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EFFICACY OF PENOXSULAM AGAINST WEEDS IN TRANSPLANTED RICE (*Oryza sativa* L.) UNDER TEMPERATE CONDITIONS OF KASHMIR

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ABSTRACT

Field studies were conducted to evaluate the efficacy of penoxsulam against complex weed flora both as pre- and post-emergence herbicide in transplanted rice during *Kharif* seasons of 2008 and 2009 at Mountain Research Centre for Field Crops, SKUAST-K, Khudwani, Kashmir (India) on a silty clay loam soil with normal reaction and medium fertility status. Major weed species infesting the field were *Echinochloa crus-galli, Echinochloa colona, Cyperus iria., Cyperus difformis, Marsilea quadrifolia, Potamogeton distinctus, Ammania baccifera* and *Monochoria vaginalis*. The experiment consisted of eight treatments replicated thrice and laid out in a randomized block design. Penoxsulum application @ 22.5 g *a.i.* ha^{-1} as pre-emergence 3-5 days after transplantation (DAT) provided effective control of almost all types of weed species thereby resulting in higher paddy yield (72.8 q ha^{-1}) as compared to weed-free (77.2 q ha^{-1}) and two hand weeding (71.9 q ha^{-1}). Penoxsulam @ 20 g ai ha^{-1} was also effective in controlling weeds when applied as post-emergence (8-12 DAT) and gave a paddy yield of 69.2 q ha^{-1}.

Key words: Butachlor, herbicides, Kashmir, penoxsulum, rice, weeds

INTRODUCTION

Rice is staple food for majority of the population in Jammu and Kashmir State in general and for Kashmir valley in particular. It is cultivated on an area of 261.35 thousand hectares with annual production of 507 thousand tones, of which Kashmir valley alone contributes 62% of the production with an average productivity of 2.48 t ha^{-1} (Anonymous, 2011). Weed infestation in rice crop is one of the major constraints in improving the productivity and the weed flora under transplanted conditions causes yield reduction upto 43% (Bhat *et al.*, 2011). In view of the increasing water scarcity it will no longer feasible to flood the rice field so as to ensure better crop establishment as well as control weeds. The effective control measures at initial stage of crop growth can help in improving the productivity of rice. Although a number of pre-emergence herbicides provide good control of grassy weeds but continuous use of such herbicides not only has lead to development of resistance in plants but also has paved the way for a shift in weed flora (Rajkhowa *et al.*, 2006). Hence, the evaluation of new herbicide molecules for the control of wide spectrum of weed flora is imperative. Recent trend of herbicide use is to find out the effective weed control measures using low dose and high efficiency herbicides which not only reduce the total volume of herbicide but also make their application easier and economical. Penoxsulam, a sulfonamide-based herbicide and acetolactate synthase (ALS) inhibitor is {2-(2,2-difluoroethoxy)-6-(trifluoromethyl-N-(5,8-dimethoxy [1,2,4] triazolo [1,5,-c] pyrimidin-2-yl)) benzene sulfonamide)} has been used to control broadleaf, sedges and grass weeds in dry seeded and transplanted rice. In view of the above facts, present study was undertaken to standardize the dose and

time of application of penoxsulum against complex weed flora in transplanted rice under temperate conditions of Kashmir.

MATERIALS AND METHODS

Field experiments were conducted to evaluate the efficacy of penoxsulam 24 SC at Mountain Research Centre for Field Crops, SKUAST-K, Khudwani, Kashmir (India) during *kharif* 2008 and 2009. The soil of the experimental field was silty clay loam in texture, neutral in reaction (pH 7.1), low in available nitrogen and medium in available phosphorus and potassium. Rice cultivar 'Jhelum' was transplanted using 30 days old seedlings in first week of June at a spacing of 15 cm x 15 cm during both the years. The experiment consisted of eight treatments *i.e.*, butachlor @ 1500 g *a.i.*ha^{-1}, penoxsulam @ 22.5 g and 25.0 g *a.i* ha^{-1} (as pre-emergence at 3-5 days after transplanting, DAT), penoxsulam @ 20.0 and 22.5 g *a.i.* ha^{-1} at 8-12 DAT (*i.e.* post-emergence), two hand weeding (20 and 40 DAT), weed-free and weedy checks. The treatments were replicated thrice in a randomized block design. Herbicides were sprayed with a knapsack sprayer fitted with flat fan nozzle using 300 L water ha^{-1}. Crop was raised as per the recommended package of practice of SKUAST-K. Weed density and dry weight were recorded at 60 DAT with a quadrant and data analyzed using square root (X+1) transformation. The rice yield and yield attributes were recorded at maturity. The crop was harvested during last week of September in both the years.

