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Evaluation of Some Graminicides Against *Polypogon monspeliensis* (L.) Desf.

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Polypogon monspeliensis (L.) Desf. (beard grass, rabbit foot grass, foxtail grass or loombar ghas), an annual grass weed of Poaceae family, is native to Great Britain and Europe and has become naturalized throughout the world (Russell *et al*., 1955; Munz, 1959; Clapham *et al*., 1962; Tselev, 1984; Montenegro *et al*., 1991). It is a major grass weed of winter season crops in northern India. Survey conducted in Haryana revealed it third major grass weed of wheat with greater preponderance in the moist fields under rice-wheat rotation areas (Singh *et al*., 1995). López-Granados *et al*. (2008) reported that recently *P. monspeliensis* was spreading fast in southern Spain in wheat fields where rice is being cultivated in rotation. Surveillance data in Haryana state revealed its greater infestation in disturbed soils where moisture was high and huge populations thriving in water channel, close to field bunds and edges avoiding herbicide application. Earlier it was under control due to application of isoproturon in wheat, but due to evolution of resistance in *P. minor* biotypes (Malik and Singh, 1995; Singh *et al*., 1997), isoproturon was replaced by other herbicides that were less effective against it. *P. monspeliensis* is a prolific seed producer and small seed easily blown by winds inundate new fields each year. It has long emergence window and delayed emergence under field conditions escapes herbicide application. A single plant can produce 72 tillers when growing without any intra- and inter-specific competition. It has also been associated with sheep poisoning (Finnie, 1991) and disease when the animals ingest bacterium (*Clavibacter toxicus)* infected spikelets (McKay *et al*., 1993; Bertozzi and McKay, 1995), and also harbors rust fungus, *Puccinia polypogonis* (Baka and Gjaerum, 1996). Though, it also has phytoremedian properties and can absorb heavy metals (Hg and Cd) from soil (Su *et al*., 2008; Ansari *et al*., 2009). Not much is known about its biology and efficacy of wheat herbicides under field conditions. It is becoming a major weed in many wheat fields necessitating an investigation for its effective control. Keeping this in view, primary studies were carried out to evaluate some herbicides against *P. monspeliensis* under controlled conditions.

Pot studies were conducted during 2007-08 and 2008-09 to assess the efficacy of isoproturon (0.50, 0.75 and 1.0 kg/ha), clodinafop-propargyl (40, 50 and 60 g/ha), sulfosulfuron (20, 25 and 30 g/ha), fenoxaprop-P-ethyl (80, 100 and 120 g/ha), premix of mesosulfuron + iodosulfuron (Atlantis) (10.0, 14.4 and 17.3 g/ha), premix of sulfosulfuron+metsulfuron (Total) (24, 32 and 40 g/ha) and pinoxaden (25, 50 and 100 g/ha) against *P. monspeliensis*. Control pots were maintained for comparisons. Plastic pots of medium size (20 cm height and top diameter) were filled with field soil of sandy loam texture by mixing with vermicompost and dunal sand in 2: 1 : 1 ratio (by volume) and 30 seeds of *P. monspeliensis* were planted in each pot on December 28, 2007 and January 10, 2009. Thinning was done after emergence and 10 plants per pot were maintained for spraying. Herbicides were sprayed on February 26, 2008 and February 20, 2009 using backpack sprayer fitted with flat fan nozzle using 500 l/ha water volume. *P. monspeliensis* plants had 2-3 tillers (3-5 in the first year) at the time of spraying. Pots were arranged in a completely randomized design and watered as and when needed. Visual observations were recorded periodically on weed mortality on a 0-100 scale, where 0 = no control and 100 = complete mortality and fresh weight was recorded before terminating the experiments 9 weeks after treatment (WAT). Data from both sets were averaged as there were similar trends and combined data for two years were subjected to ANOVA using SPSS. Arcsin transformation was done to visual mortality data before ANOVA and data for 7 and 9 WAT are presented alongwith fresh weight recorded 9 WAT.

