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Performance of promising herbicides on growth and yield attributes of late sown wheat (*Triticum aestivum* L.) and its associated weeds

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ABSTRACT

An experiment was conducted to assess the effect of different herbicides on growth and yield of late sown wheat variety, UP 2425 and associated weeds during rabi season by taking ten treatments viz. Isoproturon @ 1000 g ha^{-1}, Clodinafop @ 60g ha^{-1}, Sulfosulfuron @ 25 g ha^{-1}, Metasulfuron methyl @ 4 g ha^{-1}, Isoproturon + Metasulfuron methyl @ (1000+4) g ha^{-1}, Clodinafop + Metasulfuron methyl @ (60+4) g ha^{-1}, Sulfosulfuron + Metasulfuron methyl @ (25+4) g ha^{-1}, Carfentazone @ 25 g ha^{-1}, Weedy and Weedy free. The treatments were arranged in randomized block design with three replications. Results revealed that post emergence application of sulfosulfuron + MSM (25+4 g ha^{-1}) significantly reduced the number and dry weight of weeds as compared to other treatments but remained at par with weed free and isoproturon +MSM @ (1000 + 4g ha^{-1}). All the growth and yield contributing characters viz. plant population and height, shoots m^{-2}, leaf area index, no. and length of spike, grains spike^{-1} and 1000 grain weight as well as grain and straw yield were significantly higher with weed free and the values were at par with post emergence application of sulfosulfuron + Metasulfuron methyl @ (25 + 4 g ha^{-1}) and isoproturon + Metasulfuron methyl (1000+4 g ha^{-1}). Thus, it could be concluded that post emergence application of sulfosulfuron (25g ha^{-1}) tank mixed either with Metasulfuron methyl (4 g ha^{-1}) or with isoproturon (1000g ha^{-1}) applied at 45 DAS was found most effective in weed control for higher production of late sown wheat.

Keywords : Growth and yield characters, herbicides, weeds, wheat

Wheat (*Triticum aestivum* L.), the most important cereal crop that revolutionized agriculture and wiped out hunger and starvation from the face of the World. Wheat yield under late sown condition is poor due to the less exploitation of potentialities of the crop. Reduction in yield is mainly caused by delayed emergence of seedling and curtailing the growth and development periods of the crop. Weeds are considered as one of the major constraints in wheat cultivation. The introductions of high yielding dwarf varieties, which comparatively require larger amount of water and fertilizers, have created conducive condition for luxuriant growth of weeds with high density. The prominent weeds noted in late sown wheat are *Phalaris minor, Cynodon dactylon, Cyperus rotundus, Anagallis arvensis, Chenopodium album, Polygonium plebejum, Vicia sativa* and *Melilotus indica*.

Weed infestation in late sown wheat causes heavy reduction in crop yield ranging from 15 to 50 per cent (Gill and Brar, 1975), which may be minimized to a greater extent simply by adopting an appropriate weed management practices. Herbicides like pendimethaline @ 1.0 to 1.5 kg ha^{-1} as pre-emergence or isoproturon @ 1.25 kg ha^{-1} as post emergence has been reported effective to control the grassy weeds in wheat (Panda *et al.*, 1996). At present no herbicide is available which alone can provide desired degree of weed control in wheat. It has also been reported that *Phalaris minor* a problematic weed of wheat is becoming resistant to isoproturon. The immunity in weeds against any herbicide may be altered through alternate application of herbicides, which implies that any specific herbicide should not be used continuously for a longer period in a particular field for a particular crop.

MATERIALS AND METHOD

A double gene dwarf wheat cultivar UP 2425 was sown using seed rate of 125 kg ha^{-1}. The sowing was done in line with seed drill. All herbicides (as per treatments) were applied as post emergence after first irrigation at 45 days after sowing with the help of manually operated knapsack sprayer fitted with flat fan nozzle using 600 liters water per hectare. The net plot area (4.5×2.2m) was harvested separately and was bundled and tagged properly for recording biological yield. Initial plant population was recorded by placing a quadrate of 50×50 cm size at three places selected randomly in each plot at 15 days after sowing. The plant height was measured at 30, 60 90 days stages and at harvest stage.

