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EFFECT OF HERBICIDES WITH AND WITHOUT SURFACTANT AGAINST GRASSY AND BROAD LEAF WEEDS IN WHEAT

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ABSTRACT

Field experiment was carried out during rabi season of 2009-10 at Reseach farm, College of Agriculture, Gwalior (M.P.) to study the effect of herbicides on growth and yield of wheat. Unchecked weeds growth caused 61.5% reduction in grain yield of wheat. The results showed that yield attributing character and grain yield significantly by differed due to weed control treatments, where highest number of effective ears (85.69)/m row length and grain yield (5312kg ha^{-1}) were recorded with two hand weeding at 25 and 50 DAS. It was on par with Pinoxaden at 40 g ha^{-1}fb carfentrazone (AS 1%) at 25 g ha^{-1}. Among the herbicidal treatments, Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) resulted highest weed control efficiency (78.7%) and lowest grassy (0.63) and broad leaves weeds (0.59) weed dry weight (4.43) and weed index (6.27) followed by Sulfosulfuron (25 g/ha PoE). Hand weeding twice at 25 and 50 DAS fetched the highest net income of ₹ 58260 ha^{-1} while *B:C ratio was maximum (4.54) under Pinoxaden at 40 g ha^{-1}fb carfentrazone at 25 g ha^{-1} (AS 1%).*

Key words: Integrated weed management, weed control efficiency, herbicides, wheat, weed flora.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in India. There has been tremendous increase in area, production and productivity of this crop during the green revolution phase of Indian agriculture. It occupies second position both in terms of area and production. In India, it is cultivated in 29.07 million hectares of land with annual production of 86.87 million tonnes and productivity of 2989 kg ha^{-1}, whereas in Madhya Pradesh, it is cultivated in an area of 37.85 lakh hectares with an annual production of 68.38 lakh tonnes and productivity of 1885 kg ha^{-1}. Weed infestation during the crop period causes more than 53 % reduction in grain yield depending on the weed densities and type of weed flora present (Singh *et al.*, 2002). Commonly used herbicide isoproturon controls grassy weeds only but had little effect on trouble some broad leaf weeds. Further, continuous use of isoproturon may lead to development of resistant bio-types of *Phalaris minor* (Walia *et al.*, 1997). Hence, it is essential to identify alternative herbicide molecules with broad spectrum activity for sustainable weed management in wheat .Conventional methods of weed control being weather dependent, laborious, time consuming and costly due to high cost of labour and mechanical means being less efficient in controlling weeds compare to use of herbicides. Under such conditions it is important to find out the economic feasibility of wheat cultivation with herbicides.Keeping these facts in view; the present study was carried out.

MATERIALS AND METHODS

An experiment was conducted at the Research farm College of Agriculture, Gwalior (M.P.) during Rabi season of 2009-10. The soil of experimental field was sandy clay loam in texture with low available nitrogen (218 kg ha^{-1}) medium in phosphorus (17.5 kg ha^{-1}) and high in potassium (285 kg ha^{-1}) content and neutral in soil reaction (pH 7.6). Experiment was conducted in randomized block design having twelve treatments with three replications.Weed management practices comprised of viz., T_1, Carfentrazone at 15 g ha^{-1} fb pinoxaden at 30 g ha^{-1} (PoE), T_2 ,Carfentrazone at 20 g ha^{-1} fb pinoxaden at 35 g ha^{-1} (PoE), $T_{3,}$ Carfentrazone at 25 g ha^{-1} fb pinoxaden at 40 g ha^{-1} (PoE), $T_{4,}$ Pinoxaden at 30 g ha^{-1} fb carfentrazone (AS 1%) at 15 g ha^{-1} (PoE), $T_{5,}$ Pinoxaden at 35 g ha^{-1} fb carfentrazone (AS 1%) at 20 g ha^{-1}, T_6, Pinoxaden at 40 g ha^{-1}fb carfentrazone (AS 1%) at 25 g ha^{-1} (PoE),T_7, Carfentrazone (25 g ha^{-1} PoE), T_8, Pinoxaden (40 g ha^{-1}PoE), T_9, Isoproturon at 1000 g ha^{-1} + 2, 4-D at 500 g ha^{-1} (PoE), T_{10}, Sulfosulfuron (25 g ha^{-1}PoE), $T_{11,}$ two hand weeding at 25 and 50 DAS, and T_{12} weedy check . Application of 120 kg N, 60 kg P_2O_5, 40 kg K_2O and 25 kg $ZnSO_4$ ha^{-1} was made as urea, diammonium posphate and muriate of potash repectively. The half dose of nitrogen with full dose of P_2O_5, K_2O and Zn were applied at the time of sowing as a basal dose. Seed was sown @ 120 kg ha^{-1}at row to row distance of 22.5 cm. The sowing was done on 28 November 2009. Herbicides were sprayed with a knap sack sprayer fitted with a flat fan nozzle

