*Indian Journal of Weed Science* **45**(4): 228–230, 2013

# Bioefficacy of penoxsulam against broad-spectrum weed control in transplanted rice

**Chandra Prakash, R.K. Shivran* and N.R. Koli**
*Agriculture Research Station, MPUA&T, Ummedganj, Kota, Rajashthan 234 001*

Received: 29 July 2013; Revised: 7 November 2013

**ABSTRACT**

Comparative efficacy of penoxsulam against weed control in transplanted rice was studied at Agricultural Research Station, Ummedganj, Kota (Rajasthan). The experiment was laid out in randomized block design with 7 treatments and 4 replications. Results revealed that the major weed flora associated with the transplanted rice were grasses like*Echinochloa colonum* and *Echinochloa crusgalli*; sedges like *Cyperus rotundus, Cyperus difformis* and *Cyperus iria*; and broad-leaved weeds like *Eclipta alba* and *Ammenia baccifera*. Penoxsulam at 0.0250 kg/ha applied at 0-5 days after transplanting was most effective to check all types of weed growth. This treatment also gave the maximum grain yield and straw yield, resulting in the lowest weed index, dry weight of weeds, weed persistence index and highest herbicidal efficiency index

**Key words:** Herbicide, Chemical control, Rice, Transplanted

In India, rice is the staple food for millions of people and plays a pivotal role in the economy. Weeds are regarded as one of the major limiting factors of crop production. Weeds share light, nutrients and water with the crop and thus interfere with rice growth in many ways. Living or decaying weeds can secrete toxic root exudates or leaf leachates that lower the normal growth of rice plant. Weed infestation provides a habitat for growth of various pest organisms (insects, nematodes and pathogens), which adversely affect the production of rice and other crops. The productivity of wet season rice is very low as weeds pose serious menace as compare to other rice ecosystems. This is because of aerobic soil conditions, high temperature and dry tillage practices. With the introduction of short-statured high-yielding rice varieties with erectophylic leaves, the weed menace becoming more acute (Mishra *et al.* 2006). The weed flora under transplanted condition is very much diverse and consists of grasses, sedges and broad leaf weeds causing yield reduction of rice up to 76% (Singh *et al*. 2004). The effective control of weeds at initial stages (0-40 DAT) can help in the improving productivity of this crop. Therefore, evaluation of new herbicides for wide spectrum control of weed flora is imperative. Recent trend of herbicide use is to find out an effective weed control measure by using low dose high efficiency herbicides which will not only reduce the total volume of herbicide use but also increase grain production (Kathiresan 2001). Therefore, the present study was undertaken to evaluate the performance of penoxsulam in transplanted *kharif* rice and associated weeds.

## MATERIALS AND METHODS

A field experiment was conducted during *Kharif* season of 2006 and 2007 at the Agriculture Research Station, Ummedganj, Kota (Rajasthan). The soil was clayey in texture, slightly alkaline in reaction (pH 7.5), low in organic C (0.56%) and medium in available N (278 kg/ha), P (12.3 kg/ha) and high in available K (305 kg/ha). The experiment was laid out in randomized block design with 7 treatments comprises of butachlor 1.5 kg/ha at 5-7 DAT, penoxsulam 0.0225 kg/ha at 0-5 DAT, penoxsulam 0.0250 kg/ha at 0-5 DAT, penoxsulam 0.0200 kg/ha at 8-12 DAT, penoxsulam 0.0225 kg/ha at 8-12 DAT, Weed-free check (where weeds were completely removed from the plot at 10 days interval until harvest), two hand weedings at 20 and 40 days after transplanting (DAT) and non weeded control replicated four times. Fertilizers were applied to the plots as N-$P_2O_5$-$K_2O$ 150-60-40 kg/ha through urea, SSP, MOP respectively. The whole amount of P and K was applied as basal dose during final land preparation. N was top-dressed in three equal installments at 20, 40 and 55 DAT, respectively The variety '*PHB-71*' was used as the test crop. Thirty-day old rice seedlings were transplanted 20 cm x 10 cm apart on 29 July, 2006 and 25 July, 2007 at the seed rate of 25 kg in nursery for one hectare. Two sprays of monocrotophos 1 l/ha were applied as pro-

***Corresponding author:** rshivranars2007@gmail.com

phylactic measure against insects-pests. The crops were kept under constant observation from transplanting till harvesting. The data on weed infestation and weed density were collected from each unit plot at 30, 60, 90 DAT and at harvest. A quadrate of 0.25 $m^2$ was placed randomly at three different spots outside an area of 12 $m^2$ in the middle of the plot. The infesting species of weeds within each quadrate were identified and their number was counted species-wise. The average number of three samples was then multiplied by 4 to obtain the weed density per $m^2$. The weeds inside each quadrate were uprooted, cleaned. The collected weeds were first dried in the sun and then in an electric oven for 72 hours maintaining a constant temperature of 80°C. After drying, weight of weeds was taken and expressed in $g/m^2$. Weed control efficiency was calculated using standard formula. Results of both the years were analysed statistically and data which did not show the homogeneity hence were given individual year-wise least significant differences was used for means verification and for discussion of the results under probability level of 0.05.

