Himachal Journal of Agricultural Research 48(2): 296-299 (2022)

Short Communication

Bio-efficacy of flumioxazin against mixed weed flora in grassland of Himachal Pradesh

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Manuscript Received: 06.09.2022; Accepted: 24.09.2022

Abstract

A field experiment was conducted during *kharif* 2021 at the Research Farm of Department of Agronomy, College of Agriculture CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to study the bio-efficacy of flumioxazin against mixed weed flora in grassland. The experiment was laid out in Randomized Block Design with three replications. The experiment consisted of nine weed control treatments *viz.,* flumioxazin 150 g/ha, 200 g/ha, 250 g/ha, 300 g/ha, 500 g/ha, oxyfluorfen 1000 g/ha, weed free, glyphosate 4000 g/ha and untreated control. The major weeds in the experiment area were *Ageratum conyzoides*, *Erigeron canadensis*, *Bidens pilosa*, *Cynodon dactylon*, *Cyperus* sp., *Digitaria sanguinalis* and *Plantago lanceolata*. The results revealed that post-emergence application of flumioxazin 500 g/ha, which was statistically at par with flumioxazin 300 g/ha, flumioxazin 250 g/ha, flumioxazin 200 g/ha and glyphosate 4000 g/ha were quite effective in controlling weeds with higher weed control efficiency. Application of flumioxazin 300 g/ha resulted in significantly higher fresh and dry herbage yield of grasses which was at par with flumioxazin 500 g/ha, 250 g/ha and 200 g/ha.
Key words: Flumioxazin, weed control, grassland

Weeds are unacceptable plants that interfere with the growth of the desired plant species and negatively with human activities in a particular situation. They are persistent, prolific and effectively competing with the beneficial crop plants and thus adversely affect crop production and human welfare. In the agricultural production system, weeds are major constraints to cropped as well as non-cropped lands. Himachal Pradesh has an agrarian economy in which farmers usually keep dairy animals besides crop production. The availability of green fodder throughout the year is essential for obtaining higher milk production and for this grasslands play an important role. However the grasslands have been infested with number of weeds which must be controlled for maintaining the productivity of grasslands. In India wide range of area is enclosed under non-cropped land, which is badly infested with perennial as well as annual monocot and dicot weeds. In Himachal Pradesh, this category of land occupies most of the geographical area (about 80%) due to typical physiography of the state (Rana *et al.* 2015).

Numbers of herbicides have been recommended for controlling weeds under such situations and are being used by the farming community. However use of same herbicide over a period of time could lead to the problem of herbicide resistance. This emphasizes the need to evaluate new herbicide formulation for efficient and economical control of weeds under grassland. Flumioxazin is one such herbicide which is effective in controlling mixed flora of weeds in grassland. Flumioxazin works by inhibition of plant enzyme protoporphyrinogen oxidase (PPO) which is important for the synthesis of chlorophyll. In view of the above facts the present investigation was conducted to evaluate the efficacy of flumioxazin against mixed weed flora in grassland.

The field experiment was carried out at the Research Farm of Department of Agronomy, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (32.6^0 N, 76.3^0 E) during *kharif* 2021. The experimental site was an established grassland, the soil was silty clay loam in texture, acidic in reaction (5.22), medium in organic carbon (0.93%),

low in available nitrogen (250.8 kg/ha), medium in available phosphorus (18.32 kg/ha) and available potassium (150.2 kg/ha). Nine weed control treatments *viz.,* flumioxazin 150 g/ha, 200 g/ha, 250 g/ha, 300 g/ha, 500 g/ha, oxyfluorfen 1000 g/ha, weed free check, glyphosate 4000 g/ha and untreated control were evaluated in randomized block design with three replications. Herbicides were applied using spray volume of 750 litres of water/ha with a flat fan nozzle attached to a Knapsack sprayer. Weed count and weed dry weight were recorded from two spots using a quadrate of 0.50 X 0.50 m and expressed as number and g/m^2, respectively. The data on weed count and weed dry weight were subjected to ($\sqrt{x+1}$) square root transformation before statistical analysis. Weed control efficiency of different treatments was calculated as per the following formula given by Mishra and Tosh (1979).

