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RESEARCH NOTE

Herbicidal impact on density of *Cuscuta campestris Yunck.* emerged in berseem fodder crop

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ABSTRACT

A field experiment was conducted at the research farm of RVSKVV Gwalior during *Rabi* 2018-19 and 2019-20 to assess the efficacy of different pre- and post- emergence herbicides to manage *Cuscuta campestris Yunck.* in berseem. *C. campestris*, well known as a dodder, is a serious problem in berseem. Eight treatments consisting of pre-emergence application (PE) of pendimethalin 1000 g/ha, early post-emergence application (EPoE) at 10 days after sowing (DAS) of pendimethalin 1000 g/ha, oxyfluorfen 250 g/ha PE, post-emergence application (PoE) of imazethapyr 40 g/ha after first cut at 60 DAS, imazethapyr 40 g/ha PoE after last cut at 120 DAS, imazethapyr 40 g/ha PoE after first cut + 40 g/ha after last cut, *Cuscuta* free and control plot (no herbicide application) were laid out in RBD with three replications. Imazethapyr 40 g/ha PoE after first cut at 60 DAS was found to be very effective in controlling the *C. campestris* resulting 43% and 16% higher fodder and seed yield, respectively with 43.6% higher profitability. The next best was imazethapyr 40 g/ha PoE after first cut + 40 g/ha after last cut. Pendimethalin PE and oxyfluorfen PE caused phytotoxicity to berseem due to the higher dose of both herbicides and reduced the fodder and seed yield drastically.

Key words: Berseem, *Cuscuta campestris*, Fodder crop, Imazethapyr, Oxyfluorfen, Pendimethalin

Berseem (*Trifolium alexandrinum* L.) is one of the most important *Rabi* season leguminous fodder crop in India and is widely cultivated because of multi cut test regeneration, high fodder yield and nutritional value. After Egypt and Pakistan, India is having the highest area under berseem cultivation (Muhammad *et al*. 2014). In India, it is grown in approximately 2 Mha area (Pandey and Roy 2011) with a productivity of 60-110 t/ha (Anon 2012a). It is widely cultivated because of multi cut test regeneration, high fodder yield and nutritional value. Berseem fodder has 20% crude protein, 62% total digestible nutrients with 65% digestibility (Anon 2012b) and feeding of green fodder stimulates and enhances the milk production in dairy animals. The infestation of weeds reduces green fodder (23-28%) and seed yield (38-44%) (Wasnik *et al*. 2017). Among the weeds infesting berseem, *Cuscuta campestris Yunck.* (Cuscuta) is a serious problem in berseem.

The frequent irrigation, suitable temperature and better nutrient availability during the forage production provides conducive environment for growth of *Cuscuta* which appears simultaneously with crop plants and competes with the crop for essential nutrients, light, moisture and space thus causing substantial reduction in green forage yield. Besides this, seed quality is also impaired due to mixing of weed seeds. Cuscuta, well known as a dodder and locally called as *Amar bail*, has hard-coated seed that can remain dormant in the soil for more than 20 years. It is an annual stem holoparasitic weed. It grows only by penetrating tissues of host plants to obtain water and nutrients. *Cuscuta* density of 2 plants/m^2 caused 15-16% reduction in yield of fodder crop (Mishra 2012). *Cuscuta* can be controlled by using *Cuscuta* free crop seeds, harrowing in crop rows before it parasitizes the host (Mishra 2009). This study was conducted to assess the efficacy of different pre- and post- emergence herbicides to manage *C. campestris* in berseem.

A field experiment was conducted at the research farm of Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalaya, Gwalior of 412 m altitude from sea level, 23^{0}10'N latitude, 79^{0}54'E longitude during *Rabi* 2018-19 and 2019-20 seasons. The soil of the experimental field was sandy clay loam in texture with organic carbon of 0.3% having pH 7.8, low in available nitrogen (237 kg/ha), medium in available phosphorus (19.7 kg/ha) and potash (277 kg/ha). Eight treatments consisting of pre-emergence application (PE) of pendimethalin 1000 g/ha, early