The crop was harvested separately at maturity by harvesting 50 cm border both sides across the length and two rows from each side. The net plot area (4.5 × 2.2m) was harvested separately and was bundled and tagged properly for recording biological yield. Net plot material threshed very carefully by a power thresher. The grain yield of individual plot after winnowing was weighed. The quantity of straw per plot was calculated by subtracting the weight of grain from biological produce.

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Initial plant population was recorded by placing a quadrate of 50 × 50 cm size at three places selected randomly in each plot at 15 days after sowing. The height of main shoot of tagged plants were measured at 30, 60, 90 days stages and at harvest stage. The height was measured from the ground level to the ligules of highest leaf prior to ear emergence and from ground to the base of ear after ear emergence with the help of meter scale and average values were taken.

The number of shoots was received randomly at three places from each plot at 30, 60, 90 DAS and at harvest stage and finally average number of shoots was calculated.

The leaf area was measured at 30th, 60th, 90th and at harvest day stagers of crop to calculate the leaf area index. The plants of 0.25 m row length were taken, and leaves were separated to record their surface area by automatic leaf area meter. All the leaves are grouped into three categories *viz.*, small, medium and large. The leaves from each group were taken and their surface area was measured. Area of three leaves were multiplied with respective leaf number of a group and sum of all these gave the total leaf area. For obtaining leaf area index, leaf area was divided by ground area.

$$\mathrm{LAI} = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Ground area (cm}^2\text{)}}$$

Ear heads were counted at three different places at random in each plot by placing a quadrate of 50 × 50cm and the average number of spikes m^{-2} were calculated. Five ear heads were sampled from the tagged plants in each plot and their length was measured and the average length of ear head was calculated. Five spikes were threshed manually and grains were cleaned; collected and counted to calculate the average grain per spike. The samples were collected randomly from the cleaned grains of each plot and 1000 grains were counted out with the help of electronic balance the weight of their 1000 grain was recorded. The total weight of grain harvested from net area was recorded. The yield per plot was converted into quintals ha^{-1} at 14 per cent moisture. The moisture percentage was determined by moisture meter. The weight of straw was obtained by subtracting the grain yield from the total biological yield of finally. Straw yield per plot was determined converted into quintals ha^{-1}.

RESULTS AND DISCUSSION

Plant height increased with the advancement in age of the plant. At 30 DAS, plant height was not affected significantly due to herbicides (Table 1). The rate of increase was slow up to 30 DAS but increased abruptly up to 60 DAS and slowed down thereafter indicating that grand growth period lies between 30 to 60 days after sowing. The data presented in table 1 clearly indicate that the initial plant population m^{-2} recorded at 15 days after sowing was not influenced significantly by the different weed management practices as all herbicides were applied as post emergence at 35 days after sowing. The plant height was influenced appreciably by the different weed management practices at 60th, 90th day and harvest stage of crop growth. The tallest plants were recorded under weed free which was *at par* with post-emergence application of sulfosulfuron + MSM (25 + 4 g ha^{-1}) and isoproturon + MSM (1000 + 4 g ha^{-1}) and significantly better than weedy where shortest plants were recorded at all the growth stages.

Table 1: Effects of various treatments on initial plant population and plant height of wheat at various growth stages.

Treatments		Plant population (m^{-2})	Plant height (cm) 30 DAS	60 DAS	90 DAS	At harvest
T$_{-1}$	Isoproturon @ 1000 g ha^{-1}	123.13	17.88	42.62	64.80	69.10
T$_{-2}$	Clodinafop @ 60 g ha^{-1}	114.33	16.60	41.70	63.40	67.60
T$_{-3}$	Sulfosulfuron @ 25 g ha^{-1}	111.82	16.23	45.87	69.74	74.36
T$_{-4}$	Metasulfuron methyl @ 4 g ha^{-1}	128.15	18.60	38.92	59.17	63.09
T$_{-5}$	IPU + MSM @ (1000+4) g ha^{-1}	129.41	18.79	49.11	74.67	79.62
T$_{-6}$	Clodinafop + MSM @ (60+4) g ha^{-1}	121.87	17.69	47.72	72.55	77.36
T$_{-7}$	Sulfosulfuron + MSM @ (25+4) g ha^{-1}	118.10	17.15	51.43	78.19	83.37
T$_{-8}$	Carfentrazone @ 25 g ha^{-1}	110.56	16.05	37.99	57.76	61.59
T$_{-9}$	Weedy	115.59	16.78	33.82	51.42	54.83
T$_{-10}$	Weed free	124.38	17.33	53.28	81.01	86.38
SEm(±)		**6.76**	**0.86**	**2.00**	**2.56**	**3.06**
LSD (0.05)		**NS**	**NS**	**5.94**	**7.62**	**9.09**

