

## EFFICACY OF HERBICIDES FOR WEED MANAGEMENT IN BERSEEM

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### ABSTRACT

The experiment was conducted during winter seasons of 2011-12 and 2012-13 at G.B.Pant University of Agriculture & Technology, Pantnagar to evaluate suitable herbicide for the control of weeds in berseem. Among herbicidal treatments the weed dry weight was significantly less (48.73 g/0.25m<sup>2</sup>) due to application of Pendimethalin @ 1.0 kg a.i./ha + Imazethapyr @ 0.15 kg a.i./ha applied immediate after 1<sup>st</sup> cut resulting in higher weed control efficiency (43.53 %). The green forage (2283.80 q/ha), dry forage (319.30 q/ha) and crude protein yield (75.99 q/ha) was significantly more due to Imazethapyr @ 0.15 kg a.i./ha applied immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut but seed yield was significantly more due to Oxyflourfen @ 0.10 kg a.i./ha + Imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) i.e. 6.75 q/ha compared to remaining herbicidal treatments. This indicates the application of broad spectrum post-emergence herbicides like imazethapyr should be applied twice after 1<sup>st</sup> and 2<sup>nd</sup> cut for higher fodder and crude protein yield, while for seed production it need to be combined with pre-emergence herbicides like oxyflourfen and applied once before 1<sup>st</sup> cut.

### INTRODUCTION

Berseem (*Trifolium alexandrinum* L.) is one of the most important winter forage crop in north, north-west, and central parts of India under irrigated conditions but it often suffers due to high crop- weed competition at initial stages of crop growth. Slow growth rate coupled with least leaf area and branching expection allows weeds to grow fast during initial 30-40 DAS and after 1<sup>st</sup> cutting. At later cuttings, vigorous branching and faster growth of the crop plants smother the weeds. It has been estimated that the fodder yield loss in berseem may likely to recure 23 to 30 per cent (Joshi and Bhilare, 2006; Alfred, 2012) and seed yield loss upto 50 per cent. The contamination of produce with weeds and weed seeds reduces the crop quality. The problem of weeds in berseem is much severe due to lack of suitable weed control option. Current strategies for weed control in berseem include mostly application of pre-emergence herbicides. Other practices like crop rotation, mechanical weed control, hand weeding etc. are also followed. Most of the crop is grown by farmers using one and two hand weedings which is time taking and cumbersome and timely operations are usually not applied leading to poor quality fodder and seed. Since the crop is of longer duration (October to May), the use of post emergence herbicides for season long weed control is preferred. The pre-emergence (pendimethalin) or pre-plant soil (fluchloralin) herbicides control weeds only at initial stages that too much before first cutting. Therefore an integration of pre-emergence and post-emergence herbicides is needed for season long weed management strategy. There is also possibility of using single post-emergence herbicide which may raise the farm income. Imazethapyr in the Imidazolinones class of herbicide registered in 1989 controls

a wide spectrum of annual broad leaved and grassy weeds in leguminous crops (Kantar *et al.*, 1999). Imazethapyr is compatible with pendimethalin, oxyflourfen, trifluralin etc. to formulate commercial mixture (Rao, 2000). It can be applied as pre-emergence and early post-emergence. Imazethapyr @ 125g/ha at 20 DAS has been found to effectively reduced weed density (320/m<sup>2</sup>) and weed biomass (23.35 g/m<sup>2</sup>) of associated weeds compared to other treatments (Singh *et al.*, 2014). Least dry weight of weeds (10.17 g/m<sup>2</sup>) has been found with post emergence (35 DAS) application of imazethapyr @ 100 g/ha (Goud *et al.*, 2013). Since work on post-emergence herbicides for controlling weeds in berseem is meager therefore, present investigation was undertaken for effective weed control in berseem with the objective to evaluate pre & post emergence herbicides along or in combination for crop safety and bioefficacy in berseem crop under *Tarai* conditions of Uttarakhand.

### MATERIALS AND METHODS

The field experiment was carried out in Forage Agronomy block of Instructional Dairy Farm (IDF), Nagla, G.B.Pant University of Agriculture and Technology, Pantnagar during winter seasons of 2011-2012 and 2012-2013. The soil of experiment site was silty clay loam having 7.2 pH, 0.86 % organic carbon, 278.48, 27.80 and 232 kg/ha available N, P, and K respectively as analysed following Walkley and Black method (Walkley and Black, 1934) for organic carbon, Micro Kjeldahl method (Jackson, 1973) for available nitrogen, Olsen's method (Olsen *et al.*, 1954) for available phosphorus and Flame photometry (Jackson, 1973) for available potassium. The experiment consisted of 10 treatments i.e.

weedy check, weed free, one hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing, pendimethalin @ 1.0 kg a.i./ha-PE, pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing, oxyflourfen @ 0.10 kg a.i./ha -PE, oxyflourfen @ 0.10 kg a.i./ha -PE + one hand weeding at 5 weeks after sowing, pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut), oxyflourfen @ 0.10 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) and imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) which were tested in a randomized block design with 3 replications (Gomez and Gomez, 1984). Berseem variety Mascavi was sown @ 30 kg/ha seed rate at row spacing of 20 cm (Alfred, 2012). Crop was fertilized with 30:60 kg N, P<sub>2</sub>O<sub>5</sub>/ha and cuttings were taken manually with the help of sickle at 55 DAS and subsequent cuttings were taken at an interval of 30 days till 6<sup>th</sup> cut.

