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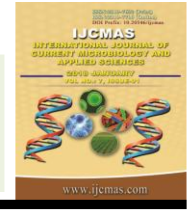

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Studies on Chemical Weed Control in Berseem (*Trifolium alexandrinum* L.)

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A B S T R A C T

A field experiment was conducted during winter (*Rabi*) season of 2013-14 at Research Farm of Department of Agronomy, CCS Haryana Agricultural University, Hisar to find out suitable herbicides for productivity enhancement by suppression of associated weeds in berseem (*Trifolium alexandrinum* L.). Fifteen herbicide combinations namely butachlor at 1000 and 1500 g/ha, pendimethalin at 750 and 1000 g/ha as PRE, imazethapyr at 50, 75 and 100 g/ha as PPI, PRE and 3 WAS and oxadiargyl at 75 and 100 g/ha as PRE were evaluated and compared along with unweeded control (weedy check) and these herbicide combinations along with weedy check were tested in Randomized Block Design with three replications. The observations were recorded on weed density (No./m^2), total weed density (No./m^2), dry matter accumulation by weeds (g/m^2), weed control efficiency (%), visual phyto-toxicity (%) and total green fodder yield (t/ha). Among herbicides, imazethapyr at 100 g/ha at 3 WAS (also imazethapyr at 75 g/ha at 3 WAS found second best treatment for yield (85 t/ha) and weed control efficiency (67.7-75.8)) and butachlor 1500 g/ha as pre-emergence were significantly superior in controlling weed flora (weed control efficiency 69.7-77.3 and 68.7-75.8%) and recorded higher green fodder yield (86.0 and 82.1 t/ha) in berseem than other treatments.

Introduction

Among the forage crops, the berseem suits well to irrigated areas after harvest of rice and provides abundant and nutritious green forage to the animals for longer period of time during *Rabi* season. Berseem is the most dominant winter season forage crop grown in 1.9 mha area in India with a productivity of 60-110 t/ha (Anon, 2012). It provides high quality green forage which is rich in protein (15-25%), minerals (11-19%) and carotene (Sharma and Murdia, 1974). Biomass production per unit time in berseem basically depend on the photosynthetic efficiency, regeneration after each cut and enzyme system controlling source sink relationship during the vegetative growth of the crop. Apart from nutrient and cutting management, control of weeds has significant effect on total biomass production from different cuts of berseem. Being a winter season crop several weeds infest berseem crop; dominant being *Coronopus didymus*, *Anagallis arvensis*, *Melilotus indica*, *Lathyrus aphaca*, *Cirsium arvense*, *Cyperus rotundus*, *Chenopodium album* and *Rumex dentatus*. These weeds cause substantial reduction (30-40%) in yields besides deteriorating the quality of green forage, if not controlled during critical period of crop-weed competition (Jain, 1998b). Due to several cuttings it can suppress many weeds, but some weeds like *C. didymus* survive and compete to reduce its growth and also lower the quality. The presence of *C. didymus* in the forage in spite of repeated cuts provides an offensive smell which is repulsive to animals. Being a dense crop (broadcast seeding) manual weeding is not practicable in removing weeds. Herbicides offers a scope to control weeds, but not all the herbicides are selective to berseem and effective against infesting weed species. Keeping the above factors in view a field study was conducted using different pre-plant incorporation, pre and post- emergence herbicides in berseem to evaluate their efficacy on weeds and crop selectivity.

