Progressive Research 9 (Special) : 492-494 (2014) *Society for Sci. Dev. in Agric. and Tech.*

EVALUATION OF BIO-EFFICACY OF HERBICIDES FOR CONTROL OF COMPLEX WEED FLORA IN WHEAT (*Triticum aestivum* L.)

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ABSTRACT

A field experiment was conducted during 2011-12 and 2012-13 at Crop Research Farm Nawabganj of C. S. Azad University of Agriculture and Technology, Kanpur to evaluate the herbicides against complex weeds flora and find out the bio-efficacy of herbicides in wheat cultivar K307, under timely sown irrigated condition. The data was analyzed on pooled basis and results have been described on the basis of pooled analysis. The experiment was conducted involving further treatments such as Metribuzin; Clodinafop; Pinoxaden; Sulfosulfuron; Clodinafop + Metribuzin; Pinoxaden + Metribuzin; Sulfosulfuron + Metribuzin; Accord Plus (Fenoxaprop + Metribuzin); Total (Sulfosulfuron + Metsulfuron); Atlantis (Metsulfuron + idosulfuron); Vesta (Clodinafop + Metsulfuron); Isoproturon + 2, 4-D; Weedy Check and weed free plot were evaluated under timely sown irrigated condition. Weed free treatment recorded maximum grain yield (56.83 q/ha) over all other treatments. Among herbicide treatments ready mix combination of Pinoxaden + Metribuzin @ 40 + 210 g a. i. /ha yield produced significantly by higher grain yield (51.42 q/ha) over weedy check (35.91 q/ha). The lowest grain yield was recorded in weedy check (35.91 q/ha). High weed intensity and dry weight of the weed were recorded at 60 DAS in weedy check treatment (0.00). Yield components viz., ear head, Grains/ear head and test weight showed highly significant positive correlation with grain yield.

Key words : *Wheat, herbicides, weed flora, weed density.*

Chemical weed control in wheat is preferred by farmers due to cost and time effectiveness as compared to manual weeding. However, continuous use of same herbicide or herbicides of similar mode and mechanism of action is resulting in the buildup of tolerant weed species as well as evolution of resistant populations of weeds. In India, Phalaris minor has evolved multiple herbicide resistance and is a threat to wheat production. The evolution of multiple herbicide resistance is causing the crop failure in extreme cases and it is also making the weed control expensive. Long term strategies to manage or avoid the herbicide resistance should include integration of crop rotation, herbicide rotation, herbicide mixture along with various other agronomic practices and increased seeding rate of the crop over weeds. The integration of multiple cultural practices along with chemical use for weed control provides greater benefits than the effects of using just one or two weed control practices in isolation. In India, record production of 95.60 million tons of wheat has been achieved in 2013-14 (1). The significant role of herbicides was recorded in the production of wheat. Weed infestation is one of the major factors limiting crop productivity for realizing full genetic yield potential of the crop, the proper weed control is one of the essential ingredients. About 80 per cent of the interactions that has been observed in species of the family poaceae (grasses) refer to cases of antagonism (2). Weed infestation is one of the major biotic constraints in wheat production.

Wheat is infested with diverse type of weed flora, as it is grown under diverse agro-climatic conditions, different cropping sequence, tillage and irrigation regimes. The yield losses due to weeds vary depending on the weed species, their density and environmental factors. Among weeds, Phalaris minor Retz. is single most dominant grassy weed in northern Indian plains causing significant yield losses. 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 (Sulfosulfuron + Metsulfuron; Mesosulfuron; Metsulfuron + Carfentrazone (ready mix); 2, 4-D-E) or as sequential, if not compatible are required. Further, the herbicide efficacy can be improved by use of adjuvant, safeness and proper spray technology. Weeds cause significant annual regional productivity losses in rice-wheat system (3). Evolution of resistance in Phalaris minor (4) against isoproturon made it a single weed species limiting wheat productivity in the North Western plains of India. Weed infestation is one of the major factors limiting crop productivity. For

Table-1: Effect of herbicides on yield attributes, grain yield and weeds in wheat (Pooled over 21011-12 and 2012-13)

