



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2021; 9(1): 2944-2947

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Received: 22-11-2020

Accepted: 30-12-2020

Himalay Sahu

Department of Agronomy,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Nitish Tiwari

Department of Agronomy,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Influence of different herbicides on weed flora of Berseem (*Trifolium alexandrinum* L.)

Himalay Sahu and Nitish Tiwari

DOI: <https://doi.org/10.22271/chemi.2021.v9.i1ao.11677>

Abstract

A field experiment was conducted at Research cum Instructional Farm, IGKV, Raipur (C.G.) during *rabi* 2019-20 to know the influence of different herbicides on weed flora of berseem (*Trifolium alexandrinum* L.). The experiment was laid out in a Randomized Block Design with three replications of ten treatments *viz.* pendimethalin (PE) 1000 g/ha (T₁), pendimethalin (EPoE) at 10 DAS 1000 g/ha (T₂), oxyfluorfen (PE) 250 g/ha (T₃) imazethapyr (PoE) 40 g/ha just after 1st cutting (T₄), imazethapyr (PoE) 40 g/ha just after 2nd cutting (T₅), imazethapyr (PoE) 40 g/ha just after 1st and 2nd cutting (T₆), imazamox 35% + imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 1st cutting (T₇), imazamox 35% + imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 2nd cutting (T₈), sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1st cutting (T₉) and control (T₁₀). The soil of experimental field was clayey in texture and slightly alkaline with (pH 7.4) in reaction. The amount of available N, P and K were low, medium and high respectively. Among these treatments, at 20 DAS and before 1st cutting of berseem the density and dry weight of weeds were found significantly lowest under the treatment oxyfluorfen 250 g/ha applied as PE (T₃). However, before 2nd cutting and at harvest of berseem the density and dry weight of weeds were found significantly lowest under sodium acifluorfen 16.5% + clodinafop-propargyl 8% as PoE applied just after 1st cutting (T₉). With regards to total weed density it was found at par with the PE application of oxyfluorfen 250 g/ha (T₃). But it was also found phytotoxic effect on berseem crop up to 15-20 DAA, hence negative impact on the growth and yield of berseem plants was observed.

Keywords: Berseem, herbicide, phytotoxic, oxyfluorfen, sodium acifluorfen 16.5% + clodinafop-propargyl 8%

Introduction

Berseem (*Trifolium alexandrinum* L.) is India's most dominant winter season forage crop with a productivity of 60-110 t/ha in 1.9 mha area (Anonymous, 2012) [2]. It is not a crop of Chhattisgarh but getting popularity among the farmers because it offers high quality, protein-rich green forage (15-25%), minerals (11-19%) and carotene (Sharma and Murdia, 1974) [7].

Even Berseem suffers from strong crop weed competition at initial 30-40 DAS, or at times up to 1st cutting. Fodder yield and seed yield losses have been estimated to be 23-30 per cent and 50 percent, respectively due to weeds (Joshi and Bhilare, 2006; Alfred, 2012) [4, 1]. Weeds particularly *Cichorioium intybus*, *Medicago denticulata*, *Trifolium flagiferum*, *Cyperus rotundus*, *Alternanthera sessilis* and *Chenopodium album* etc., are found associated with berseem and increase computational stress by stealing vital plant nutrients, water, moisture and space (Jain, 1998) [3]. *Cichorioium intybus* is one of the major obnoxious weed associated with berseem crop that offer more competition for essential growth factors (Kewat *et al.*, 2002) [5].

Conventional techniques of weed management are quite expensive, laborious and are sometimes not reliable due to labours being unavailable. In such a scenario, chemical weed control offers a decent option in contrast to conventional weeding, so testing pre and post-emergence herbicides alone and in combination is a better alternative to conventional methods. Since the comparative analysis of bio-efficiency of different weed control practices in berseem is available with very scarce knowledge, the present investigation is planned to reveal the appropriate herbicides for weed management in berseem.

Corresponding Author:**Himalay Sahu**

Department of Agronomy,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

Materials and Methods

Study Site Description

The experiment was performed at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), during the 2019-20 *rabi* season. Raipur is the capital of Chhattisgarh state and is situated at 21° 16' North latitude and 81° 36' East longitudes at an altitude of 298.56 meters above the mean sea level.