At harvest, the tallest plants of 86.38 cm were recorded by weed free which was 31.55cm taller than weedy check but remained *at par* with T$_7$; T$_5$ and significantly superior over all other treatments (Table1). The increase in plant height was due to less competition between crop plants and weeds for various growth factors. Similar results have also been reported by Kumar *et al.* (2009).

Data presented in table 2 reveal that the number of shoots increased with increase in the age of crop up to 90 DAS and declined slightly thereafter. The rate of increase was rather slow up to 30 DAS but increased abruptly up to 60 DAS, indicating that grand growth period for tillering lies between 30 to 60 days after sowing. Amongst weed control treatments, weed free and sulfosulfuron + MSM (25 + 4 g ha^{-1}), IPU + MSM (1000 + 4 g ha^{-1}) and clodinafop + MSM being at par recorded the maximum number of shoots (461.35, 445.30, 425.24 and 413.23 m^{-1}) which were significantly superior to rest of the treatments against lowest number of shoots (292.85 m^{-2}) recorded in weedy check. It may be attributed to the fact that there was better availability of nutrients under well managed plots which result in better tillering than weedy plots. Similar results have been also reported by Kumar *et al.* (2009).

Table 2: Effect of various treatments on number of shoots m^{-2} of wheat at growth stages.

Treatment		Number of shoots (m^{-2}) 30 DAS	60 DAS	90 DAS	At harvest
T_{-1}	Isoproturon @ 1000 g ha^{-1}	174.59	356.57	375.56	369.08
T_{-2}	Clodinafop @ 60 g ha^{-1}	162.12	348.82	367.40	361.05
T_{-3}	Sulfosulfuron @ 25 g ha^{-1}	158.55	383.70	404.14	397.16
T_{-4}	Metasulfuron methyl @ 4 g ha^{-1}	181.71	325.57	342.90	336.98
T_{-5}	IPU + MSM @ (1000+4) g ha^{-1}	183.49	410.83	432.71	425.24
T_{-6}	Clodinafop + MSM @ (60+4) g ha^{-1}	172.81	399.21	420.47	413.21
T_{-7}	Sulfosulfuron + MSM @ (25+4) gha^{-1}	167.46	430.21	453.12	445.30
T_{-8}	Carfentrazone @ 25 g ha^{-1}	156.77	317.82	334.74	328.96
T_{-9}	Weedy	163.90	282.93	298.00	292.85
T_{-10}	Weed free	169.24	445.72	469.45	461.35
SEm (±)		**8.42**	**16.73**	**14.86**	**16.34**
LSD(0.05)		**25.01**	**49.70**	**44.13**	**48.54**

Table 3 : Influence of various treatments on leaf area index of wheat at various growth stages.

Treatment	Leaf area index 30 DAS	60 DAS	90 DAS
Isoproturon @ 1000 g ha^{-1}	1.50	3.27	3.06
Clodinafop @ 60 g ha^{-1}	1.39	3.20	3.00
Sulphosulfuron @ 25 g ha^{-1}	1.36	3.51	3.30
Metasulfuron methyl @ 4 g ha^{-1}	1.56	2.98	2.80
IPU + MSM @ (1000+4) g ha^{-1}	1.58	3.76	3.53
Clodinafop + MSM @ (60+4) gha^{-1}	1.48	3.66	3.43
Sulphosulfuron + MSM @ (25+4) g ha^{-1}	1.44	3.94	3.70
Carfentrazone @ 25 g ha^{-1}	1.35	2.91	2.73
Weedy	1.41	2.59	2.43
Weed free	1.45	4.08	3.83
SEm(±)	**0.07**	**0.15**	**0.12**
LSD(0.05)	**0.21**	**0.46**	**0.36**