Materials and Methods

The present study was conducted at Research Farm of Department of Agronomy, CCS Haryana Agricultural University, Hisar during 2013-14 to study the chemical weed control in berseem. The general features of this region are semi-arid climate with hot and dry winds during summer and severe cold in winter. Fifteen herbicide combinations namely butachlor at 1000 and 1500 g/ha, pendimethalin at 750 and 1000 g/ha as PRE, imazethapyr at 50, 75 and 100 g/ha as PPI, PRE and 3 WAS and oxadiargyl at 75 and 100 g/ha as PRE were tested along with unweeded control (weedy check) and were applied in plots of size 5×4 m^2 in Randomized Block Design replicated thrice. The berseem crop was planted on 12^{th} November, 2013.The berseem variety HB-1 was selected for the present study and five cuts were taken at different time intervals. The observations recorded during course of study were weed density (no./m^2), total weed density (no./m^2), dry matter accumulation by weeds (g/m^2), weed control efficiency (%), visual phyto-toxicity (%) and total green fodder yield (t/ha). The data recorded on different parameters were subjected to statistical analysis, and the mean differences were evaluated by critical difference (C.D.) test at 5% level of significance.

Results and Discussion

Effect on weeds

The major weed flora consisted of *Coronopus didymus*, *Anagallis arvensis*, *Melilotus indica*, *Lathyrus aphaca*, *Cirsium arvense*, *Cyperus rotundus*, *Chenopodium album* and *Rumex dentatus*. Similar trend in weed flora was observed by Singh (2012). All the herbicidal treatments were effective in reducing the population and dry matter accumulation of *C. didymus* and other associated weeds over weedy check. The highest population of *C. didymus* 8, 12.8 and 14.7 plants/m^2, total weed density 61.6, 82.4 and 83.5 plants/m^2 and their dry weight 6.6, 10.0 and 9.9 g/m^2 at 30, 60 and 120 days after sowing (DAS), respectively, were recorded when weeds were not controlled throughout the crop season. But the population of *C. didymus* scaled down to a minimum level of 0, 0 and 0.3 plants/m^2 when imazethapyr at 100 g/ha was applied as pre-plant incorporation (PPI), whereas, the minimum total weed density (3.4, 7.0 and 6.3 plants/m^2) and their dry weight (1.5, 2.6 and 3.0 g/m^2) at 30, 60 and 120 DAS was observed due to application of imazethapyr at 100 g/ha as post-emergence (Table 1). The maximum weed control efficiency ranging between 69.7-77.3% from 30 days after treatment (DAT) to 120 days after treatment (DAT) was obtained with imazethapyr at 100 g/ha at 3 weeks after sowing (WAS) followed by imazethapyr at 75 g/ha (67.7-75.8%) and butachlor 1500 g/ha as pre-emergence (68.7-75.8%) as showed in Table 2. These results confirm the findings of Kumar and Dhar (2008).

Crop phytotoxicity

Except imazethapyr and butachlor all the herbicides proved phytotoxic to berseem when observed before first cut (Table 2). Among the imazethapyr treatments, post-emergence application of imazethapyr was less phytotoxic to crop as the crop injury was 4.7% at its highest concentration (100 g/ha). The application of pendimethalin and oxadiargyl was phytotoxic to the crop and the lowest dose of pendimethalin (750 g/ha) was also phytotoxic to the crop as it caused 75.0% injury before first cut which could not be recovered upto second cut (120 DAT).

Table.1 Effect of different herbicides on *Coronopus didymus*, total weed density and weed dry weight in berseem

