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Estimation of GR_{50} Values of New Herbicides Used to Control Isoproturon Resistant *Phalaris minor* in Wheat

U. S. Walia, L. S. Brar and Devinder Singh
Department of Agronomy and Agrometeorology
Punjab Agricultural University, Ludhiana-141 004 (Punjab), India

ABSTRACT

Pot experiments were conducted to find out GR_{50} values of isoproturon, clodinafop, sulfosulfuron and fenoxaprop-p-ethyl for controlling *Phalaris minor*. Clodinafop, sulfosulfuron and fenoxaprop-p-ethyl were recommended at 60, 25 and 100 g ha^{-1}. On an average of two years, GR_{50} values for isoproturon, clodinafop, sulfosulfuron and fenoxaprop-p-ethyl were found to be 1210, 2.47, 2.08 and 7.58 g ha-l, respectively. Among the alternate herbicides, lowest GR_{50} value was observed in clodinafop which was followed by sulfosulfuron and fenoxaprop-p-ethyl and these values were many times lower than their recommended doses; however, GR_{50} values for isoproturon were found to be much higher than even its recommended dose.

INTRODUCTION

Wheat *(Triticum aestivum)* is very important crop of Punjab state and *Phalaris minor* is a major weed of this crop especially in rice-wheat sequence. Isoproturon provided very effective control of this weed for more than one decade. But for the last 6-7 years, this herbicide is not providing satisfactory control of *P. minor* on the farmers' field which was due to development of resistance to isoproturon (Walia *et al,* 1997). The failure of isoproturon to control resistant *P. minor* led to the recommendation of clodinafop, sulfosulfuron and fenoxaprop-p-ethyl which are providing effective control of isoproturon resistant *P. minor* and there is no report of resistance against these herbicides. However, these herbicides belong to the most susceptible/ sensitive groups of herbicides i. e. 'fops' and 'sulfonylureas' which are amongst the most prone chemical groups for rapid development of resistance. Gressel (1993) reported development of resistance in rye grass to sulfonyl urea herbicides when used continuously for three years.

Estimation of GR_{50} (amount of herbicide required to reduce dry weight to 50 % as compared to control) of a problematic weed indicates about the time required for occurrence of resistance to a particular herbicide. So, this study was made to estimate GR_{50} values of clodinafop, sulfosulfuron and fenoxaprop-p-ethyl, so that their effectiveness over the coming years can be predicted which may be helpful for planning the future strategies to combat the resistance menace.

MATERIALS AND METHODS

Isoproturon resistant biotypes of *P. minor* were collected from farmers' field in Punjab state where it was used continuously for more than 10 years. The experiment was laid out in randomized block design with five replications and graded levels of recommended doses of clodinafop 60 g ha^{-1}, sulfosulfuron 25 g ha^{-1} and fenoxaprop-p-ethyl 100 g ha^{-1} were used. Trial was conducted in iron rectangles (9" x 4"), which were filled with soil free from seeds of *P. minor*. One part of FYM was mixed with five parts of field soil which was sandy loam in texture. Sowing of seeds of *P. minor* was done in the 3rd week of November during 2001 and 2002. After two weeks of sowing, plants were thinned to

Table 1. GR_{50} value for different herbicides

Treatment	Recommended dose (g ha^{-1})	GR_{50} value on dry weight basis (g ha^{-1})		Per cent increase/decrease in GR_{50} values over recommended levels		
		2001-02	2002-03	2001-02	2002-03	Mean
Isoproturon	940.0	1380	1040	+46.8	+ 10.6	+28.7
Clodinafop	60.0	2.45	2.50	-95.9	-95.8	-95.9
Sulfosulfuron	25.0	1.89	2.27	-92.4	-90.9	-91.7
Fenoxaprop-p-ethyl	100.0	6.62	8.55	-93.1	-91.4	-92.3

