Indian J. Weed Sci. **36** (1 & 2) : 112-114 (2004) *Short Communication*

Classification of Isoproturon Resistant Biotypes of *Phalaris minor* Retz.

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Phalaris minor Retz. is the dominant grass weed of wheat in the rice-wheat zone of north-west India. The increase in the importance of the weed in N-W India is associated with the dominating rice-wheat rotation. Isoproturon was very effectively used for the control of *P. minor* in wheat for many years; however, its efficacy has fallen with the development of resistance in this weed in Haryana (Malik and Singh, 1993) and Punjab (Walia *et al.*, 1997). Resistance to isoproturon is now well established fact especially in rice-wheat fields of north-west India (Yadav and Malik, 2001). Out of total area under wheat, which is approximately 26.0 m ha, the area following rice-wheat is 10.5 m ha (Bhan and Kumar, 1998). The resistance has spread over approximately one million hectares of north-west India, thereby causing a threat to the wheat productivity in the region (Singh, 2001). Also, in the Punjab state of India, the level of resistance of *P. minor* to isoproturon is variable on the fields of different farmers.

Resistance is not absolute and it became necessary to devise a rating system for populations for their degree of resistance (Clarke and Moss, 1989). Clarke *et al.* (1994) have developed a classification system describing different degree of resistance in *Alopecurus myosuroides* to chlortoluron. However, till date, no proper classification of resistance rating has been done based on which various biotypes/ecotypes of *P. minor* can be classified as susceptible or resistant. There is a need to do a detailed study to classify resistant biotypes of *P. minor.* Based on this, farmer's field can be rated for their degree of resistance that can form the basis of management strategies. Keeping above in view, the present study was conducted to classify the isoproturon resistant biotypes of *P. minor.*

Pot studies were conducted at Research Farm of Punjab Agricultural University, Ludhiana during the **rabi** seasons of 1999-2000 and 2000-01. Seeds of *P. minor* showing resistance to isoproturon were collected from the farmer's field in Punjab during 1998-99. The seeds of these biotypes were sown on Nov. 15, 1999 and Nov. 24, 2000 with three replications in completely randomized block design. During 1999-2000, circular plastic trays with 10" diameter and 1½" depth were filled with soil free from *P. minor* seed after making minute holes at the bottom of these trays, while during 2000-01 iron rectangles measuring 9" x 4" were used instead of plastic trays. Watering of trays/rectangles was done regularly and 15 plants of uniform growth per treatment were maintained after complete germination of *P. minor* seeds. These biotypes were exposed to isoproturon at recommended (0.94 kg ha^{-1}) and double the recommended (1.88 kg ha^{-1}) level on area basis using 250 l ha^{-1} spray volume on Dec. 17, 1999 and Dec 27, 2000 when plants of *P. minor* attained 3-4 leaf stage. An unsprayed control treatment was also kept for comparison.

Dry matter accumulation (g/pot) by different biotypes of *P. minor* was recorded two months after sowing and per cent reduction in dry matter with the application of isoproturon at recommended as well as double the recommended dose as compared to control (unsprayed) was worked out for each biotype. Average of per cent reduction in dry matter by six sensitive (with more per cent

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reduction) and resistant (with less per cent reduction in dry matter) populations of *P. minor* each were considered as standard reference population and these values were used in the formulae given by Clarke *et al.* (1994). The 30 populations exposed to recommended as well as double the recommended doses of isoproturon were classified, depending upon their sensitivity to isoproturon into six categories as given below :

Categories	Formulae of Clarke *et al.* (1994)
Highly susceptible	≥S
Moderately susceptible	S-[0.5 (S-R)/4]
Susceptible	S-[(S-R)/4]
Partially resistant	S-[2(S-R)/4]
Resistant	S-[3(S-R)/4]
Highly resistant	<S-[3(S-R)/4]

S=Per cent reduction in dry matter of reference susceptible population as compared to control.
R=Per cent reduction in dry matter of reference resistant population as compared to control.