Experimental details

The experimental soil was clayey in texture and slightly alkaline with (pH 7.4) with medium fertility having 0.63% soil organic carbon, low nitrogen (189.64 kg/ha), medium phosphorous (12.30 kg/ha) and high potassium (257.60 kg/ha) content. The variety of berseem "SS-51" was line sown with a row to row distance of 20 cm by seed drill on 29th November, 2019 and harvested on 3rd May, 2020. The experiment was laid out in a Randomized Block Design with three replications of ten treatments *viz.* pendimethalin (PE) 1000 g/ha (T₁), pendimethalin (EPoE) at 10 DAS 1000 g/ha (T₂), oxyfluorfen (PE) 250 g/ha (T₃) imazethapyr (PoE) 40 g/ha just after 1st cutting (T₄), imazethapyr (PoE) 40 g/ha just after 2nd cutting (T₅), imazethapyr (PoE) 40 g/ha just after 1st cutting *fb* imazethapyr (PoE) 40 g/ha just after 2nd cutting (T₆), imazamox 35% + imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 1st cutting (T₇), imazamox 35% + imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 2nd cutting (T₈), sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1st cutting (T₉) and control (T₁₀).

Cultivation details

"Berseem seeds @ 25 kg/ha was sown 2-3 cm deep while maintaining 20 cm row to row spacing by seed drill on 29 November 2019. In order to maintain uniform plant population in all the treatments gap filling was done at 10 DAS. The first cutting was done at 55 DAS and subsequent two cuttings were made at 30 days after first cutting. Cutting was done with the help of sickle manually at 5 cm above ground level. After the 3rd cut, the rejuvenated crop was left for seed growth and final harvesting was done at 155 DAS (3 May 2020). Herbicides namely, pendimethalin, oxyfluorfen, imazethapyr, imazamox 35% + imazethapyr 35% (ready mix), and sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) were sprayed as per treatments. The dosage of various herbicides provided under each treatment was determined by the active ingredient present in the commercial products. Before spraying, the weighed amount of herbicide and water for each plot was thoroughly mixed in the bucket and later sprayed uniformly in the plot using a *flat-fan nozzle* with the help of a knapsack sprayer. Every time, fresh solution was prepared separately for individual treatment. Once all three replications of a treatment were sprayed with their respective herbicide, the sprayer was washed properly with detergent and eventually rinsed with fresh water before adding other herbicides. At the time of application of the herbicide all precautions were taken into consideration.

Observations recorded

The data on weed density and dry weight were recorded with the help of a quadrat (0.25 m²) at four places randomly chosen and then expressed in number per square meter and gram per square meter. The weed control efficiency (WCE) was worked out on the basis of weed dry matter recorded in each treatment at 20 DAS, before 1st cut (55 DAS), before 2nd

cut (85 DAS) and at harvest (155 DAS) by using the formula suggested by Mani *et al.*, 1973^[6].

$$WCE (\%) = \frac{DMc - DMt}{DMc} \times 100$$

Where, DMc = Dry matter of weeds in the in the unweeded check (control), DMt = Dry matter of weeds in the treated plot.

Values were subjected to square root transformation ($\sqrt{x + 0.5}$) prior to statistical analysis to normalize their distribution.

Results and Discussion

Weed flora

During the crop growth period *Medicago denticulata*, *Cichorium intybus*, *Chenopodium album* were found abundantly and grouped as major weeds while the density of *Melilotus indica*, *Alternanthera sessilis*, and *Echinochloa colona*, *Physallis minima* observed lesser and grouped as other weeds.

Effect of different herbicides on weed density

Weed density/m² in berseem was recorded at 20 DAS, before 1st cutting (55 DAS), before 2nd cutting (85 DAS) and at harvest (155 DAS) and are presented in Table 1. Weed density was significantly influenced by various herbicidal treatments.

At 20 DAS and before 1st cutting of berseem, the PE application of oxyfluorfen 250 g/ha (T₃) was superior over all the treatment as total density of weeds (5.00 and 17.33/m², respectively) were recorded lowest under this treatment. While, the total weed density was recorded highest (42.00 and 81.00/m²) under control (T₁₀). While, before 2nd cutting and at harvest of berseem, total density of weeds (27.33 and 32.00/m², respectively) were found significantly lowest under the PoE application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1st cutting (T₉) and found at par with the PE application of oxyfluorfen 250 g/ha (T₃). Before 2nd cutting highest values of total weed density (117.00/m²) was recorded under the PoE application of imazamox 35% + imazethapyr 35% (ready mix) 70 g/ha applied just after 2nd cutting (T₈) and at harvest highest values of total weed density (150.00/m²) was recorded under control (T₁₀).

Effect of different herbicides on weed dry weight

The data on dry matter of weeds in different treatments recorded at 20 DAS, before 1st cut (55 DAS), before 2nd cut (85 DAS) and at harvest (155 DAS) are presented in Table 2.