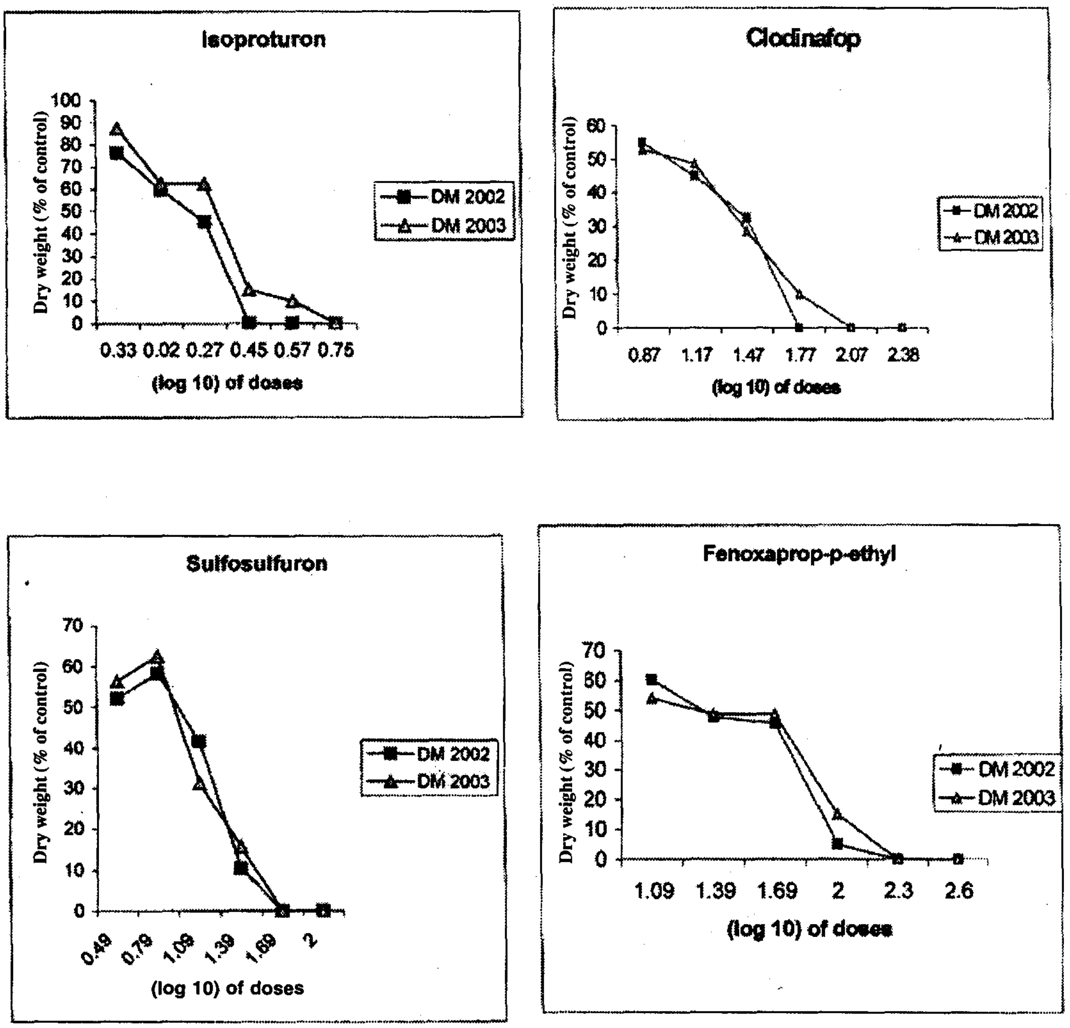

Fig. 1. Effect of different levels of herbicides on dry matter of *Phalaris minor.*

15 plants/rectangle. Iron rectangles were watered regularly and were sprayed as per treatments when *P. minor* had attained 3-4 leaf stage (30-35 days after sowing). The levels of clodinafop, fenoxaprop-p-ethyl and sulfosulfuron were kept as 1/8 recommended level (R), ¼R, ½R, R, 2R and 4R. The treatments for isoproturon were ½ R, R, 2R, 3R, 4R and 6R, whereas the recommended dose for this herbicide was 940 g ha^{-1}. One control treatment with no spray was also kept with each herbicide treatment.

Herbicides were applied with Knap-sack sprayer fitted with flat fan nozzle on area basis. The dry weight of *P. minor* was recorded four weeks after the spray of these herbicides and data were subjected to log-logistic analysis (Seefeldt *et al.*, 1995). The values of dry matter accumulation by *P. minor* were assigned to Y-axis and log of doses was assigned to X-axis on graph to obtain a dose response curve. The mathematical equation used relating to the response Y to dose X is given below:

$$Y = f(x) = C + (D - C)/1 + (X/GR_{50})b \quad \text{(I)}$$

$$Y = f(x) = C + (D - C)/1 + \exp[b(\log x) - \log(GR_{50})] \quad \text{(II)}$$

Where,

C=Lower limit in the mean response (dry matter) at very high dose.

D=Upper limit corresponding to the mean response of the control.

GR_{50}=Dose giving 50% response.

b=The slope of curve around GR_{50} value.

One of the advantages of using curve described by equation (I) is that parameters are biologically meaningful.

RESULTS AND DISCUSSION

GR_{50} value for isoproturon was worked out at 1380 and 1040 g ha^{-1} during 2001-02 and 2002-03, respectively, and these values were quite higher as compared to even the field recommended level of isoproturon 940 g ha^{-1}. The corresponding values for GR_{50} during the two years were 2.45 and 2.5 g ha^{-1} for clodinafop, 1.89 and 2.27 g ha^{-1} for sulfosulfuron and 6.62 and 8.55 g ha^{-1} for fenoxaprop-p-ethyl, respectively (Table 1 and Fig. 1). There was slight increase in GR_{50} value during the second year of study in all the alternate herbicide treatments. However, there was slight decrease in GR_{50} value of isoproturon during second year indicating improvement in its bio-efficacy. Mahajan and Brar (2001) reported GR_{50} values for isoproturon, clodinafop, sulfosulfuron and fenoxaprop-p-ethyl as 1700, 6.6, 4.2 and 17.3 g ha^{-1}, respectively, in isoproturon resistant *P. minor*.

On an average of two years, an increase in GR_{50} value by 28.7 % was observed in isoproturon as compared to its recommended dose indicating thereby that it is unable to control *P. minor* at the recommended level (Table 1). Per cent decrease in GR_{50} value for clodinafop, sulfosulfuron and fenoxaprop-p-ethyl was found to be 95.9, 91.7 and 92.3 %, respectively, over their recommended level indicating thereby that all these herbicides are giving very effective control of isoproturon resistant *P. minor* even at lower than their recommended rates and there seems no chance of development of cross resistance in *P. minor* to these herbicides in the near future.

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