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CHEMICAL WEED MANAGEMENT IN BERSEEM (*TRIFOLIUM ALEXZANDRIUM* L.)

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SUMMARY

The field experiment was conducted to find out most suitable weed management practices to control of weeds in berseem (*Trifolium alexandrium* L.). The results indicated that all weed control treatments significantly reduced the density and dry weight of weeds in berseem. Among the weed control treatment T_7- Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut recorded significantly the lowest total weed count/m^2 and its total dry weight at harvest as compared to rest of the treatments except treatment T_5 and T_6 which were on par with treatment T_7. Among pre emergence application of Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* post emergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} recorded significantly higher WCE (67.88 %) over rest of the treatment but it was at par with treatments T_5 and T_6. The growth attributes *viz.,* plant height and L: S ratio of berseem was significantly differ due to weed management practices. Plant height was significantly maximum (44.56 cm) with weedy check but it was at par with treatment T_7- Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut (39.60cm). However, the L: S ratio was significantly higher (0.61) with treatment T_7 but it was at par with treatment T_5 and T_6. All yields attributes and yield parameters *viz.,* GFY, DMY, seed and straw yield and CPY were significantly higher in treatment T_7 which was followed by treatment T_6. Pre emergence application of oxyflororfen @ 0.100 kg a.i. ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} as post emergence registered significantly the highest gross monitory (Rs. 1,11,866 ha^{-1}), net monitory (Rs. 54,810 ha^{-1}) and B:C ratio (1.96) than rest of treatments followed by treatment T_6 (Gross monitory Rs.1,01,402 ha^{-1}, net monitory Rs. 47,523 ha^{-1} and B:C ratio 1.88).

Key words : Weed management, oxyflororfen, *fb* mazethapyr, berseem, *Trifolium alexandrium*

Berseem or Egyptian clover (*Trifolium alexandrium* L.), a potential winter forage legume, is one of the most popular crop in north, north-west and central parts of India. It is well known green forage crop to stimulate milk production in dairy animals. Due to its excellent and quick re-growing ability and long durational nutritious green fodder availability (November to April), the crop is grown under irrigated conditions. Because of its slow growth in the initial stages, wide-ranging yield reduction in the crop on account of weeds is well documented. Weeds particularly *Cichorium intybus* found associated with berseem and give more competitional stress by robbing the crop of essential nutrients, light, moisture and space (Thakur *et al.,* 1990). Weed competition substantially reduces the green forage yield and consequently, it causes reduction up to 30 - 40 per cent besides deteriorating quality of green forage, if not controlled during critical period of crop – weed competition (Jain, 1998). Therefore, there is need to create an environment that is detrimental to weeds and favorable to the crops. Hence, weed control need to be restored during initial period of crop growth. Mechanical methods of weed control are very costlier, labour intensive and sometimes it is not possible due to non-availability of labours. Under such a situation, chemical weed control offers a better alternative to manual weeding so it is felt necessary to evaluate pre- and post emergence herbicides alone and in combination which may be the best alternative to the traditional practices. Since, very meager information is available on the comparative study of bio-efficiency of different weed control practices in berseem. To assess the bio-efficacy of different weed control practices the present investigation was undertaken to evaluate the bioefficacy of herbicide alone or in combination with use of two different herbicides in sequence for managing the weeds in berseem.

MATERIALS AND METHODS

An experiment was conducted at Forage Crops Research Project, MPKV, Rahuri during *rabi* season 2012-13. The soils of the experimental field were clayey in texture, low in available nitrogen (194.38 kg/ha), medium in available phosphorus (11.92 kg/ha) and high in available potassium (504.00 kg/ha). It was moderately alkaline in reaction (pH 8.06) with 0.35 dS m^{-1} electrical conductivity. The organic carbon content was 0.39 per cent.

The experiment consisting of 10 treatments (Table1) was laid out in randomized block design replicated thrice. The gross and net plot size employed was 4.00 x 3.00 m and 3.40 x 2.40 m, respectively. The maximum and minimum temperature during the crop growth period was ranging from 29.9^0C- 40.8^0C and 10.1^0C- 24.4^0C, respectively. Whereas, the morning and evening humidity was in the range of 40-76 and 20-36 per cent, respectively. Herbicides were sprayed with the manually operated knapsack sprayer fitted with flat fan nozzle at spray volume of 500 lit./ha. The pre-emergence herbicides were sprayed 3 days after sowing prior to emergence of weed as well as crop when the soil attended *wapsa* condition which was irrigated immediate after sowing and post emergence herbicide was applied immediately after harvest of I st cut for fodder as per the treatment. The crop was fertilized with the recommended dose of fertilizer, 20 kg N, 80 kg P_2O_5 and 40 kg K_2O/ ha. The variety 'Wardan' was sown at 30 cm apart by using seed rate of 30 kg ha^{-1}. First two cuts were taken for green forage purpose and after harvesting of second cut for fodder there after crop was left for seed production purpose and harvesting of seed was done in the month of May. From each plot, 250 g representative fresh plant sample was taken in each cut to estimate the dry matter content for computing dry matter yield of fodder.

