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ORIGINAL ARTICLE

Effect of herbicides on nitrogen removal by *Phalaris minor* and wheat (*Triticum aestivum* L.).

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ABSTRACT

Significantly higher leaf area, nitrogen content, nitrogen uptake and grain yield of wheat were recorded in fenoxaprop-p-ethyl at 90g a.i./ha as compared to metsulfuron methyl and metribuzin treatments. Fenoxaprop-p-ethyl significantly reduced growth & development of Phalaris minor and increased grain yield of wheat. Application of metribuzin at 70g a.i./ha and metsulfuron methyl at 4.0g a.i./ha also increased leaf area, nitrogen content, nitrogen uptake and grain yield of wheat as compared to weedy (control). The maximum leaf area/plant (47.29 cm^2) nitrogen uptake (154.19 kg/ha) by crop and grain yield (5439 kg/ha) was recorded under weed-free treatment. All the herbicide treatments reduced the Phalaris minor leaf area, dry weight, nitrogen content, nitrogen uptake, and total dry weight of weeds significantly. Phalaris minor and other weeds growing throughout the crop season reduced the grain yield to the extent of 35.62%.

KEY WORDS: *Herbicides, leaf area, Nitrogen content, Phalaris minor, Wheat, Yield.*

INTRODUCTION

Wheat occupies a prominent place as an important crop contributing 40 percent in the total food grain production and is next only to rice. Weeds are one of the major factors affecting the productivity, resulting in 30-50 percent losses in crop yield [1], and therefore need immediate attention. It is well known that weeds cause severe loss to yield and deplete soil nutrients considerably. These nutrient losses caused by weeds could be effectively tackled either through the use of effective herbicides or effective weed management treatments. The use of herbicide offers selective and economic control of weeds right from the beginning, giving crop an advantage of good head start and competitive superiority. Herbicidal control of weeds assumes greater significance being efficient and economical method. *Phalaris minor* is the most troublesome weed affecting wheat production. It is an annual grass weed and with the development of resistance against isoproturon [2], it has emerged as the most problematic weed causing yield stagnation of wheat. The infestation of *Phalaris minor* alone can reduce wheat grain yield upto 40 percent [3]. *Phalaris minor* in wheat is dominant weed which pose a serious threat to its successful cultivation. Due to the morphological similarity, this weed escapes manual weeding and hence its control through herbicides has been a popular option amongst farmers. Keeping these facts in mind, there is urgent need to identify the effective herbicides which may provide wide range of weed control. The present investigation was undertaken to assess the effect of herbicides on nitrogen removal by *Phalaris minor* and wheat.

MATERIALS AND METHOD

The field experiment was conducted during winter season of 2005-06 at Kargaina village, in Bareilly district. The soil of the experiment was sandy clay loam in texture with pH 7.4, organic carbon 0.60%, available P 16.45 kg/ha and available K 201 kg/ha. Sowing of wheat variety PBW 343 was done on 25 November 2005 with row spacing of 20 cm. A constant seed rate per plot @ 100kg/ha was used, crop was raised by applying 120kg N, 60kg P_2O_5 and 40kg K_2O per ha. The experiments were laid out in randomized block design with three replications. Treatments consisted fenoxaprop-p-ethyl at 90 g a.i./ha, metsulfuron methyl at 4.0 g a.i./ha metribuzin at 70g a.i./ha, weed free and weedy check. All the herbicides were applied 35 days after sowing (DAS) using countineuse sprayer at spray volume of 450 litre water per hectare. Dry weight of total weed species at 120 days harvest stage of wheat crop was recorded from randomly selected quadrate (2500cm^2) in each plot and expressed as g/m^2. Observation of leaf area/plant (cm^2), nitrogen content (%) in leaves and dry

weight (g/m^2) of *Phalaris minor* were recorded at 90 days after sowing. The data on leaf area/plant (cm^2), nitrogen content (%) in leaves, crop dry weight production (g/m^2) and grain yield (kg/ha) of wheat were recorded at 90 DAS and harvest stage respectively. Nitrogen contents was analysed in dried leaves of wheat at 90 DAS by a microkjeldahal method [4]. The total nitrogen uptake (kg/ha) was calculated by multiplying the values of percent nitrogen content in wheat with their respected dry weight. The uptake of nitrogen (kg/ha) was worked out as

$$\text{Uptake of nitrogen (kg/ha)} = \frac{\text{N(\%) in the material x dry weight (kg/ha)}}{100}$$

Statistical Analysis

The experimental data obtained during the course of study were subjected to statistical analysis by applying the technique of analysis of variance (ANOVA) prescribed for the randomized block design to test the significance of the overall differences among treatments by the 'F' test and conclusion were drawn at 5 percent probability level. Standard error of mean was calculated in each case. When the 'F' value from analysis of variance tables was found to be significant, the critical difference (C.D.) was computed to test the significance of the difference between the two treatments [5].

