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Efficacy of Pre-Emergence and Post-Emergence Herbicides on Weed Control and Yield in Wheat

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A B S T R A C T

The field experiment was conducted at the Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar, Punjab, to study the efficacy of pre-emergence and post-emergence herbicides on wheat yield during 2016-17. The experiment was laid out in randomized block design with eight treatments such as Weed free, Weedy check, Pendimethalin 2.5L/ha, Pendimethalin 3.75 L/ha, Clodinofop 400 g/ha, Sulfosulfuron 32.5g/ha, Pinoxaden 1000 ml/ ha, Atlantis 400g/ha and replicated thrice. Results revealed that Pendimethalin (3.75 L/ha) was found effective to control weed population and produced higher number of effective tillers, 1000 grain weight and enhanced the yield upto 43.1% over weedy check.

Introduction

Wheat (*Triticum aestivum*) 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 small, medium and large farmers of Amritsar district are well aware about integrated weed control strategies, even though chemical weed control measures have prominent place and popularity among them. Therefore, proper selection of herbicide and time of application remains the only resort to check weed population and to improve crop yield. Herbicidal treatments increased grain yield as compared with un-weeded and hand

weeding treatments (Amin *et al.*, 2008). But as a part of rat-race among each other the farmers use excessive chemicals which are not only pollute the environment but hazardous human health too. That's why choice of best herbicide and time of application are the important consideration for lucrative returns. Keeping in view the importance of weeds problem in wheat, this study was undertaken to investigate the effectiveness of different herbicides for controlling the weeds in wheat crop.

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^{o} – 38^{o} North latitude and 74^{o} - 52^{o} East longitude and at an altitude of 236 meters above mean sea level. Maximum temperature ranged between 14.9^{o}C and 41.2^{o} C while minimum temperature ranged between 1.9 ^{0}C and 23.3^{0}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 kg/ha), high available P (31.7 kg/ha) and high available K (347.5 kg/ha). 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 such as Weed free, Weedy check, Pendimethalin 2.5L/ ha, Pendimethalin 3.75L/ha, Clodinofop 400g/ha, Sulfosulfuron 32.5g/ha, Pinoxaden 1000 ml/ha, Atlantis 400g/ha 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 day after sowing, while clodinofop, sulfosulfuron, pinoxaden and atlantis were applied as post-emergence at 32 DAS. The weed density and dry weight of weeds- grass and broad-leaf 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.

The weed control efficiency was calculated by using the following formula:

$$WCE\ (\%) = \frac{DMC\text{-}DMT}{DMC} \times 100$$

(Where, WCE =Weed control efficiency in percent, DMC = Dry matter weight of weeds in control plot and DMT = Dry matter weight of weeds in treated plots)

Results and Discussion

The data recorded on weed density (number/m^2), weed dry matter (g/m^2), weed control efficiency (%),effective tillers (number/m^2), test weight (g), straw yield (t/ha) and grain yield (t/ha) were significantly affected by different herbicides treatments.

Effect on weeds

The density and dry matter of narrow and broad weeds decreased significantly as compared to weedy check. The decline in weed density and weed dry matter was owed to withering of weeds (Table 1 and 2). Removing the weeds whenever they appear under the weed free treatment resulted in complete elimination of weed competition as it resulted in lowest total weed dry weight. Among pre-emergence herbicide treated plots, the maximum reduction of narrow weeds and broad weeds were observed with the application of pendimethalin @ 3.75 L/ ha followed by pendimethalin @ 2.5 L/ ha. The higher dose of pendimethalin was more effective in controlling weeds than the lower dose (Kaur *et al.*, 2010). Among post – emergence treated plots, atlantis @ 400 g provide effective control on weed population and lowest weed dry matter being par with pendimethalin.

Table.1 Effect of different weed control treatments on population (number/m^2) of narrow weeds and dry matter of narrow weeds (g/m^2) in wheat (*Triticum aestivum*)

Treatments	Narrow weeds/ m^2				Dry matter of narrow weeds (g/m^2)		
	30 DAS	60 DAS	At harvest		30 DAS	60 DAS	At harvest
Weed free	1(0)	1(0)	1(0)		1(0)	1(0)	1(0)
Weedy check	9.0(80.6)	8.1(64.2)	7.6(58.2)		3.2(9.8)	6.4(40.5)	14.8(221)
Pendimethalin (2.5L/ha)	2.7(6.34)	2.6(5.63)	2.3(4.44)		1.3(0.7)	2.9(7.8)	6.7(44.5)
Pendimethalin(3.75 L/ha)	2.7(6.29)	2.5(5.34)	2.0(3.03)		1.1(0.4)	2.5(5.6)	6.2(37.5)
Clodinofop(400 g/ha)	8.9(79.2)	3.1(8.86)	2.7(6.46)		3.3(9.7)	3.7(13.2)	6.0(35.4)
Sulfosulfluron(32.5 g/ha)	8.8(76.6)	3.9(14.9)	3.6(12.5)		3.2(9.4)	4.8(22.7)	7.9(62.3)
Pinoxaden(1000 ml/ha)	8.8(76.8)	3.5(11.9)	2.9(7.95)		3.2(9.4)	4.5(19.8)	7.0(48.6)
Atlantis(400 g/ha)	8.7(76.4)	2.3(4.31)	2.0(3.02)		3.2(9.3)	3.4(10.3)	5.6(33.1)
LSD (p=0.05)	1.69	0.49	0.34		1.4	1.5	1.8