RESULTS AND DISCUSSION

Effect on crop

Effective tillers and number of panicles under all the herbicidal treatments and weed free were at par with each other but significantly higher than weedy check during 2008 while during 2009 significantly higher number of panicles was recorded in weed free and hand weeded plots as compared to butachlor (Table 1). All the herbicidal treatments produced significantly higher grain yield than weedy check but at par with weed free and hand weeding treatments. Maximum grain yield of rice (77.8 and 76.5 q ha^{-1}) was obtained under weed free which was at par with pre-emergence application of penoxsulam 22.5 g ha^{-1} (74.0 and 71.6 q ha^{-1}). Penoxsulam @ 22.5 g ha^{-1} applied at 3-5 days after transplanting (DAT) provided 2.5 and 4.2% higher grain yield than standard herbicide butachlor, while its yield advantage over weedy check was 44.8 and 44.4% during 2008 and 2009, respectively. Higher efficacy of penoxsulam in controlling weeds and increased rice grain yield was also reported by Bond *et al*.

Table 1: Yield and yield attributes of rice as influenced by different herbicidal treatments

Treatments	Dosage (g *a.i* ha^{-1})	Time of application (DAT*)	Plant height (cm)		Panicles No. m^{-2}		Panicle weight (g)		Grain yield (q ha^{-1})		Straw yield (q ha^{-1})	
			2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Butachlor	1500	3-5	110	109	441	422	2.76	2.74	72.2	68.7	99.7	90.9
Penoxsulum	22.5	3-5	113	111	453	447	2.71	2.76	74.0	71.6	102.1	94.8
Penoxsulum	25.0	3-5	114	110	435	442	2.66	2.64	73.1	70.4	100.9	93.2
Penoxsulum	20.0	8-12	114	108	429	431	2.49	2.66	68.4	69.6	94.4	92.1
Penoxsulum	22.5	8-12	113	107	441	427	2.52	2.58	68.2	66.8	94.1	89.4
Weed free	-	-	114	111	462	449	2.76	2.71	77.8	76.5	108.3	101.2
Two hand weeding	-	20 and 40	112	109	454	458	2.73	2.76	74.6	69.2	101.9	91.6
Weedy check	-	-	96	94	371	342	2.14	2.19	51.1	49.6	70.5	65.6
$CD_{0.05}$	-	-	9.5	8.4	42	26	0.38	0.32	6.4	5.9	8.8	7.8

*DAT = Days after transplantation;

(2007) and Mishra *et al.* (2007). Rice plant height was not affected by herbicidal treatments and there was no phyto-toxicity of penoxsulam on rice. Singh *et al.* (2009) reported that comparatively lower doses of penoxsulam could be applied at early post-emergence (8-12 DAT).

Effects on weeds

The major weed flora of experimental field consisted of grasses (*Echinochloa crus-galli, Echinochloa colona*, sedges (*Cyperus iria* L., *Cyperus difformis* L., *Fimbristylis littoralis* Gaudich.) and broad leaved weeds (*Marselia quadrifolia* L., *Potamogeton distinctus* A. Benn., *Ammania baccifera* L., *Monochoria vaginalis* (Burm. F.) C. Presl ex Kunth). The composition of grasses, sedges and broad leaved weeds averaged over two years was 39.1, 19.1 and 41.7%, respectively (Table 2). All the penoxsulum treatments effectively suppressed grasses, broad leaf weeds and sedges over weedy check and it was better than butachlor. The density and dry weight of weeds did not show proper trend with the increase in dose of penoxsulam at both the stages of application (pre- and post-emergence) during both the years.

Table 2: Influence of different rates and time of application of penoxsulum on weed density, weed dry weight and weed control efficiency

Treatments	Dosage (g *a.i.* ha^{-1})	Time of application (DAT*)	Weed density (No. m^{-2})						Weed dry weight (g m^{-2})		Weed control efficiency (%)	
			Grasses		Sedges		Broad leaf					
			2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Butachlor	1500	3-5	2.50 (5.20)**	2.65 (6.00)	2.02 (3.07)	2.03 (3.11)	2.53 (5.41)	2.62 (5.87)	5.71 (30.26)	5.79 (32.80)	63.4	60.5
Penoxsulum	22.5	3-5	1.96 (2.12)	2.14 (3.58)	1.49 (1.23)	1.61 (1.60)	1.77 (2.23)	2.09 (3.38)	4.63 (20.51)	4.75 (21.71)	75.2	73.8
Penoxsulum	25.0	3-5	1.77 (2.88)	2.24 (4.03)	1.63 (1.67)	1.79 (2.24)	2.07 (3.27)	2.28 (4.22)	5.14 (27.34)	4.97 (24.07)	67.0	71.0
Penoxsulum	20.0	8-12	2.25 (4.06)	2.24 (3.87)	1.77 (2.13)	1.76 (2.10)	2.27 (4.18)	2.31 (4.33)	4.92 (22.35)	4.91 (23.26)	73.0	72.0
Penoxsulum	22.5	8-12	2.40 (4.75)	2.36 (4.59)	1.80 (2.23)	1.82 (2.33)	2.43 (4.89)	2.42 (4.69)	4.85 (23.74)	4.98 (23.77)	71.3	71.4
Weed free	-	-	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	100.0	100.0
Two hand weeding	-	20 & 40	2.63 (5.93)	2.77 (6.74)	2.03 (3.21)	2.04 (3.18)	2.70 (6.29)	2.7 (6.36)	5.13 (24.61)	5.16 (25.69)	70.3	69.0
Weedy check	-	-	5.22 (26.21)	5.27 (26.74)	3.68 (12.61)	3.78 (13.30)	5.31 (27.18)	5.5 (29.40)	9.11 (82.76)	9.16 (82.98)	0.00	0.0
$CD_{0.05}$			0.33	0.35	0.37	0.33	0.43	0.48	0.69	0.64	8.23	8.68