Herbicides (Pooled over 11-1 and 1-13)	Weed index	No. of earheads/sqm	Grains/ Earhead	Test weight (g)	Weed density (No/sqm)		Weed dry weight (g/m2)		Grain yield (q/ha)
					60 DAS	120 DAS	60 DAS	120 DAS	
Metribuzin	24.48	374	30.99	37.07	3.88	4.50	2.26	2.24	42.92
Clodinafop	22.61	375	31.43	37.32	3.14	3.62	1.96	1.94	43.98
Pinoxaden	12.28	376	35.67	37.18	3.08	3.45	1.95	2.04	49.85
Sulfosulfuron	23.68	377	30.72	37.44	3.71	3.90	2.26	2.34	43.37
Clodinafop + Metribuzin	20.78	373	32.32	37.37	5.38	3.47	1.91	2.07	45.02
Pinoxaden + Metribuzin	9.52	374	36.82	37.37	3.70	3.19	2.25	1.81	51.42
Sulfosulfuron + Metribuzin	21.52	374	32.21	37.03	4.02	3.55	2.53	2.18	44.60
Accord Plus (Fenoxaprop + Metribuzin)	20.50	373	32.56	37.20	3.88	3.71	2.42	2.32	45.18
Total (Sulfosulfuron + Metsulfuron)	20.80	373	32.22	37.48	4.05	3.75	2.49	2.54	45.01
Atlantis (Metsulfuron + idosulfuron)	25.90	372	30.76	36.90	4.02	3.65	2.37	2.47	42.11
Vesta (Clodinafop + Metsulfuron)	27.47	373	30.10	36.74	4.05	3.59	2.51	2.31	41.22
Isoproturon + 2, 4-D	28.33	371	29.77	36.84	3.87	3.43	2.48	2.38	40.73
Weedy Check	36.81	365	26.88	36.60	6.86	4.90	4.27	3.65	35.91
Weed Free	0.00	378	40.04	37.65	0.00	0.00	0.00	0.00	56.83
Mean	21.05	374	32.32	37.16	3.91	3.55	2.34	2.24	44.87
ntblCD at 5%	2.01	12	3.49	1.40	0.74	1.07	0.41	0.41	4.31

Table-2: Correlation of weed intensity, dry weight, and yield components with yield (Pooled over 21011-12 and 2012-13)

Correlation		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GY	(1)	-	-0.999**	0.756**	0.997**	0.773**	-0.792**	-0.791**	-0.806**	-0.882**
WI	(2)		-	-0.860**	-0.866**	-0.707**	0.877**	0.767**	0.993**	0.999**
EH	(3)			-	0.714**	0.761**	-0.851**	-0.523**	-0.895**	-0.860**
GEH	(4)				-	0.728**	-0.772**	-0.796**	-0.778**	-0.866**
TW	(5)					-	-0.606**	-0532**	-0.741**	-0.707**
WD at 60 DAS	(6)						-	0.719**	0.857**	0.877**
WDat 120 DAS	(7)							-	0.682**	0.767**
WDW at 60 DAS	(8)								-	0.953**
WDW at 120 DAS	(9)									-

GY = Grain Yield (q/ha); WI = Weed index; EH = Ear head (m^2); GEH = Grains/Earhead;
TW = Test weight (g); WD = Weed Density; WDW = Weed Dry Weight.

realizing full genetic yield potential of the crop, the proper weed control is one of the essential ingredients. Weeds not only reduce the yield but also make the harvesting operation difficult. Therefore, for sustaining food grain production to feed ever-increasing population and ensuring food security, effective weed management is very essential.

MATERIALS AND METHODS

An experiment was conducted during Rabi season of 2011-12 and 2012-13 at Crop Research Farm Nababganj of C. S. Azad University of Agriculture and Technology, Kanpur for evaluation of herbicides against bio-efficacy of weed flora in wheat cultivar K307. Fourteen treatments including 12 herbicides viz., Metribuzin; Clodinafop; Pinoxaden; Sulfosulfuron; Clodinafop + Metribuzin; Pinoxaden + Metribuzin; Sulfosulfuron + Metribuzin; Accord Plus (Fenoxaprop + Metribuzin); Total (Sulfosulfuron + Metsulfuron); Atlantis (Metsulfuron + idosulfuron); Vesta (Clodinafop + Metsulfuron); Isoproturon + 2, 4-D; Weedy Check and weed free were evaluated under randomized block design with three replications, under timely sown irrigated condition. For weed free treatment, weeds were removed manually as when appeared. Weed density and dry weight were recorded at 60 and 120 DAS to see the effect of herbicides on broad leaf weeds. Recommended seed rate of 100 kg/ha was used. The experimental site had a semi-arid type of climate and was situated at the height of 125.9 meters above the sea level at located of 26.390 N Latitude and 80.150 E Longitude. Recommended dose of fertilizers (120:60:40 kg N, P_2O_5 and K20/ha) was used to raise good crop.

