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Bio-efficacy of carfentrazone-ethyl + sulfosulfuron in wheat

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ABSTRACT

An experiment was conducted during *Rabi* season of 2008-09 and 2009-10 at Varanasi (Uttar Pradesh) to evaluate the boiefficacy of carfentrazone-ethyl + sulfosulfuron in wheat. The experimental field was infested with *Phalaris minor, Rumex dentatus, Chenopodium album, Anagalis arvensis and Melilotus spp* during both the years of study. The result indicated that post-emergence application of carfentrazone + sulfosulfuron with surfactant at 45 g/ha recorded minimum density and dry weight of weeds and it was at par to 54 and 90 g/ha, without any phytotoxicity symptoms on the crop. Significant variation in wheat yield was recorded due to application of different herbicides when compared with control. Carfentrazone-ethyl + sulfosulfuron with surfactant at 45 g/ha recorded significantly the highest grain yield over its rate of 36 g/ha and it was at par to 54 and 90 g/ha. The regration equation indicated that extent of reduction could be 26.5 kg/ha for weed dry weight. The evaluation of weed dry weight and weed control efficiency of the different treatments and the regression of yield on it reveled that reduction in grain yield could be 0.025 t/ha for weed dry weight and 1% increase in the weed control efficiency increased the grain yield by 0.020 t/ha, respectively.

K**ey word:** Carfentrazone, Sulfosulfuron, Weeds, Wheat yield, Yield attributes

Wheat is most important winter season cereal crop of India. Cultivation of semi-dwarf input responsive wheat cultivars with slow initial growth, provide favorable environment for weeds. It suffers from severe weed competition which reduces its yield to the tune of 25-55% (Singh *et al*. 2009) and 43.6% (Verna *et al*. 2008) or even more, if not managed effectively. Further, in wheat, a number of weed species belonging to narrow and broad-leaf morphology infest the crop. Hand weeding has been the most widely practiced method of weed control by farmers in our country. However, in recent years, its practical and economic feasibility is often limited by unfavourable climatic and soil conditions, unavailability of labourer during critical period of weeding and also high wages of labour (Pandey *et al*. 2008). The most widely used herbicide isoproturon, which is being used as post-emergence for weed control in wheat, controls only grassy weed like *Phalaris minor* in wheat. Whereas, 2,4-D, has activity only against broad-leaf weeds. Development of resistance in *P. minor* against isoproturon and ear-head deformities in wheat due to 2,4-D, raised serious concern about their use in wheat. Thus, it became important to evaluate new herbicide molecules for management of weeds in wheat. Since, no single herbicide controls both narrow and broad-leaved weeds in wheat, therefore, mixing of herbicides have shown great promise in controlling complex weed flora of wheat (Walia *et al*. 2010). Carfentrazone-ethyl is new herbicide which is effective against BLW including other problematic weeds (Singh *et al*. 2004 and Walia and Singh 2006). Hence, compatibility of carfentrazone-ethyl with sulfosulfuron was studied for making any sound recommendation regarding their use as tank mix application against important weeds in wheat.

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MATERIALS AND METHODS

A field experiment was conducted during winter (*Rabi*) season 2008-09 and 2009-10 at the Agronomy research farm, BHU, Varanasi, which is geographically situated at 23.2^0 N latitude, 83.03^0E longitude and at an altitude of 113 msl in the north-eastern Gangetic Plains. This location has a typical sub tropical climate characterized by hot, dry summer and cool winter. The soil of experimental site was sandy clay loam in texture with slightly saline in reaction (pH-7.4). It was low in organic C (0.32%) and available N (150.9 kg/ha), medium in available P (24.6 kg/ha) and K (232.5 kg/ha) in soil surface. The total rainfall received during 2008-09 and 2009-10 was 68.9 and 151.2 mm, respectively, of which 24. 5 and 52.6, 18.4 and 70.4, 26.4 and 28.2 mm, respectively was received during December, January and February. The field was kept under rice-wheat rotation for the last ten years. The experiment consisted of 15 treatments was done in com-

plete randomized block design with three replications. The wheat variety '*HUW 234'* was sown with the help of fertiseed drill at 22 cm row spacing using 100 kg seed/ha on 2nd December 2008 and 5th December 2009 in 4.6 x 5.5 m^2 gross plot size. All the herbicides were applied with the help of flat fan nozzle attached to the foot sprayer using volume of spray 500 l/ha, at 30 days after sowing. Urea, diammonium phosphate and murate of potash were used as sources of nitrogen, phosphorus and potassium, respectively. An uniform dose of 40: 60: 40, N:P: K kg/ha was applied uniformly at the time of sowing and remaining 80 kg N was top-dressed in two equal splits, each at after first irrigation and flowering time. Four irrigations were given to critical growth stages of crop and 6cm water were applied per irrigation. Density, dry weight and weed control efficiency of weeds were observed at 45 days after sowing of crop. Weed control efficiency was calculated using standard formula. Data on weed density was recorded from an area enclosed in the quadrate of 0.25/ m^2 randomly selected at four places in each plot. Weed species were separately counted from each sample and their density was recorded. Oven dry weight of weeds was recorded at 70^0C for 48 hr. Data on yield contributing characters, grain and straw yield at harvest were studied for both the years. The crop was harvested on 8th April 2009 and 15th April 2010. Data collected on various parameters were analyzed statistically for valid conclusion.

