Indian Journal of Agricultural Sciences **84** (1): 154–7, January 2014/Short Communication

Evaluation of the performance of penoxsulam for weed management in direct-seeded and transplanted rice (*Oryza sativa*)

TUSHAR RAMCHANDRA KHARE[1], RAJVIR SHARMA[2] and SHASHI BALA SINGH[3]

Indian Agricultural Research Institute, Pusa, New Delhi 110 012

Received: 8 October 2012; Revised accepted: 18 November 2013

Key words : Direct-seeded rice, Penoxsulam, Pretilachlor, Transplanted rice, Weeds

Rice (*Oryza sativa* L.) is mainly grown as transplanted in puddle field, wet-seeded and direct-seeded. Uncontrolled weed growth causes 15-45% yield loss in transplanted rice (Chopra and Chopra 2003), and 40-100% in direct-seeded rice (Choubey *et al*. 2001). A number of herbicides, namely butachlor, anilofos and pretilachlor are being applied as pre-emergence for weed control in rice. However, these herbicides do not provide satisfactory broad-spectrum weed control (Reddy *et al*. 2002). Of late, the increased emphasis has been witnessed on the use of low-dose high-efficacy herbicides capable of controlling mixed weed flora (Shekhar and Mankotia 2005). Penoxsulam is a new selective and acetolactate synthase (ALS) inhibitor herbicide for control of grasses, sedges and broad leaved weeds in rice culture. Hence, the present experiment was conducted to evaluate the performance of penoxsulam for weed management in rice cultures.

The field experiment was conducted at Indian Agricultural Research Institute, New Delhi (28.4°N, 77.1°E, 228 m above mean sea level) during *kharif* 2010-11. The soil was sandy loam with pH 7.5, organic carbon 0.53%, available P 14.50 kg/ha, and available K 247 kg/ha. The total rainfall of 898.6 mm was received in 23 rainy-days during the crop-growing season. Treatments comprising two rice cultures (transplanted and direct-seeding) as main-plot and seven weed control measures (two doses of penoxsulam (20 and 25 g/ha) each applied at 10 and 15 days after transplanting-DAT/sowing-DAS, pretilachlor at 750 g/ha as pre-emergence, along with weed-free and weedy checks) as sub-plot, were laid-out in a split-plot design with three replications. An uniform dose of 120 kg N/ha in the form of urea, 60 kg P_2O_5/ha through SSP and 40 kg K_2O/ha through MOP was applied. Half dose of N and full dose of P_2O_5 and K_2O was applied at the time of sowing while the remaining N was applied at 40 DAS. Rice Pusa Sugandh 5 was sown in rows at a seed rate of 40 kg/ha using *kera* method of sowing at row spacing of 20 cm on to non-puddle soil on 15, June 2010 while nursery for transplanting crop of rice was sown on the same date and 21 days old seedlings were transplanted using two seedling per hill at spacing of 20 cm × 10 cm. Penoxsulam and pretilachlor was applied with the help of Knap-sack sprayer delivering a spray volume of 600 litres/ha through flat-fan nozzle. Data on weeds were recorded at 70 DAS in each plot in two quadrats, each measuring 50 cm × 50 cm. Weeds were counted species-wise and were removed for recording their dry weights. Weed sample were sun-dried before oven drying at 70°C until constant weight was attained. All the growth attributes, viz plant height, number of tillers, leaf area index were recorded at 70 days after sowing while the panicles/m^2 and grains/panicle was recorded just before harvest of the crop. Grain and straw yields was also recorded after the harvest of the rice crop and then converted into tonnes/ha. Crop was manually harvested on 17 October 2010. Data on weeds were subjected to square root transformation before statistical analysis. The least significant difference (LSD) values were calculated at P=0.05 level of significance to test significant differences between treatment means.

