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QUANTIFICATION OF TOLERANCE OF DIFFERENT WILD OATS (*Avena fatua* L.) BIOTYPES TO CLODINAFOP PROPARRGYL AND FENOXAPROP-P-ETHYL

Gul Hassan[1], Haroon Khan[1], Imtiaz Khan[1] and Malik Ghulam Rabbani[2]

ABSTRACT

Studies were conducted in the Weed Science Research Laboratory, Department of Weed Science, NWFP Agricultural University Peshawar, Pakistan during 2004. The experiment comprised of 7 biotypes of wild oats subjected to Topik 15 WP (clodinafop-propargyl) or Puma super 75 EW (fenoxaprop-p-ethyl), each at 4 rates including an untreated check. The experiment was laid out in completely randomized design (CRD) with two replications. The wild oats biotypes were collected from all across the NWFP and the federal capital. 10 seeds per pot were planted on 1st January, 2004. Herbicides were applied on 30th January, 2004. Data were recorded on the fresh weight and its percent reduction as compared to the respective check for each biotype and herbicide and were subjected to regression analysis. GR_{50} and GR_{90} were also computed for comparison of tolerance. For clodinafop-proparrgyl, the biotypes responded almost similarly as their GR_{50} values fluctuated between 0.15 to 0.17 kg ha^{-1} except the biotype D.I.Khan white which attained a GR_{50} value of 0.68 kg ha^{-1} which has an exceptionally higher value and killing of this biotype under the field conditions at the normal recommended doses is extremely difficult. A similar trend in GR_{90} for the different biotypes was evaluated. For the fenoxaprop-p-ethyl the similar trend was recorded although the values were higher for the later herbicide. The GR_{50} estimates of different biotypes revealed an almost similar tolerance as the values ranged between 0.45 to 0.84 kg ha^{-1}. The GR_{50} value of D.I.Khan white was however distinctly higher (1.422 kg a.i ha^{-1}). In the light of the results, it is concluded that lesser dose of Topik 15 WP is required for the control of wild oats as compared to Puma super 75 EW, except D.I.Khan white which possess more tolerance to both herbicides and will require higher doses of the herbicides for its control. Cautions is however, required that the increase in doses applied for killing this tolerant biotype might kill or injure the wheat crop as well.

Key words: Tolerance, wild oats, *Avena fatua* biotypes, GR_{50}, clodinafop fenoxaprop-p-ethyl

INTRODUCTION

Avena fatua is a grassy weed of wheat, which belongs to family Poaceae. This is the most problematic annual weed of wheat fields in tropical countries including India and

[1]Department of Weed Science, NWFP Agricultural University, Peshawar – Pakistan. E-mail: hassanpk_2000pk@yahoo.com
[2]Agricultural Research Institute, Dera Ismail Khan – Pakistan.

Pakistan. It is highly competitive with wheat and causes severe reduction in its yield. It is difficult to differentiate this weed from wheat at the seedling stage, as its seedlings are identical to wheat seedlings in morphology. Life cycle of this weed also coincides with wheat. The problem in identification at the early stage impedes in the manual control, hence herbicides application becomes inevitable (Seefeldt, et al. 1995).

Avena fatua is an erect annual grass with extensive fibrous root system. Leaves are flat, with broad base and acute apex, 7-20 cm long and 5-15 mm wide. Culms are smooth, erect, stout and in small tufts. Sheaths are smooth or slightly hairy on the margins in younger plants. Panicle is loose and open, slender branches ascending and rough. Spikelets are made up of 2 to 3 florets enclosed by a pair of papery bracts; each floret bears a long, abruptly bent bristle. Seed is 6-10 mm long and the most characteristic distinction from cultivated oats is the presence of long silky hairs, especially around its base. The panicles of wild oats are looser and more widely spaced than those of cultivated oats. Wild oat plants grow on a wide range of light to heavy soil types and in both acid and alkaline soils. Freshly harvested seeds are dormant but germinate well after a prolonged storage at 20°-25°C (Xie *et al.*, 1995).