The weed count (monocot and dicot) and its dry weight were recorded from each plot by using a quadrate method (1.0 x 1.0 m) at harvest of last cut for seed. The weed count and weed dry weight values were transformed $\sqrt{X+1}$ for statistical analysis. The weed control efficiency (WCE) and weed index (WI) was calculated as per the standard formula suggested by Gautam *et al.* (1975) and Gill and Vijaykumar (1969), respectively.

RESULTS AND DISCUSSION

I. Weed studies:

Weed flora

Major grassy (monocot) weeds were *Cynadon dactylon, Chloris barbata, Digitaria longiflora* and *Dactylocterium aegyptiu*, among broad leaved (dicot) weeds *Amaranthus viridi, Euphorbia geniculata, Celosia argentia, Lantana camera, Trianthema portulacastrum, Commmelina benghalensis, Corchorus aestuans, Parthenium hysterophorus, Tridax procumbent, Portulaca oleracea, Cichorium intybus and Cyprus rotundus* from sedges. Among the weed flora noticed *Parthenium hysterophorus, Celosia argentia, Euphorbia geniculata, Amaranthus viridi, Cynadon dactylon and Cyprus rotundus* were the most dominant dicot and monocot weeds, respectively.

Weed count

The data regarding monocot, dicot and total weed count are presented in Table1.The data revealed that treatment T_1- weedy check (control) recorded significantly higher grasses (monocot), broad leaved (dicot) and total weed count m^{-2} at harvest than rest of the treatments. However, significantly minimum monocot, dicot and total weed count m^{-2} (21.67, 8.33 and 30.30 m^{-2} was observed with treatment T_7- Oxyflourfen @ 0.100 kg a.i.ha^{-1} *followed by* Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut, but it was at par with T_5 and T_6 in respect of monocot and total weed count.

Weed dry weight

The dry weight of monocot, dicot and total weed dry weight m^{-2} were significantly higher (135.26, 67.76 and 203.03 g/m^2, respectively) with treatment T_1- weedy check as compared to rest of the treatments. Whereas, treatment T_7- Oxyflourfen @ 0.100 kg a.i.ha^{-1} *followed by* Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut registered significantly the lowest monocot, dicot and total dry weight of weed m^{-2} at harvest but monocot and total dry weight of weed were found at par with treatment T_6 (Table 1). The results are in

TABLE 1
Weed count and weed dry weight as influenced by different weed management practices

Treatment	Weed count (m^{-2})			Weed dry weight (g/m^{-2})		
	Monocot	Dicot	Total	Monocot	Dicot	Total
T_1–Weedy check (Control)	8.80 (76.50)	6.26 (38.33)	9.20 (114.83)	11.67 (135.26)	8.28 (67.76)	12.07 (203.02)
T_2–Pendimethalin @ 0.300 kg a.i.ha^{-1}	7.14 (50.00)	4.81 (22.17)	7.66 (72.17)	9.44 (88.33)	6.33 (39.18)	9.97 (127.51)
T_3–Pendimethalin @ 0.400 kg a.i.ha^{-1}	7.75 (59.17)	5.05 (24.50)	8.26 (83.67)	10.27 (104.82)	6.66 (43.41)	10.79 (148.23)
T_4–Pendimethalin @ 0.500 kg a.i.ha^{-1}	8.22 (66.67)	5.56 (30.00)	8.55 (96.67)	10.90 (117.87)	7.33 (53.03)	11.22 (170.90)
T_5–Oxyflourfen @ 0.100 kg a.i.ha^{-1}	5.41 (28.33)	3.69 (12.60)	5.85 (40.93)	7.17 (50.55)	4.84 (22.43)	7.62 (72.98)
T_6–Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of I^{st} and II^{nd} cut)	5.02 (24.33)	3.54 (11.67)	5.48 (36.00)	6.63 (43.09)	4.63 (20.66)	7.08 (63.75)
T_7–Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of I^{st} cut)	4.74 (21.67)	3.05 (8.33)	5.33 (30.00)	6.25 (38.37)	3.96 (14.76)	6.85 (53.13)
T_8–Pendimethalin @ 0.300 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I^{st} cut).	5.91 (34.17)	4.19 (16.67)	6.40 (50.83)	7.82 (60.51)	5.50 (29.52)	8.31 (90.03)
T_9–Pendimethalin @ 0.400 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I^{st} cut).	5.99 (35.00)	4.38 (18.33)	6.50 (53.33)	7.92 (61.99)	5.77 (32.47)	8.44 (94.45)
T_{10}–Pendimethalin @ 0.500 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I^{st} cut).	6.40 (40.00)	4.48 (19.17)	6.40 (59.17)	8.47 (70.84)	5.89 (33.94)	8.47 (104.78)
SEm±	0.24 (2.29)	0.15 (1.50)	0.22 (2.99)	0.24 (5.30)	0.15 (2.63)	0.22 (5.29)
CD (P=0.05)	0.70 (8.89)	0.45 (4.44)	0.65 (8.83)	0.70 (15.75)	0.45 (7.81)	0.65 (15.72)

