The Bioscan 10(1): 271-274, 2015 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EVALUATION OF METRIBUZIN IN COMBINATION WITH CLODINAFOP, SULFOSULFURON AND PINOXADEN FOR WEED CONTROL IN WHEAT

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KEYWORDS
Metribuzin
Clodinafop
Sulfosulfuron
Weeds
Wheat

Received on :
26.10.2014

Accepted on :
07.01.2015

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ABSTRACT
A field experiment was conducted during winter season in two consecutive years 2010-11 and 2011-12 at Indira Gandhi Krishi Vishwavidyalaya, Raipur to test the efficacy of metribuzin alone and in combination with other herbicides for the control of mixed weed flora of wheat crop. Out of a total of ten treatments, four consisted of Clodinafop, Sulfosulfuron ,Metribuzin and Pinoxaden applied as alone, another four consisted of combinations of these and one each of weed free and weedy check. During both the years, minimum weed density was recorded in weed free plots at 28DAS. However, similar weed density was observed in sulfosulfuron and metribuzin treated plots at 60DAS and at harvest where the herbicides were applied @25g and 105g ha^{-1}, respectively. Lowest biomass of weeds was observed in weed free plots at 60DAS, whereas at harvest application of sulfosulfuron and metribuzin (25 and 105g ha^{-1}, respectively) showed their highest efficacy to reduce the biomass of weeds. Hence, above treatment combination was proved best with respect to weed control efficacy i.e.56.84 and 60.8 per cent in two respective years. The data of weed index (00 and 00) also supported the efficacy of above treatment. The data on yield and yield attributing characters showed significance of the combination of sulfosulfuron and metribuzin for getting higher yield over weedy check which was however found statistically comparable with weed free condition. The supremacy of above treatment was proved by increment of grain yield with the tune of 48 and 52 per cent in two consecutive years, respectively. Thus it can be concluded that metribuzin in combination with sulfosulfuron is effective to control mixed weed flora of wheat when applied @25g and 105g ha^{-1}, respectively.

INTRODUCTION

Wheat is the most important and widely cultivated food crop of the world. In India, its production increased from a mere 11.0 million tons during 1960-61 to 93.9 million tons during 2011-12. This increment was mainly due to the adoption of dwarf high yielding varieties, increased fertilizers use, irrigation and herbicides. The high nutrient and water requirements along with less competitive nature of these high yielding dwarf varieties have provided the conducive environment for increased weed infestation (Chhokar *et al.*, 2012). Weed infestation is one of the major biotic constraints in wheat production. Wheat is infested with diverse type of weed flora like *Chenopodium album, Melilotus indica, Melilotus alba, Lathyrus aphaca, Anagallis arvensis, Vicia sativa, Rumex dentatus* and *Medicago denticulata*. Weeds are regarded as main hindrance to crop production and account for about one third of total losses caused by all the pests. The extent of yield reduction largely depends on growth behavior of individual weed species in relation to agro-ecological condition (Singh *et al.,* 1997). If the weeds are not controlled in the critical stages of crop, they may cause reduction in yield up to 66% (Angiras *et al.,* 2008, Kumar *et al.,* 2009 and Kumar *et al.,* 2011). For controlling weeds in wheat, growers mostly rely on herbicides due to cost and time effectiveness. For control of diverse weed flora in wheat combination of herbicides either as tank mixture, if compatible or as sequential, if not compatible are required. In recent year, metribuzin has been found effective against associated weeds of wheat (Dixit and Bhan, 1997). The main use of metribuzin is to control germinating and newly emerging grasses and broad leaf weeds in wheat crop. Other herbicides are also necessary to be evaluated for controlling weeds from the point of eco-safety under the present day of sustainable agriculture. Therefore, the present investigation was undertaken with an objective to evaluate the efficacy of metribuzin in combination with recommended post-emergence herbicides clodinafop, sulfosulfuron and pinoxaden against mixed weed flora particularly in wheat.

