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Influence of Weed Management Practices on Productivity of Wheat (*Triticum aestivum* L.) under Middle Indo-Gangetic Plains of Eastern India

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A B S T R A C T

A field experiment was conducted during the *rabi* season of 2013-14 and 2014-15 at farmer's field of Krishi Vigyan Kendra, Jehanabad, Bihar to evaluate the effect of weed management practices on productivity and profitability of wheat. The treatments were comprised of four weed management practices i.e. control or farmer practices, sulfosulfuron 25 g *a.i.*/ha, metsulfuron-methyl 4 g *a.i.*/ha and premix of sulfosulfuron and metsulfuron methyl (30+2) g *a.i.*/ha, laid out in randomized block design and replicated five times. Results revealed that application of sulfosulfuron and metsulfuron-methyl (30+2) g *a.i.* /ha produced significantly higher grain yield (3868 kg/ha) but being on a with sulfosulfuron 25 g *a.i.* /ha (3818 q/ha). The lowest grain yield was recorded with the farmers practices (2576 kg/ha). Further, markedly higher weed dry weight (138 g/m^2) was recorded with control and lowest with application of premix formulation of sulfosulfuron and metsulfuron methyl (40 g/m^2). Hence, it may be concluded that application of premix sulfosulfuron and metsulfuron methyl (40 g/m^2) is beneficial in achieving the higher productivity and profitability of wheat for the farming community of Eastern India.

Introduction

During the last four decades, wheat production and productivity increased almost six times in India and its alone contributes ~1/3rd of total food grain production (Bohra and Kumar, 2014). Area under wheat was increased since start of Green revolution in 1967 and production and productivity were also increased. In this period, production has also increased from 11.4 to 88.3 mt and productivity has gone up 887 kg ha^{-1} to 3140 kg ha^{-1} (Maurya *et al*.2014). This crop has a global significance because of the staple food of millions of people and supplies ~20% of the food calories for world's growing population. In India, it is the 2nd staple food crop next to rice having an annual production of 95.91 mt from 29.7 m ha (Kumar et al.2016).

Though wheat is an important cereal crop in India, its productivity is lower as compared to other wheat growing countries of the world (Jeet et al 2010a, b, c). A formidable factor that limits its productivity is severe weed competition during the initial crop growth stages. Continuous cultivation of dwarf wheat in rice-wheat system has led to perceptible change in weed flora. Further, the continuous and appropriate use of isoproturon since 1978 has caused shift in weed flora and

development of resistance in *Phalaris minor* to the herbicides (Singh *et al.*, 2011a).

The dominant weed flora in wheat consists of both grassy and broad leaf weeds i.e. *Phalaris minor, Avena spp., Chenopodium album, Melilotus spp., Anagallis arvensis, Vicia sativa, Lathyrus aphaca and Rumex dentatus etc.* In recent years, a new species *Rumex spp*. has emerged as serious problem in irrigated wheat eco-system. Therefore, complexity and diversity of weed flora requires more than one herbicide either in sequence or as mixture for their management. Thus, it is imperative to screen the herbicides, with alternate mode of action for effective weed control and to ensure the better yield. Significant reduction in wheat yield ranging from 18-73% due to severe infestation of weeds has been reported by Pandey and Verma (2004).

Many sulphonylurea herbicides have been more and more used in wheat due to their low application rate and less persistence in environment (Singh et al.2011b). The availability and recommendations of selective herbicides including metaxuron, methabonzthrazuron, isoproturon, and diclofopmethyl made it possible to realize potential yield of wheat. The use of new alternate herbicides including sulfosulfuron was recommended, which provides a great relief to wheat crop from resistant population of *P. minor*. Therefore, keeping these facts in mind and importance of problems from the national point, the present front line demonstration was conducted to find out the efficacy of sulfosulfuron against complex weed flora and wheat yield.

Materials and Methods

An experiment was conducted during the *rabi* season of 2013-14 and 2014-15 at farmers field of Krishi Vigyan Kendra, Jehanabad, Bihar to study the efficacy of sulfosulfuron in weed management practices on wheat. The mechanical analysis of soil showed that textural class of experimental plot was sandy loam, while chemical analysis indicated that soil reaction slightly alkaline i.e. 6.64 and electrical conductivity were normal (0.02 ds/m). Soil was found to be low in organic carbon (0.46%), available nitrogen (263 kg/ha) and available phosphorus (9.46 kg/ha). The crop was sown with the seed rate of 100 kg/ha and row spacing of 20 cm was maintained for optimum plant population and fertilized with recommended dose of fertilizer of 160, 60 and 40 kg/ha of N, P_2O_5 and K_2O, respectively through urea, di-ammonium phosphate (DAP) and muriate of potash (MOP).

Half dose of N and full dose of P_2O_5 and K_2O was applied as basal and rest doses of nitrogen were applied in two equal splits at maximum tillering and panicle initiation stages. First irrigation was given at crown root initiation (CRI) stage (21 DAS) and then applied as per crop requirement. All the herbicides of sulfosulfuron groups were applied as a post -emergence at 60 DAS with manually operated Knapsack sprayer delivering a spray volume of 600 liter/ha through flat-fan nozzle. For recording the biometric observation, plants were tagged randomly in net plots.

The harvested total dry matter production was weighed in field with the help of spring balance and noted separately. Each plot material threshed separately with the help of thresher and for removed of inert material. Data were recorded on following parameters of growth, yield attributes and yields *viz*, no. of tillers, 1000-grain weight, grain, straw and biological yields as per the standard procedure. The field data obtained for 2 years were pooled and statistically analyzed using F-test (Gomez and Gomez, 1984). Test of significance of the treatment differences were

done on the basis of t-test. The significant difference between treatment means were compared with critical differences at 5% levels of probability.