RESULTS AND DISCUSSION

Effect on weeds

The experimental crop was infested by *Phalaris minor* L. (narrow leaf-weed) and *Rumex dentatus* L., *Chenopodium album* L., *Anagallis arvensis* L., and *Melilotus* sp. (broad-leaf weeds). Tnfestation of BLWs was lower during both the years of study. The density of different narrow and broad-leaf weeds was significantly affected by herbicides treatments. The data revealed that test sample carfentrazone + sulfosulfuron (premix) with surfactant at 45 g/ha recorded significantly the lowest density of all the dominant weed species and was at par to 55 and 90 g/ha (Table 1). Alone application of carfentrazone and sulfosulfuron were effective only against broad-leaf and narrow-leaf weeds during both the years, respectively.

The dry weight of weeds differed significantly due to different treatments (Table 1). Test sample of carfentrazone + sulfosulfuron (premix) at 45 g remained at par with its higher rates (54 and 90 g/ha) and significantly superior to its lower rates and also to other herbicide treatments. However, all the herbicides were significantly superior to untreated control. These results are conformity with the finding of Walia and Singh (2006), Bharat and Kachroo (2007), Pandey *et al.* (2007) and Yadav *et al*. (2009). No phytotoxicity symptoms appeared in crop even at higher rate 90 g/ha (Table 3).

Yield attributes and yield

All the weed control measures recorded significantly the highest yield attributes and grain yield over control (Table 2). The maximum ear heads/m^2, grains/ear head, 1000-grain weight and grain yield was recorded in carfentrazone + sulfosulfuron at 45 g/ha remained at par with its higher rates (54 and 90 g/ha) and were significantly superior to its rate of 36 g/ha. The test herbicide molecule carfentrazone + sulfosulfuron at 45 g/ha with and without surfactant remained at par with each other, but proved significantly superior over carfentrazone-ethyl 40% DF and isoproturon. Sulfosulfuron 75% + metsulfuron 5% WG + surfactant recorded maximum yield attributes and grain yield of wheat but was statistically at par with carfentrazone + sulfosulfuron at 45 g and 54 g/ha. Higher grain yield under carfentrazone + sulfosulfuron at 45 g/ha

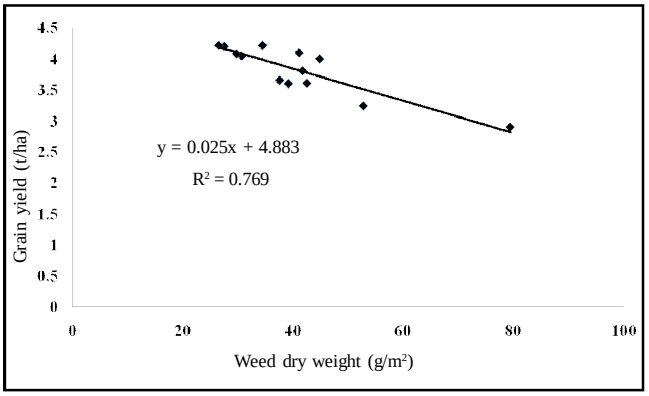

Fig. 1. Relationship between total weed dry weight and grain yield (pooled data of two year)

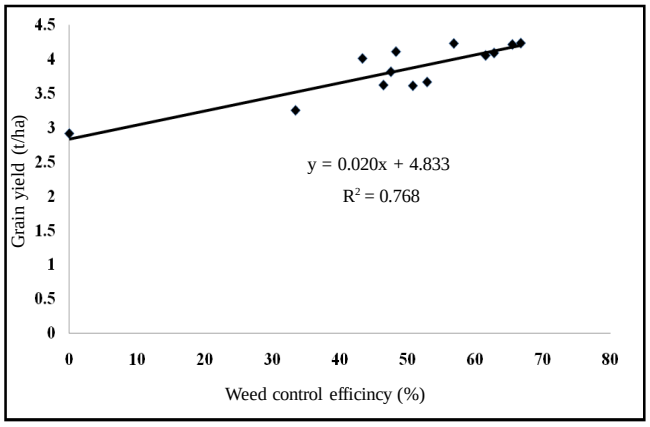

Fig. 2. Relationship between weed control efficiency and grain yield (pooled data of two year)

Table 1. Effect of carfentrazone-ethyl 20% + sulfosulfuron 25% (PREMIX) WDG on weeds in wheat