RESULT AND DISCUSSION

Experimental field was uniformly infested with grassy and non-grassy weeds. The major weed flora at the experimental site comprised grassy weeds *Phalaris minor* (52.08%), *Avean fatua* (9.06%) and non-grassy weeds *Chenopodium album* (15.46%) and *Melilotus indica* (8.29%).

Effect of herbicides on *Phalaris minor*

The maximum leaf area, dry weight, nitrogen content, nitrogen uptake of *P. minor* and dry weight of total weed species were recorded in weedy and zero in weed free treatment. *Phalaris minor* (Little seed canary grass) was the major weed in the experimental field of wheat. The data presented in Table 1 revealed that application of fenoxaprop-p-ethyl (90 g a.i./ha), metsulfuron methyl (4g a.i./ha) and metribuzin (70g a.i./ha) significantly reduced the *Phalaris minor* leaf area, dry weight, nitrogen content and total dry weight of weed species as compared to weedy treatment. Minimum leaf area (20.51cm^2), dry weight (12.41g/m^2), nitrogen content (1.13%), nitrogen uptake (1.41kg/ha) of *Phalaris minor* and total dry weight of weed species (32.51g/m^2) were recorded under fenoxaprop-p-ethyl treatment. The bio-efficacy of fenoxaprop-p-ethyl at 80-120g/ha provided nearly 100% control of *Phalaris minor* [6]. Fenoxaprop-p-ethyl showed the most potent direct effect and caused maximum decrease in leaf area, dry weight and nitrogen content of *Phalaris minor*. Fenoxarpop-p-ethyl was the best treatment in reducing the growth and development of *Phalaris minor* in comparison to other herbicides. Application of metribuzin and fenoxaprop-p-ethyl significantly reduced the dry matter of *P. minor* along with other broad leaved weeds [7]. Metribuzin and metsulfuron methyl treatments also reduced the *Phalaris minor* leaf area/plant (21.67 and 21.59cm^2), dry weight (15.33 and 15.42g/m^2) and nitrogen content (1.16 and 1.23%) respectively. Metribuzin was the second best treatment, reducing the nitrogen content of the *Phalaris minor* as compared to metsulfuron methyl treatment. All the herbicide treatments significantly reduced leaf area, dry weight, nitrogen content of *Phalaris minor* and dry weight of total weed species as compared to weedy.

Nitrogen uptake by *Phalaris minor*

The highest nitrogen uptake by *Phalaris minor* was recorded in weedy plot due to the presence of higher population and dry weight of *Phalaris minor*. Nitrogen uptake by weeds is directly related with weed population and dry matter of weeds and inversely related to grain yield [8]. The lowest uptake of nitrogen by *Phalaris minor* was recorded under fenoxaprop-p-ethyl treatment (1.41 kg/ha) followed by metribuzin (1.77 kg/ha) and metsulfuron methyl (1.89 kg/ha) treatments. Which were statistically at par with each other. Reduction in dry weight of *Phalaris minor* might be the reason for lower nitrogen uptake by *Phalaris minor* under herbicide treatments. Nitrogen uptake reduction of 61.03% in weedy plot was recorded in comparison to weed free plot. Shekara and Nanjappa [9] have also reported a reduction in nutrients removal by weeds with their control. Fenoxaprop-p-ethyl treatment at 90 g.a.i./ha was very effective in reducing the population, dry weight of *Phalaris minor* and therefore resulted in significantly low nitrogen removal by *Phalaris minor* than other herbicides and weedy treatment. All the herbicide treatments significantly reduced the *Phalaris minor* competition in wheat field and decreased the nitrogen uptake by *Phalaris minor* as compared to weedy

Table 1 Effect of herbicides on leaf area/plant, dry weight of *P. minor*, nitrogen content, nitrogen uptake by *P. minor* and dry weight of total weed species

