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Yield and Economics of Berseem (*Trifolium alexandrinum* L) influenced by herbicide under slight acidic Alfisol soil of Jharkhand

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Abstract
Experiment was conducted under All India Coordinated Research Project on Forage Crops to study the Herbicidal response on economical effectiveness of Berseem (*Trifolium alexandrinum* L) under slight acidic medium land condition of Jharkhand. The field experiment was conducted during three consecutive years from *Rabi* 2011 -12. The soil of experimental plot slightly acidic with pH 6.4 crop faced narrow leaf, Broad leaf weeds and sedges problem. The different treatment combinations were made with pre-emergence herbicides viz. pendimethalin and oxyflourfen and post-emergence herbicide, viz. imazethapyr in different proportion along with weedy check (control). Results revealed that the pre - emergence application of Pendimethalin @ 0.4 kg a.i/ ha resulted into less weed population (54.66), weed dry weight/m^2 (8.89), Green fodder yield (478.97 q/ha), Dry fodder yield (74.96 q/ha), Seed yield (2.48 q/ha), Gross return (1,92,903 Rs/ha), Net return (1,69,191 Rs/ha) with B:C ratio (7.12) over other herbicidal combinations. Further, interms of economics Pendimethalin @ 0.4 kg a.i/ ha produced about 47.36% economicaly more over lowest under Oxyflourfen @ 0.100 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (after first cut). The pre emergence application of Pendimethalin @ 0.4 kg a.i/ ha and Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (after first cut) were comparable in terms of efficacy of the herbicides.

Keywords: Green Fodder yield, Seed yield, Weed management, Herbicide and Economics

Introduction
Being "King of fodder" as well as known with slogan "BERSEEM HARA CHARA DUDH KI DHARA" ; Berseem (*Trifolium alexandrium* L.) having versatile adoptability and it is a best *Rabi* season legume fodder of Jharkhand. Long winter period of Jharkhand comparison to other Northern state it become potential fodder crop. It is well known proteineous green fodder crop to improve milk ability in dairy animals. It its excellent and quick re-growing and long durational nutritious green fodder available from November to April under assured irrigated condition in Jharkhand. At earlier stages of growth Berseem faces serious problem with fast growing different weeds Jain (1998 a) [3]. Among the different weeds, *Cichorium intybus* is one of the major obnoxious Berseem crop associated weed which exert more nutrient and moisture stress (Kewat *et al*., 2005)[4]. Consequently, it causes substantial reduction (25-30%) in green fodder production, besides deteriorating the quality of seeds (Tiwana, *et. al*. 2002) [10] and finally negative impact on economics. Manual removal and frequent inter row weeding are the usual control measures. However, these methods are labour intensive, which causes drain of money and time. Under such situation, chemical weed control play a better alternative to manual weeding. Since, meager information is available on the comparative studies of different weed controlling new generation herbicides on Berseem, the present investigation was undertaken to study the response of herbicides on yield and economics of Berseem (*Trifolium alexandrinum* L.) under medium land slight acidic condition of Jharkhand**.**

Materials and Methods
A Field experiment was conducted during *Rabi* season 2011-12, 2012-13 and 2013-14 under All India Coordinated Project on Forage Crops at BAU, Ranchi Jhrakhand. It falls under humid sub-tropical climatic conditions, which is characterized by the features of hot dry summers and slightly longer cool dry winters.