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using 500 litres of water per hectare. Hand weeding was done using a *khurpa*. Harvesting was done on 25 March, 2010. The growth and yield attributes were recorded from five selected plants in each plot. Observations were recorded with the help of a quadrant 0.5 m x 0.5 m weeds placed randomly at two spots in each plot at 60DAS. The data on weeds were subjected to log transformation (log1+x) to normalize their distribution. Weeds were cut at ground level, washed with tap water, sun dried for a few days and then oven dried at 65°C for 48 hours and then weighed. Total dry matter was determined by the summing up the dry weight of each plant. Weed control efficiency was calculated using weed dry weight data at 60 DAS which was maximum during weed growth period irrespective of treatments. Economics of different weed control treatments was worked out on prevailing market prices of inputs and outputs.

RESULTS AND DISCUSION

Maximum weed infestation was observed in weedy check and the dominant weeds were Chenopodium album (42.8%) and Phalaris minor (26.7%). The contribution of other weeds like Cyperus rotundus, Cynodon dactylon, Anagallis arvensis, Melilotus indica, Spargula arvensis, Fumaria parviflora and Convolvulus arvensis was less than 31% to total weed infestation. All the herbicidal treatments including weed free recorded a significant reduction in population of narrow and broad leaf weeds compared to weedy check at 60DAS. Two hand weeding at 25 and 50 DAS significantly controlled the narrow leaf weeds at 60 DAS which was at par with Pinoxaden at 40 g/ha fb carfentrazone at 25 g ha^{-1} (AS 1%) and Sulfosulfuron (25 g ha^{-1}). The lowest count of broad leaf weeds throughout the crop growth cycle was under hand weeding twice followed by Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) and Sulfosulfuron (25 g ha^{-1}). Among the herbicidal treatments, post-emergence application of Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) recorded significantly lowest population of broad leaf weeds. However, this was found at par with Pinoxaden fb carfentrazone (AS 1%) (35 + 20 g ha^{-1}), Isoproturon at 1000 g ha^{-1} + 2, 4-D at 500 g ha^{-1} and Sulfosulfuron (25 g ha^{-1}) at 60 DAS. The superiority of new herbicides like carfentrazone-ethyl in respect of controlling the weeds especially broad-leaf weeds was reported by Walia and Singh (2006), Pandey *et al.* (2007), Shukla *et al.* (2008),Verma *et al.* (2008), Saini *et al.* (2010) and Chauhan (2014).

Table 1: Effect of different treatments on No. of narrow and broad leaf weeds /m^2, weed dry weight g/m^2, weed control efficiency and weed index

	Treatment	No.of narrow weeds at 60 DAS	No. of Broadleaf weeds at 60 DAS	Weed dry weight at 60 DAS	Weed control efficiency (%)	Weed index (%)
T_1	T_1 Carfentrazone at 15g/ha fb Pinoxaden at 30g/ha (PoE)	0.85 (6.00)	0.95 (8.00)	12.53	51.61	35.20
T_2	Carfentrazone at 20 g/ha fb pinoxaden at 35 g/ha (PoE)	0.82 (5.67)	0.90 (7.33)	11.30	51.93	33.18
T_3	Carfentrazone at 25 g/ha fb pinoxaden at 40 g/ha (PoE)	0.77 (5.00)	0.88 (6.67)	10.80	55.48	31.68
T_4	Pinoxaden at 30 g/ha fb carfentrazone (AS 1%) at 15 g/ha (PoE)	0.75 (4.67)	0.84 (6.00)	8.13	58.06	26.93
T_5	Pinoxaden at 35 g/ha fb carfentrazone (AS 1%) at 20 g/ha (PoE)	0.69 (4.00)	0.75 (4.67)	6.17	65.16	24.26
T_6	Pinoxaden at 40 g/ha fb carfentrazone (AS 1%) at 25 g/ha (PoE)	0.63 (3.33)	0.59 (3.33)	4.43	78.71	6.27
T_7	Carfentrazone (25 g/ha PoE)	1.09 (11.33)	1.03 (9.67)	22.60	17.74	42.38
T_8	Pinoxaden (40 g/ha PoE)	0.90 (7.00)	0.98 (8.67)	17.27	32.25	40.26
T_9	Isoproturon at 1000 g/ha + 2, 4-D at 500 g/ha (PoE)	0.77 (5.00)	0.74 (4.67)	6.73	61.61	24.40
T_{10}	Sulfosulfuron (25 g/ha PoE)	0.66 (3.67)	0.70 (4.00)	5.93	73.87	14.12
T_{11}	Weed free (2 H.W. at 25 and 50 DAS)	0.55 (2.67)	0.26 (1.00)	3.50	82.90	-
T_{12}	Weedy check	1.95 (89.67)	2.20 (156.33)	202.53	-	61.51
Transformation		**Log (1+x)**	**Log (1+x)**		**-**	
C.D. (P=0.05)		**0.13**	**0.22**	**23.98**		