Original data given in parenthesis was subjected to square root (+ 1) transformation before analysis

Table.2 Effect of different weed control treatments on population (number/ m^2) of broad weeds and dry matter of broad weeds (g/m^2) in wheat (*Triticum aestivum*)

Treatments	Broad weeds/ m^2				Dry weight of broad Weeds (g/m^2)		
	30 DAS	60 DAS	At harvest		30 DAS	60 DAS	At harvest
Weed free	1(0)	1(0)	1(0)		1(0)	1(0)	1(0)
Weedy check	8.7(79.7)	8.7(75.6)	8.3(68.4)		4.4(18.4)	7.8(60.3)	16.5(273.1)
Pendimethalin (2.5L/ha)	2.9(7.84)	2.9(7.98)	2.7(6.54)		1.4(1.1)	3.0(9.3)	9.5(91.0)
Pendimethalin (3.75 L/ha)	2.4(5.23)	2.6(5.64)	2.6(5.98)		1.2(0.6)	2.4(8.4)	8.8(77.1)
Clodinofop (400 g/ha)	8.8(76.8)	5.1(25.0)	5.3(27.2)		4.2(17.2)	7.2(50.5)	11.6(135.1)
Sulfosulfluron (32.5 g/ha)	8.7(75.2)	2.5(4.31)	2.5(5.73)		4.1(16.4)	4.7(21.1)	9.9(98.7)
Pinoxaden (1000 ml/ha)	8.7(75.8)	5.1(25.8)	5.4(27.5)		4.2(16.6)	6.9(47.8)	11.9(142.2)
Atlantis (400 g/ha)	8.8(77.2)	2.5(5.26)	2.5(5.11)		4.3(17.5)	4.6(20.8)	10.1(101.1)
LSD(p=0.05)	1.63	0.46	0.44		2.3	1.9	1.3

Original data given in parenthesis was subjected to square root (+ 1) transformation before analysis

Table.3 Effect of different weed control treatments on weed control efficiency (%) in wheat (*Triticum aestivum*)

Treatments	Weed control Efficiency (%)
Weed free	100
Weedy check	-
Pendimethalin (2.5L/ha)	72.6
Pendimethalin (3.75 L/ha)	76.9
Clodinofop (400 g/ha)	65.6
Sulfosulfluron (32.5 g/ha)	67.4
Pinoxaden (1000 ml/ha)	61.3
Atlantis (400 g/ha)	72.8

Table.4 Effect of different weed control treatments on effective tillers (number/m^2) and test weight (g), grain yield (t/ha) and straw yield (t/ha) of wheat (*Triticum aestivum*)

Treatments	Effective tillers /m^2		Test weight (g)	Grain Yield (t /ha)	Straw Yield (t/ ha)
Weed free	406.4		38.7	5.88	9.19
Weedy check	347.2		34.4	3.63	6.77
Pendimethalin (2.5L/ha)	384.0		37.7	5.10	8.24
Pendimethalin(3.75 L/ha)	384.4		37.9	5.19	8.29
Clodinofop (400 g/ha)	365.9		36.9	4.40	7.50
Sulfosulfluron(32.5 g/ha)	383.7		37.0	4.86	8.14
Pinoxaden(1000 ml/ha)	364.8		36.8	4.38	7.49
Atlantis(400 g/ha)	383.7		37.4	5.07	8.23
LSD (p=0.05)	16.02		2.80	0.35	0.42

The highest weed population and dry matter was observed in weedy check. The results are in line with those of Walia *et al.,* (2012).

The weed control efficiency among the weed control management practices ranged from 61.3 to 100 %. The highest weed control efficiency was found in weed free plots followed by pendimethalin @ 3.75 L /ha (76.9%). The lowest weed control efficiency (61.3%) was recorded in where pinoxaden @ 1000 ml/ha was used (Table 3).

Effect on crop

Grain and straw yield differed significantly due to different weed control treatments (Table 4). Weed control treatments registered significantly higher grain and straw yield than weedy check. The higher grain and straw yield was recorded with application of pendimethalin @ 3.75 L/ha (5.19 and 8.29 t/ha respectively) which was at par with pendimethalin @ 2.5 L/ha (5.10 and 8.24 t/ha respectively), atlantis @ 400 g/ha (5.07 and 8.23 t/ha) and sulfosulfuron @ 32.5 g /ha (4.86 and 8.14 t/ha respectively). The higher grain and straw yield in these treatments is mainly due to better control of weeds and higher weed control efficiency during early stage of crop growth which resulted in effective utilization of resources such as nutrients, moisture, space and light resulted in better expression yield component viz.,

number of effective tillers per m^2 (384.4, 384.0, 383.7 and 383.7 respectively) and the test weight g (37.9, 37.7, 37.4 and 37.0 respectively). Whereas, lower grain and straw yield was recorded with weedy check (3.63 and 6.77 t/ha respectively) owing to severe crop weed competition which resulted in reduction in the expression of yield components such as effective tillers per m^2 (347.2). It was further observed that the lowest test weight (36.8 g) was obtained from pinoxaden followed by clodinofop (36.9 g) treated plots, which was statistically equal (34.4g) to the weedy check plots which in turn was statistically lower with the remaining herbicidal treatments. These results are in conformity with the findings of Khalil *et al.*, (2013), Hussain *et al.*, (2013), Chemma *et al.*, (2006) and Ali *et al.*, (2004).

It can be concluded that, application of pendimethalin 3.75L/ha as pre emergence is the best weed management practice in wheat to obtain greater yield with more efficient weed control.

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