The soil of the experimental field was sandy loam in texture, slightly acidic in reaction (pH 6.4), and low in organic carbon (0.41%) and available nitrogen (238 kg/ha), medium available phosphorus (17.18 kg/ha) and medium available potassium (319 kg/ha) with normal electrical conductivity (0.34). The ten treatments namely, T1 – Weedy check (Control), T2 – Pendimethalin @ 0.3 kg a.i/ ha,T3 – Pendimethalin @ 0.4 kg a.i/ ha, T4 – Pendimethalin @ 0.5 kg a.i/ ha, T5 – Oxyflourfen @ 0.100 kg a.i./ha, T6 – Imazethapyr @ 0.100 kg a.i./ ha (Immediate after I st and II nd cut), T7– Oxyflourfen @ 0.100 kg a.i/ha + Imazethapyr @ 0.100 kg a.i/ ha (Immediate after I st cut). T8 – Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (Immediate I st cut), T9 – Pendimethalin @ 0.400 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (Immediate after harvest of I st cut), T10 –Pendimethalin @ 0.500 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (Immediate after I st cut) were tested in a randomized block design with three replications. Pendimethalin and oxyfluorfen were applied as pre-emergence (one day after sowing) and imazethapyr was applied as post emergence (immediately after cuts as per plan). The spraying of herbicides was done by mixing with calculated amount of water. The measured quantity of herbicides and water for each plot was mixed thoroughly before spraying. Knapsack sprayer of 15 liters capacity with fine mist spray nozzle was used. The Berseem variety " *Vardan"* was shown on the flat beds in line sowing at row to row distance of 30 cm on 15th November, 2011 and 10 th November during second & third years with seed rate of 25 kg/ha. The seed was treated with *Rhizobium meliloti* and 20 kg N, 60 kg P_2O_5 and 20 kg K_2O/ha were applied as basal dose through urea, single super phosphate and muriate of potash. Various observations were recorded on weed and crop parameters. The quadrate of 0.25 m^2 (0.5 m × 0.5 m) was randomly placed at four places in each plot and then the species wise and total weed count was recorded. The weed control efficiency and weed index were worked out as per formula given by Gill and Kumar (1969) [1]. Total three cuttings were taken after nipping (carried at about 5-7 cm height) for better re-growth at 25 DAS. The first cutting was done 55 DAS and subsequent two cuttings were done at 25-30 days intervals when the crop attained the height of around 45 cm from the ground. The yield from three cuttings and nipping were summed up to get the total green forage yield under each treatment in both the years. The crop were facilitated with assured moisture after each cutting and left for seed production after the third cutting and given light irrigations frequently at 5 to 7 days intervals until flowering and seed setting. Crop was harvested in the mid of May and the seed and Stover yields were recorded. The selling rate of green fodder, dry byproduct and seeds were Rs. 300/q, 250/q and 20,000/ quintal, respectively. Weed density and weed dry matter values were subjected to square root transformation of (x ± 0.5) before statistical analysis to normalize data distribution. Experimental data were analyzed using standard statistical procedures for Randomized Block Design (RBD). Weed control efficiency (WCE) and Weed index (WI) has been calculate by the under mentioned formula,

Weed control efficiency (WCE): It indicates the percentage reduction in weed population or dry weight of weeds under treated plot compare with untreated (weedy check). It also known as weed control index and it is used to compare the different herbicide. Higher the value of WCE that means better herbicidal response, Hazra and Sinha (1996) [2].

Weed control efficiency (WCE) = $\frac{x-y}{x}$ x 100,

where x = weed dry weight in
weedy check and y = weed dry weight

Weed Index (WI): It refers to the reduction in crop yield due to the presence of weed in comparison to weed free plot (Maximum yielding plot). This is used to assess the efficacy of herbicide. Lesser the weed index betters the efficacy Hazra and Sinha (1996) [2].

Weed Index (WI) = $\frac{x-y}{x}$ x 100,

where x = Yield from un- treated plot (hand weeding) and y = Yield from treated plot.
In this experiment as there is no any weed free treatment *i.e* hand weeding so in order to calculate weed index the maximum yield produced can be consider as x in Weed index formula. Thus, calculated relative weed index will be with reference to the T_3 on GFY basis.