*DAT = Days after transplantation;

**Figures in parenthesis are the original values, data subjected to square root (X+1) transformation

Penoxsulum application at all the doses recorded significantly lower densities of grasses, sedges and broad leaf weeds as compared to weedy check (Table 2). The density of grassy weeds under pre-and post emergence treatments of penoxsulam at all doses was significantly lower than butachlor and weedy check. Population of grassy weeds observed in pre-emergence application of penoxsulam though at par with each other was significantly lower than post-emergence application (Table 2). Among various herbicide treatments, penoxsulam @ 22.5 g ha^{-1} at 3 DAT provided effective control of all categories of weeds resulting in higher weed control efficiency of 75.3 and 73.8% during 2008 and 2009, respectively. Weed dry matter accumulation for penoxsulam 022.5 g ha^{-1} applied at 3 DAT, though at par with other penoxsulam treatments was significantly lower than the

standard butachlor @ 1500 g ha^{-1} and weedy check. Similar trend was also reflected in weed control efficiencies, penoxsulam maintaining significant superiority to over the weedy check and standard herbicide butachlor. Higher efficacy of penoxulam against grasses and sedges has also been reported by Singh *et al.* (2009).

Correlation between the yield attributes, grain yield and weed dry matter

Perusal of the correlation matrix showed high degree of relationship of yield attributes namely panicles m^{-2} (0.91^{**} to 0.95^{**}), panicle weight (0.89^{**} to 0.95^{**}) with grain yield. Conversely, the weed dry matter m^{-2} showed negative and significant association with number of panicles m^{-2} (-0.92^{**} to -0.94^{**}), panicle weight (-0.84^{**} to -0.86^{**}), grain yield (-0.93^{**} to -0.95^{**}) and straw yield (-0.94^{**}). This eventually suggested that effective weed control measure lowering the weed dry weight would eventually increase the yield attributes and higher yield.

Table 3: Correlation between the yield attributes, yield and weed dry matter in rice

Parameters	Panicles m^{-2} (No.)		Panicle weight (g)		Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Weed dry matter (g m^{-2})	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Panicles m^{-2} (No.)	1	1								
Panicle weight (g)	0.93	0.93	1	1						
Grain yield (q ha^{-1})	0.96	0.91	0.95	0.89	1	1				
Straw yield (q ha^{-1})	0.97	0.90	0.94	0.92	0.97	0.95	1	1		
Weed dry matter (g m^{-2})	-0.94	-0.92	-0.84	-0.86	-0.93	-0.95	-0.94		1	1

Conclusion: From the study it may be concluded that the use of penoxsulam at 22.5 g ha^{-1} as pre-emergence (3 DAT) and 20.0 g ha^{-1} as early post-emergence (10-12 DAT) gives satisfactory weed control and higher yield in transplanted rice without any residual toxicity of to the succeeding crop.

REFERENCES

Anonymous. 2011. *Digest of Statistics.* Directorate of Economics and Planning, Jammu and Kashmir Government, Srinagar, Jammu & Kashmir, India.

Bhat, M Anwar, Hussain, A., Ganai, M.A and Mushki G.M. 2011. Effect of herbicide use alone and in combination on weeds and transplanted rice. *Applied Biological Research,* **13**: 75-78.

Bond, J.A., Walker, T.W., Webster, E.P., Buehring, N.W. and. Harrell, D.L. 2007. Rice cultivar response to penoxsulam. *Weed Technology,* **21**: 961-965.

Mishra, J.S., Dixit Anil and Varshney, J.G. 2007. Efficacy of penoxsulam on weeds and yield of transplanted rice (*Oryza sativa*). *Indian Journal of Weed Science*, **39**: 24-27.

Rajkhowa, D.J., Borah, N., Barua, I.C. and Deka, N.C. 2006. Effect of pyrazosulfuron-ethyl on weeds and productivity of transplanted rice during rainy season. *Indian Journal of Weed Science*, **38**: 25-28.

Singh V.P., Singh S.P., Tripathi, N., Singh M.K., Abnish Kumar. 2009. Bioefficacy of penoxsulam on transplanted rice weeds. *Indian Journal of Weed Science*, **41**: 28-32.