$$\text{Weed control efficiency (\%)} = \frac{\text{DWC-DWT}}{\text{DWC}} \times 100$$

Where,

DWC - weed dry weight (g/m^2) in control plot, and

DWT - weed dry weight (g/m^2) in treated plot

The dominant weed flora in the experimental site included *Erigeron canadensis*, *Bidens pilosa*, *Cynodon dactylon*, *Ageratum conyzoides*, *Cyperus* sp., *Digitaria sanguinalis* and *Plantago lanceolata*. A similar type of weed flora in non-cropped area has also been observed by Angiras (2014), Pooja *et al.* (2021) and Kumar *et al.* (2021) under the mid-hill conditions of Himachal Pradesh.

Different weed control treatments significantly influenced the total weed density (Table 1). Significantly highest density of total weed was recorded in untreated control. Weed free check resulted in significantly lower count of total weeds as compared to other treatments. Among herbicide treatments, flumioxazin 250 g/ha resulted in significantly lower count of total weeds which was at par with flumioxazin 200 g/ha, flumioxazin 300 g/ha, flumioxazin 500 g/ha and glyphosate 4000 g/ha as compared to other weed control treatments. This happened due to the effective control of the weeds with flumioxazin which significantly reduced the species wise weed density which ultimately resulted in significantly lowest total weed count. These results are in close conformity with the findings of Pooja *et al.* (2021) and Rana *et al.* (2017).

Table 1.Effect of weed control treatments on total weed count (No./m^2) in grassland

Treatment	Commercial dose (g/ha)	Weed count (No./m^2)		
		15 DAS	30 DAS	60 DAS
Flumioxazin	150	6.48(41.33)	7.25(52.00)	7.97(62.67)
Flumioxazin	200	5.24(26.67)	4.99(24.00)	6.38(40.00)
Flumioxazin	250	4.24(17.33)	4.26(17.33)	5.26(26.27)
Flumioxazin	300	4.42(18.67)	4.32(18.67)	5.12(25.33)
Flumioxazin	500	4.40(18.67)	3.27(10.67)	5.50(29.33)
Oxyfluorfen	1000	7.26(52.00)	7.63(57.33)	8.60(73.33)
Weed free check	-	1.00(0.00)	1.00(0.00)	1.00(0.00)
Glyphosate	4000	4.32(18.67)	4.72(21.33)	6.29(38.67)
Untreated control	-	8.92(78.67)	10.10(101.33)	11.41(129.33)
S.Em±	-	0.41	0.38	0.39
LSD (p=0.05)	-	1.24	1.15	1.18

Values given in the parentheses are the means of original values, Data subjected to ($\sqrt{x+1}$) square root transformation; DAS: days after spray

All the weed control treatments significantly influenced the total dry matter accumulation of total weeds (Table 2). There was a gradual increase in weed dry matter accumulation. Highest total weed dry matter accumulation was observed in untreated control at all the stages. Weed free resulted in significantly lower dry weight of weeds as compared to other treatments. All the weed control treatments showed significant reduction in total weed dry matter over untreated control at all the stages of observation. Among herbicide treatments, flumioxazin 250 g/ha which was at par with flumioxazin 200 g/ha, flumioxazin 300 g/ha, flumioxazin 500 g/h and glyphosate 4000 g/ha resulted in significantly lower dry matter of total weeds at all the stages of observation. This is because of the effective control of the weeds with flumioxazin which reduced the species wise weed dry weight which ultimately resulted in significantly lowest total weed dry matter. These findings are in direct conformity with the findings of Corbett *et al.* (2004) and Pooja *et al.* (2021).