The weed dry matter was recorded using a quadrat of 0.5x 0.5 m size at the time of each cutting. From each plot, 500 g representative fresh sample was taken at each cut to estimate the dry matter content for determination of dry matter yield. The weed control efficiency (WCE) was calculated as suggested by Mani *et al.* (1973).

$$WCE = \frac{DMC - DMT}{DMC} \times 100$$

Where, DMC = dry matter production by weeds in control plot.

DMT = dry matter production by weeds in treated plots.

## RESULTS AND DISCUSSION

### Weed

The major weeds observed in the experimental plots were *Polygonum spp*, *Medicago denticulate*, *Cornopus dedymus*, *Cyprus rotundus*, *Cichorium intybus* and *Vicia spp*. under Tarai conditions of Uttarakhand. Similar work done by Pathan *et al.* (2012) under Rahuri condition indicates *Cyprus rotundus*, *Cichorium intybus*, *Cynadon dactylon*, *Celosia argentia* as major weeds in berseem.

### Weed dry matter

In general, all the weed control treatments caused significant reduction in dry weight of weeds compared to weedy check treatment (Table 1). One hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing treatment was statistically at par with pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) and imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) (Table-1). The results corroborate the finding of Pathan *et al.* (2012). Among herbicidal treatments, pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) caused significant reduction in weed dry weight followed by imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) which were statistically at par with pendimethalin @ 1.0 kg a.i./ha-PE, pendimethalin @ 1.0 kg a.i./ha-PE + One hand weeding at 5 weeks after sowing and Oxyflourfen @ 0.10 kg a.i./ha -PE + One hand weeding at 5 weeks after sowing. The results were in conformity with the finding of Tiwana *et al.* (2002). This might be due to inhibition effect of imazethapyr

on acetohydroxy acid synthase and the synthesis of branched chain amino acids in legumes resulting in poor growth of weeds (Papierniks *et al.*, 2003)

### Weed control efficiency

Weed control efficiency was significantly higher due to one hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing treatments, which was statistically at par with pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut), imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut), pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing and oxyflourfen @ 0.10 kg a.i./ha -PE + one hand weeding at 5 weeks after sowing. Higher weed control efficiency with 2HW has been reported earlier (Aggarwal *et al.*, 2014). Among herbicidal treatments pendimethalin @ 1.0 kg ai/ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) caused significant enhancement in weed control efficiency which was statistically at par with pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing, oxyflourfen @ 0.10 kg a.i./ha -PE + one hand weeding at 5 weeks after sowing and imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) (Table 1).

### Crop

Among herbicidal treatments, imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) treatment, being at par with oxyflourfen @ 0.10 kg a.i./ha -PE + one hand weeding at 5 week after sowing, pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 week after sowing and one hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing treatments, caused significantly more plant population compared to remaining treatments. Long lasting effects of imazethapyr in reducing weed dry matter (upto 85%) might be primarily appeared due to broad-spectrum toxic activity of herbicide particularly on established plants of both narrow and broad leaf weeds and its greater efficiency to retard cell division of meristems as a result weed died rapidly (Kantar *et al.*, 1999). Among herbicidal treatments, imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> & 2<sup>nd</sup>cut) treatment, being at par with pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut), oxyflourfen @ 0.10 kg a.i./ha -PE + one hand weeding at 5 weeks after sowing, oxyflourfen @ 0.10 kg a.i./ha -PE and one hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing treatments, caused significantly taller plants compared to remaining treatments (Table 1). It may be due to the effective weeds control throughout the growth of the crop. The results were confirmed comparing the finding of Chandel and Saxena (2001). Among herbicidal treatments imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup>cut) treatment, being at par with oxyflourfen @ 0.10 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) and pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing treatments, caused significantly more L:S ratio compared to remaining treatments (Table 1). This may be ascribed to least competition from weeds due to their effective suppression and higher plant height by application of imazethapyr (Skrzypczak *et al.*, 1994).