Leaf growth was very slow till 30 day stage and thereafter it expand at faster rates reaching the maximum at 90 day stage and declined thereafter mainly due to senescence (Table 3). The leaf area index was increased significantly with various herbicide treatments recording the highest value in weed free followed by sulfosulfuron + MSM and isoproturon + MSM with their respective doses at 60th and 90th day stages of crop growth. Maximum leaf area index of 4.08 and 3.83 were recorded with weed free closely followed by sulfosulfuron + MSM of 3.94 and 3.70 as compared to 2.59 and 2.43 of weedy at 60 and 90 DAS, respectively. The better leaf area index with these treatments might be due to the fact that sufficient moisture and nutrient availability due to lesser weed density resulted in better growth *i.e.* leaf number and size leading to increased leaf area and leaf area index. The results are in conformity with those of Malik *et al.* (1989) who have also reported better leaf area index with best weed managed plots.

Table 4: Effects of various treatments on yield contributing characters of wheat.

Treatment	No. of spike (m^{-2})	Length of spike (cm)	No. of grain spike^{-1}
Isoproturon @ 1000 g ha^{-1}	317.41	7.40	35.48
Clodinafop @ 60 g ha^{-1}	317.73	7.24	34.70
Sulphosulfuron @ 25 g ha^{-1}	345.53	7.96	38.17
Metasulfuron methyl @ 4 g ha^{-1}	283.07	6.75	32.39
IPU + MSM @ (1000+4) g ha^{-1}	352.95	8.52	40.87
Clodinafop + MSM @ (60+4) g ha^{-1}	351.22	8.28	39.72
Sulphosulfuron + MSM @ (25+4) g ha^{-1}	360.69	8.92	42.80
Carfentrazone @ 25 g ha^{-1}	279.62	6.59	31.62
Weedy	193.28	5.87	28.15
Weed free	396.76	9.25	44.34
SEm(±)	**12.28**	**0.33**	**1.40**
LSD(0.05)	**36.48**	**0.97**	**4.17**

Number of spike m^{-2} increased significantly under all the weed control treatment as compared to weedy check (Table 4). Weed free was found significantly superior over weedy check and being *at par* with T_7. Amongst herbicide treatments carfentrazone @ 25 g ha^{-1} recorded the lowest number of spike m^{-2} (279 m^{-2}) as compared to weedy check (193m^{-2}). A cursory glance of the data graphically presented in Table 4 revealed that length of spike was affected significantly by various herbicidal treatments and weed free was significantly superior over weedy check and being at par with T_7, T_5 and T_6. Table 4 depicted in reveal that the number of grains per spike was found significantly more under all the weed control treatments as compared to weedy check. Weed free produced highest number of grains spike^{-1} (44) being at par with T_7 (42), T_5 (40) and T_6 (39) but significantly superior to the rest of treatments. The lowest grains spike^{-1} (38) was recorded in weedy check.

Yield attributes is the resultant of the vegetation development of the plants. The entire yield attributes *viz*. number of spike m^{-2}, no. of grains spike^{-1} and test weight increased significantly due to different herbicide treatments except length of spike. The highest values of all the yield contributing characters were significantly greater with weed free than rest of the weed control treatments except post emergence application of sulfosulfuron + MSM (25 + 4 g ha^{-1}) and isoproturon + MSM (1000 + 4g ha^{-1}). This may be due to better availability of nutrient under well managed treatments which resulted better growth and development of plants vis-à-vis yield attributes. Gavanier *et al.* (2008) have also observed increase in yield attributes with use of herbicides in wheat.

Table 5: Effect of various treatments on test weight, grain yield and straw yield of wheat.

