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Response of wheat cultivars to herbicides

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Abstract

A field experiment entitled "Response of wheat cultivars to herbicides" was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) India during *Rabi* seasons of 2004-05 and 2005-06 with an object to ascertain the response of wheat cultivars to herbicides. Field trial was laid out in a split plot design with three replications keeping four treatments of herbicides viz., T_1-control, T_2-isoproturon @ 1.0 kg ha^{-1}, T_3-sulfosulfuron @ 25 g ha^{-1} and T_4 – fenoxaprop-p-ethyl @ 80 g ha^{-1} in main plot and eight wheat cultivars (PBW-154, HUW-234, PBW-343, PBW-443, HUW-468, NW-1012, UP-2003, Raj 3077) in sub plot. The experimental field was kept free from weeds, throughout the life-span of the crop. The herbicides as per treatments were sprayed with the help of manual operated knapsack sprayer fitted with flatfan nozzle using 600 litres water ha^{-1}. Other agronomic practices as per recommendation were adopted. Post-emergence application of sulfosulfuron @ 25 g ha^{-1}, fenoxaprop-p-ethyl @ 80 g ha^{-1} and isoproturon @ 1.0 kg ha^{-1} did not show their harmful effects on the performance of different wheat cultivars. Wheat cultivars HUW-468, PBW-443 and PBW-343 were screened out as higher yielder.

Key words: Herbicides, wheat cultivars, Isoproturon, Sulfosulfuron and Fenoxaprop-p-ethyl.

Introduction

Out of several reasons for low productivity of wheat, inadequat weed management in wheat is considered to be the major one. Definitely invasion of weeds caused heavy reduction in wheat yield. The weeds when allowed to complete with the crops for different growth factors for entire crop season reduced the crop yield ranging from 18 to 73 per cent as reported by Dixit and Bhan (1997). There are several methods by which weeds are controlled effectively. Hand hoeing and hand weeding have been the most common method of weed control in India. This practice is possible only after a stage when weeds have put forth sufficient growth in provide sufficient grip for uprooting. By this time, weeds always do some damage to crop. Weed competition in wheat is more severe in early stages of crop growth which necessitates early weed control measures. On the other hand, manual removal of weeds is not only expensive but crop also suffers from weeds due to non-availability of labours when the crop is due for weeding. So,we have to have look forward towards other methods of weed control in this crop.Chemical control has recently come to the forefront as an important phase of modern scientific agriculture. Control of weeds with herbicides may be the best alternative of manual weeding in wheat, because herbicides control the weeds from very beginning. Gill and Brar (1977) and Gill *et al.* (1981) have also reported that the use of selective herbicides in wheat seemed to be effective and economic. Several herbicides have been tested to get desired control of grassy and non-grassy weeds without damage to wheat crop. The herbicides which have been found promising for effective control of weeds in wheat are 2, 4-D @ 0.5 kg ha^{-1} as post emergence, isoproturon @ 1.0 kg ha^{-1} post-em. and Pendimethalin @ 1.0 kg ha^{-1} as post em., (Kumar, 1987 and Mederios *et al.*, 1981). The continuous application of herbicides may be determental to the environment. In addition, selectivity of herbicides may lead to severe infestation of more obnoxious weeds formerly of secondary importance. Isoproturon is being used since 1980's in the wheat belt of India for effective control of weeds particularly *Phalaris minor* and *Avena* spp. but its

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efficacy have declined from last one decade due to the development of resistant *P. minor* as reported by Walia *et al.* (1997) from Punjab Agricultural University, Ludhiana, Punjab and C.C.S.H.A.U., Hissar, Haryana, respectively. Wheat is considered to detoxify the effect of isoproturon by phytochrome P_{450} mono oxygenase enzyme (Cabanne *et al.*, 1987). Due to continuous use of particular herbicide (isoproturon) against *P. minor* lead to higher activity of this degrading enzyme as the metabolities formed in wheat and *P. minor* found to be similar. To avoid such situation, some other alternate herbicides are advised to use in herbicide rotation system. Introduction of new molecule of herbicides has made it possible to control a wide spectrum of weeds in wheat effectively. In order to control isoproturon resistant *P. minor* and other weed flora of wheat, sulfosulfuron and fenoxaprop-p-ethyl (100 g ha^{-1}) were recommended as post emergence (Walia & Singh, 2005). Other new molecules of herbicides viz., clodinafop (60-80 g ha^{-1}) affinity (2 kg ha^{-1}), carfentrazome (20 g ha^{-1}), metsulfuron methyl, (4 g ha^{-1}) and metribuzin (75-210 g ha^{-1}) have been introduced for effective control of weeds. Likewise development of new molecule of herbicides, new varieties of wheat are also being introduced year to year. Crop varieties have been reported to differ in their response to herbicides and it is quite possible that wheat varieties also differ in their tolerance to herbicides suggested for use in this crop (Gill and Walia, 1987). It has also been observed by Vaishya (2006) at N.D.U.A.&T., Kumarganj, Faizabad, that use of carfentrozone @ 60 g/ha, affinity 2 kg ha^{-1} and metsulfuron 4 g ha^{-1} imposed their phytotoxic effect on crop plants of wheat particularly variety UP-2425. Without knowing that the new cultivars of wheat are tolerant or susceptible to new molecules of herbicide there is risk enough for there use in newly released wheat cultivars. Hence, it is imperative that before making any general recommendation for herbicide use in crop, the available varieties must be tested for their tolerance/susceptibility to a particular herbicide. The present effort is in this direction.