Pinoxaden was most effective against *P. monspeliensis* followed by fenoxaprop, clodinafop and isoproturon (Table 1). Effect of isoproturon was maximum 3 WAT, but reduced significantly at 7 and 9 WAT; also the efficacy of isoproturon was lower when *P. monspeliensis* plants were at 3-5 tiller stage (first year) compared to 2-3 tiller stage (second year). Sulfosulfuron, Atlantis (premix of mesosulfuron+iodosulfuron) and Total (premix of sulfosulfuron + metsulfuron) were not found effective against *P. monspeliensis* at any application rate as the highest reduction in growth was no more than 41% (Table 1). Pinoxaden 50 g/ha provided 100% mortality of *P. monspeliensis*. Similar effect was recorded with 100 g/ha of fenoxaprop, but required 70 g/ha rate of clodinafop. When data were averaged over rates for *P. monspeliensis* mortality 9 WAT, clodinafop, fenoxaprop and pinoxaden provided 82, 97 and 98% control, respectively. Effect of clodinafop was slow and slightly lower than fenoxaprop, though statistically similar. Isoproturon provided 64% control of *P. monspeliensis* 9 WAT, whereas Atlantis, sulfosulfuron and Total provided only 24, 29 and 34% control, respectively, when data were averaged over rates.

Table 1. Effect of different herbicides on mortality and fresh weight of *P. monspeliensis*

Treatments (g/ha)		Visual mortality (%)		Fresh weight (g/pot)
		7 WAT	9 WAT	9 WAT
Isoproturon	500	48 (44)	43 (41)	13.0
	750	65 (53)	65 (54)	14.7
	1000	79 (63)	85 (68)	5.5
Clodinafop	50	36 (37)	48 (44)	23.7
	60	58 (49)	97 (81)	1.7
	70	63 (52)	100 (90)	1.7
Fenoxaprop	80	67 (55)	92 (73)	5.0
	100	70 (57)	100 (90)	0.9
	120	85 (67)	100 (90)	0.8
Sulfosulfuron	20	12 (20)	20 (26)	21.7
	25	18 (25)	32 (34)	26.0
	30	23 (28)	36 (37)	19.0
Atlantis	10.0	15 (22)	19 (26)	18.9
	14.4	18 (25)	22 (28)	19.7
	17.3	26 (30)	30 (33)	16.0
Total	24	14 (22)	28 (32)	18.0
	32	17 (24)	33 (35)	16.7
	40	24 (29)	41 (40)	16
Pinoxaden	25	73 (58)	93 (74)	1.2
	50	92 (76)	100 (90)	0.6
	100	95 (80)	100 (90)	0.6
Control				23.7
LSD (P=0.05)		9	6	4.2

Figures in parentheses are transformed values subjected to ANOVA.

The fresh weight of *P. monspeliensis* was 23.7, 22.2, 18.11 and 16.9 g/pot under untreated control, sulfosulfuron, Atlantis and Total (averaged over three rates), respectively. Though mean fresh weight of *P. monspeliensis* was less in Total than Atlantis and sulfosulfuron, statistically it was similar to untreated check (Table 1). Similarly, fresh weight by *P. monspeliensis* was statistically similar under pinoxaden, fenoxaprop and clodinafop treatments; whereas no difference was observed in the fresh weight with isoproturon and clodinafop (data averaged over rates and subjected to Tukey's test). Increasing the application rates of Atlantis or Total from less than recommended to recommended rates or higher had no significant reduction in fresh weight of *P. monspeliensis* plants. Isoproturon 1.0 kg/ha reduced the fresh weight of *P. monspeliensis* by 77% over untreated plants; similar reduction was recorded with 80 g/ha of fenoxaprop, but clodinafop 50 g/ha was similar to control plants in fresh weight accumulation by plants. Pinoxaden 25 g/ha reduced the fresh weight of *P. monspeliensis* by 95% compared to untreated plants.