Note: *DAS – Days after sowing, PoE – Post emergence, Figures in parentheses indicate original values*

All weed control treatments at 60 DAS gave significantly lower weed dry weight than weedy check at each growth stage. At early stage of weed growth (60 days), all weed control treatments were at par to each other. This may be mainly attributed to lower narrow and broad-leaf weed population per unit area recorded under the effect of above treatments. (Singh *et al.* 2002).Weed control efficiency ranged from 17.74 to 82.90%. The highest weed control efficiency was estimated in two hand weeding at 25 and 50 DAS (82.9%) followed by Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) (78.71%). Verma *et al.* (2008) also reported reduced dry weight and increased weed control efficiency due to application of Carfentrazone and Sulfosulfuron. Post-emergence application of Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) recorded lowest weed index (6.27%) followed by Sulfosulfuron at 25 g ha^{-1} (14.12%). Similarly weedy check observed in maximum weed index (61.51). Similar resuts were reported by Walia and Singh (2006).

Number of effective ears/m row length and grain yield showed significant differences due to weed control treatments where, highest number of effective ears 85.69/m row length and grain yield were recorded with two hand weeding at 25 and 50 DAS treatment and it was on par with Pinoxaden at 40 g ha^{-1} fb carfentrazone (AS 1%) at 25 g ha^{-1}. All the weed control treatments except Carfentrazone at 15 g/ha fb pinoxaden at 30 g/ha, Carfentrazone at 20 g/ha fb pinoxaden at 35 g/ha, Carfentrazone at 25 g/ha fb pinoxaden at 40 g/ha, Carfentrazone (25 g/ha) and Pinoxaden (40 g/ha) were significantly superior to weedy check with respect to yield parameter. All the herbicidal treatments (Pinoxaden at 40 g ha^{-1} fb carfentrazone (AS 1%) at 25 g ha^{-1}) recorded highest number of effective ears /m row length and grain yield. It was on par with Sulfosulfuron (25 g ha^{-1} PoE). Two hand weeding at 25 and 50 DAS treatment resulted in significantly highest number of grains per ear, however it was at par with the application of Pinoxaden at 40 g ha^{-1} fb carfentrazone (AS 1%) at 25 g ha^{-1}, Sulfosulfuron (25 g ha^{-1}), Isoproturon at 1000 g ha^{-1} + 2, 4-D at 500 g ha^{-1} and Pinoxaden at 35 g ha^{-1} fb carfentrazone (AS 1%) at 20 g ha^{-1}. Among weed control treatments, two hand weeding at 25 and 50 DAS treatment resulted in significantly highest test weight (40.00 g). This might be due to less population of weeds especially broad-leaf weeds in the plots treated with these herbicides and in two hand weeding at 25 and 50 DAS plots where there was less competition between crop and weed plants for moisture, light, space and nutrients utilized provided congenial condition to the crop for proper development of its reproductive phase which resulted in the enhancement of all these yield contributing characters. The highest grain yield was due to effective suppression of weeds in the early stages, which was evidenced from maximum yield attributes recorded. Sharma and Singh (2011), Shukla *et al.* (2008), Singh *et al.* (2011) and Verma *et al.* (2008) also reported similar results.