The tolerance is the phenomenon in which certain weed species resists the phytotoxic effect of a herbicide due to its inherited resistance, while some weeds develop resistance against certain herbicides under the selection pressures of herbicides. This acquired resistance is most challenging for weed scientists. A differential tolerance has been practically observed in *Avena fatua* and *Phalaris minor* (Unpublished data, Department of Weed Science, NWFP Agricultural University, Pehsawar).

The increase in wheat yield during the recent years in Pakistan is attributed to the successful launching of Topik 15 WP (clodinafop-proparrgyl) and Puma Super 75 EW (fenoxaprop-p-ethyl). The grass species most competitive in wheat are wild oats and little seed canary grass. These weeds could be controlled at much lower rates as compared to those specified by the different pesticide companies. But accurate information regarding the tolerance of biotypes of these weeds in Pakistan is lacking. Juan *et al.* (1995) studied the effects of post-emergence selective graminicides upon the development of the *Avena fatua* seed bank in wheat crop and *Avena fatua* seed production was reduced to between 60 and 95% as compared with control.

To investigate the tolerance among the wild oat germplasm collected across the NWFP and federal capital area, the experiments laid out with the following objectives:1) to find out the more effective and economical herbicide for controlling wild oats in wheat 2) to quantify the response of wild oats biotypes to two graminicides and 3) to find out the precise rate of the aforesaid herbicides for different biotypes of wild oats.

MATERIALS AND METHODS

The experiment was conducted in the Weed Science Research Laboratory, Department of Weed Science, NWFP Agricultural University Peshawar, Pakistan. The studies comprised of 7 biotypes of wild oats (collected from all across NWFP and the federal capital area) subjected to Topik 15 WP (clodinafop-proparrgyl) or Puma super 75 EW (fenoxaprop-p-ethyl), each at 4 rates including an untreated check. The experiment was laid out in completely randomized design (CRD) with two replications. Each treatment was comprised of a single pot having 20 cm dia. 10 seeds per pot were planted on 1st January, 2004. Herbicides were applied on 30th January, 2004. The biotypes included in the studies were NARC, D.I.Khan (black), D.I.Khan (white), Swabi, Mardan, Swat and Karak. Each of the above biotypes was exposed to the following different doses of the two herbicides.

Table1. Detail of herbicidal treatments.

S.No.	Trade name	Common name	Formulation Rate (kg a.i ha^{-1})
1	Topik 15WP	clodinafop propargyl	0.126
2	Topik 15WP	clodinafop propargyl	0.160
3	Topik 15WP	clodinafop propargyl	0.109
4	Puma super 75EW	fenoxaprop-p-ethyl	1.260
5	Puma super 75EW	fenoxaprop-p-ethyl	1.000
6	Puma super 75EW	fenoxaprop-p-ethyl	0.750
7	Untreated check	.....	.....

Three weeks after herbicidal application the weight of plants in pots were taken which were still green (plants damaged portions were discarded and only green portions were weighed). The percent reduction of fresh weight was calculated with the following formula.

$$\%\text{Reduction in fresh weight} = \frac{\text{Untreated check weight (g) given treatment weight (g)}}{\text{Untreated check weight (g)}} \times 100$$

The data recorded for each herbicide in each biotype were individually subjected to simple linear regression. Linear regression equations were derived for each biotype subjected to each herbicide. Then finally, **GR_{50}** and **GR_{90}** were computed by using the aforesaid regression equation for each biotype for the individual herbicide (Gomez and Gomez, 1984). Where **GR_{50}** is the dose of herbicide (kg ha^{-1}), which reduces the fresh weight of plant by 50% and **GR_{90}** is the dose of herbicides (kg ha^{-1}), which reduces the fresh weight by 90%, respectively.

