

Evaluation of herbicides and their combinations for weed control in wheat (*Triticum aestivum* L.)

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Abstract— The field experiment was conducted at the Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar, Punjab, to study the evaluation of various herbicides and their combinations on wheat during 2016-17. The experiment was laid out in randomized block design with seven treatments such as weed free, weedy check, pendimethalin 2.5L/ha, pendimethalin 2.5L/ha + clodinofof 400 g/ha, pendimethalin 2.5L/ha + sulfosulfuron 32.5g/ha, pendimethalin 2.5L/ha + pinoxaden 1000 ml/ ha, pendimethalin 2.5L/ha + atlantis 400g/ha and replicated thrice. Results revealed that pendimethalin 2.5 L/ha + atlantis 400g/ha was found effective to control weed population and produced higher number of grains per ear and enhanced grain yield upto 62.3 per cent over weedy check.

Keywords—Herbicides, Weed control, Wheat, Yield.

I. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important winter cereal crop of Punjab and staple food for millions of people in India and across the world. Regardless of all the other ways of crop yield enhancement, weed control is one of the important key factors in crop yield improvement particularly in Amritsar districts to cope with the annual weed population blast. Weeds compete with crop for available moisture, nutrients, space, light and provide shelter for harmful insect-pests which result in yield reduction. Weeds cause yield reduction upto 15-50 percent depending upon the weed density and weed flora (Jat *et al.* 2003). Weeds not only reduce yield but also lower the quality of the produce and increases the cost of harvesting, threshing and cleaning. Apart from improved agronomic practices and preventive measures, chemical weed control is one of the important key factors to enhance the wheat production and productivity. Most of the farmers cultivating wheat crop in the region have a psychological competition among other farmers to eliminate weeds in their respective field. Therefore, adding over dose of chemical herbicides which develops resistance in various weed species associated with wheat crop. Moreover when they use combination of various herbicides it further aggravates economics of small farmers. Therefore, some suitable and judicious herbicidal

combinations may check to prevent environmental pollution and to human health issues. Several combinations of herbicides are there that can provide good control of broad - and narrow- leaved weeds and cause significant reduction in their density and increases the yield as compared to weedy check (Chaudhary *et al.*

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2008). Therefore, an experiment was carried out on various herbicides generally used in wheat to evaluate their impact on weed control in combinations and to assess the efficacy of the herbicides on grain yield of wheat.

II. MATERIALS AND METHODS

The experiment was conducted at Students' Research Farm, Khalsa College, Amritsar during *rabi* season of 2016-17. Amritsar is located at 31° – 38° North latitude and 74° - 52° East longitude and at an altitude of 236 meters above mean sea level. Maximum temperature ranged between 14.9 °C and 41.2 °C while minimum temperature ranged between 1.9 °C and 23.3°C during this season. The soil of experimental site was sandy loam having pH 7.8, medium in organic carbon (0.49%), low available N (164.5%), high available P (31.7%) and high available K (347.5%). The wheat variety 'WH 1105' was sown at 22.5cm spacing on 5th November 2016. The experiment was laid out in randomized block design with eight treatments and replicated thrice. The gross plot size was 4.5m x 4.5m. Herbicides were applied with knapsack sprayer. Pendimethalin was applied as pre-emergence at two days after sowing, while clodinofof, sulfosulfuron, pinoxaden and atlantis were applied as post-emergence at 32 days after sowing (DAS). The weed density and dry weight of narrow- leaved weeds and broad-leaved weeds were analyzed using transformation of square root *i.e.* ($\sqrt{x + 1}$), before carrying out analysis of variance and comparison were made on transformed values (Table 1).

III. RESULTS AND DISCUSSION

The data recorded were weed density (number/m²), weed dry matter (g/m²), grains /spike and grain yield (kg/ha). Increase in yield over weedy check was calculated for all the treatments.

Effect on weeds

All the weed control treatments significantly reduced the weed density and dry matter of weeds (Table 2). Pre-emergence application of pendimethalin (30 EC) 2.5 L/ha along with the post-emergence application of atlantis 400 g resulted in the lowest weed density and weed dry matter. The better performance of this treatment might be attributed to the effective control of narrow-leaved weeds and broad-leaved weeds by pendimethalin along with atlantis. This was statistically similar to pendimethalin *fb* + sulfosulfuron, pendimethalin *fb* + clodinafop and pendimethalin *fb* + pinoxadin. The highest weed density and weed dry weight were recorded in weedy check. These results are in conformity with the findings of Kailkhura *et al.* (2015) that herbicidal combinations of pre-emergence application followed by post-emergence application were found most effective in controlling weed infestation.