Note: * PE- Pre- emergence, POE- Post emergence, *fb*- followed by
** Original values given in parenthesis are square root transform

TABLE 2
Weed control efficiency, plant height and leaf: stem ratio as influenced by different weed management practices.

Treatment	Weed control efficiency (%)	Plant height (cm)	Leaf :Stem ratio
T_{1} - Weedy check (Control)	0.00	44.56	0.48
T_{2}- Pendimethalin @ 0.300 kg a.i.ha^{-1}	31.65	36.68	0.46
T_{3} - Pendimethalin @ 0.400 kg a.i.ha^{-1}	20.22	33.27	0.49
T_{4} - Pendimethalin @ 0.500 kg a.i.ha^{-1}	13.60	32.73	0.47
T_{5} - Oxyflourfen @ 0.100 kg a.i.ha^{-1}	60.29	37.76	0.57
T_{6}- Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of Ist and IInd cut)	65.87	38.02	0.58
T_{7}- Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of I st cut)	67.88	39.60	0.61
T_{8} - Pendimethalin @ 0.300 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut)	52.80	34.87	0.53
T_{9} - Pendimethalin @ 0.400 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut)	51.14	35.16	0.45
T_{10} - Pendimethalin @ 0.500 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut)	50.87	33.00	0.50
S. Em±	3.57	2.05	0.02
C. D. (P=0.05)	10.71	6.10	0.06

Note: * PE- Pre- emergence, POE- Post emergence, *fb*- followed by

accordance with the findings of Jain (1998 a) and Tamrakar *et al.* (2002).

Weed control efficiency

Pre emergence application of Oxyflourfen @ 0.100 kg a.i. ha^{-1} *followed by* post immergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut recorded maximum (67.88 %) and significantly superior weed control efficiency over rest of the treatments except treatment T_{5} and T_{6}. The weed control efficiency with respect to treatment T_{5} and T_{6} were 60.29 and 65.87 per cent, respectively. The higher weed control efficiency might be due to reduced total dry weight of weeds in treatment $T_{7,}$ T_{5} and T_{6} as compared to weedy check (Table 2). This observation was in agreement of Cheema (1987), Singh (1991), Jain (1998 a) and Tiwana *et al.* (2002).

Growth attributes:

Weedy check recorded significantly maximum plant height (44.56cm) than rest of the treatment but it was at par with treatment T_{7} (Pre emergence application of Oxyflourfen @ 0.100 kg a.i. ha^{-1} *followed by* post immergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut). This might be due to the more weed density per unit area might have created more completion for the sunlight with the berseem crop resulted in more plant height in weedy check. Same result was arrived by Jain 1998b. The maximum leaf: stem ratio indicates the better quality of the forage. Significantly superior L: S ratio was noticed in treatment T_{7} compared to rest of all the treatments except treatment T_{5} and T_{6}. Reduced crop weed completion resulted in more translocation of photosynthetes in sink which favors increasing the L: S ratio. These results are also similar with those of Jain (1998b) and Tamrakar *et al.* (2002).

Yield studies

The green forage yield, dry matter yield, seed yield, straw yield and crude protein yield are presented in Table 3. The data pertaining to GFY, DMY, seed yield, straw yield and CPY revealed that treatment T_{7}- Pre emergence application of Oxyflourfen @ 0.100 kg a.i. ha^{-1} *followed by* post immergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut recorded significantly higher values of GFY, DMY, seed yield, straw yield and CPY 452.74, 79.08, 2.46, 12.17 and 14.19 q ha^{-1}, respectively) than rest of the treatment which was followed by treatment T6- Imazethapyr @ 0.100 kg a.i. ha^{-1} immediate after harvest

TABLE 3
Effect of different weed management practices on yield and economics of berseem.