Treatments	*Coronopus didymus* (no./m^2)			Total weed density (no./m^2)			Dry matter accumulation (g/m^2)		
	30 DAS	**60 DAS**	**120 DAS**	**30 DAS**	**60 DAS**	**120 DAS**	**30 DAS**	**60 DAS**	**120 DAS**
Butachlor at 1000 g/ha PRE	1.3 (0.7)	1.7 (2.0)	1.7 (2.0)	3.1 (8.8)	3.5 (11.3)	3.6 (11.8)	2.1	3.9	3.6
Butachlor at 1500 g/ha PRE	1.1 (0.3)	1.5 (1.3)	1.6 (1.7)	2.5 (5.2)	2.9 (7.7)	2.9 (7.4)	1.6	2.9	3.1
Pendimethalin at 750 g/ha PRE	2.2 (3.7)	2.8 (6.7)	2.9 (7.7)	3.6 (11.8)	5.9 (33.5)	6.0 (35.0)	4.7	7.3	7.9
Pendimethalin at 1000 g/ha PRE	2.1 (3.3)	2.3 (4.3)	2.8 (6.7)	3.4 (10.9)	5.0 (23.9)	5.3 (26.7)	3.8	6.1	6.9
Imazethapyr at 50 g/ha PPI	1.3 (0.7)	1.3 (0.7)	2.1 (3.3)	3.5 (11.4)	5.2 (26.0)	4.1 (16.0)	3.0	5.9	5.9
Imazethapyr at 75 g/ha PPI	1.3 (0.7)	1.3 (0.7)	1.4 (1.0)	2.9 (7.4)	4.4 (18.4)	3.7 (12.4)	2.3	4.7	4.9
Imazethapyr at 100 g/ha PPI	1.0 (0.0)	1.0 (0.0)	1.1 (0.3)	2.4 (5.0)	3.6 (12.0)	3.0 (7.9)	2.2	4.5	3.6
Imazethapyr at 50 g/ha PRE	1.4 (1.0)	1.0 (0.0)	1.7 (2.0)	3.5 (11.4)	4.4 (18.7)	3.9 (14.4)	3.0	3.8	4.4
Imazethapyr at 75 g/ha PRE	1.4 (1.0)	1.0 (0.0)	1.6 (1.7)	3.3 (9.7)	4.1 (16.0)	3.5 (11.5)	1.8	3.6	4.1
Imazethapyr at 100 g/ha PRE	1.0 (0.0)	1.0 (0.0)	1.4 (1.0)	2.6 (5.7)	3.3 (10.1)	3.0 (8.0)	1.8	3.2	3.8
Imazethapyr at 50 g/ha 3 WAS	2.1 (3.3)	1.7 (2.0)	2.2 (4.0)	3.2 (9.3)	3.8 (13.8)	3.4 (10.8)	2.0	3.6	3.9
Imazethapyr at 75 g/ha 3 WAS	1.6 (1.7)	1.7 (2.0)	2.0 (3.0)	2.6 (5.7)	3.5 (11.0)	3.1 (8.4)	1.6	3.2	3.2
Imazethapyr at 100 g/ha 3 WAS	1.3 (0.7)	1.5 (1.3)	1.4 (1.0)	2.1 (3.4)	2.8 (7.0)	2.7 (6.3)	1.5	2.6	3.0
Oxadiargyl at 75 g/ha PRE	1.9 (2.7)	2.2 (4.0)	1.9 (2.7)	3.3 (9.7)	4.0 (15.4)	3.6 (12.3)	3.7	4.3	5.5
Oxadiargyl at 100 g/ha PRE	1.3 (0.7)	2.1 (3.3)	1.8 (2.3)	2.3 (4.4)	3.6 (12.3)	3.3 (10.0)	3.3	4.0	5.2
Weedy check	3.0 (8.0)	3.7 (12.8)	4.0 (14.7)	7.9 (61.6)	9.1 (82.4)	9.2 (83.5)	6.6	10.0	9.9
CD (p=0.05)	0.36	0.41	0.26	0.63	0.78	0.67	0.28	0.34	0.38

Original data were subjected to square root $\sqrt{(x+1)}$ transformation and presented in parentheses

Table.2 Effect of different herbicides on weed control efficiency (%), crop phytotoxicity and total green fodder yield