Result and Discussion

Effect on weed

Berseem showed significant response on application of different herbicides and observed that highest weed density (174.55/m^2) and its dry weight (40.22 g/m^2) were recorded in weedy check (Table.1). The crop weed competition was markedly reduced by weed control treatments i.e due to application of different herbicides which were evident from the significant decrease in weed population, dry matter accumulation due to weed killing efficiency *i.e* weed control efficiency. Transformed value reflects that, the application of (T_3) Pendimethalin @ 0.4 kg a.i/ ha resulted significantly lower weed density (54.66 / m^2) which were at par with (T_7) Oxyflourfen @ 0.100 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i./ha **. Weed dry matter produced/m^2 under (T_3) Pendimethalin @ 0.4 kg a.i/ ha (8.89 g) were at par with (T8) Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i.ha-1** (7.66 g) which was significantly lesser than other chemical used and its doses. This is due to more effectivness of pendemethaline at 0.4 kg a.i /ha over its higher dose as well as other chemical used. Prajapati *et al.*(2015) [8] recorded that weed dry weight was significantly less (195 g/m^2) due to application of pendimethalin 1.0 kg/ha + imazethapyr 0.15 kg/ha applied immediate after 1st cut resulting in higher weed control efficiency (43.53%).

Weed control efficiency (WCE) and Weed Index (WI)

The effectivness herbicide in terms of Weed control efficiency, the treatment (T_3) Pendimethalin @ 0.4 kg a.i/ ha (77.89%) Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha ** (80.32%) were at par to each other and which were highest over others (Table 1).
The significantly lower relative Weed Index (WI) *w. r. t.* (T_3) Pendimethalin @ 0.4 kg a.i/ ha was recorded 7.45% under (T8) Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **. These observations of WCE and WI reflects that, the efficacy of (T_3) Pendimethalin @ 0.4 kg a.i/ ha and and (T8) Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha ** were more over other herbicidal combinations. Prajapati *et.al* (2015) also reported the similer result, and this was due to effectiviness of herbicides.

Effect on yield

The highest green fodder yield (GFY : 478.97 q/ha), dry fodder yield (DFY: 74.96 q/ ha) as well as green fodder yield

equivalent (563.97 q/ha) were recorded under pre- emergence application of (T_3) Pendimethalin @ 0.4 kg a.i/ ha (Table 2). The said DFY was at par with the application of (T8) Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha ** (73.34 q/ha). However seed yield was higher under slightly lower dose of pendimethaline *i.e* Pre- emergence application of Pendimethalin @ 0.300 kg a.i/ ha. The results were due to less weed population which leads to less competition for nutrient and water. Mani *et. al.*(1968) [5] accepted the similer types of thing for loss in fodder production due to application of herbicidesa after cuttings.

Further, (T9) Pendimethalin @ 0.400 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha ** which is just T4 + Imazethapyr @ 0.100 kg a.i/ ha resulted that on application of extra amount of Imazethapyr @ 0.100 kg a.i/ ha at just after second and third cuts retarded the growth of Berseem resulted into significant reduction in GFY (15.89%) as well as in DFY(31.17%). The nearly 15.25% more reduction in DFY which also reflects in detoriation in quality of herbage produced. Tamrakar *et. al*. (2002) [9], Pathan and Kamble (2012) [6] also supported the similar result.

Effect on economics

Application of Pendimethalin @ 0.4 kg a.i/ ha significantly improves the economics of fodder produced in terms of Gross return (1,92,903 Rs/ha), Net return (1,69,191 Rs/ha) with B:C ratio (7.12) over other herbicidal combinations. Results also indicate that pre- emergence application of Pendimethalin @ 0.4 kg a.i/ ha produced about 47.36% economicaly more over lowest under (T7) Oxyflourfen @ 0.100 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **. This is due to better growth and less effect of weed flora due to more efficacy of pre-emergence application of Pendimethalin @ 0.4 kg a.i/ ha, which finly converted to more yield. Similar reults were also recorded by Pathan *et.al* (2013) [7].

Summery and conclusion

The effectve weed controlled in berseem can be done through the pre-emergence application of Pendimethalin @ 0.4 kg a.i/ ha as well as Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha (Imazethapyr was applied after the first and second cutting). Higher dose of Pendimethalin @ 0.500 kg a.i/ ha along with Imazethapyr @ 0.100 kg a.i/ ha after first cutting reduces the growth of Berseem in medium land condition of Jharkhand wher water is limiting factor.