RESULTS AND DISCUSSION

The data of present investigation on wheat (*Triticum aestivum* L.) variety K0307 to assess the effect of herbicides have been presented in Table-1. Weeds free treatment recorded maximum grain yield (56.83 q/ha) over all other treatments. Among the weedicides highest yield was recorded in treatment combination of Pinoxaden + Metribuzin (51.42 q/ha) followed by Pinoxaden (49.85 q/ha) and Accord Plus (Fenoxaprop + Metribuzin) (45.18 q/ha) over other herbicides while weedy check (35.91 q/ha) recorded the lowest yield. Lowest weed index was recorded in treatment combination of Pinoxaden + Metribuzin (9.52) while it was maximum in weedy check (36.81). Treatment Metsulfuron + Carfentrazone (RM) + 0.2% NIS recorded maximum ear heads (377.0 m-2) followed by Pinoxaden (376.0 m^{-2}) and Clodinafop (375.0 m^{-2}) over weedy check (365.0 m-2) while weed free plot recorded highest ear head (378.0 m^{-2}). Among herbicides combination of Pinoxaden + Metribuzin gave maximum number of grains/ear head (36.82) followed by Pinoxaden (35.67). The lowest number of grain/ spike was recorded in weedy check (26.88). The maximum value of 1000-grain weight was recorded in Weed free (37.65 g) followed by Total (Sulfosulfuron + Metsulfuron) (37.9 g) and Sulfosulfuron (37.44 g), while lowest value was recorded in weedy check (36.60 g). Maximum weed intensity and dry weight of weed were recorded in weedy check at 60 and 120 DAS (6.86, 4.90 g) and (4.27, 3.65 g), respectively. Among the herbicides, combination Clodinafop + Metribuzin (5.38) recorded maximum weed intensity followed by Vesta (Clodinafop + Metsulfuron) (4.05) at 60 DAS while at 120 DAS Metribuzin (4.5) recorded higher weed intensity followed by Vesta (Clodinafop + Metsulfuron) (3.9) over weed free (1.00 g). Maximum weed dry weight at 60 DAS was recorded in Sulfosulfuron + Metribuzin (2.53 g) followed by Vesta (Clodinafop + Metsulfuron) (2.51 g) while at 120 DAS its maximum value was recorded in Total (Sulfosulfuron + Metsulfuron) (2.54 g) and Atlantis (Metsulfuron + indosulfuron) (2.47 g) in comparison to other herbicides.

Grain yield showed highly significant and positive correlation with ear head, Grains/ear head and test weight while negative and highly significant correlation with weed index, weed intensity and Weed dry weight at 60 and 120 DAS were also recorded (Table-2). Weed index showed highly significant and positive correlation with weed density, weed dry weight at 60 DAS and at 90 DAS (Table-2).

(5) reported improved control of hard weed Canada thistle (*C. arvense*) with tank mix application of herbicides. Therefore, for sustaining wheat production, we have to evaluate new herbicide and herbicide mixtures with different mechanism of action. The effectiveness of grass herbicides are generally reduced when mixed with broad-leaved herbicides. Results have also been supported by (6).

The advantage of combination of Metsulfuron and Carfentrazone over alone application of Metsulfuron and Carfentrazone will be in situations having the diverse infestation of broad-leaved weeds particularly the *M. parviflora, S. nigrum and L. aphaca*. Metsulfuron and 2,4-D are not effective against M. parviflora and S. nigrum, whereas, Carfentrazone is not effective against *L. aphaca*. The ready mix combination of Metsulfuron + Carfentrazone will provide the control of these weeds. Similarly, (7) reported better control of *R. spinosus* (92%) with Metsulfuron + Carfentrazone tank mixture compared to sole application of either Metsulfuron (85%) or Carfentrazone (78%).

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