MATERIALS AND METHODS

An experiment was conducted to evaluate the bio efficacy of metribuzine in combination with clodinafop, sulfosulfuron and pinoxaden against mixed weeds in wheat during the winter seasons of 2010-11 and 2011-12, at Instructional cum research farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur. The experimental soil was inceptisols low in organic carbon, low in available nitrogen, medium in phosphorus and high in potassium with neutral soil reaction. The experiment was laid down in randomized block design replicated thrice with ten weed control treatments comprised of post emergence

application of clodinafop 60 g/ha, sulfosulfuron 25 g/ha, metribuzin 175 g/ha, pinoxaden 50 g/ha, clodinafop 60 + metribuzin 105 and 122.5 g/ha, sulfosulfuron 25 g + metribuzin 105 g/ha, sulfosulfuron 25 + pinoxaden 40 g/ha, weed free (two hand weeding at 20 and 40 DAS) and weedy check. All herbicides alone and in combination were applied as post emergence between 28-35 DAS as per treatment with knapsack power sprayer using flat fan nozzle and 500 litres of water per ha. Wheat variety 'Kanchan' was sown during first fortnight of December for both the years. The recommended fertilizer dose of 100:50:30 kg/ha N: P: K was applied, of which, 1/3 of nitrogen and full dose of P & K was applied as basal. A seed rate of 100 kg/ha was sown at a distance of 20 cm row to row spacing. Rest of the recommended package of practices was followed. Observations on weed density and biomass were recorded at 28, 60 DAS and at harvest. The weed control efficiency was worked out on the basis of weed dry matter production Mallikarjun *et al.* (2014)

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

Where,

WCE = weed control efficiency (%)

DMC = dry matter of weeds in unweeded plot (g/0.25 m-2)

DMT = dry matter of weeds in treated plot (g/0.25 m-2)

weed index was calculated by using the formula suggested by Gill and Vijayakumar (1966).

$$Weed\ index\ (\%) = \frac{X-Y}{X} \times 100$$

Where,

X = Grain yield of weed free plot

Y = Grain yield from treated plot

Wheat grain yield and yield attributes were recorded at maturity and analyzed using analysis of variance.

RESULTS AND DISCUSSION

Weed flora

The important weed species observed in the experiment field were: *Medicago denticulata, Chenopodium album, Anagallis arvensis, Alternanthera triandera* and constituted 90.87% and 89.77% of the total weed flora in 2010-2011 and 2011-2012, respectively. Weeds like *Echinochloa colona, Melilotus indica, Rumex dentatus* etc. also showed their presence but their occurrence was negligible in the experimental field. *Medicago denticulata* alone contributed 61.92%, *Chenopodium album* 7.5%, *Anagallis arvensis* 12.6% and *Alternanthera triandera* 8.84% of the total weed flora in 2010-2011 and 2011-2012, respectively. The weed density decreased after the application of post emergence herbicides up to harvest. Almost similar weed flora in wheat has been reported by Jain *et al.* (2014).

Effect on weed density and biomass

The density and weed biomass of weeds were remarkably influenced by weed control treatments at all stages of observation in both the years of study (Fig. 1 and Table 1). The minimum weed density at 28 DAS was recorded under weed free treatment which was followed by clodinafop + metribuzin treatment. At 60 DAS and at harvest, lowest weed density was observed under sulfosulfuron + metribuzin (25 + 105 g/ha) treatment followed by weed free and clodinafop + metribuzin (60 + 105 g/ha), in order. Highest weed density at 28, 60 DAS and at harvest was found in weedy check treatment. Similar results have been documented by Singh *et al.* 2009.