Treatment	Dose (g.a.i./ha)	Leaf area/plant (cm^2) 90 DAS	Dry weight of *P. minor* (g/m^2) 90 DAS	Nitrogen content (%) 90 DAS	Nitrogen uptake by *Phalaris minor* (Kg/ha) 90 DAS	Dry weight of total weeds species (g/m^2) 120DAS
Fenoxaprop-p-ethyl	90.0	20.51	12.41	1.13	1.41	32.51
Metsulfuron methyl	4.0	21.59	15.42	1.23	1.89	38.70
Metribuzin	70.0	21.67	15.33	1.16	1.77	35.34
Weed free	-	0.00	0.00	0.00	0.00	0.00
Weedy	-	31.29	75.30	1.73	13.03	176.83
S. Em. ±	-	0.58	1.20	0.854	0.151	1.50
C.D. at 5%	-	1.89	3.93	0.278	0.495	4.91

Effect of herbicide of crop

Maximum leaf area, crop dry weight production, nitrogen content, nitrogen uptake and grain yield were recorded in weed free plots, because no weeds were observed in weed free plots, which may have resulted in increased nutrient, water, space and light supply to wheat crop due to the absence of crop weed competition. Minimum leaf area, crop dry weight production, nitrogen content and grain yield were recorded in weedy plots. All the herbicides treatments resulted in significant improvement in crop growth, yield attributes, parameters and grain yield of wheat. The second highest leaf area, crop dry weight production, nitrogen content and grain yield were recorded in fenoxaprop-p-ethyl at 90g a.i./ha treatment (Table 2). Fenoxaprop-p-ethyl at 100g/ha produced wheat grain yields at par with weed free treatment [10]. Metsulfuron methyl and metribuzin were also increased leaf area, crop dry weight production, nitrogen content and grain yield of wheat as compared to weedy treatment. Application of herbicides (metribuzin and fenoxaprop-p-ethyl) provided effective control of weeds and resulted more grain yields than weedy [11]. All the herbicide effectively controlled the *P. minor* weed and consequently made more nitrogen available to the crop and enhanced the nitrogen uptake and grain yield.

Table 2 Effect of herbicides on leaf area/plant, crop dry weight production, nitrogen content, nitrogen uptake and grain yield of wheat

Treatment	Dose (g.a.i./ha)	Leaf area/plant (cm^2) 90 DAS	Crop dry weight production (g/m^2) 90 DAS	Nitrogen content (%) 90 DAS	Nitrogen uptake by crop (Kg/ha) 90DAS	Grain yield (kg/ha)
Fenoxaprop-ethyl	90.0	42.86	752.66	1.67	125.68	4988
Metsulfuronmethyl	4.0	38.82	717.66	1.39	99.75	4495
Metribuzin	70.0	39.22	723.66	1.49	107.82	4589
Weed free	-	47.29	838.00	1.84	154.19	5439
Weedy	-	31.37	551.33	1.09	60.09	3502
S. Em. ±	-	0.65	23.43	0.924	7.41	135
C.D. at 5%	-	2.12	76.53	0.301	24.17	442

DAS = Days after sowing

Nitrogen uptake by crop

All the herbicide treatments caused higher nitrogen uptake than weedy (control) treatment. Application of fenoxaprop-p-ethyl (90g a.i./ha), metsulfuron methyl (4g a.i./ha) and metribuzin (70g a.i./ha) at applied 35 DAS, resulted in higher nitrogen uptake by crop and differed significantly than weedy treatment. However, metsulfuron methyl and metribuzin were not similar to fenoxaprop-p-ethyl treatment in increasing nitrogen uptake by crop. Application of metribuzin and metsulfuron methyl proved significantly equally effective in reducing the nitrogen uptake by weeds than weedy [12]. The application of fenoxaprop-p-ethyl provided highest nitrogen uptake (125.68kg/ha) by crop than other herbicides. This could be attributed to the effective control of *P. minor* by fenoxaprop-p-ethyl application, which checked the nitrogen depletion by *P. minor* to a greater extent. All the herbicide treatments significantly increased the nitrogen uptake due to the less weed competition and low dry weight of total weight species. Nitrogen uptake reduction was recorded 52.19% in weedy plot when it compared with fenoxaprop-p-ethyl treatment.

CONCLUSION

This study suggests that the application of fenoxaprop-p-ethyl significantly reduced the growth & development of *Phalaris minor* and increase the nitrogen uptake by crop which may have resulted in increased leaf area/plant, crop dry weight production, nitrogen content and grain yield of wheat. All the herbicides controlled *Phalaris minor* and other weeds effectively and therefore resulted in significantly low nitrogen removal than the weedy treatment.

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