Table 1: Weed density and efficacy of herbicides in Berseem under medium land condition (Pooled).

Treatments	Original value		Transformed value		Weed control efficiency (%)	Relative Weed Index (%)
	Total weeds	dry weight (g/m^2)	Total weeds	dry weight (g/m^2)		
T1 – Weedy check (Control)	174.55	40.22	13.25	6.40	0	35.19
T2 – Pendimethalin @ 0.3 kg a.i/ ha	72.77	19.00	8.58	4.47	52.05	17.92
T3 – Pendimethalin @ 0.4 kg a.i/ ha	54.66	8.89	7.46	3.13	77.89	0
T4 – Pendimethalin @ 0.5 kg a.i/ ha	71.77	15.34	8.53	4.04	61.50	16.72
T5 – Oxyflourfen @ 0.100 kg a.i/ ha	65.55	20.33	8.15	4.61	46.39	15.82
T6 – Imazethapyr @ 0.100 kg a.i. ha-1 *	77.55	14.00	8.86	3.87	64.02	25.50
T7 – Oxyflourfen @ 0.100 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	62.11	15.00	7.94	4.00	61.78	30.28
T8 – Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	80.55	7.66	8.98	2.94	80.22	7.45
T9 – Pendimethalin @ 0.400 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	89.00	14.33	9.48	3.88	63.13	15.97
T10 – Pendimethalin @ 0.500 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha * *	82.22	16.00	9.12	4.11	60.08	19.33
S. Em ±	4.43	1.83	0.23	0.19	3.58	1.43
CD at 5%	13.26	5.47	0.68	0.59	10.73	4.27
CV%	9.23	18.54	4.36	8.23	10.95	13.43

*Immediate after harvest of I st and II nd cut. ** Immediate after harvest of I st cut only.

Table 2: Yield and Economics of herbicidal treated fodder Berseem under medium land condition (Pooled).

Treatments	Fodder study (q/ha)				Total green fodder yield equivalent (q/ha)	Gross return (Rs/ha)	Net Return (Rs/ha)	B:C ratio
	Green fodder yield	Dry fodder yield	Seed yield	Straw yield				
T1 – Weedy check (Control)	310.29	67.48	2.54	4.96	402.12	1,44,350	120,635	5.133
T2 – Pendimethalin @ 0.3 kg a.i/ ha	393.05	66.58	2.80	3.58	499.03	1,73,424	149,709	6.359
T3 – Pendimethalin @ 0.4 kg a.i/ ha	478.97	74.96	2.48	4.17	563.97	1,92,906	169,191	7.172
T4 – Pendimethalin @ 0.5 kg a.i/ ha	398.72	64.72	2.34	4.03	473.14	1,65,658	141,943	6.028
T5 – Oxyflourfen @ 0.100 kg a.i/ ha	403.17	58.96	2.16	3.67	463.68	1,62,820	139,105	5.913
T6 – Imazethapyr @ 0.100 kg a.i. ha-1 *	356.63	59.18	2.20	3.74	420.44	1,49,847	126,132	5.363
T7 – Oxyflourfen @ 0.100 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	333.86	55.95	2.00	3.47	382.71	1,38,527	114,812	4.884
T8 – Pendimethalin @ 0.300 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha ** *	443.25	73.34	1.90	4.10	486.34	1,69,616	145,901	6.195
T9 – Pendimethalin @ 0.400 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	402.39	51.16	1.85	3.50	440.55	1,55,881	132,166	5.616
T10 – Pendimethalin @ 0.500 kg a.i/ ha + Imazethapyr @ 0.100 kg a.i/ ha **	386.18	53.14	1.75	3.82	418.41	1,49,238	125,523	5.335
S. Em ±	6.99	1.66	0.09	0.15	9.86	2,957	2,957	0.125
CD at 5%	20.93	4.97	0.28	0.44	29.52	8,855	8,854	0.373
CV%	3.10	4.61	7.41	6.5	3.75	3.19	3.752	3.721

* Immediate after harvest of I st II nd cut. ** Immediate after harvest of I st cut only.

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