## RESULTS AND DISCUSSION

The major weeds observed in the experimental plots were grasses like *Echinochloa colona* and *Echinochloa crusgalli,* sedges like *Cyperus rotundus, Cyperus difformis* and *Cyperus iria,* and broad-leaved weeds like *Eclipta alba* and *Ammenia baccifera.*

The weed density was higher during 2007 than 2006. Density and biomass of weeds were significantly higher in non-weeded control treatment. In contrast, hand weeding (twice at 20 and 40 DAT) treatment recorded lower weed density (5 and $4/m^2$) and biomass of weeds (3.15 and 3.7 $g/m^2$) than rest of the weed management practices (Table 1) respectively in both the years. Among the tested herbicides, penoxsulam 0.0250 kg/ha applied at 0-5 days after transplanting (DAT) was most effective to check all types of weeds and their growth resulting in lowest biomass (7.3 and 10.6 $g/m^2$) of weeds due to its higher weed control efficiency (59.8 and 76.0%) in both the years, respectively. Among the tested herbicides, penoxsulam at 0.0250 kg/ha applied at 0-5 days after transplanting (DAT) recorded highest herbicidal efficiency index (3.51 and 3.46) and lowest weed persistence index (0.01 and 0.01), respectively in both the years. The lower density and biomass of weeds were due to the fact that penoxsulam inhibited the plant enzyme acetolactate synthase (ALS), which was involved in biosynthesis of the branched-chain amino acids. The ALS compounds inhibit the production of the amino acids valine, leucine, and isoleucine in plants by binding to the ALS enzyme (Tranel and Wright 2002). Without these amino acids, protein synthesis and growth are inhibited, ultimately causing plant death (WSSA 2007).

Increasing rates of herbicides did not influence the weed density by markedly increase the dry matter of weeds (Table 2). Hand weeding twice showed the maximum control of weeds, which was significantly superior to other treatments. Weed control measures brought about measurable improvement in growth and yield attributes and yield of transplanted rice compared with the weedy check. Among all the herbicide treated plots produced grain and straw yields significantly more than the non-weeded plots. The highest grain yield of rice (6.4 and 6.2 t/ha) was obtained with hand weeding twice at 20 and 40 DAT and among the herbicide tested penoxsulam at 0.0250 kg/ha applied at 0-5 DAT gave significantly higher gain yield (6.1 and 5.8 t/ha) in both the years respectively. Similar trend of result was also found in case of straw yield of rice. Among different tested herbicides, lowest weed index (5.0-7.4%) was recorded with the application of penoxsulam at 0.0250 kg/ha (at 0-5 DAT) resulting in 36-41% increase

**Table 1. Effect of penoxsulam on weed growth in transplanted rice**

| Treatment | Doses (kg/ha) | Weeds ($no./m^2$) | | Dry weight of weeds ($g/m^2$) | | Weed control efficiency (%) | | Weed persistence index | | Weed index (%) | | Herbicide efficiency index | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Butachlor at 3-5 DAT | 1.5000 | 12 | 21 | 9.5 | 20.3 | 56.7 | 65.1 | 0.02 | 0.05 | 9.4 | 12.3 | 2.25 | 1.49 |
| Penoxsulam at 0-5 DAT | 0.0225 | 18 | 25 | 14.8 | 23.8 | 49.1 | 61.0 | 0.05 | 0.07 | 13.1 | 14.3 | 1.18 | 1.15 |
| Penoxsulam at 0-5 DAT | 0.0250 | 10 | 9 | 7.3 | 10.6 | 59.8 | 76.0 | 0.01 | 0.01 | 5.0 | 7.4 | 3.51 | 3.46 |
| Penoxsulam at 8-12 DAT | 0.0200 | 35 | 45 | 26.6 | 43.3 | 32.3 | 38.9 | 0.16 | 0.24 | 23.0 | 23.6 | 0.28 | 0.35 |
| Penoxsulam at 8-12 DAT | 0.0225 | 22 | 29 | 18.3 | 25.8 | 44.2 | 58.8 | 0.07 | 0.09 | 17.4 | 16.6 | 0.72 | 0.94 |
| Two hand weedings at 20 and 40 DAT | - | 5 | 4 | 3.15 | 3.7 | 65.7 | 83.9 | 0.00 | 0.00 | 0.0 | 0.0 | - | - |
| Weedy check | - | 81 | 92 | 70.2 | 88.1 | - | - | - | - | 30.5 | 34.7 | - | - |
| LSD (P=0.05) | | 2.6 | 3.0 | 5.44 | 2.9 | | | | | | | | |