The two-year pot studies confirm the poor efficacy on *P. monspeliensis* observed under field conditions when wheat fields were treated with Atlantis, sulfosulfuron or Total herbicides at recommended rates. Chhokar *et al.* (2008) reported that pinoxaden at 30 g/ha provided complete control of *P. monspeliensis* infesting barley under field conditions. Isoproturon (1.0 kg/ha), though effective against *P. monspeliensis* when applied at its early growth stage, may be of little use due to evolution of resistance in *Phalaris minor* biotypes as *P. monspeliensis* is more prevalent in rice-wheat rotation areas. Efficacy of clodinafop against *P. monspeliensis* has been found inconsistent under field conditions which may be dose-dependent as many farmers' resort to under-dosing for the control of *P. minor* (Yadav *et al.*, 2006). Moreover, resistance is also brewing against clodinafop in *P. minor* biotypes at several locations in Haryana state (Chhokar and Sharma, 2008; Singh *et al.*, 2009) and reduced efficacy of fenoxaprop against *P. minor* already made it redundant (Yadav *et al.*, 2001). Clodinafop and fenoxaprop resistance was also reported from Iran when used continuously for the control of *P. minor* (Gherekhloo *et al.*, 2010). Pinoxaden, though found most effective against *P. monspeliensis* in the present study, can also have serious issues of resistance evolution in grass weeds as some warning signals were evident in *P. minor* (Chhokar and Sharma, 2008; Singh *et al.*, 2009). Pinoxaden was found effective against grass weeds of wheat and barley (Singh and Punia, 2007; Chhokar *et al.*, 2008) and is an excellent herbicide for controlling grassy weeds in wheat and barley without any adverse effect on crop or persistence. Pinoxaden has been recommended at 50 g/ha for the control of *P. minor* in Haryana state; a lower recommended rate is a sure recipe for resistance evolution going by the tendency of many farmers to use lower than recommended rates of herbicides (Walia and Brar, 2006; Yadav *et al*., 2006). Atrazine and simazine resistant populations of *P. monspeliensis* were first detected from Israel in 1979 as reported by Prof. Baruch Rubin *(http://www.weedscience.org/Case/Case.asp?ResistID=99)*. Lower application rates and repetitive use may be the culprit for herbicide failure against the target weed and care should be taken to rotate herbicides and other agronomic practices, wherever possible. Thus, it can be concluded that judicious use of pinoxaden will be able to control *P. monspeliensis* and other grass weeds effectively. Fenoxaprop, clodinafop and isoproturon can also be used if there are no resistant populations of *P. minor* in the field; however, Atlantis, sulfosulfuron or Total should be avoided with heavy infestations of *P. monspeliensis*.

REFERENCES

Ansari, T. M., Khuala Umbreen, Raziya Nadeem and M. A. Hanif. 2009. *Polypogon monspeliensis* waste biomass : A potential biosorbent for Cd (II). *African J. Biotechnol.* **8** : 1136-1142.

Baka, Z. and H. Gjaerum. 1996. Egyptian Uredinales: I. Rusts on wild plants on the Nile Delta. *Mycotaxon*. **60** : 291-303.

Bertozzi, T. and A. McKay. 1995. Incidence on *Polypogon monspeliensis* of *Clavibacter toxicus* and *Anguina* sp., the organisms associated with "flood plain staggers" in South Australia. *Austr. J. Exp. Agri*. **35** : 567-569.

Chhokar, R. S. and R. K. Sharma. 2008. Multiple herbicide resistance in little seed canarygrass (*Phalaris minor*) : A threat to wheat production in India. *Weed Biol. Manage*. **8** : 112-123.

Chhokar, R. S., R. K. Sharma and R. P. S. Verma. 2008. Pinoxaden for controlling grass weeds in wheat and barley. *Ind. J. Weed Sci*. **40** : 41-46.

Clapham, A., T. Tutin and E. Warburg. 1962. Flora of the British Isles. Cambridge University Press, Cambridge. 1269 pp.

Finnie, J. W. 1991. Corynetoxin poisoning in sheep in the south-east of South Australia associated with annual beard grass (*Polypogon monspeliensis*). *Aust. Vet. J*. **68** : 370.

Gherekhloo, J., M. D. Osuna, M. H. R. Mohassel, M. N. Mahallati, E. Zand, A. Ghanbari and R. De Prado. 2010. Biochemical and molecular basis of resistance to ACCase inhibiting herbicides in Iranian resistant *Phalaris minor* populations. *Pest Manage. Sci.* (in press).