At 20 DAS and before 1st cutting of berseem, the PE application of oxyfluorfen 250 g/ha (T₃) was superior over all the treatment as total dry weight of weeds (3.09 and 17.53 g/m², respectively) were recorded lowest under this treatment. Followed by PE application of pendimethalin 1000g/ha (T₁). While, the total weed dry weight was recorded highest (10.52 and 40.59/m²) under control (T₁₀). Before 2nd cutting and at harvest of berseem, total dry weight of weeds (15.57 and 46.17 g/m², respectively) were found significantly lowest under the PoE application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1st cutting (T₉). However, highest values of total weed dry weight (106.33 and 198.03 g/m², respectively) was recorded under control (T₁₀).

The selective action of oxyfluorfen, pendimethalin and imazethapyr was the reason for better control of grassy and broad-leaves weeds. That resulted in poor crop weed competition during critical crop growth period. This resulted in meagre competition of weeds to crop with respect to moisture, space, sunlight and nutrition which caused better growth and development of crop. It may be inferred that weed free environment facilitated better growth and crop development with higher berseem green forage and seed yield.

While the non-selective action of sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) caused significant reduction in the density and dry matter production of weeds, the growth of berseem plants were also inhibited due to its phytotoxicity. Hence, this treatment recorded very poor green forage and seed yield.

Effect of different herbicides on Weed control efficiency

Weed control efficiency (WCE) was computed at 20 DAS, before 1st cutting (55 DAS), before 2nd cutting (85 DAS) and

at harvest (155 DAS) and presented in Table 3. It was evident from the data that at 20 DAS and before 1st cutting of berseem the highest weed control efficiency (70.66% and 56.81%, respectively) was recorded under the PE application of oxyfluorfen 250 g/ha (T₃) as compared to all other treatments. It was followed by the PE application of pendimethalin 1000 g/ha (T₁) (51.05 and 41.41%, respectively). While the lowest weed control efficiency (2.98% and 2.86%, respectively) was recorded under sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) 187.5 g/ha applied just after 1st cutting as PoE (T₉).

Before 2nd cutting and at harvest weed control efficiency was calculated highest (85.36% and 76.41%, respectively) under the PoE application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) 187.5 g/ha applied just after 1st cutting (T₉). The non-selective action of sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) 187.5 g/ha just after 1st cutting (T₉) was the reason for effective control of weeds so recorded highest weed control efficiency than rest of the treatments.

Table 1: Total weed density during different growth periods of berseem as influenced by different herbicidal treatments

Treatment	Weed density (number/m ²)			
	At 20 DAS	Before 1 st cut (55 DAS)	Before 2 nd cut (85 DAS)	AT harvest (155 DAS)
T ₁ -Pendimethalin (PE) 1000 g/ha	3.98 (16.33)	5.98 (35.33)	7.88 (61.67)	8.67 (74.67)
T ₂ - Pendimethalin (EPoE) 1000 g/ha at 10 DAS	4.81 (23.67)	6.62 (43.34)	7.72 (51.67)	7.71 (60.33)
T ₃ -Oxyfluorfen (PE) 250 g/ha	2.35 (5.00)	4.22 (17.33)	5.93 (34.67)	6.01 (35.66)
T ₄ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting	5.87 (34.00)	8.59 (73.33)	9.19 (84.00)	10.09 (101.33)
T ₅ -Imazethapyr (PoE) 40 g/ha just after 2 nd cutting	6.28 (39.00)	8.86 (78.00)	10.27 (105.00)	11.29 (127.00)
T ₆ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting <i>fb</i> Imazethapyr just after 2 nd cutting	6.10 (36.67)	8.67 (74.67)	9.08 (82.00)	9.08 (82.00)
T ₇ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 1 st cutting	5.99 (35.33)	8.75 (76.00)	9.21 (84.33)	9.41 (88.00)
T ₈ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 2 nd cutting	6.42 (40.67)	8.48 (71.33)	10.83 (117.00)	11.58 (133.67)
T ₉ -Sodium acifluorfen 16.5% + Clodinafop-Propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1 st cutting	6.18 (37.67)	8.84 (78.33)	5.28 (27.33)	5.70 (32.00)
T ₁₀ -Control	6.52 (42.00)	9.02 (81.00)	10.75 (115.00)	12.27 (150.00)
S.Em±	0.21	0.26	0.32	0.35
CD (P=0.05)	0.64	0.80	0.95	0.99

