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RESEARCH NOTE

Effect of weed management practices on seed yield of berseem (*Trifolium alexandrinum* L.)

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ABSTRACT

Field research was conducted during the winter season of 2020-21 at Central Research Farm of the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, (U. P.) to study the effect of weed management practices on seed yield of berseem (*Trifolium alexandrinum* L.). The study was conducted in a randomized block design with three replications with a set of seven treatments. The treatment combinations consisted of pre-emergence application (PE) of pendimethalin + imazethapyr and post-emergence application (PoE) of imazethapyr + imazamox, glyphosate followed by (*fb*) imazethapyr + imazamox, glyphosate *fb* one hand weeding (HW) along with mechanical stale seedbed, weed free and weedy check. At 30 days after sowing of berseem, application of glyphosate 1.0 kg/ha to kill the existing weed flora before sowing (as chemical stale seedbed) *fb* one hand weeding and at first and second cut glyphosate 1.0 kg/ ha *fb* imazethapyr + imazamox 0.07 kg/ha as post emergence were found to be most effective in reducing weed density and biomass. Weed free treatment registered the significantly highest green fodder (28.98 t/ha), straw (3.20 t/ha) and seed yield (545.00 kg/ha) of berseem followed by glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha. The highest net returns ₹ 70,597/ha and benefit: cost (2.23) was recorded with glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha.

Keywords: Berseem, Glyphosate, Imazamox, *Trifolium alexandrinum*, Weed management, Yield

Berseem (*Trifolium alexandrinum* L.) is a most important winter season legume fodder crop of northern and central parts of India. In India it is cultivated in an area of about 2 million hectares (Pandey and Roy 2011). Due to rapid rejuvenation and high yielding potential of this crop, 4-8 cuts of green fodder can be taken. It provides 100-120 t/ha green fodder and 15-20 t/ha dry fodder to livestock during November to April months. Berseem green fodder is very nutritious, succulent and highly palatable to cattle (Mahanta and Karnani 2010) but production related problems still exist. One of the important factors affecting the berseem seed yield as well as quality is weeds menace. The problem of weeds in berseem is very much severe due to the lack of appropriate weed control methods. Weeds reduce the fodder and seed yield because of competition for light, moisture, space, and nutrients with crop plants (Thakur *et al.* 1990). The initial growth of berseem is very slow and the infestation of weeds reduces 23-28% green fodder and 38-44% seed yield of berseem (Wasnik *et al.* 2017). Weed management is an important factor for enhancing the productivity of berseem (Kauthale *et al.* 2016). Therefore, addressing the weeds problem in berseem seed production for higher yield and quality is of prime importance. The success of weed control method depends on its effectiveness and economics (Pathan and Kamble 2012). Mechanical methods of weed control are very labour intensive and costlier. The reduced availability of labour in the agricultural sector not only enhances the cost of production but also severely limits the timely weeding operations, resulting in a reduction of both quality and quantity of fodder and seed. In berseem, mechanical weeding is also not possible due to dense plants population and prevailing moist soil conditions. In such a situation, chemical weed control offers a better alternative to manual or physical weeding when integrated with other weed control approaches as it helps in achieving agronomically superior, economically viable and ecologically safe weed control (Wasnik *et al.* 2020). Therefore, the present study was conducted to understand the effect of various weed management practices on the green fodder and seed yield of berseem.