Increase in dose of isoproturon from 0.94 to 1.88 kg ha^{-1}, increased the susceptibility of *P. minor* biotypes, while resistance level of these biotypes of the herbicide decreased. A higher proportion of populations tested for isoproturon resistance at normal field rate of isoproturon was classified as highly resistant (28.3%) compared to double the recommended dose with only 11.7% in the highly resistant category (Table 1). These figures confirm that resistance can substantially reduce the herbicide activity at normal field rates and more dose of isoproturon is required for killing resistant *P. minor.* Further, it was observed that the number of biotypes in the resistant categories was more during 2000-01 compared to 1999-2000. This might be because, during 1999-2000, plants were raised in plastic trays which had limited volume of soil available for their growth and development as well as no percolation of isoproturon into deeper soil layers took place while during 2000-01, there was no restriction for the roots to penetrate upto the deeper soil depths as well as for the percolation of isoproturon. Probably due to this reason, tolerance to isoproturon by more biotypes was recorded during 2000-01 as compared to 1999-2000 season. Also the dose of isoproturon had less influence on number of biotypes registered in moderately susceptible and susceptible categories during 2000-01. In contrast, more number of population/biotypes i. e. 18 came under the susceptible categories with double the recommended dose of isoproturon compared to only 10 under recommended dose of isoproturon during 1999-2000. These results further confirm that, under field conditions, where there is no restriction for growth and development, the resistance level of the biotypes to the herbicide increased.

Table 1. Classification of level of resistance of *Phalaris minor* biotypes to recommended (0.94 kg ha^{-1}) (Iso R) and double (Iso 2R) the recommended dose of isoproturon

Categories	Number of biotypes				% Biotypes	
	1999-2000		2000-01		(Mean of 2 years)	
	Iso R	Iso 2R	Iso R	Iso 2R	Iso R	Iso 2R
Highly susceptible	4	6	4	4	13.3	16.6
Moderately susceptible	4	8	0	1	6.7	15.0
Susceptible	2	4	0	1	3.3	8.3
Partially resistant	8	8	4	8	20.0	26.7
Resistant	8	3	9	10	28.4	21.7
Highly resistant	4	1	13	6	28.3	11.7
Total	30	30	30	30	100.0	100.0

It may be concluded that a sizeable number (76.7%) of *P. minor* biotypes has developed resistance to isoproturon, which explains poor efficacy of this herbicide.

REFERENCES

Bhan, V. M. and D. Kumar, 1998. Integrated management of *Phalaris minor* in rice-wheat ecosystems in India. Proc. International Symposium Ecological Agriculture and Sustainable Development, Vol. **I**, Chandigarh. pp. 400-415.

Clarke, J. H., A. M. Blair and S. R. Moss, 1994. The testing and classification of herbicide resistant *Aloepcurus myosuroides* : Sampling to make decisions. *Aspects Appl. Biol.* **37** : 181-188.

Clarke, J. H. and S. R. Moss, 1989. The distribution and control of herbicide resistant *Aloepcurus myosuroides* in Central and Eastern England. Proc. Crop Protection Conference Weeds, Brighton, U. K. pp. 301-308.

Malik, R. K. and S. Singh, 1993. Evolving strategies for herbicide use in wheat : Resistance and Integrated Weed Management. Proc. International Symposium Indian Society Weed Science, Vol. **1**, Hisar. pp. 225-238.

Singh, S. 2001. Evaluation of JV 485 and sulfosulfuron against resistant biotypes of *Phalaris minor.* Proc. 1st Biennial Conference in the New Millennium Ecofriendly Weed Management Options Sustainable Agriculture, Bangalore. pp. 148.

Walia, U. S., L. S. Brar and B. K. Dhaliwal, 1997. Resistance to isoproturon in *Phalaris minor* Retz. in Punjab. *Plant Protec. Quarterly* **12** : 138-140.

Yadav, A. and R. K. Malik, 2001. Isoproturon resistance in *P. minor* – An irreversible phenomenon. Proc. 1st Biennial Conference in the New Millennium Ecofriendly Weed Management Options Sustainable Agriculture, Bangalore. pp. 149.