Weed control efficiency also followed the same trend as that of weed dry matter with hand weeding resulted in highest weed control efficiency (Table 3). However, among different weed control treatments flumioxazin 300 g/ha recorded significantly higher weed control efficiency. This treatment was followed by flumioxazin 250 g/ha, flumioxazin 200 g/ha and flumioxazin 500 g/ha. Lowest weed control efficiencies were achieved with oxyfluorfen 1000 g/ha. The higher weed control efficiencies achieved by different herbicides treatments were due to significant reduction in the dry weight of weeds through effective control over untreated control. Similar results were

Table 2. Effect of weed control treatments on weed dry matter (g /m^2) in grassland

Treatment	Commercial dose (g/ha)	Weed count (No./m^2)		
		15 DAS	30 DAS	60 DAS
Flumioxazin	150	3.41(10.76)	3.83(13.85)	4.36(18.28)
Flumioxazin	200	2.81(7.08)	3.00(8.18)	3.34(10.32)
Flumioxazin	250	2.38(4.88)	2.55(5.68)	2.83(7.18)
Flumioxazin	300	2.29(4.44)	2.43(5.08)	2.74(6.68)
Flumioxazin	500	2.68(6.35)	2.63(6.08)	2.87(7.36)
Oxyfluorfen	1000	3.75(13.18)	4.17(16.56)	4.77(21.88)
Weed free check	-	1.00(0.00)	1.00(0.00)	1.00(0.00)
Glyphosate	4000	2.63(6.12)	2.68(6.36)	3.01(8.26)
Untreated control	-	4.56(19.90)	5.37(27.90)	6.18(37.23)
S.Em±	-	0.32	0.35	0.41
LSD (p=0.05)	-	0.96	1.06	1.22

Values given in the parentheses are the means of original values, Data subjected to ($\sqrt{x+1}$) square root transformation; DAS: days after spray

Table 3. Effect of weed control treatments on weed control efficiency (%) in grassland

Treatment	Commercial dose (g/ha)	Weed control efficiency (%)		
		15 DAS	30 DAS	60 DAS
Flumioxazin	150	45.93	50.36	50.90
Flumioxazin	200	64.42	70.68	72.28
Flumioxazin	250	75.48	79.64	80.71
Flumioxazin	300	77.69	81.79	82.06
Flumioxazin	500	68.09	78.21	80.23
Oxyfluorfen	1000	33.77	40.65	41.23
Weed free check	-	100.00	100.00	100.00
Glyphosate	4000	69.25	77.20	77.81

DAS: days after spray

reported by Sridhara *et al.* (2019).

The effects of various treatments on fresh and dry herbage yield of associated grasses in grassland have been presented in Table 4. A perusal of data revealed that fresh and dry yield of associated grasses in grassland have been significantly influenced by different weed control treatments. Weed free check recorded significantly highest fresh and dry herbage yield of grasses as compared to other treatments. Among herbicide treatments, significantly higher fresh and dry herbage yield was recorded with the application of flumioxazin 300 g/ha which was statistically at par with flumioxazin 200 g/ha, flumioxazin 250 g/ha and flumioxazin 500 g/ha. This might be due to the fact that the population of weeds was reduced significantly in these treatments as compared to other treatment which might have reduced the competition between weeds and grasses and ultimately resulted in increased fresh and dry herbage yield. Glyphosate 4000 g/ha resulted in lowest fresh and dry herbage yield of grasses in grassland since glyphosate 4000 g/ha resulted in complete kill of grass species due to translocative nature of the herbicide.

Conclusion

The study indicated that weeds in grassland can be controlled effectively with flumioxazin 250 g/ha which further improved the fresh and dry herbage yield.

Conflict of interest: The authors have no conflict of interest.

Acknowledgement: The authors are thankful to Sumitomo Chemical India Limited for providing the herbicide for testing.

Table 4. Effect of weed control treatments on fresh and dry herbage yield (q/ha) of grasses in grassland

Treatment	Commercial dose (g/ha)	Herbage yield(q/ha)	
		Fresh herbage yield	Dry herbage yield
Flumioxazin	150	160.7	48.1
Flumioxazin	200	168.4	50.4
Flumioxazin	250	175.4	52.5
Flumioxazin	300	178.0	53.3
Flumioxazin	500	175.7	52.6
Oxyfluorfen	1000	109.6	32.8
Weed free check	-	180.8	54.1
Glyphosate	4000	101.2	30.2
Untreated control	-	138.0	41.3
S.Em±	-	3.5	1.6
LSD (p=0.05)	-	10.5	4.7

DAS: days after spray

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