The dominant weed flora comprised *Echinochloa crus-galli* (L.), *Echinochloa colona* (L.), *Leptochloa chinensis* (L.), *Eclipta alba* (L.) and *Cyperus difformis* (L.). *E. crus-galli* was found as the predominant weed in both methods of rice culture. All the weed control treatments proved effective in minimizing the density and dry weight of weed (Table 1). Transplanted rice culture registered the lowest density and dry weight of weeds. This might be due to the fact that in transplanted rice, the germinating weeds have to compete with the established crop seedlings, whereas in the case of

Based on part of information of M Sc thesis of the first author submitted to IARI, New Delhi (Unpublished).

[1]Ph D Scholar (Agronomy) (e mail: tushar.khare88@rediffmail.com), [2]Principal Scientist (Agronomy) (e mail: drrajvir@yahoo.com), Division of Agronomy, [3]Principal Scientist (Agricultural chemicals) (e mail: sbs_agch@yahoo.com)

Table 1 Effect of methods of rice culture and weed control measures on weed growth at 70 days after sowing.

Treatment	*E. crussgalli*		*E. colona*		*L. chinensis*		*E. alba*		*C. difformis*		WCE (%)
	Density (No/m^2)	Dry weight (g/m^2)	Density (No/m^2)	Dry weight (g/m^2)	Density (No/m^2)	Dry weight (g/m^2)	Density (No/m^2)	Dry weight (g/m^2)	Density (No/m^2)	Dry weight (g/m^2)	
Method of rice culture											
Direct-seeded	7.13 (58.22)	5.03 (29.35)	5.50 (34.57)	2.92 (9.06)	6.25 (45.09)	2.59 (7.68)	5.70 (37.24)	2.85 (8.64)	4.32 (20.90)	2.22 (4.91)	39.38
Transplanted	5.42 (33.94)	3.99 (17.58)	4.22 (20.10)	2.22 (5.05)	4.92 (27.08)	2.11 (4.54)	4.21 (19.71)	2.11 (4.36)	3.03 (10.48)	1.50 (1.89)	66.03
LSD (P=0.05)	0.45	0.27	0.33	0.18	0.35	0.14	0.33	0.16	0.26	0.13	
Weed control measure											
Penoxsulam @ 20 g/ha at 10 DAS/DAT	7.29 (53.14)	5.16 (26.62)	5.48 (30.03)	2.90 (8.41)	6.31 (39.81)	2.72 (7.39)	5.68 (32.26)	2.71 (7.34)	4.44 (19.71)	2.21 (4.88)	44.46
Penoxsulam @ 25 g/ha at 10 DAS/DAT	5.76 (33.17)	3.90 (15.00)	4.30 (18.49)	2.20 (4.6)	5.23 (27.24)	1.98 (3.92)	4.40 (19.7)	2.30 (4.7)	2.82 (7.95)	1.60 (2.3)	68.98
Penoxsulam @ 20 g/ha at 15 DAS/DAT	7.59 (58.33)	5.26 (27.50)	5.79 (33.67)	3.03 (8.77)	6.64 (44.33)	2.74 (7.07)	5.92 (35.33)	2.84 (7.78)	4.53 (20.33)	2.24 (4.67)	43.29
Penoxsulam @ 25 g/ha at 15 DAS/DAT	6.24 (39.67)	4.20 (19.17)	4.67 (21.83)	2.38 (5.85)	5.65 (31.62)	2.12 (4.08)	4.76 (22.67)	2.44 (5.60)	3.10 (9.61)	1.71 (2.93)	61.75
Pretilachlor @ 750 g/ha PE	7.72 (60.17)	5.49 (30.00)	5.83 (34.33)	3.05 (8.90)	6.70 (45.33)	2.87 (7.12)	6.01 (36.33)	2.87 (8.00)	4.73 (22.17)	2.29 (4.93)	40.08
Weed free check	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	100
Weedy check	9.21 (85.00)	6.93 (49.33)	7.39 (54.83)	3.83 (14.35)	8.22 (68.83)	3.86 (16.45)	7.32 (55.00)	3.60 (12.90)	5.55 (31.00)	2.32 (5.35)	
LSD (P=0.05)	0.50	0.36	0.38	0.20	0.44	0.18	0.40	0.19	0.30	0.15	

PE, Pre-emergence; DAS, days after sowing; DAT, days after transplanting. Data were subjected to $\sqrt{x+0.5}$ transformations before statistical analysis. Figures in parentheses are the original values.