### Yield

Green forage yield was significantly higher in weed free

Table 1: Weed dry weight, weed control efficiency, growth and yield of berseem as influenced by different weed control treatments (Pooled data of 2 years)

Treatments	Weed growth			Crop growth and yield			L:S ratio	Total Green forage yield (q/ha)	Total Dry matter yield (q/ha)	Crude protein yield (q/ha)	Seed yield (q/ha)
	Mean weed dry weight g/0.25 m <sup>2</sup>	mean weed control efficiency (%)	Plant population /mt. row length	Plant height (cm)	Plant population /mt. row length	Plant height (cm)					
T1-Weedy check	85.82	0.00	61.68	37.75	1.36	1525.70	205.70	47.93	3.50		
T2-Weed free	0.00	100.00	79.83	39.32	1.44	2531.80	313.70	76.28	7.19		
T3-One hoeing at 3 week after sowing + one hand weeding 5 weeks after sowing (2 HW)	45.88	47.37	75.13	37.98	1.42	2141.40	286.60	67.75	4.10		
T4-Pendimethalin @ 1.0 kg a.i./ha-PE	59.07	21.39	30.57	34.47	1.36	984.40	126.70	32.00	3.21		
T5-Pendimethalin @ 1.0 kg a.i./ha-PE + One hand weeding at 5 weeks after sowing	59.01	35.28	70.17	36.48	1.47	1332.80	180.40	44.44	3.90		
T6-Oxyflourfen @ 0.10 kg a.i./ha -PE	66.88	25.32	60.38	37.43	1.31	1954.20	272.20	65.24	4.42		
T7-Oxyflourfen @ 0.10 kg a.i./ha -PE + One hand weeding at 5 weeks after sowing	58.21	33.30	74.17	38.08	1.44	1832.50	245.40	57.61	4.24		
T8-Pendimethalin @ 1.0 kg a.i./ha + Imazethapyr @ 0.15 kg a.i./ha (Immediate after 1 <sup>st</sup> cut)	48.73	43.53	52.18	37.95	1.18	1297.90	178.40	44.58	3.60		
T9-Oxyflourfen @ 0.10 kg a.i./ha + Imazethapyr @ 0.15 kg a.i./ha (Immediate after 1 <sup>st</sup> cut)	63.40	25.50	68.03	36.38	1.49	1996.60	263.90	63.86	6.75		
T10-Imazethapyr @ 0.15 kg a.i./ha (Immediate after 1 <sup>st</sup> & 2 <sup>nd</sup> cut)	52.14	39.34	79.73	39.03	1.66	2283.20	319.30	75.99	4.89		
SEm ±	3.63	5.16	3.52	0.61	0.66	19.68	3.15	0.76	0.66		
CD at 5%	10.78	15.34	10.46	1.81	0.20	58.48	9.38	2.27	0.20		

treatment compared to remaining treatments. One hoeing at 3 weeks after sowing + one hand weeding 5 weeks after sowing was comparable with imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut) but caused significant enhancement in green forage yield compared to remaining treatments except weed free treatment because of high weed control efficiency (Table 1). Among herbicidal treatments, imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut) caused significantly higher green forage yield compared to remaining treatments. It has been reported that imazethapyr was highly toxic to grassy and broad leaf weeds and is registered for weed control in alfalfa, pea and Clearfield canola (Anonymous 2000). In present investigation weed growth was significantly suppressed by application of imazethapyr @ 0.15 kg a.i./ha and gave higher weed control efficiency with higher plant population/m row length and plant height which might have caused significant increase in total green forage yield (Table 1). Weedy check led to significant reduction in less green forage yield compared to remaining treatments except pendimethalin @ 1.0 kg a.i./ha-PE, pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing and pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut). The results corroborate the finding of Pathan *et al.* (2012).

Dry matter yield was significantly higher in weed free treatment compared to remaining treatments except imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut). Among herbicidal treatments, imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut) caused significantly higher dry matter yield compared to remaining treatments (Table-1). However, weedy check led to significantly less dry matter yield compare to remaining treatments except pendimethalin @ 1.0 kg a.i./ha-PE, pendimethalin @ 1.0 kg a.i./ha-PE + one hand weeding at 5 weeks after sowing and pendimethalin @ 1.0 kg a.i./ha + imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut). Among herbicidal treatments, imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut) caused significantly higher crude protein yield but seed yield was significantly more due to Oxyflourfen @ 0.10 kg a.i./ha + Imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> cut) i.e. 6.75 q/ha compared to remaining herbicidal treatments. The results are in conformity with the findings of Kantar *et al.* (1999), Papiernik *et al.* (2003) and Tamrakar *et al.* (2002).

From the present investigation it may be inferred that imazethapyr @ 0.15 kg a.i./ha (Immediate after 1<sup>st</sup> and 2<sup>nd</sup> cut) was the most effective in controlling weeds in berseem which enhanced crop growth component and resulted in production of higher yield and quality of berseem under *Tarai* conditions of Uttarakhand.

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