Treatment	Weed population (no./m^2) at 45 DAS										Weed dry weight at 45 DAS (g/m^2)		WCE (%)	
	Phalaris minor		*Rumex dentatus*		*C. album*		*Anagallis arvensis*		*Melilotus* spp.					
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	18.6	19.7	9.0	13.0	9.0	8.0	8.6	7.7	8.9	10.7	46.2	43.4	39.2	47.5
T_2	16.0	23.7	7.0	12.0	11.2	8.3	6.0	9.7	9.0	16.3	33.8	44.6	55.5	46.1
T_3	14.1	22.3	8.0	12.7	6.0	4.7	4.1	8.3	6.3	13.0	32.4	42.7	57.4	48.4
T_4	12.6	13.3	6.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	24.6	36.8	67.6	55.5
T_5	11.9	11.7	5.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	23.9	35.6	68.6	57.0
T_6	11.0	9.7	3.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	22.3	32.8	70.7	60.3
T_7	10.2	8.4	8.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	21.9	31.2	71.2	62.3
T_8	32.8	31.4	9.0	7.0	5.6	3.7	8.8	6.3	12.0	5.0	38.8	46.3	48.9	44.0
T_9	17.9	19.2	26.0	23.7	6.9	10.7	13.9	15.6	17.6	16.0	37.4	44.8	50.8	45.8
T_{10}	20.6	18.0	10.0	15.0	5.8	12.4	24.6	14.0	13.9	11.3	26.9	42.1	64.6	49.1
T_{11}	22.9	23.0	13.0	14.7	8.2	15.3	18.9	18.7	15.7	14.3	36.7	46.8	51.7	43.4
T_{12}	17,8	22.3	31.0	29.0	15.8	15.7	21.6	23.7	24.6	20.3	51.9	53.6	31.7	35.2
T_{13}	57.9	44.0	49.0	58.0	46.9	31.3	67.9	41.3	35.7	35.7	76.0	82.7	0.0	0.0
T_{14}	10.2	10.3	9.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	22.7	29.6	70.1	64.2
T_{15}	9.8	8.4	10.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	28.8	71.6	65.2
LSD (P=0.05)	1.82	7.3	0.88	5.2	0.9	3.62	3.6	4.9	4.8	4.0	3.5	3.0		

T_1- Carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% premix, 20 + 25 g/ha), T_2- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 16 + 20 g/ha) + cationic surfactant (625 g/ha), T_3- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 16 + 20 g/ha) + cationic surfactant (750 g/ha), T_4- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 20 + 25 g/ha) + cationic surfactant (625 g/ha), T_5- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 20 + 25 g/ha) + cationic surfactant (750 g/ha), T_6- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 24 + 30 g/ha) + cationic surfactant (625 g/ha), T_7- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 24 + 30 g/ha) + cationic surfactant (750 g/ha), T_8- carfentrazone – ethyl 40% DF (20 g/ha), T_9- sulfosulfuron 75% WDG (leader 25 g/ha) + cationic surfactant, T_{10}- total (sulfosulfuron 75% (32 g/ha) + metsulfuron 5% WG + surfactant, T_{11}- Atlantis (metsulfuron-methyl 3% , 12 g/ha + iodosulfuron-methyl-sodium 0.6%WG, 2.24 g/ha) + surfactant, T_{12}- isoproturon 75% WP (1000 g/ha), T_{13}- untreated control T_{14}- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 40 + 50 g/ha + 750 g/ha) and T_{15}- carfentrazone–ethyl 20% + sulfosulfuron 25% WDG (45% Premix, 40 + 50 g/ha) + cationic surfactant (750 g/ha)

Table 2. Effect of carfentrazone-ethyl 20% + sulfosulfuron 25% (Premix) WDG on yield attributes and yield of wheat

Treatment	Ear head/m^2		1000-grain weight (g)		Grains/ear head		Grain yield (t/ha)	
	2009	2010	2009	2010	2009	2010	2009	2010
T_1	290	350	37.5	36.5	37.5	36.9	4.07	3.95
T_2	345	311	40.1	37.4	27.2	25.5	3.76	3.46
T_3	363	318	35.6	36.9	29.3	28.6	3.79	3.54
T_4	360	321	39.0	37.0	28.7	28.2	4.02	4.09
T_5	358	356	37.0	37.4	30.8	31.1	4.06	4.12
T_6	342	342	40.2	37.3	29.8	32.1	4.09	4.34
T_7	358	353	37.5	35.0	30.7	33.0	4.11	4.36
T_8	298	328	38.2	36.4	31.4	31.8	3.56	3.68
T_9	350	338	37.9	36.2	30.6	30.9	4.05	4.17
T_{10}	315	355	38.3	37.7	34.8	35.1	4.17	4.29
T_{11}	323	342	36.9	35.7	32.5	32.4	3.86	3.77
T_{12}	340	319	36.3	33.3	27.4	26.7	3.36	3.14
T_{13}	268	279	36.4	38.5	29.5	29.8	2.88	2.94
T_{14}	330	357	38.7	36.2	32.8	33.5	4.18	4.38
T_{15}	332	366	38.7	36.3	32.6	33.9	4.19	4.37
LSD (P=0.05)	29.9	29	3.4	1.9	1.7	1.8	0.14	0.29

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