Table 2 Effect of methods of rice culture and weed control measures on total weed density and dry weight, yield and yield attributes of rice

Treatment	Total weed density (No/m^2)	Total weed dry weight (g/m^2)	Plant height (cm)	Plant tillers/ m^2	Leaf area index 70 DAS	Grains/ panicle	Panicles/ m^2 (cm)	Grain yield (tonnes/ha)	Straw yield (tonnes/ha)	Weed index (%)
Method of rice culture										
Direct-seeded	12.93 (196.84)	8.51 (85.42)	100	474	5.23	149	324	3.76	7.56	24.43
Transplanted	9.74 (111.69)	6.48 (48.58)	105	542	5.67	170	387	4.25	8.98	17.75
LSD (P=0.05)	0.78	0.48	4	31	0.34	9	30	0.23	0.52	
Weed control measures										
Penoxsulam @ 20 g/ha at 10 DAS/DAT	12.56 (159.57)	8.19 (67.55)	101	496	5.30	162	343	4.13	8.67	18.46
Penoxsulam @ 25 g/ha at 10 DAS/DAT	10.0 (102.2)	6.5 (42.50)	105	583	6.00	172	404	4.86	9.17	4.23
Penoxsulam @ 20 g/ha at 15 DAS/DAT	13.74 (192.00)	8.93 (80.68)	102	485	5.32	158	341	4.06	8.37	20.14
Penoxsulam @ 25 g/ha at 15 DAS/DAT	11.25 (128.95)	7.29 (53.62)	105	550	5.83	170	384	4.67	8.98	8.02
Pretilachlor @ 750 g/ha PE	13.97 (198.33)	9.12 (84.38)	101	467	5.25	156	334	3.91	8.30	22.94
Weed free check	0.71 (0.00)	0.71 (0.00)	108	590	6.21	177	423	5.07	11.14	
Weedy check	17.14 (298.83)	11.72 (140.27)	95	387	4.25	124	261	1.33	3.28	73.83
LSD (P=0.05)	0.91	0.60	4	36	0.44	9	34	0.32	0.61	

PE, Pre-emergence; DAS, days after sowing; DAT, days after transplanting

direct-seeded crop, both the rice crop and weeds germinate simultaneously and compete with each other for essential inputs.

Among herbicidal treatments, penoxsulam at 25 g/ha applied at 10 DAS/DAT was found effective in reducing the weed population and dry weight, and was on a par with its application at 15 DAS/DAT, irrespective of its dose. The weed density and dry weight decreased with increase in dose (20-25 g/ha) of penoxsulam at 10 and 15 DAS/DAT. Singh *et al.* (2007) documented that post-emergence application of penoxsulam has an edge over pre-emergence application. Application of penoxsulam was found more effective against *E. crus-galli*, *E. colona* and *C. difformis* as compared to pretilachlor. Mishra *et al.* (2007) and Yadav *et al.* (2008) also reported the better efficacy of penoxsulam applied at 10 DAT than at 5 DAT in controlling *E. colana, C. difformis* and *E. crus-galli*. The lowest reduction in weed growth (19-22%) was observed with pre-emergence application of pretilachlor at 750 g/ha which was on a par with penoxsulam 20 g/ha applied at 10 and 15 DAS/DAT. The highest weed control efficiency of 68.98% was recorded with penoxsulam 25 g/ha applied at 10 DAS/DAT. Season-long weed competition caused 64% reduction in grain yield in transplanted rice and 75% in direct-seeded rice. Herbicidal treatments provided a yield advantage of 66 to 73% over weedy check.