Note* Data in parenthesis are pre transformed original values, which were transformed to $(x + 0.5)^{0.5}$ and analysed statistically

Table 2: Total weed dry weight during different growth periods of berseem as influenced by different herbicidal treatments

Treatment	Weed dry weight (g/m ²)			
	At 20 DAS	Before 1 st cut (55 DAS)	Before 2 nd cut (85 DAS)	At harvest (155 DAS)
T ₁ -Pendimethalin (PE) 1000 g/ha	2.37 (5.15)	4.92 (23.78)	7.78 (60.00)	10.75 (115.16)
T ₂ - Pendimethalin (EPoE) 1000 g/ha at 10 DAS	2.49 (5.68)	4.92 (24.66)	8.14 (65.76)	11.30 (127.21)
T ₃ -Oxyfluorfen (PE) 250 g/ha	1.89 (3.09)	4.25 (17.53)	7.30 (52.73)	10.27 (104.89)
T ₄ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting	3.21 (9.81)	6.23 (38.30)	8.98 (80.16)	12.51 (156.00)
T ₅ -Imazethapyr (PoE) 40 g/ha just after 2 nd cutting	3.27 (10.14)	6.31 (39.32)	10.20 (103.73)	12.73 (161.48)
T ₆ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting <i>fb</i> Imazethapyr just after 2 nd cutting	3.22 (9.86)	6.26 (38.27)	8.78 (76.66)	10.16 (102.67)
T ₇ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 1 st cutting	3.13 (9.30)	6.28 (39.00)	8.24 (67.33)	11.44 (130.26)
T ₈ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 2 nd cutting	3.08 (9.00)	6.27 (38.82)	10.18 (103.08)	12.17 (147.67)
T ₉ -Sodium acifluorfen 16.5% + Clodinafop-Propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1 st cutting	3.27 (10.21)	6.33 (39.43)	4.01 (15.57)	6.87 (46.71)
T ₁₀ -Control	3.31 (10.52)	6.36 (40.59)	10.34 (106.33)	14.09 (198.03)
S.Em±	0.15	0.22	0.36	0.40
CD (P=0.05)	0.46	0.66	1.07	1.19

Note* Data in parenthesis are pre transformed original values, which were transformed to $(x + 0.5)^{0.5}$ and analysed statistically

Table 3: Weed control efficiency during different crop growth periods of berseem as influenced by different herbicide treatments

Treatment	Weed control efficiency (%)			
	AT 20 DAS	Before 1 st cut (55 DAS)	Before 2 nd cut (85 DAS)	At harvest (155 DAS)
T ₁ -Pendimethalin (PE) 1000 g/ha	51.05	41.41	38.76	37.31
T ₂ - Pendimethalin (EPoE) 1000 g/ha at 10 DAS	46.01	39.25	37.21	35.75
T ₃ -Oxyfluorfen (PE) 250 g/ha	70.66	56.81	50.41	47.03
T ₄ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting	6.78	5.63	24.62	21.21
T ₅ -Imazethapyr (PoE) 40 g/ha just after 2 nd cutting	3.61	3.12	2.45	18.44
T ₆ -Imazethapyr (PoE) 40 g/ha just after 1 st cutting <i>fb</i> Imazethapyr just after 2 nd cutting	6.24	5.72	27.90	48.15
T ₇ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 1 st cutting	11.63	3.92	36.68	34.21
T ₈ -Imazamox 35% + Imazethapyr 35% (ready mix) (PoE) 70 g/ha just after 2 nd cutting	14.48	4.37	3.06	25.42
T ₉ -Sodium acifluorfen 16.5% + Clodinafop-Propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1 st cutting	2.98	2.86	85.36	76.41
T ₁₀ -Control	---	---	---	---

Conclusion

The results of the experiment revealed that PE application of oxyfluorfen 250 g/ha found superior over rest of the treatments, as total weed density and dry weight of weeds were found significantly lowest at 20 DAS and before 1st cutting of berseem. However, before 2nd cutting and at harvest of berseem, total weed density and dry weight of weeds were found lowest under treatment sodium acifluorfen 16.5% + clodinafop-propargyl 8% (ready mix) (PoE) 187.5 g/ha just after 1st cutting, but it was also found phytotoxic effect on berseem crop up to 15-20 DAA, hence negative impact on the growth and yield of berseem plants was observed. So it is not advisable for weed management in berseem crop.

Acknowledgement

The authors feel privileged to thank to Dr. Nitish Tiwari, Scientist, Department of Agronomy I.G.K.V., Raipur (C.G.), for his continuous help, support and guidance throughout this research work.

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