RESULTS AND DISCUSSION

GR_{50} and GR_{90} Estimation

The value of GR_{50} and GR_{90} of wild oat biotype for Topik 15 WP were less than Puma super 75 EW, which revealed that wild oat is more susceptible to Topik 15 WP as compared to Puma super (Table-3). All the biotypes of wild oats when exposed to Topik 15 WP responded almost similarly as their GR_{50} values fluctuated between 0.15 to 0.17 kg ha^{-1} except D.I. Khan white which attained a GR_{50} value of 0.68 kg ha^{-1} which is exceptionally higher value and killing of this biotype under the field conditions at the normal recommended dose is extremely difficult. The value of the tolerant biotype is 4-fold higher than the other biotypes tested. A similar trend was also noticed in GR_{90} for the different biotypes when exposed to Topik 15 WP (Table-3). These findings are also in a great analogy with those of Singh et al. (1998) and Rohitashave et al. (1999), who controlled grassy weeds with different grass killers and also reported that the fresh weight declined successively when the plants were subjected to the higher doses of Topik 15 WP. Hassan and Khan (2005) also corroborate our inferences, who obtained differential interaction of wild oats biotypes with different grass killers. The GR_{50} estimates of different biotype subjected to Puma super 75 EW revealed similar tolerance as the values ranged between 0.45 to 0.84 kg ha^{-1} (Table-3). The GR_{50} value of D.I.Khan white was

however distinctly higher (0.84 kg a.i ha^{-1}). Likewise, a similar trend in the GR_{90} values was recorded among the various biotypes studied (Table-3).

CONCLUSIONS AND RECOMMENDATIONS

Results revealed that lesser dose of Topik 15 WP is required for the control of wild oats as compared to Puma super 75 EW. The biotypes collected across the NWFP and the Federal capital area were killed on equal doses of both herbicides except D.I.Khan white, which possesses more tolerance to both herbicides, will require higher doses of the herbicides for its control. Caution is however required that the increase in doses applied for killing this tolerant biotype might kill or injure the wheat crop as well.

Table 2. The linear regression equations for different genotypes of wild oats treated with different doses of clodinafop and fenoxaprop

- **Topik 15WP**

NARC	$\hat{Y}_1 = 15 + 68.17\ X$
DIK(Black)	$\hat{Y}_2 = 15.81 + 70.26\ X$
Swabi	$\hat{Y}_3 = 14.2 + 75.12\ X$
Mardan	$\hat{Y}_4 = 16.81 + 72.74\ X$
D.I.K(White)	$\hat{Y}_5 = 5.75 + 18.42\ X$
Swat	$\hat{Y}_6 = 17.43 + 71.03\ X$
Karak	$\hat{Y}_7 = 16.81 + 62.82\ X$

- **Puma super 75EW**

NARC	$\hat{Y}_1 = 10.38 + 61.07\ X$
D.I.K(Black)	$\hat{Y}_2 = 10.56 + 64.09\ X$
Swabi	$\hat{Y}_3 = 9.68 + 60.31\ X$
Mardan	$\hat{Y}_4 = 10.01 + 64.67\ X$
D.I.K(White)	$\hat{Y}_5 = -9.93 + 52.66\ X$
Swat	$\hat{Y}_6 = 10.01 + 64.67\ X$
Karak	$\hat{Y}_7 = 13.72 + 51.03\ X$

Table 3. GR_{50} and GR_{90} values (kg a.i ha^{-1}) of Wild oat biotypes *(Avena fatua)* treated with clodinafop and fenoxaprop-p-ethyl

Biotypes	Clodinafop (Topik 15 WP)		Fenoxaprop-p-ethyl (Puma super 75 EW)	
	GR_{50} kg a.i.ha^{-1}	GR_{90} kg a.i.ha^{-1}	GR_{50} kg a.i. ha^{-1}	GR_{90} kg a.i. ha^{-1}
NARC	0.08	0.16	0.48	0.97
D.I.Khan black	0.07	0.15	0.45	0.92
Swabi	0.07	0.15	0.49	0.99
Mardan	0.06	0.15	0.45	0.92
D.I.Khan white	0.36	0.68	0.84	1.42
Swat	0.06	0.15	0.46	0.92
Karak	0.08	0.17	0.52	1.10

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