All treatments caused significant reduction in weed biomass as compared to weedy check during both the years at 60 DAS and at harvest. The results of two years revealed that at 60 DAS, significantly lowest weed biomass was observed in weed free treatment (two hand weeding at 20 and 40 DAS), but, it was at par with all the treatments except weedy check but during first year of experimentation, it was also found superior to Clodinafop and pinoxaden alone. While, at harvest the lowest weed biomass was recorded under sulfosulfuron + metribuzin (25 + 105 g/ha) which was found statistically similar with all the treatments except clodinofop, pinoxaden and weedy check, but in first year, it was also found superior to metribuzin and sulfosulfuron + pinoxaden. Kumar *et al.* (2006) also reported lowest weed biomass under sulfosulfuron + metribuzin treatment than weedy check. It is mainly because sulfosulfuron is a selective, systemic sulfonyl urea herbicide, absorbed through both roots and leaves. It translocates

Table 1: Effect of metribuzin in combination with clodinafop, sulfosulfuron and pinoxaden on weed biomass and weed index at different intervals in wheat

Treatments	Dose, g/ha	Weed biomass at 60 DAS, g m^2		Weed biomass at harvest, g m^2		Weed Control Efficiency (%-), -At harvest		Weed Index	
		2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012
Clodinafop	60	6.10	6.29	22.92	21.84	15.17	14.31	11.03	13.14
Sulfosulfuron	25	4.12	3.92	15.11	16.85	44.07	33.89	8.45	12.80
Metribuzin	175	4.67	4.30	18.17	17.68	32.75	30.63	8.45	11.07
Pinoxaden	50	5.98	5.72	22.30	21.65	17.46	15.06	10.29	12.45
Clodinafop + Metribuzin	60 + 105	5.50	5.29	13.78	13.93	49.00	47.47	1.84	3.46
Clodinafop + Metribuzin	60 + 122.5	3.87	3.77	16.54	15.90	38.78	37.62	4.78	4.49
Sulfosulfuron + Metribuzin	25 + 105	3.36	3.67	11.66	9.99	56.84	60.80	00	00
Sulfosulfuron + Pinoxaden	25 + 40	5.53	5.44	19.22	17.81	28.86	30.12	8.45	10.72
Weed free	-	3.32	3.26	13.18	11.47	51.22	55.00	1.83	4.49
Weedy Check	-	14.39	13.52	27.02	25.49	-	-	48.90	52.24
SEm ±		0.87	1.13	1.72	2.89				
CD (P= 0.05)		2.61	3.39	5.16	8.66	-	-	-	-

Table 2: Effect of metribuzin in combination with clodinafop, sulfosulfuron and pinoxaden on yield attributes and yields of wheat

Treatments	Plant height, cm At harvest		Number of tillers/m row at harvest		Test weight, g		Grain yield t/ha	
	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012	2010-2011	2011-2012
Clodinafop	77.37	74.3	70.72	71.2	33.49	33.66	2.42	2.51
Sulfosulfuron	80.61	80.6	74.55	74.5	35.69	34.40	2.49	2.52
Metribuzin	79.76	79.4	73.44	75.2	35.46	35.77	2.49	2.57
Pinoxaden	77.72	77.6	73.44	74.6	35.40	35.32	2.44	2.53
Clodinafop + Metribuzin	81.33	81.4	78.44	79.2	36.96	37.17	2.67	2.79
Clodinafop + Metribuzin	80.93	81.5	76.88	76.6	36.83	36.67	2.59	2.76
Sulfosulfuron + Metribuzin	82.58	82.6	81.33	81.4	37.43	38.12	2.72	2.89
Sulfosulfuron + Pinoxaden	80.85	80.7	75.44	75.5	35.81	35.58	2.49	2.58
Weed free	81.51	81.3	78.88	78.3	36.40	37.80	2.67	2.76
Weedy Check	77.29	78.0	53.99	53.5	33.16	33.63	1.39	1.38
SEm ±	2.14	3.13	3.28	3.86	1.83	1.95	0.12	0.12
CD (P= 0.05)	N.S.	N.S.	9.85	11.58	N.S.	N.S.	0.36	0.35