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The field experiment was conducted during winter season of 2020–21 at the Central Research Farm of ICAR-Indian Grassland and Fodder Research Institute, Jhansi. The farm is geographically situated at an altitude of 270 m above mean sea level on 25°27' N latitude and 78°33' E longitude. The region falls under Agro-climatic zone VIII Central Plateau and Hills region [Bundelkhand Agro climatic Zone (6)] of the Uttar Pradesh. The soil of experimental site was clay loam with pH 7.14, organic carbon (0.53%), low available nitrogen (230.96 kg/ha.) and medium available phosphorus (15.17 kg/ha.) and potassium (137.85 kg/ha.). The randomized block design with three replications was used to conduct the experiment. The experiment consisted of seven treatments, *viz.* mechanical stale seedbed (20 days after seedbed preparation killing of emerged weeds and previous year fallen berseem seedling using mechanical means); pre-emergence application (PE) of pendimethalin + imazethapyr 0.75 kg/ha [3 days after seedbed preparation (DASP)]; post-emergence application (PoE) of imazethapyr + imazamox 0.07 kg/ha. [20 days after sowing of berseem (DAS)]; glyphosate 1.0 kg/ha (PoE of herbicide at 20 DASP to kill emerged weeds and previous year fallen berseem seedlings) followed by (*fb)* imazethapyr + imazamox 0.07 kg/ha (PoE at 20 DAS of berseem); glyphosate 1.0 kg/ha (PoE of herbicide at 20 DASP to kill emerged weeds and previous year fallen berseem seedlings) *fb* one hand weeding (20 DAS); weed free and weedy check. Berseem cultivar *'Wardan'* was sown in the first week of December using 20 kg/ha seed rate at a 40 cm row to row spacing. Recommended dose of fertilizer *i.e.* 20 kg N, 60 kg P and 40 kg K/ha was applied. Full dose of N, P and K was applied as basal at the time of sowing. All the herbicide treatments were applied with the help of knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 liters water/ha. Its first cutting was done for the green fodder when the crop completed 65 days and succeeding two cutting were taken at 25-30 days interval. After two cuttings, the crop was left for the seed production. To record the dry weight, 500 g of fresh samples collected during each cut was sun dried and later oven dried at 65°C to obtain the constant weight.

The weed density (no./m^2) and dry biomass (g/m^2) were recorded from each plot in a quadrat of one square meter at 30 days after sowing, first and second cut of berseem. The weed samples collected after cutting the weeds from the ground level were air dried in shade initially followed by oven dried at 65°C for 48 hours to determine the biomass in g/m^2. The weed density and dry weight data were transformed $\sqrt{x+0.5}$ due to high variance before statistical analysis. (Gomez and Gomez 1984).

Effect on weeds

The major weeds in berseem were *Poa annua* among grasses, *Rumex dentatus*, *Chenopodium album, Cichorium intybus, Melilotus albus, Melilotus indicus,* and *Trifolium resupinatum* among broad leaved weeds and *Cyperus rotundus* a sedge.

Weed management treatments significantly influenced the total weed density and biomass at all the growth stages of berseem. Among the tested weed control treatments glyphosate 1.0 kg/ ha PoE *fb* one hand weeding recorded the significantly lowest total weed density (3.05 /m^2) and biomass (2.18 g/ m^2) of weeds at 30 days after sowing of berseem **(Table 1)**. Though at first and second cut of berseem glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha PoE recorded the significantly lowest density (4.24 and 3.78/m^2) and biomass (2.88 and 2.74 g/m^2) of weeds due to the effective control of weeds with the sequential herbicides application as also recorded by the Swetha *et al.* 2015 and Saimaheswari *et al.* 2022.

The data indicated that at 30 DAS the highest weed control efficiency (88.76%) was registered with glyphosate 1.0 kg/ha PoE (chemical stale seedbed) *fb* one hand weeding treatment. Whereas, at first and second cut of berseem the highest weed control efficiency (84.29 and 83.87%) was registered with PoE of glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha and the lowest was in mechanical stale seedbed treatment because of the poor weed control. The highest weed index (39.76%) was found in weedy check treatment **(Table 1)**, while the lowest was reported with glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha (6.73%) PoE. Wasnik *et al.* (2020) also reported the lowest weed index in berseem with imazethapyr PoE.