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post-emergence application (EPoE) at 10 days after sowing (DAS) of pendimethalin 1000 g/ha, oxyfluorfen 250 g/ha PE, post-emergence application (PoE) of imazethapyr 40 g/ha after first cut at 60 DAS, imazethapyr 40 g/ha PoE after last cut at 120 DAS, imazethapyr 40 g/ha PoE after first cut + 40 g/ha after last cut, *Cuscuta* free and weedy check (no herbicide application) were laid out in RBD with three replications.The *Cuscuta* infested seed was purchased from the local market and sown in rows 20 cm apart in first week of November during both the years with a seed rate 25 kg/ha. Before sowing seeds were soaked for half an hour and treated with *Rhizobium meliloti* culture which helps in nitrogen fixation after the establishment of the seedlings. Basal dose of N:P:K 20:80:20 kg/ha through urea, SSP and muriate of potash, respectively was applied in the field. Herbicides were applied with a knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 l/ha. Number of *Cuscuta campestris* emerged/m^2 was recorded at 30, 60 90 and 120 DAS.The first cutting of fodder was done at 60 DAS and subsequent two cuttings were done in 30 days intervals when the crop attained the height of around 45 cm from the ground. The cuttings were done at about 5-7 cm height for better quick growth. The total fodder yield includes the weight of *Cuscuta* vines as it was very difficult to remove from the host plants. The crop was left for seed production after the third cut and given light irrigations until flowering and seed setting. It was harvested in the last week of May during both the years.

Effect on *Cuscuta*

Imazethapyr 40 g/ha PoE after first cut and 40 g/ha after last cut in berseem have effectively reduced the density of *Cuscuta* and caused 68% and 80% reduction in the density of *Cuscuta* at 90 and 120 DAS, respectively. Imazethapyr 40 g/ha PoE after first cut caused *Cuscuta* density reduction of 65% and 73% over weedy check at 90 and 120 DAS, respectively (**Table 1**). Pendimethalin 1000 g/ha PE and oxyfluorfen 250 g/ha PE caused reduction in *Cuscuta* density of 83% and 73%, respectively at 30 DAS. At 60 and 90 DAS, the impact of both herbicides was decreased and reduction in *Cuscuta* density of 57-40% and 73-51%, respectively was noticed.

Effect on crop

Maximum fodder yield (65.82 t/ha) and seed yield (357 kg/ha) was recorded with imazethapyr 40 g/ha PoE after first cut of berseem and was proved significantly superior over rest of the treatments. Imazethapyr 40 g/ha PoE after first cut and 40 g/ha PoE after last cut in berseem were next best treatments (**Table 2**). The oxyfluorfen 250 g/ha PE and pendimethalin 1000 g/ha PE were phytotoxic to the crop as they caused 78 and 77% injury,

Table 1 Effect of different weed management practices on density of *Cuscuta* emerged, in berseem during 2018-19, 2019-20 and pooled

Treatment	Emerged *Cuscuta* density (no./m^2)											
	30 DAS			60 DAS			90 DAS			120 DAS		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
Pendimethalin 1000 g/ha PE	1.02 (0.54)	1.17 (0.86)	1.09 (0.70)	1.66 (2.27)	1.76 (2.67)	1.71 (2.47)	1.70 (2.38)	1.22 (0.99)	1.46 (1.69)	1.71 (2.43)	1.23 (1.02)	1.47 (1.73)
Pendimethalin 1000 g/ha EPoE at 10 DAS	1.05 (0.61)	1.07 (0.64)	1.06 (0.63)	1.56 (1.94)	2.29 (5.70)	2.02 (3.82)	1.61 (2.09)	1.16 (0.85)	1.39 (1.47)	1.59 (2.10)	1.21 (0.95)	1.40 (1.53)
Oxyfluorfen 250 g/ha PE	1.26 (1.09)	1.31 (1.23)	1.29 (1.16)	1.43 (1.53)	1.41 (1.50)	1.42 (1.52)	1.48 (1.69)	1.24 (1.04)	1.36 (1.37)	1.47 (1.65)	1.29 (1.17)	1.38 (1.41)
Imazethapyr 40 g/ha PoE after first cut	1.32 (1.23)	2.53 (5.97)	1.92 (3.60)	1.14 (0.81)	1.63 (2.17)	1.39 (1.49)	1.15 (0.81)	1.23 (1.01)	1.19 (0.91)	1.17 (0.88)	1.23 (1.01)	1.20 (0.94)
Imazethapyr 40 g/ha PoE after last cut	1.33 (1.27)	2.49 (5.70)	1.91 (3.48)	2.02 (3.60)	2.24 (4.53	2.13 (4.07)	2.03 (3.63)	1.58 (2.00)	1.80 (2.82)	1.22 (1.00)	1.59 (2.04)	1.41 (1.52)
Imazethapyr 40 g/ha PoE after first cut *fb* imazethapyr 40 g/ha PoE after last cut	1.35 (1.32)	2.48 (5.70)	1.91 (3.51)	1.26 (1.08)	1.87 (3.00)	1.56 (2.04)	1.25 (1.06)	1.18 (0.90)	1.22 (0.98)	1.11 (0.73)	1.20 (0.95)	1.15 (0.84)
Cuscuta free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weedy check	1.35 (1.32)	2.81 (7.40)	2.08 (4.36)	2.10 (3.93)	2.82 (7.50)	2.46 (5.72)	2.02 (3.58)	1.59 (2.03)	1.80 (2.81)	2.13 (4.03)	1.65 (2.23)	1.89 (3.13)
LSD (p=0.05)	0.062	0.287	0.205	0.158	0.280	0.224	0.072	0.149	0.115	0.203	0.075	0.150