Treatment	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Isoproturon @ 1000 g ha^{-1}	38.92	31.68	42.27
Clodinafop @ 60 g ha^{-1}	38.54	31.00	43.48
Sulphosulfuron @ 25 g ha^{-1}	40.07	34.10	46.32
Metasulfuron methyl @ 4 g ha^{-1}	37.40	28.93	40.91
IPU + MSM @ (1000+4) g ha^{-1}	41.21	36.51	49.21
Clodinafop + MSM @ (60+4) g ha^{-1}	40.45	35.47	48.53
Sulphosulfuron + MSM @ (25+4) g ha^{-1}	41.98	38.23	51.98
Carfentrazone @ 25 g ha^{-1}	37.60	28.24	40.51
Weedy	35.11	25.14	35.03
Weed free	42.36	39.61	54.31
SEm(±)	**1.44**	**1.40**	**1.72**
LSD(0.05)	**4.28**	**4.17**	**5.10**

All the weed control treatments increased the test weight significantly as compared to weedy. The highest test weight of 42.36 g was recorded with weed free followed by sulfosulfuron + MSM of (41.98 g) these remained *at par* with T_6, T_5, T_3, T_2 and T_1 but significantly superior to T_4, T_8 and weedy check (33.2 g). All the weed control treatments resulted in significant increase in grain yield as compared to weedy check (25.14 q ha^{-1}). The maximum grain yield of 39.61 q ha^{-1} was recorded under weed free closely followed by sulfosulfuron + MSM (38.23 q ha^{-1}) which were *at par* with T_5 and T_6 and significantly superior to other treatments. Weed free and sulfosulfuron + MSM recorded an increase of 14.47 and 13.09 q ha^{-1} over the grain yield of weedy check, respectively (Table 5).

The critical examination of data clearly revealed that most of the weed control treatments resulted into significant increase in straw yield as compared to weedy (Table 5). Weed free recorded the maximum straw yield of 51.98 q ha^{-1} closely followed by sulfosulfuron + MSM of 51.98 q ha^{-1}. The lowest straw yield was recorded under weedy (35.03 q ha^{-1}) which was *at par* with T_5 and T_6.

Yield is the resultant of coordinated inter play of growth characters and yield attributes under the limit of genetic potential of the variety. Weed free recorded the highest grain yield of 39.61 q ha^{-1} followed by 38.23 q ha^{-1} of post emergence application of sulfosulfuron + MSM (25 + 4 g ha^{-1}) and 36.51 q ha^{-1} of post emergence Isoproturon + MSM (1000 + 4 g ha^{-1}) which were significantly superior over the weedy (25.14 q ha^{-1}). The highest straw yield of 54.31 q ha^{-1} was recorded by weed free and followed post emergence application of sulfosulfuron + MSM (25+ 4 g ha^{-1}). The above findings might be due to adequate weed management which contributed to better growth parameters and yield attributes. Better vegetative growth coupled with higher yield attributes resulted in higher grain and straw yield over weedy check. The similar results have been also reported by (Sharma 2003).

Keeping above results in view it might be concluded that for effective weed control and obtaining maximum grain yield post-emergence application of sulfosulfuron (25g ha^{-1}) tank mixed either with MSM (4 g ha^{-1}) or with IPU + MSM @ (1000+4) gha^{-1} might be applied at 35 days after sowing in late sown wheat.

REFERENCES

Gill, H. S. and Brar, L. S. 1975. Importance of herbicide in agriculture of Punjab and Haryana. *Pesticides*, **9**: 20-24.

Kumar, D., Angiras, N.N. and Rana, S.S. 2009. Influence of seed bed manipulation and herbicides on leaf area index and growth rate of wheat and associated weed. *Himanchal Pradesh Agric. Res*., **29**: 1-10.

Malik, R. S., Malik, R. K., Panwar, R. S. and Bhan, V. M. 1989. The influence of surfactant on the performance of herbicides applied under complex weed flora situation in wheat. *Indian J. Agron.*, **34**: 217-21.

Panda, S. C., Pattanaik, A., Rath, B. S., Tripathi, R. K. and Behra, B. 1996. Response of wheat to crop geometry and weed management. *Indian J. Agron.* **41 (4)**: 553-57.

Sharma, R. 2003. Effect of low dose of sulfonylurea herbicides on weeds and yield of wheat. *Ann. Agril. Res.*, **24**: 217-19.