Effect on berseem

Incremental increase in berseem dry weight with the advancement of crop growth irrespective of treatment was observed **(Table 2)**. The significantly highest dry weight of berseem at first (49.05 g) and second cut (55.70 g) was recorded in weed free treatment and lowest in weedy check treatment (32.49 and 37.66 g). Among all other weed control treatments after weed free, the significantly highest dry weight of berseem at first (46.56 g) and second cut (53.10 g) was with PoE of glyphosate 1.0 kg/ ha *fb* imazethapyr + imazamox 0.07 kg/ha. Weed free also resulted in maximum plant height at harvest

(62.34 cm) which was significantly superior than the plant height recorded with all other weed control treatments. Weedy check recorded the significantly lowest plant height at harvest (40.14 cm) as also reported by Jha *et al.* (2014) and Wasnik *et al.* (2020).

Maximum number of effective tillers (314.75/ m^2), number of heads (748.40/m^2), no. of seeds/ head (97.22), individual head weight. (0.43 g), seed weight/head (0.35 g), test weight (3.38 g), highest total green fodder (28.98 t/ha), straw (3.20 t/ha) and seed (545.00 kg/ha) yield of berseem were recorded with the weed free treatment which was significantly superior to all other treatments **(Table 2** and **3).** Among the treatments chemical stale seedbed by glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha application recorded the highest total green fodder (27.78 t/ha), straw (2.97 t/ha) and seed (508.33 kg/ha) yield of berseem. The excellent weed control reduced the crop -weed competition and generated significant increase in growth and yield parameters ultimately led to higher green fodder, seed and straw yield of berseem. Increase in berseem green fodder, straw and seed yield due to the post-emergence application of herbicide was also found by the Prajapati *et al.* (2015), Kauthale *et al.* (2016) and Wasnik *et al.* (2020).

Economics

The highest gross returns (₹ 1,36,678/ha) were registered with weed free followed by the glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha (₹ 1,28,173/ha) PoE **(Table 3)**. The lowest gross returns (₹ 85,790/ha) were obtained with weedy check. Among all the treatments the highest net returns and benefit: cost ratio was obtained with the glyphosate 1.0 kg/ha *fb* imazethapyr + imazamox 0.07 kg/ha PoE followed by imazethapyr + imazamox 0.07 kg/ha PoE. This may be due to the better control of weeds and improvement in yield by the sequential application of herbicides (Kumar and Shivadhar 2008, Wasnik *et al.* 2017, Wasnik *et al.* 2020).

Conclusion

It can be concluded that application of glyphosate 1.0 kg/ha (20 days after seedbed preparation for killing of emerged weeds and previous year fallen berseem seedling) *fb* imazethapyr + imazamox 0.07 kg/ha (20 days after sowing of berseem) produced the maximum green fodder, straw and seed yields and profits.

Table 1. Influence of weed management treatments on weed density and biomass in berseem

Treatment	Weed density (no./m^2)			Weed biomass (g/m^2)			Weed control efficiency (%)			Weed index (%)
	30 DAS	I CUT	II CUT	30 DAS	I CUT	II CUT	30 DAS	I CUT	II CUT	
Mechanical stale seedbed	13.0(168.8)	13.9(192.1)	13.1(170.3)	4.9(23.0)	6.0(34.5)	5.7(31.2)	30.93	25.66	22.88	35.17
Pendimethalin + imazethapyr 0.75 kg/ha PE	5.3(26.7)	7.5(55.1)	6.4(40.5)	3.1(8.6)	4.2(17.0)	4.1(16.1)	74.09	63.39	60.30	20.80
Imazethapyr + imazamox 0.75 kg/ha PoE	10.6(111.8)	5.0(23.7)	4.4(19.0)	4.1(16.1)	3.1(8.7)	3.0(7.9)	51.75	81.23	80.48	11.31
Glyphosate 1.0 kg/ha PoE *fb* imazethapyr + imazamox 0.75 kg/ha PoE	9.7(92.9)	4.2(17.0)	3.8(13.4)	3.8(13.3)	2.9(7.3)	2.7(6.5)	59.93	84.29	83.87	6.73
Glyphosate 0.75 kg/ha PoE *fb* one HW	3.0(8.3)	6.5(42.0)	5.6(31.0)	2.2(3.7)	4.0(14.9)	3.8(13.7)	88.76	67.94	66.14	16.51
Weed free	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	100.0	100.0	100.0	-
Weedy check	17.3(298.2)	18.7(347.7)	17.6(307.9)	5.9(33.3)	6.9(46.4)	6.4(40.5)	-	-	-	39.76
LSD (p=0.05)	0.42	0.7	0.6	0.22	0.23	0.22	-	-	-	-