Original data were subjected to square root $\sqrt{x+0.5}$ transformation and presented in parentheses, PE = pre-emergence application, EPoE = early post-emergence application, PoE = post-emergence application, *fb* = followed by, DAS = days after seeding

Table 2. Effect of different weed management practices on crop phytotoxicity, yield and economics in berseem during 2018-19, 2019-20 and pooled

Treatment	Visual phytotoxicity (%) before first cut	Total fodder yield in three cuts (t/ha)			Seed yield (kg/ha)			Net returns (`/ha)			B:C ratio		
		2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
Pendimethalin 1000 g/ha PE	77.17	14.47	11.34	12.91	61	76	68	-14483	-6774	-10628	0.68	0.82	0.75
Pendimethalin 1000 g/ha EPoE at 10 DAS	23.67	53.65	55.47	54.56	273	371	322	76052	112631	94341	2.68	4.02	3.35
Oxyfluorfen 250 g/ha PE	78.00	11.76	7.06	9.41	64	47	56	-18433	-18571	-18502	0.60	0.51	0.55
Imazethapyr 40 g/ha PoE after first cut	4.33	59.84	71.80	65.82	233	480	357	79234	157075	118154	2.74	5.23	3.99
Imazethapyr 40 g/ha PoE after last cut	0.00	59.18	69.03	64.10	212	462	337	73206	147326	110266	2.55	4.75	3.65
Imazethapyr 40 g/ha PoE after first cut *fb* imazethapyr 40 g/ha PoE after last cut	2.67	61.01	67.37	64.19	248	451	349	82943	144437	113690	2.81	4.83	3.82
Cuscuta free	0.00	65.04	79.13	72.09	236	516	376	83852	168470	126161	2.71	4.92	3.81
Weedy check	0.00	42.19	50.08	46.13	147	468	308	41212	123265	82238	1.93	4.41	3.17
LSD (p=0.05)	5.449	4.737	7.077	5.934	31.1	45.4	38.4	7574.6	18350.3	13834	0.164	0.513	0.375

*PE = pre-emergence application, EPoE = early post-emergence application, PoE = post-emergence application, *fb* = followed by, DAS = days after seeding

respectively before first cut which could not be recovered upto third cut (120 DAS). Similar results were reported in Hisar (Priyanka *et al.* 2018).

Economics

The highest fodder yield of 72.09 t/ha and seed yield of 376 kg/ha resulted in higher net monetary returns and B:C ratio (₹ 126161/ha and 3.81, respectively) under *Cuscuta* free plots. Among herbicides-based treatments, the maximum monetary returns (₹ 118154/ha) and B:C ratio (3.99) was recorded with imazethapyr 40 g/ha PoE after first cut. Due to higher dose of pre-emergence herbicides, pendimethalin 1000 g/ha and oxyfluorfen 250 g/ha led to negative net returns and B:C ratio (0.75 and 0.55, respectively), which was 76% and 82% lesser over weedy check.

It was concluded that imazethapyr 40 g/ha PoE after first cut was most efficient in controlling the *Cuscuta* and provided 43% and 16% higher fodder and seed yield, respectively with 43.6% higher profitability compared to weedy check. The next effective treatment was imazethapyr 40 g/ha PoE after first cut + 40 g/ha PoE after last cut.

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