Material and methods

A field experiment was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) India during *Rabi* seasons of 2004-05 and 2005-06 with an object to ascertain the response of wheat cultivars to herbicides. Field trial was laid out in a Split Plot Design with three replication keeping four treatments as herbicides viz., T_1-control, T_2-isoproturon @ 1.0 kg ha^{-1}, T_3-sulfosulfuron @ 25 g ha^{-1} and T_4 – fenoxaprop-p-ethyl @ 80 g ha^{-1} in main plot and eight varieties as wheat (PBW-154, HUW-234, PBW-343, PBW-443, HUW-468, NW-1012, UP-2003, Raj 3077) in sub plot. The experimental field was kept free from weeds, throughout the life-span of the crop. The herbicides as per treatment were sprayed with the help of manual operated Knapsak sprayer fitted with flatfan nozzle using 600 litre water ha^{-1}. Other agronomic practices as per recommendation were adopted. The results achieved during the course of investigation are being given below.

Results and Discussion

Length of spike (cm): Length of spike was measured after harvesting the crop under the effects of herbicides and wheat cultivars during both the years of study. The data pertaining to this character were analysed statistically and the overall effects of different treatments have also been represented by Table 1. Table 1 depicts that the maximum length of spike was associated with control treatment followed by sulfosulfuron @ 25 g ha^{-1} post-em. while, the minimum was noted under the effect of isoproturon @ 1.0 kg ha^{-1} post-em. during both the years. Statistical analysis of data showed non-significant effects of herbicide treatments on length of spike in both the years . Table 1 related to effect of cultrivars demonstrated that wheat cultivar PBW-154 produced the longest spike followed by HUW-468 and the smallest spike was produced by Raj-3077 in both the years. It is evident from the results that the length of spike of cultivar PBW-154 was significantly greater than the remaining wheat cultivars during both the years.The interaction effect of herbicides and cultivars on length of spike was not pronounced in any of the experimental year.

Number of spikelets spike^{-1}:

Table 1 representing the overall effects of herbicide treatments on number of spikelets spike^{-1} demonstrates that the earheads sampled from control plot had maximum number of spikelets

Table 1 Effect of herbicide treatments, wheat cultivars and their interaction on length of spike, number of spikelets spike^{-1} and number of grains spike^{-1}

Treatment	Length spike (cm)		No of spikelets spike^{-1}		No. of grains spike^{-1}	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
A. Herbicide treatments						
T_1	15.84	14.99	52.27	51.91	54.70	53.98
T_2	15.05	13.79	52.14	50.51	54.54	53.03
T_3	15.74	14.78	52.24	51.22	54.63	53.70
T_4	15.09	14.30	52.22	50.79	54.60	53.35
SEm$\pm$	0.22	0.31	0.74	1.11	0.49	0.83
CD at 5%	NS	NS	NS	NS	NS	NS
B. Wheat cultivars						
V_1	18.08	16.37	42.52	41.52	46.12	45.53
V_2	14.94	14.26	53.28	52.25	56.06	55.86
V_3	14.83	14.72	56.60	55.07	58.15	57.44
V_4	15.49	14.90	58.40	57.89	60.41	57.83
V_5	15.71	15.10	60.75	58.93	62.45	59.71
V_6	14.97	13.29	49.35	48.29	52.14	51.46
V_7	14.81	14.05	52.45	51.11	54.17	53.67
V_8	14.62	13.03	44.40	43.81	47.43	46.64
SEm$\pm$	0.25	0.27	0.86	0.89	1.25	1.23
CD at 5%	0.72	0.77	2.45	2.55	3.58	3.50
T x V						
SEm$\pm$	0.50	0.54	1.71	1.79	2.50	2.46
CD at 5%	NS	NS	NS	NS	NS	NS