Significant increase in the growth and yield attributes were recorded in transplanted method of rice culture than that of direct-seeded rice due to favorable effect of puddling on nutrient availability (Izumi, 1966). Early post-emergence application of penoxsulam @ 25 g/ha at 10 DAS/DAT caused the highest increase in the plant height, number of tillers, leaf area index, grains/panicle, panicles/m^2 and weed index over the rest of the herbicidal treatment except its same dose applied at 15 DAS/DAT. This might be due to better control of grassy weeds and sedges which resulted in less crop-weed competition. The highest grain (4.86 tonnes/ha) and straw yield (9.17 t/ha) was recorded with penoxsulam @ 25 g/ha applied at 10 DAS/DAT, and was comparable to its similar dose applied at 15 DAS/DAT. Efficacy of penoxsulam in controlling weeds and increasing grain yield was also reported by Jason *et al.* (2007) and Mishra *et al.* (2007).

SUMMARY

A field experiment was conducted during rainy season of 2010 at the research farm of the Indian Agricultural Research Institute, New Delhi to evaluate the performance of penoxsulam for weed management in direct-seeded and transplanted rice. The weed growth in terms of density and dry weight was relatively less in transplanted condition as compared to direct-seeded rice. Post-emergence application of penoxsulam @ 25 g/ha at 10 DAS/DAT was found more effective against weeds as compared to its application at 15 DAS/DAT. Herbicidal treatments provided a yield advantage of 66-73% over weedy check. Growth and yield attributes, grain and straw yield increased significantly with the penoxsulam at 25 g/ha applied at 10 DAS/DAT which was on par with its application at 15 DAS/DAT with the same dose. It may be concluded that weeds can be managed during critical period of competition with the application of penoxsulam at 25 g/ha at 10 DAS/DAT in both direct-seeded and transplanted rice cultures.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Dow AgroSciences India Pvt Ltd, Hyderabad, India for supplying penoxsulam formulation and also the financial assistance and infrastructural facility provided by Indian Agricultural Research Institute, New Delhi.

REFERENCES

Chopra N K and Chopra N S. 2003. Effect of doses and stages of application of pyrazosulfuron-ethyl on weeds in transplanted rice. *Indian Journal of Weed Science* **35**(1&2): 27–9.

Choubey N K, Kolhe S S and Tripathi R S. 2001. Relative performance of cyhalofob-butyl for weed control in direct-seeded rice. *Indian Journal of Weed Science* **33**: 132–5.

Izumi S. 1966. *Ploughing, Puddling and transplanting. Theory and Practices of Rice Culture*, Second edition. pp 379–96. Ministry of Agriculture, Japan.

Mishra J S, Dixit A and Varshney J G. 2007. Efficacy of penoxsulam on weeds and yield of transplanted rice (*Oryza sativa* L.). *Indian Journal of Weed Science* **39**(1&2): 24–7.

Reddy C N, Reddy M D and Devi M P. 2002. Evaluation of fenoxaprop-p-ethyl and ethoxysulfuron in transplanted rice. *Indian Journal of Weed Science* **32**(1&2): 105–7.

Shekhar J and Mankotia B S. 2005. Efficacy of some new herbicides in wet-seeded rice (*Oryza sativa* L.). *Indian Journal of Weed Science* **37**(1&2): 58–60.

Singh I, Ram M and Nandal D P. 2007. Efficacy of new herbicides for weeds control in transplanted rice under rice-wheat system. *Indian Journal of Weed Science* **39**(1&2): 28–31.

Jason A B, Timothy P W, Eric W B N and Dustin L H. 2007. Rice cultivar response to penoxsulam. *Weed Technology* **21**: 961–65.

Yadav D B, Yadav A and Punia S S. 2008. Efficacy of penoxsulam against weeds in transplanted rice. *Indian Journal of Weed Science* **40**(3&4) : 142–6.