Values are $\sqrt{x+0.5}$ transformed and original values are in parenthesis; PE: Pre-emergence application; PoE: Post-emergence application; DAS: Days after sowing; *fb*: Followed by; HW: hand weeding

Table 2. Influence of weed management treatments on growth parameter and yield attributes of berseem

Treatment	Berseem dry weight (g)		Plant height at harvest (cm)	No. of effective tillers/m^2	No. of heads/m^2	No. of seeds/ head	Individual head wt. (g)	Seed wt./head (g)	Test weight (g)
	I Cut	II Cut							
Mechanical stale seedbed	35.70	41.16	43.38	240.00	655.33	62.00	0.29	0.16	2.75
Pendimethalin + imazethapyr 0.75 kg/ha PE	41.22	46.98	51.69	272.48	695.50	69.63	0.30	0.19	2.93
Imazethapyr + imazamox 0.75 kg/ha PoE	44.50	51.08	56.87	293.00	722.17	83.00	0.34	0.26	3.09
Glyphosate 1.0 kg/ha PoE *fb* imazethapyr + imazamox 0.75 kg/ha PoE	46.56	53.10	59.48	302.07	734.88	89.89	0.39	0.3	3.17
Glyphosate 0.75 kg/ha PoE *fb* one HW	42.84	49.00	54.21	283.33	708.76	76.00	0.32	0.22	3.00
Weed free	49.05	55.70	62.34	314.75	748.40	97.22	0.43	0.35	3.38
Weedy check	32.49	37.66	40.14	229.78	642.13	58.19	0.27	0.14	2.70
LSD (p=0.05)	1.52	1.98	2.42	8.83	11.84	6.19	0.03	0.04	0.19

PE: Pre-emergence application; PoE: Post-emergence application; *fb*: Followed by

Table 3. Influence of weed management treatments on yield and economics of berseem

Treatment	Yield (t/ha)				Seed yield (kg/ha)	Cost of cultivation (`/ha)	Gross returns (`/ha)	Net returns (`/ha)	Benefit: cost ratio
	Green fodder			Straw					
	I CUT	II CUT	Total						
Mechanical stale seedbed	5.74	16.82	22.56	1.85	353.33	54688	91702	37014	1.68
Pendimethalin + imazethapyr 0.75 kg/ha PE	6.75	18.45	25.20	2.41	431.67	55576	110113	54538	1.98
Imazethapyr + imazamox 0.75 kg/ha PoE	7.39	19.54	26.92	2.79	483.33	56113	122277	66164	2.18
Glyphosate 1.0 kg/ha PoE *fb* imazethapyr + imazamox 0.75 kg/ha PoE	7.70	20.08	27.78	2.97	508.33	57577	128173	70597	2.23
Glyphosate 0.75 kg/ha PoE *fb* one HW	7.06	18.99	26.05	2.59	455.00	61127	115713	54587	1.89
Weed free	8.06	20.92	28.98	3.20	545.00	72526	136678	64153	1.88
Weedy check	5.40	16.29	21.69	1.67	328.33	52901	85790	32890	1.62
LSD (p=0.05)	0.27	0.49	0.51	0.16	20.91	-	-	-	-

PE: Pre-emergence application; PoE: Post-emergence application; *fb*: Followed by; Present market price of berseem: Green fodder: 1000/t; Straw ‘ 3000/t; Seed: ‘ 180/kg

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