Table 2: Effect of different treatments on yield attributing characters, yield and economics of wheat

Treatment	**Effective ear/m row length**	**Ear length (cm)**	**No. of grains /ear**	**Test weight (g)**	**Grain yield (kg ha^{-1})**	**Net income (₹.ha^{-1})**	**B:C ratio**
T_1 Carfentrazone at 15 g/ha fb pinoxaden at 30 g/ha (PoE)	80.58	8.71	32.47	31.00	3442	34699	3.21
T_2 Carfentrazone at 20 g/ha fb pinoxaden at 35 g/ha (PoE)	81.02	8.77	32.90	32.67	3550	36106	3.29
T_3 Carfentrazone at 25 g/ha fb pinoxaden at 40 g/ha (PoE)	81.37	8.97	33.70	33.33	3629	37259	3.35
T_4 Pinoxaden at 30 g/ha fb carfentrazone (AS 1%) at 15 g/ha (PoE)	81.91	9.47	34.17	34.00	3882	41517	3.64
T_5 Pinoxaden at 35 g/ha fb carfentrazone (AS 1%) at 20 g/ha (PoE)	82.76	9.57	35.07	36.00	4024	44443	3.82
T_6 Pinoxaden at 40 g/ha fb carfentrazone (AS 1%) at 25 g/ha (PoE)	84.72	9.67	36.63	38.33	4979	56218	4.54
T_7 Carfentrazone (25 g/ha PoE)	76.99	8.27	31.10	29.33	3061	30100	2.99
T_8 Pinoxaden (40 g/ha PoE)	78.47	8.40	31.50	29.33	3173	31321	3.01
T_9 Isoproturon at 1000 g/ha + 2, 4-D at 500 g/ha (PoE)	82.22	9.53	34.67	35.33	4016	43537	3.74
T_{10} Sulfosulfuron (25 g/ha PoE)	82.87	9.63	35.77	37.33	4562	51743	4.44
T_{11} Weed free (2 H.W. at 25 and 50 DAS)	85.69	9.87	37.60	40.00	5312	58260	4.10
T_{12} Weedy check	69.93	8.93	29.92	28.00	2044	16586	2.12
C.D. (P=0.05)	**2.29**	**0.94**	**3.14**	**4.92**	**587**		

Herbicides cost : *(i) Carfentrazone – 800 ₹/1.00 kg, (ii) Pinoxaden – 650 ₹/1.00 kg, (iii) Sulfosulfuron – 600 ₹/13.00g (iv) Isoproturon – 150/500g, (v) 2,4 D – 280 ₹/kg*

Economics

Hand weeding twice at 25 and 50 DAS fetched the highest net income (₹.58260 ha^{-1}) followed by Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) and Sulfosulfuron (25 g ha^{-1}) treatments recording net income of ₹. 58260 ha^{-1} ₹. 56218 ha^{-1} and ₹. 51743 ha^{-1}, respectively. The B:C ratio was maximum (₹. 3.54) under Pinoxaden at 40 g ha^{-1} fb carfentrazone at 25 g ha^{-1} (AS 1%) followed by Sulfosulfuron at 25 g ha^{-1}. (₹. 4.44) and two hand weeding at 25 and 50 DAS (₹. 4.10) due to the high labour cost in case of hand weeding at 25 and 50 DAS as compared to herbicides. These results also corroborate with the findings of Jat *et al.* (2003). It is concluded that among the herbicides Pinoxaden at 40 g/ha fb carfentrazone (AS 1%) at 25 g ha^{-1} and sulfulfuron (25 g ha^{-1}) were found more effective to control the grassy and broad leaves weeds in wheat. Weed incurred a loss of 61.51% in terms of grain yield of wheat. Amongst different weed control treatments, weed free was the best treatment for improving the growth, yield attributes and yield of wheat followed by Pinoxaden at 40 g ha^{-1} fb carfentrazone (AS 1%) at 25 g ha^{-1} and Sulfosulfuron (25 g ha^{-1}).Weed free treatment gave the highest monetary return closely followed by Pinoxaden at 40 g ha^{-1} fb carfentrazone (AS 1%) at 25 g ha^{-1} and Sulfosulfuron (25 g ha^{-1}). The highest B:C ratio was registered with Pinoxaden at 40 g/ha fb carfentrazone (AS 1%) at 25 g ha^{-1} followed by Sulfosulfuron (25 g ha^{-1}).

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