Herbicide Resistant Weeds-Worldwide, site maintained by Dr. Ian Heap. *http://www.weedscience.org/Case/Case.asp?ResistID=99,* accessed 25.10.2009.

López-Granados, J., M. Peña-Barragán, M. Jurado-Expósito, M. Francisco-Fernández, R. Cao, A. Alonso-Betanzos and O. Fontena-Romero. 2008. Multispectral classification of grass weeds and wheat (*Triticum durum*) using linear and non-parametric functional discriminant analysis and neural networks. *Weed Res.* **48** : 28-37.

Malik, R. K. and Samunder Singh. 1995. Littleseed canary grass (*Phalaris minor*) resistance to isoproturon in India. *Weed Technol*. **9** : 419-425.

McKay, A., K. Ophel, T. Reardon and J. Gooden. 1993. Livestock deaths associated with *Clavibacter toxicus -Anguina* infection in seedheads of *Agrostis avenacea* and *Polypogon monspeliensis*. *Plant Dis.* **77** : 635-641.

Montenegro, C., S. Teillier, P. Arce and V. Poblete. 1991. Introduction of plants into the mediterranean-type climate area of Chile. pp. 103-114. In : *Biogeography of Mediterranean Invasions,* Groves, R. and F. Di Castri (eds.). Cambridge Univ. Press, Cambridge. 485 pp.

Munz, P. 1959. *A Flora of California.* University of California Press, Berkeley. 1691 pp.

Russell, Gibbs G., L. Watson, M. Koekemore, L. Smook, N. Barker, H. Anderson and M. Dallwitz. 1955. Grasses of southern Africa. Memoirs of the Botanical Survey of South Africa. No. 58. 437 pp.

Singh, Samunder, R. C. Kirkwood and G. Marshall. 1997. Effects of isoproturon on photosynthesis in susceptible and resistant biotypes of *Phalaris minor* and wheat. *Weed Res*. **37** : 315-324.

Singh, Samunder, R. K. Malik, R. S. Balyan and Samar Singh, 1995. Distribution of weed flora of wheat in Haryana. *Ind. J. Weed Sci*. **27** : 114-121.

Singh, Samunder and S. S. Punia. 2007. Sensitivity of barley (*Hordeum vulgare*) to herbicides of different modes of action. *Ind. J. Weed Sci.* **39** : 205-210.

Singh, Samunder, S. S. Punia and R. K. Malik. 2009. Multiple resistance in isoproturon resistant biotypes of *Phalaris minor* in India. Weed Sci. Soc. America 49th Ann. Meet, Orlando, Florida, Feb. 9-13. *Abstr. 280.*

Su, Yi, Fengxiang Han, Jian Chen, B. B. Maruthi Sridhar and D. L. Monts. 2008. Phytoextraction and accumulation of mercury in three plant species : Indian mustard (*Brassica juncea*), beard grass (*Polypogon monspeliensis*), and Chinese brake fern (*Pteris vittata*). *Int. J. Phytoremed.* **10** : 547-560.

Tselev, N. 1984. *Grasses of the Soviet Union. Part 1.* Balkema, Rotterdam, The Netherlands. pp. 1-568.

Walia, U. S. and L. S. Brar. 2006. Current status of *Phalaris minor* resistance against isoproturon and alternate herbicides in the rice-wheat cropping systems in Punjab. *Ind. J. Weed Sci.* **38** : 207-212.

Yadav, Ashok, R. K. Malik, Gurjeet Gill, Sher Singh, B. S. Chauhan and R. R. Bellinder. 2006. Current status of weed resistance to herbicides in rice-wheat cropping system in Haryana and its management. *Ind. J. Weed Sci.* **38** : 194-206.

Yadav, Ashok, R. K. Malik, K. D. Sayre, L. S. Brar and G. Singh. 2001. Cross resistance in *Phalaris minor* against fenoxaprop-red signals appear in India. In : Proc. 1st Biennial Conference in the New Millennium on Eco-friendly Weed Management Options for Sustainable Agriculture, organized by ISWS and UAS, Bangalore *Abst.*