all the herbicidal treatments. However, the maximum total dry weight (54.65 g m^{-2}) of weeds was recorded with weedy check. This was mainly due to better control of weed growth from germination to harvesting, resulting in lower dry weight of weeds. Since the herbicides are plant killer, their use at appropriate dose and time makes them selective to kill certain plant species leaving some plant unaffected. Many weeds appear to be less sensitive to declining leaf water potential than those of the crop. The results are in confirmation with the results achieved by Chhokar and Sharma (2023),Loura et al. (2023),Samota et al.(2023),Sikeriya, et al. (2023).

Different herbicidal treatments exerted their remarkable effect on weed control efficiency (Table 1). The range of weed control efficiency (WCE), Crop resistance index and Herbicidal efficiency index among different herbicides varied between 59.1, 3.06 & 0.67 and 81.7, 7.81|&1.97 respectively over the weedy check. The highest weed control efficiency (WCE), ,Crop resistance index and Herbicidal efficiency index at 60 DAS was recorded under the application of Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} (81.7%, 7.81|&1.97) followed by Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}. The range of weed index varied from 3.67% to 45%. Maximum yield loss was found 45% in weedy check plot. These outcomes are in line with the results of Punia *et al.*, (2020)

Various growth parameters and yield attributes, viz. plant height, number of tillers/ m2, length /earhead, grains/earhead and test weight plays a vital role in increasing the productivity of wheat crop, which were favourably influenced by the herbicide treatments (Table 2). Significantly, a higher value of all said parameters were recorded under Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha-^{1} , while a lower values were recorded in the weedy check treatment. Amongst different herbicidal treatments, Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha-1 resulted in higher values of plant height (91.03.3 cm), Length of ear head (cm) (9.39), earhead/m2 (432), grains/earhead (36.15) and test weight (41.05) followed by Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}. 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 + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} exhibited higher grain yield (6010 Kg ha-1) followed Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}. 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 herbicides has

Table 4.1: Effect of herbicides on Weed dry weight at 60 DAS, weed control efficiency (%) at 60 DAS, weed index (%), crop resistance index (%) and Herbicidal efficiency index (%) of wheat crop

Treatment	*Weed dry weight at 60 DAS*	*Weed control efficiency at 60 DAS*	*Weed index*	*Crop resistance index*	*Herbicidal efficiency index*
T_1; Pyrosasulfone PE @ 127.5g ha^{-1}	21.85	60.01	15.12	3.3	0.71
T_2; Pyroxasulfone + Metsulfurone (Tank mix) PE @ 127.5 + 4g ha^{-1}	17.60	69.52	10.48	4.19	0.95
T_3; Pyroxasulfone EPoE @ 127.5g ha^{-1}	18.70	65.78	12.69	3.88	0.85
T_4; Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1}	10.00	81.7	0.00	7.81	1.97
T_5; Metribuzin PE @ 300g ha^{-1}	22.30	59.19	16.98	3.06	0.67
T_6; Pyroxasulfone + Metribuzin (Tank mix) PE @ 127.5 + 280g ha^{-1}	19.20	64.86	11.06	3.84	0.87
T_7; Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}	11.20	79.5	3.67	6.88	1.68
T_8; Weedy check	54.65	0.00	45	0.00	0.00
SEm ±	0.957				
CD 5%	2.98				

Table 4.2: Effect of herbicides on yield attributing characteristics, yield and economics of wheat crop

Treatment	*Plant height at harvest stage*	*Length of ear head (cm)*	*Number of grains per ear head*	*Test weight (g)*	*Number of ear head m^{-2}*	*Grain yield (kg ha^{-1})*	*Net return (Rsha^{-1})*	*B:C ratio*
T_1; Pyrosasulfone PE @ 127.5g ha^{-1}	87.02	8.10	33.95	38.83	389.32	5101	96870	3.73
T_2; Pyroxasulfone + Metsulfurone (Tank mix) PE @ 127.5 + 4g ha^{-1}	87.08	8.68	34.97	39.38	394.65	5380	103239	3.9
T_3; Pyroxasulfone EPoE @ 127.5g ha^{-1}	87.56	8.25	34.16	39.09	391.00	5247	99996	3.82
T_4; Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1}	91.03	9.39	36.15	41.05	432.00	6010	118006	4.32
T_5; Metribuzin PE @ 300g ha^{-1}	83.70	8.00	33.66	38.64	387.32	4989	98638	4.12
T_6; Pyroxasulfone + Metribuzin (Tank mix) PE @ 127.5 + 280g ha^{-1}	88.20	8.65	34.90	39.27	393.45	5345	102002	3.83
T_7; Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1}	88.33	9.30	35.65	39.90	421.32	5789	115662	4.52
T_8; Weedy check	79.54	7.45	31.14	35.10	335.65	3340	59005	2.96
SEm ±	2.246	0.262	1.095	0.507	12.39	153.827		
CD 5%	6.996	0.817	3.295	1.579	38.568	478.92		

helped in obtaining higher yield (Yadav, et al., 2015.; Singh et al., 2019; Kumar et al., 2022). However, weedy check gave the lowest wheat grain yield due to severe competition from all types of weeds.

The minimum net return and benefit cost (B:C) ratio was found in weedy check treatment where weeds were not suppressed. In the plot where Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} was used, the net return was found highest (Rs 118006), followed by Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha-1. While maximum benefit cost ratio was found in Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1} (4.52) followed by Pyroxasulfone + Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} (4.32).

CONCLUSION

It can be concluded that either Clodinafoppropargyl + Metribuzin (Pre mix) PoE @ 600g ha^{-1} or Pyroxasulfone +

Metsulfurone (Tank mix) EPoE @ 127.5 + 4g ha^{-1} is the most suitable and effective herbicides for achieving higher grain yield by reducing the weed growth throughout the period in wheat crop with higher net monetary returns.

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