Treatments	Weed control efficiency (%)			Visual phytotoxicity (%) before first cut	Green fodder yield (t/ha)
	30 DAT	**60 DAT**	**120 DAT**		
Butachlor at 1000 g/ha PRE	55.6 (68.2)	51.3 (61.0)	52.9 (63.6)	11.5 (4.0)	78.5
Butachlor at 1500 g/ha PRE	60.5 (75.8)	57.4 (71.0)	56.0 (68.7)	14.5 (6.3)	82.1
Pendimethalin at 750 g/ha PRE	32.4 (28.8)	31.3 (27.0)	26.7 (20.2)	60.0 (75.0)	29.7
Pendimethalin at 1000 g/ha PRE	40.6 (42.4)	38.6 (39.0)	33.4 (30.3)	63.7 (80.3)	23.8
Imazethapyr at 50 g/ha PPI	47.6 (54.5)	39.8 (41.0)	39.5 (40.4)	16.0 (7.7)	68.9
Imazethapyr at 75 g/ha PPI	53.8 (65.2)	46.7 (53.0)	45.3 (50.5)	18.7 (10.3)	80.4
Imazethapyr at 100 g/ha PPI	54.7 (66.7)	47.9 (55.0)	52.9 (63.6)	21.1 (13.0)	81.5
Imazethapyr at 50 g/ha PRE	47.6 (54.5)	51.9 (62.0)	48.2 (55.6)	17.4 (9.0)	69.6
Imazethapyr at 75 g/ha PRE	58.5 (72.7)	53.1 (64.0)	49.9 (58.6)	20.5 (12.3)	72.7
Imazethapyr at 100 g/ha PRE	58.5 (72.7)	55.5 (68.0)	51.7 (61.6)	24.8 (17.7)	78.7
Imazethapyr at 50 g/ha 3 WAS	56.6 (69.7)	53.1 (64.0)	51.1 (60.6)	10.3 (3.3)	80.4
Imazethapyr at 75 g/ha 3 WAS	60.5 (75.8)	55.5 (68.0)	55.3 (67.7)	11.5 (4.0)	85.0
Imazethapyr at 100 g/ha 3 WAS	61.5 (77.3)	59.3 (74.0)	56.6 (69.7)	12.4 (4.7)	86.0
Oxadiargyl at 75 g/ha PRE	41.5 (43.9)	49.0 (57.0)	41.8 (44.4)	31.7 (27.7)	72.0
Oxadiargyl at 100 g/ha PRE	45.0 (50.0)	50.7 (60.0)	43.5 (47.5)	36.6 (35.7)	76.3
Weedy check	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	76.7
CD (P=0.05)	5.1	4.8	4.5	2.9	0.62

Original data were subjected to arc sin transformation and presented in parentheses

Effect on crop

Herbicide phytotoxicity significantly affected berseem growth and its forage yield. Lowest total forage yield (23.8 t/ha) was recorded with the application of pendimethalin and oxadiargyl (Table 2), whereas, the suppression of weeds due to herbicide application recorded significantly higher green fodder yield than the weedy check. The highest total green fodder yield (86.0 t/ha) was recorded with the application of imazethapyr at 100 g/ha at 3 WAS being at par with imazethapyr at 75 g/ha and it proved significantly superior over rest of the treatments except plots receiving pre-emergence application of butachlor at 1000 and 1500 g/ha. The per cent increase in total green forage yield was 10.8% with imazethapyr at 100 g/ha at 3 WAS whereas butachlor 1500 g/ha as pre- emergence recorded an increase of 6.62% over weedy check, respectively. The higher yields under these treatments could be attributed to better control of weeds right from crop emergence upto critical period of crop-weed competition which led to efficient utilization of growth resources by the crop plants and less pytotoxicity to the berseem and ultimately recorded higher total green fodder yield. Singh *et al.*, (2010) also found butachlor 2.0 kg/ha effective in controlling weeds and achieving higher berseem yield. Kumar and Dhar (2008) evaluated butachlor, trifluralin, fluchloralin and imazethapyr and reported that imazethapyr at 0.10 and 0.15 kg/ha PRE was most effective against *C. intybus* with 74% weed control efficiency and 88 t/ha forage yield and higher benefit cost ratio of 1.86 compared to other treatments.

On the basis of weed dynamics, weed control efficiency and total green fodder yield it can be concluded that post-emergence application of imazethapyr at 100 g/ha 3WAS and butachlor at 1500 g/ha as pre-emergence effectively controlled the weeds in berseem thereby increased green fodder yield and monitory returns, thus these were found more remunerative.

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