Results and Discussion

The experimental field was infested mainly with grassy and broad leaf weeds during both the years. The dominant weeds flora in experimental field were *Cynodon dactylon, Cyperus rotundus, Anagallis arvensis* and *Convolvulus arvensis,* which constituted 41.4, 20.4, 10.4 and 13.8%, respectively under farmers' practices at 60 days stage of crop growth.

Application of different doses of sulfosulfuron resulted into significantly lower weed dry weight as compared to the farmer's practices. The maximum reduction in weed dry weight (70.3 g/m^2) was recorded with application of sulfosulfuron and metsulfuron methyl (30+2) g *a.i./*ha at 60 DAS, which was found to be significantly superior over rest of the treatments. The maximum weed dry weight (139.7 g/m^2) was associated with the farmer's practices. Different dose of sulfosulfuron reduced weed control efficiency to the extent of 98.7% (Table 2).

Singh *et al.,* (2010a) also reported that sulfosulfuron has been reported to be very effective against the grassy weeds and to some extent against BLWs. Similarly, weed control efficiency (WCE) was also influenced markedly with application of herbicides.

Premix application of sulfosulfuron and metsulfuron methyl (30+2) g *a.i./*ha at 60 DAS was the highest weed control efficiency as compared to rest of the treatments. However, the lowest WCE was associated with control. This might be due to application of herbicide stunted the growth of weed with the respective treatments.

The yield attributes of wheat were markedly influenced by different weed management practices. The yield attributes i.e. tillers/m row was recorded significantly higher with mixture of sulfosulfuron and metsulfuron methyl (30+2) g *a.i./*ha but being at par with mixture. However, the reverse trends were followed in case of 1000-grain weight, where these attributes was recorded higher with sulfosulfuron (38.8 g). This is attributed to higher dry matter production was associated with the crop, which leads to higher number of grains/spike and test weight. This might be due to better weed control efficiency associated, which ultimately caused the higher yield attributes in wheat (Singh *et al.,* 2011b). Similar line of confirmation has been reported by Lalji *et al.,* (2013) (Table 1).

Application of sulfosulfuron significantly increased grain yield over the farmer's practices. Application of premix of sulfosulfuron and metsulfuron methyl (30+2) g *a.i.*/ha increased grain yield of wheat to the tune of 51.2% over the farmers practices.

Higher grain yield in herbicide treatments was due to the better weed control, which gave reduction in weed dry matter as compared to unweeded control thus, resulting in better crop development including tillering, dry matter production and grain formation there by favoring the grain yield. Further, straw and biological yield crop followed the similar trend.

Significantly higher crop productivity (29.76 kg/ha/day) was recorded premix application of sulfosulfuron and metsulfuron methyl but being on a par with sulfosulfuron (29.37 kg/ha/day). This might be due to the higher yield associated with the respective treatments.

Table.1 Effect of weed management practices on yields attributes and yields of wheat (Pooled data of two years)

Treatment	Tillers/m row (no.)	Grains/ spike (no.)	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Crop Productivity (kg/ha/day)
Farmers Practices	39.47	25.67	36.61	2576	3432	6008	19.81
2,4-D	51.53	32.53	36.50	2969	3957	6926	22.84
Metsulfuron methyl	52.67	35.03	36.81	3098	4128	7226	23.83
Sulfosulfuron	57.12	40.62	38.33	3818	5088	8906	29.37
Mixture	62.41	41.79	38.84	3868	5155	9023	29.76
SE±M	5.09	0.59	0.54	54	117.21	313	0.42
CD (P=0.05)	15.27	1.76	1.61	162	351.38	1239	1.25

Table.2 Effect of weed management practices on weed control efficiency and economics of wheat (Pooled data of two years)

Treatment	Weed dry weight (g/m^2) at 60 DAS	WCE (%) at 60 DAS	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit: cost ratio	Economic efficiency (Rs./ha/day)
Farmers Practices	139.7	-	39920	17244	1.76	133
2,4-D	113.6	23.0	46026	22627	1.97	174
Metsulfuron methyl	108.1	29.2	48014	24565	2.05	189
Sulfosulfuron	83.0	68.3	59176	34902	2.44	268
Mixture	70.3	98.7	59959	35935	2.50	276
SE±M	1.33	-	841	841	0.03	6.4
CD (P=0.05)	3.98	-	2523	2523	0.10	19.4

*WCE: Weed control efficiency, DAS: Days after sowing

Economic attributes of wheat were influenced markedly with weed management practices. Significantly higher gross returns (Rs.59959/ha), net returns (Rs.35935/ha), and benefit: cost ratio (2.50) were recorded significantly higher with mixture of sulfosulfuron and metsulfuron methyl (30+2) g *a.i.*/ha but being noted at par with mixture of sulfosulfuron. Similarly, economic efficiency recorded significantly higher with application of herbicides mixture (276 kg/ha/day) over rest of the treatment but being on a par with sulfosulfuron and metsulfuron methyl (30+2) g *a.i.*/ha. These values were recorded the lowest with the farmer's practices (133 kg/ha/day). This might be due to higher yield associated and comparatively lower cost of production with the respective treatment (Singh et al.2010b). The similar findings have been reported by Yadav *et al.*, (2013) and Paswan *et al.*, (2012).

Hence, in this trial best efficacy of total weed biomass control and maximize the yield potential with the application of herbicide premix of sulfosulfuron and metsulfuron methyl (30+2) g *a.i.*/ha were achieved highest as compared to separate application of sulfosulfuron and metsulfuron–methyl alone. Therefore, it may be a valid approach to improve the productivity and profitability of wheat in irrigated ecosystem in middle Indo-Gangetic plains of Eastern India.

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