Treatment	Yield (q/ha)					Gross monitory returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net Monitory Returns (Rs./ha)	B : C Ratio
	Green forage	Dry matter	Seed	Straw	Crude protein				
T_{1} - Weedy check (Control)	327.90	57.46	1.80	7.90	10.31	81179	47260	33919	1.72
T_{2} - Pendimethalin @ 0.300 kg a.i.ha^{-1}	259.29	43.93	1.16	5.16	8.39	59636	44186	15450	1.35
T_{3} - Pendimethalin @ 0.400 kg a.i.ha^{-1}	234.77	40.29	1.13	4.97	7.75	55256	43619	11637	1.27
T_{4} - Pendimethalin @ 0.500 kg a.i.ha^{-1}	214.88	34.58	1.08	4.89	6.66	51474	43849	9625	1.17
T_{5} - Oxyflourfen @ 0.100 kg a.i.ha^{-1}	366.82	61.45	1.93	8.68	10.84	89324	50065	39259	1.78
T_{6} - Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of Ist and IInd cut)	408.90	70.74	2.25	10.06	13.10	101402	53879	47523	1.88
T_{7} - Oxyflourfen @ 0.100 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i. ha^{-1} (Immediate after harvest of I st cut)	452.74	79.08	2.46	12.17	14.19	111866	57056	54810	1.96
T_{8} - Pendimethalin @ 0.300 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut).	307.33	52.08	1.60	7.22	9.34	74662	50600	24062	1.48
T_{9} - Pendimethalin @ 0.400 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut).	285.27	48.94	1.47	6.60	8.64	68936	49798	19138	1.38
T_{10} - Pendimethalin @ 0.500 kg a.i.ha^{-1} *fb* Imazethapyr @ 0.100 kg a.i.ha^{-1} (Immediate after harvest of I st cut).	268.46	46.24	1.22	5.48	8.29	61956	48860	13096	1.27
SE m±	8.98	1.63	0.07	0.31	0.34	1999	-	1999	-
CD (P=0.05)	26.69	4.84	0.20	0.92	1.01	5938	-	5938	-

Selling rate of berseem: Green forage -Rs. 150 /qtl., Seed-Rs. 17500 /qtl., Straw-Rs.75 /qtl.

of Ist and IInd cut (408.90, 70.74, 2.25, 10.06 and 13.10 q ha^{-1}, respectively). The selective action of Oxyflourfen and Imazethapyr is the reason for better control of grassy and broad leaves weeds resulted in poor crop weed competition during critical crop growth period, ultimately resulted in very meager competition of weeds to crop in respect to moisture, space, sunlight and nutrition reflected in better growth and development of crop and ultimately improving yield quality parameters and broad spectrum weed control. Stidham and Singh (1991) reported that the imidozolinone herbicides inhibit acetolactate syntase (ALS) which is essential for leucine, valine and isoleucine synthesis. It may be inferred that weed free environment can be facilitated better growth and crop development and ultimately through herbicides with higher berseem green forage and seed yield. These results are corroborating with the findings of Tamrakar *et al.* (2002) and Tiwana *et al.* (2002).

III. Economic studies:

Pre emergence application of Oxyflourfen @ 0.100 kg a.i. ha^{-1} *followed by* post immergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut recorded significantly maximum gross monetary (Rs.1,11,866/ha) net monetary returns (Rs.54,810/ha) and B:C ratio (1.96) compared to rest of the treatment which was followed by treatment T6- Imazethapyr @ 0.100 kg a.i. ha^{-1} immediate after harvest of Ist and IInd cut (Rs. 1,01,402, 47,523 and 1.88, respectively). This might be due to reduced crop weed competition during the crop growth period resulted in higher uptake of nutrient resulted in more accumulation of the dry matter ultimately resulted in the yield and thereby increasing monitory returns.

CONCLUSION

On the basis of data on weed dynamics, yield quality and economic of berseem it can be concluded that pre emergence application of Oxyflourfen @ 0.100 kg a.i. ha^{-1} *followed by* post immergence application of Imazethapyr @ 0.100 kg a.i. ha^{-1} **i**mmediate after harvest of I st cut was effectively controlled weeds in berseem thereby increased in yield and monitory returns, thus it was found more remunerative.

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