Where: T_1- Control, T_2- Isoproturon @ 1.0 kg ha^{-1} post-emergence, T_3- Sulfosulfuron @ 25 g ha^{-1} post-emergence, T_4- Fenoxaprop-p-ethyl @ 80 g ha^{-1} post-emergence V_1 - PBW-154, V_2 - HUW-234, V_3 - PBW-343, V_4 - PBW-443, V_5 – HUW-468 V_6 - NW-1012, V_7 - UP-2003, V_8 - Raj-3077

spike^{-1} followed by post-em. application of sulfosulfuron used @ 25g ha^{-1} and the minimum was associated with isoproturon @ 1.0kg ha^{-1} post-em in both the years. The results summarized in Table 13 after the statistical analysis of data pertaining to this character revealed that the differences in the values of number of spikelets spike^{-1} under the effects of different herbicide treatments did not reach to the level of significance in both the years. Table 1 depicts that wheat cultivar HUW-468 counted the maximum number of spikelets spike^{-1} followed by PBW-443 and the minimum was associated with PBW-154 in both the years. The results (Table 1) obtained after the statistical analysis high lighted that HUW-468 being of par with PBW-443 provided significantly more number of spikelets spike^{-1} than rest of the cultivars during both the years. Herbicide treatments did not interact with cultivars significantly during both the years of study.

Number of grains spike^{-1}:

It is clear from the Table 1 representing the overall effects of different herbicide treatments that control plot registered maximum number of grains spike^{-1} followed by sulfosulfuron @ 25g ha^{-1} post-em. while the minimum was noted under the effect of isoprotunon @ 1.0kg ha^{-1} post-em during both the years of study. The effect of herbicide treatments on number of grains spike^{-1} was not perceptible as evident by the results summarized in Table 13 after the statistical analysis of data in both the years. Table 1 shows that wheat cultivar HUW-468 provided the highest number of grains spike^{-1} followed by PBW-443 and the lowest was provided by PBW-154 in case of both the years. The data pertaining to this character were subjected to statistical analysis and the results thus obtained (Table 1) explained that HUW-468 being at par with PBW-443 in first year and with PBW-443 and PBW-343 in second year superceeded rest of cultivars to provide more number of grains spike^{-1} in both the years of study. The interaction effect of herbicides and cultivars on number of grains spike^{-1} was not visible in any of the experimental year.

Weight of grains spike^{-1}:

It is clear from the Table 2 representing the overall effects of herbicide treatments on weight of grains spike^{-1} demonstrates that the spike sampled from control plot had maximum weight of grains spike^{-1} followed by post-em. application of sulfosulfourn used @ 25 gha^{-1} and the minimum was associated with isoproturon @ 1.0 kg ha^{-1} post-em. in both the years. The results embodied in Table 2 after the statistical analysis of data pertaining to this character revealed that the differences in the values of weight of grains spike^{-1} under the effects of different herbicides did not reach to the level of significance in both the years. Table 2 reflects that wheat cultivars HUW-468 registered the maximum weight of grains spike^{-1} followed by PBW-443 and the minimum was associated with PBW-154 in both that years. The results summarized in Table 14 obtained after the statistical analysis highlighted that HUW-468 being at par with PBW-443 provided significantly more weight of grains spike^{-1} than rest of the cultivars of wheat during both the years of study. The herbicide treatments and cultivars did not interact significantly in respect of weight of grains spike^{-1} during both the years of experiment.

Table 2 Effect of herbicide treatments, wheat cultivars and their interaction on weight of grains spike^{-1}, weight of 1000 grains and grain yield

Treatments	Weight of grains spike^{-1} (g)		Weight of 1000 grains (g)		Grain yield (q ha^{-1})	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
A. Herbicide treatments						
T_1	2.12	2.11	38.77	38.96	43.06	42.29
T_2	2.11	2.08	38.64	38.61	41.07	40.74
T_3	2.12	2.10	38.86	38.91	42.82	41.80
T_4	2.12	2.10	38.69	38.89	41.77	41.36
SEm±	0.04	0.03	0.51	0.51	0.65	0.70
CD at 5%	NS	NS	NS	NS	NS	NS
B. Wheat cultivars						
V_1	1.63	1.62	35.48	37.40	39.34	38.89
V_2	2.23	2.20	39.77	39.72	42.91	41.77
V_3	2.32	2.28	39.87	39.86	43.58	42.98
V_4	2.42	2.40	40.19	39.95	43.90	43.87
V_5	2.51	2.48	40.20	40.19	44.61	44.07
V_6	1.98	1.96	38.15	37.90	40.93	39.99
V_7	2.09	2.08	38.67	38.69	41.73	41.08
V_8	1.77	1.76	37.59	37.02	40.44	39.75
SEm±	0.04	0.04	0.62	0.63	0.60	0.61
CD at 5%	0.12	0.11	1.77	1.80	1.72	1.75
T x V						
SEm±	0.08	0.08	1.24	1.26	1.20	1.23
CD at 5%	NS	NS	NS	NS	NS	NS