**Table 2. Effect of penoxsulam on yield attributes and yield of transplanted rice**

| Treatment | Dose (kg/ha) | No. of panicles/m$^2$ | | Panicle weight (g) | | Grain yield (t/ha) | | Straw yield (t/ha) | | Harvest Index (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Butachlor at 3-5 DAT | 1.5 | 275 | 257 | 3.63 | 3.50 | 5.85 | 5.48 | 7.94 | 7.47 | 42.4 | 42.3 |
| Penoxsulam at 0-5 DAT | 0.0225 | 266 | 251 | 3.51 | 3.46 | 5.61 | 5.35 | 7.91 | 7.21 | 41.5 | 42.6 |
| Penoxsulam at 0-5 DAT | 0.0250 | 284 | 276 | 3.74 | 3.71 | 6.13 | 5.79 | 8.64 | 8.29 | 41.5 | 41.1 |
| Penoxsulam at 8-12 DAT | 0.0200 | 250 | 232 | 3.32 | 3.30 | 4.97 | 4.77 | 7.09 | 6.81 | 41.2 | 41.2 |
| Penoxsulam at 8-12 DAT | 0.0225 | 258 | 248 | 3.45 | 3.42 | 5.33 | 5.21 | 7.30 | 6.96 | 42.2 | 42.8 |
| Two hand weedings at 20 and 40 DAT | - | 293 | 293 | 4.06 | 3.96 | 6.46 | 6.25 | 8.73 | 8.46 | 42.5 | 42.5 |
| Weedy check | - | 236 | 204 | 8.17 | 3.12 | 4.49 | 4.08 | 6.73 | 5.61 | 40.0 | 42.1 |
| LSD (P=0.05) | | 18.21 | 9.35 | 0.17 | 0.13 | 0.35 | 0.21 | 0.45 | 0.48 | 2.3 | 2.3 |

in grain yield of rice over non-weeded control. The effective control of weeds starting from the early crop growth stage might have resulted in better growth and yield of rice. The variation in grain yield under different treatments was the result of variation in weed density and weed biomass. Application of herbicides under test did not show any phytotoxic symptoms on rice plant. All these findings were in close conformity with the findings of Mishra *et al.* (2004), Bond *et al.* 2007 and Pal *et al.* (2009). Based on the results of present investigation, it can be concluded that penoxsulam 0.0250 kg/ha applied at 0-5 days after transplanting was most effective to check all types of weed population which may be recommended to replace the tedious, time consuming and expensive hand weeding practice of weed control in transplanted rice.

## REFERENCES

Jason A Bond, Walker TW, Webster EP, Buehring NW and Harrell DL. 2007. Rice cultivar response to penoxsulam. *Weed Technology* **21**(4): 961-965.

Kathiresan RM. 2001. Sustainability of weed management practices in rice-blackgram cropping system, p 79. In: *Biennial Conference in New Millennium as Eco-Friendly Weed Management Options for Sustainable Agriculture*, University of Agricultural Sciences, Bangalore, India.

Mishra GC, Rath AK, Rath BS, Sahoo and Mohapatra PK. 2004. Weed management in direct seeded rice under rainfed upland eco-system. *Journal of Crop and Weed* **2**: 52-57.

Pal S, Banerjee H and Mandal NN. 2009. Efficacy of low dose of herbicides against weeds in transplanted *Kharif* rice (*Oryza sativa* L.). *Journal of Plant Protection Sciences* **1(1)**: 31-33

Singh VP, Singh G, Singh M. 2004. Effect of fenoxaprop-P-ethyl on transplanted rice and associated weeds. *Indian Journal of Weed Sciences* **36**: 190-92.

Tranel PJ and Wright TR. 2002. Resistance of weeds to ALS-inhibiting herbicides: what have we learned. *Weed Science* **50**: 700-712.

WSSA. 2007. *Herbicide Handbook, 9th ed*. W.K. Vencill (Ed.). Weed Science Society of America, Lawrence, KS. 493 p.