Effect on crop

Among the yield components number of grains per spike is essential parameter for assessment of the impact of weed control treatments on yield. Increasing the number of grains per spike will increase the weight of the spike which in turn definitely improves the final yield (Hussain *et al.* 2013). Among the herbicidal treatments the highest number of grains per spike (43) were observed with combination of pre-emergence application of pendimethalin (30 EC) 2.5 L/ha along with post-emergence application of atlantis 400 g/ha. Whereas the lowest grains per spike was observed in weedy check (31.6). All the weed control measures resulted in significantly higher grain yield than weedy check. Weed free recorded the highest values of grain yield, may be due to least competition offered by weeds. Among herbicidal treatments combination, highest grain yield (5773 kg/ha) was recorded with pre-emergence application of pendimethalin 2.5 L/ha *fb* post-emergence

application of atlantis 400 g/ha (Table 3). The higher grain yield may be due to the reduced weed competition and thereby increased crop growth. At the initial stage, pre-emergence application of pendimethalin controlled narrow and broad leaved weeds efficiently and succeeding weeds were control by atlantis, which offers broad range weed control. Similar results were reported by Khalil *et al.* (2013).

It was summarized that combination of pre-emergence application of pendimethalin 2.5L/ha with post-emergence application of atlantis 400 g/ha may be recommended for managing composite weed flora and obtaining higher yield in the wheat crop.

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Table.1: Details of the herbicidal treatments of the experiment.

Treatments	Rate /ha	Time of application
Weed free	-	-
Weedy check	-	-
Pendimethalin (30EC)	2.5 L	Pre-em
Pendimethalin (30 EC) <i>fb</i> + Clodinafop(15 WP)	2.5L <i>fb</i> 400 g	Pre <i>fb</i> Post-em
Pendimethalin(30EC) <i>fb</i> +Sulfosulfuron(75WG)	2.5 L <i>fb</i> 32.5 g	Pre <i>fb</i> Post-em
Pendimethalin (30 EC) <i>fb</i> +Pinoxaden(5 EC)	2.5 L <i>f</i> 1000ml	Pre <i>fb</i> Post-em
Pendimethalin (30 EC) <i>fb</i> +Atlantis (3.6 WDG)	2.5 L <i>fb</i> 400 g	Pre <i>fb</i> Post-em

Pre-em= Pre-emergence, Post-em= Post-emergence, *fb*= followed by

Table.2: Effect of different weed control treatments on weed density (number/m²) and dry matter of weeds (g/m²) in wheat.

Treatments	Weed density / m ²		Dry matter of weeds (g/m ²)	
	Narrow leaved weeds	Broad leaved weeds	Narrow leaved weeds	Broad leaved weeds
Weed free	1(0)	1(0)	1(0)	1(0)
Weedy check	7.6(58.2)	8.3(68.4)	14.8(221)	16.5(273)
Pendimethalin	2.3(4.44)	2.7(6.54)	6.7(44.5)	9.5(91.0)
Pendimethalin <i>fb</i> Clodinafop	1.5(1.42)	2.0(3.04)	3.9(14.7)	4.8(22.7)
Pendimethalin <i>fb</i> Sulfosulfuron	1.7(1.93)	1.8(2.26)	4.4(19.2)	3.7(13.1)
Pendimethalin <i>fb</i> Pinoxaden	1.6(1.75)	2.0(3.42)	4.0(15.4)	4.9(23.6)
Pendimethalin <i>fb</i> Atlantis	1.4(1.14)	1.7(2.01)	3.6(12.5)	3.5(11.6)
LSD (p=0.05)	0.34	0.44	1.28	1.56

Original data given in parenthesis was subjected to square root (+ 1) transformation before analysis .*fb*=followed by

Table.3: Effect of different weed control treatments on number of grains per spike, grain yield (kg/ha) and percent increase in yield of wheat.

Treatments	Grains/spi ke	Grain Yield (kg/ha)	Yield increase over weedy check (kg/ha)	Percent Increase
Weed free	43.1	5889	2259	38.35
Weedy check	31.6	3630	-	-
Pendimethalin	39.0	5107	1477	28.92
Pendimethalin <i>fb</i> Clodinafop	42.2	5663	2033	35.89
Pendimethalin <i>fb</i> Sulfosulfuron	42.9	5706	2076	36.38
Pendimethalin <i>fb</i> Pinoxaden	42.0	5591	1961	35.07
Pendimethalin <i>fb</i> Atlantis	43.0	5773	2143	37.12
LSD (p=0.05)	2.52	355		