Where: T_1- Control, T_2- Isoproturon @ 1.0 kg ha^{-1} post-emergence, T_3- Sulfosulfuron @ 25 g ha^{-1} post-emergence, T_4- Fenoxaprop-p-ethyl @ 80 g ha^{-1} post-emergence, V_1 - PBW-154, V_2 - HUW-234, V_3 - PBW-343, V_4 - PBW-443, V_5 – HUW-468,V_6-NW-1012,V_7-UP-2003,V_8-Raj-3077

Weight of 1000 grains (g):

It is clear from the Table 2 representing the overall effects of herbicide treatments that, control plot registered maximum weight of 1000 grains followed by sulfosulfuron @ 25g ha^{-1} post-em. while the minimum was noted under the effect of isoproturon used @ 1.0 kg ha^{-1} post-em during each year of study. The effect of herbicide treatments on weight of 1000 grains was not perceptible as evident by the results summarized in Table 14 after the statistical analysis of data in both the years.

Table 2 explained that wheat cutivar HUW-468 provided the highest weight of 1000 grains followed by PBW-443 during both the years, but the lowest was found in PBW-154 and Raj-3077 during first and second year respectively. The data pertaining to this character were subjected to statistical analysis and the results thus obtained (Table 2) revealed that HUW-468 being at par with PBW-443, PBW-343, HUW,234 and UP-2003 superceeded rest of cultivars to provide maximum weight of 1000 grains in both the years of study. The interaction effect of herbicides and cultivars on weight of 1000 grains was not perceptible in any of the experimental year.

Grain yield (q ha^{-1}):

The overall effects of herbicide treatments on grain yield are presented by Table 2 which depicts that control treatment provided the highest grain yield followed by sulfosulfuron applied @ 25 g ha^{-1} as post –em. and the lowest was recorded under the effect of isoproturon used @ 1.0 kg ha^{-1} post-em. in both the years of study. The data pertaining to this character were subjected to statistical analysis and the results have been included in Table 2. The perusal of result revealed that different herbicide treatments included in experiment did not cause significant variations in both the years. Table 2 representing the overall effects of wheat cultivars on grain yield disclosed that HUW-468 registered the highest grain yield followed by PBW-443 and the lowest was associated with PBW-154. The perusal of results (Table 2) obtained after the statistical analysis of data indicated that HUW-468 being statistically indentical to PBW-443, PBW-343 and HUW-234 in first year and with PBW-443 and PBW-343 in second year registered significantly higher grain yield than rest of cultivars during both the years of field experimentation. PBW-154 has been found poor yielder in this experiment. No considerable variations in grain yield due to interaction of herbicide treatments and cultivars were observed in any of the experimental year. The yield and yield contributing characters viz., length of spike, number of spikelets spike^{-1}, number of grains spike^{-1}, weight of grains spike^{-1}, weight of 1000 grains and grain yield of wheat cultivars neither significantly increased nor decreased during both the years due to herbicide treatments. It means all the wheat cultivars included in the experiment were found to be tolerant to the herbicides used. Paul and Gill (1982) also reported that grain yield of wheat cultivars did not increased or decreased significantly due to use of methabenzthiazuron @ 1.0 kg ha^{-1} as pre-em. and @ 0.7 kg ha^{-1} as early post-em. The maximum yield and yield contributing characters were observed in control followed by post-em. application of sulfosulfuron @ 25 g ha^{-1}, while, the lowest was found to be associated with isoproturon used @ 1.0 kg ha^{-1} as post-em.Among the cultivars of wheat included in experiment, HUW-468 has been found most promising followed by PBW-443 and PBW-343 to provide higher values of various yield contributing characters (length of spike, length of spike, number of spikelets spike^{-1}, number of grains spike^{-1}, weight of grains spike^{-1}, weight of 1000 grains and grain yield,) in both the years of field experimentation. These differences in wheat cultivars might be due to differences in the genetic composition of the cultivars and their physiological and biochemical process related to herbicide activity.

Conclusion

The herbicides namely sulfosulfuron @ 25 g ha^{-1}, fenoxaprop-p-ethyl @ 80 g ha^{-1} and isoproturon @ 1.0 kg ha^{-1} are recommended for safe use as post-emergence (30-35 DAS) in wheat cultivars namely HUW-468, PBW-443, PBW-343, HUW-234, UP-2003, NW-1012, Raj-3077 and PBW-154 for effective weed control and enhanced crop yield.

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