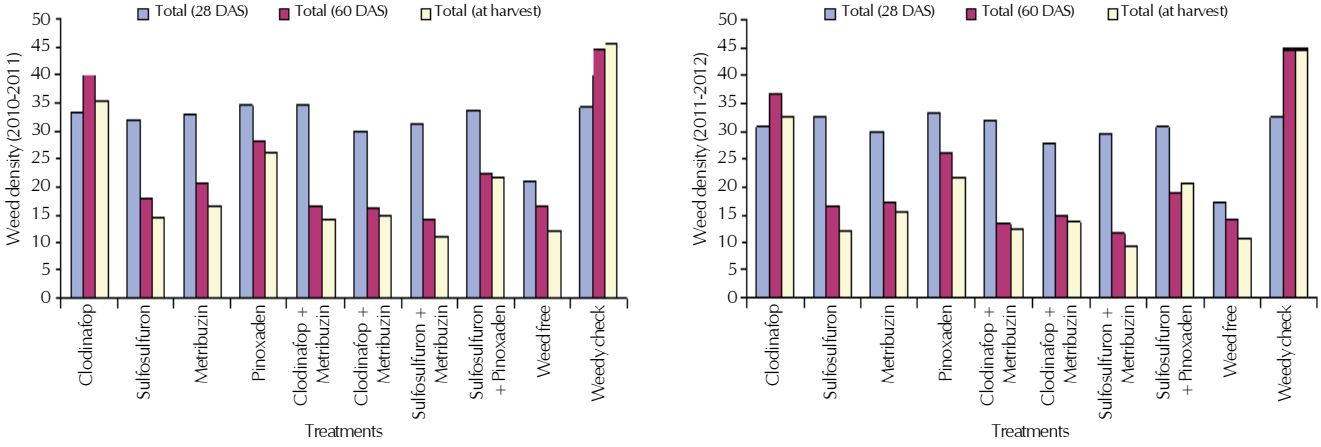

Figure 1: Effect of metribuzin in combination with clodinafop, sulfosulfuron and pinoxaden on total weed density at 28, 60 DAS and at harvest in wheat during rabi 2010-2011 and 2011-2012

throughout the plant and acts as an inhibitor of amino acid biosynthesis, hence stopping cell division and plant growth, whereas, metribuzin is a selective triazinone herbicide acting as an inhibitor of photosynthesis, specifically the inhibition of the photosynthetic electron transfer in the stage of the second light reaction. Both of these herbicides when applied in combination, the effect on weeds is more lethal than their application as alone.

Among the weed control treatments, application of sulfosulfuron + metribuzin recorded highest weed control efficiency of 56.84% and 60.80% which was followed by the weed free (51.22% and 55.00%) and clodinofop + metribuzin (49.00% and 47.47%) during 2011 and 2012, respectively. The weed control efficiency under clodinafop was lesser than that of different other treatments during both the years.

Effect on crop

Post-emergence application of sulfosulfuron + metribuzin (25 + 105 g/ha) has resulted in significantly higher grain yield of wheat and it was found comparable with other treatments except weedy check in both years, whereas in second year of experimentation, it was found significant over clodinafop, sulfosulfuron and pinoxaden, when applied alone. Higher grain yield of wheat was owing to effective control of weeds and higher growth and yield attributes of wheat. Similar findings were noticed by Kumar *et al.* (2006). Plant height and test weight in both the years were not affected significantly due to treatments under study. However, all other treatments were found statistically at par to sulfosulfuron + metribuzin in influencing the number of tillers per meter row, except weedy check in both years and clodinafop during first year.

The grain yield was negatively associated with total weed density, weeds biomass and positively associated with plant height, number of tillers per meter row and test weight. Therefore, weeds in weedy check reduced the grain yield of wheat. This might be due to effective control of weeds, less crop weed competition throughout the crop growth period which resulted in improved growth parameters of the crop. Weed index which indicate the reduction in grain yield was minimum under sulfosulfuron + metribuzin and maximum under weedy check during both the years. Higher weed control efficiency with lower weed index under sulfosulfuron + metribuzin applied plots were due to effective weed control as evident from lower weed population than other treatments.

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