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Bioefficacy of penoxsulam against broadspectrum weed control in transplanted rice

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ABSTRACT : Comparative efficacy of penoxsulam 24 SC against weed control in transplanted *Kharif* 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. The results revealed that the major weed flora associated with the transplanted rice during *Kharif* season included grasses *Echinochloa colonum*, *Echinochloa crusgalli*, sedges like *Cyperus rotundus*, *Cyperus difformis*, *Cyperus iria* and broad leaf weeds *Eclipta alba* and *Ammenia baccifera*. Penoxsulam 24 SC @ 0.0250 kg a.i/ha applied at 0-5 days after transplanting was most effective to check all types of weed population and their growth. This treatment also gave the maximum grain yield (6.1 and 5.7t/ha) and straw yield (8.6 and 8.2t/ha) of rice resulting in lowest weed index (5.08 and7.41), dry weight of weeds (7.3 and10.6g/m^2),weed persistence index (0.01 and 0.01) and highest herbicidal efficiency index (3.51 and 3.46) in both the years, respectively. Therefore, penoxsulam 24 SC @ 0.0250 kg a.i/ha applied at 0-5 days after transplanting may be recommended to replace the tedious, time consuming and expensive hand weeding practices of weed control in transplanted *Kharif* rice.

Key Words : Bioefficacy, Weed control, Penoxsulam 24 SE, Transplanted rice

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Rice is a lynch pin in the culture of many countries More fundamentally, rice is the staple food for more than half the world. In Asia alone, more than two billion people obtain over 60 per cent of their calories from rice. In India, it is also the staple food for millions of people and is next to wheat. It plays a pivotal role in the economy of India. Weeds are regarded as one of the major negative 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 depress 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 compared to other rice ecosystems. This is because of aerobic soil condition, 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.*, 2004) 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 per cent (Singh *et al.*, 2004). The effective control of weeds at initial stages (0-40DAT) 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 the application becomes easier and economic(Kathiresan,2001). In view of the above fact, the present study was undertaken to evaluate the performance of penoxsulam 24 SC in transplanted *Kharif* rice and associated weeds.

RESEARCH PROCEDURE

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 carbon (0.56%) and medium in available nitrogen (278 kg/ha), medium in available phosphorus (12.3 kg/ha) and high in available potassium (305 kg/ha). The experiment was laid out in

Randomized Block Design with 7 treatments comprised of butachlor 50 EC @ 1.5 kg a.i/ha at 5-7 DAT, penoxsulam 24 SC @ 0.0225 kg a.i/ha at 0-5 DAT, penoxsulam 24 SC @ 0.0250 kg a.i/ha at 0-5 DAT, penoxsulam 24 SC @ 0.0200 kg a.i/ha at 8-12 DAT, penoxsulam 24 SC @ 0.0225 kg a.i/ha at 8-12 DAT, weed free check (where weeds were completely removed from the plot at 10 days interval until harvest), Two hand weeding at 20 and 40 days after transplanting (DAT) and non-weeded control replicated four times. Fertilizers were applied to the plots as N-P-K @ 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 prophylactic 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 with the following formula:

$$\text{Weed control efficiency (WCE)} = \frac{\text{DMC} - \text{DMT x 100}}{\text{DMC}}$$

where,

DMC = Weed dry matter production in unweeded treatment

DMT = Weed dry matter production in weed control treatment

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 (LSD), was used for means verification and for discussion of the results under probability level of 0.05.

RESEARCH ANALYSIS AND REASONING

The results of the present study as well as relevant discussions have been presented under following sub heads:

Weed flora :

The major weeds observed in the experimental plots included grasses Echinochloa colonum, Echinochloa crusgalli sedges like Cyperus rotundus, *Cyperus difformis*, *Cyperus iria* and broad leaf weeds Eclipta alba and Ammenia baccifera.

Effect on weeds :

The weed density was higher during *Kharif* season of 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 number/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 24 SC at 0.0250 kg a.i. ha^{-1} applied at 0-5days after transplanting (DAT) was most effective to check all types of weed population and their growth resulting in lowest biomass(7.3 and 10.6g/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 24 SC at 0.0250 kg a.i. ha^{-1} applied at 0-5days after transplanting (DAT) recorded highest herbicidal efficiency index(3.51 and 3.46) and lowest weed persistence index (0.01 and 0.01) in both the years

Table1 : Effect of penoxsulam on weed density, dry matter, weed control efficiency, weed persistence index and herbicidal efficiency index in transplanted rice

Treatments	Doses (a.i. kg/ha)	No. of weeds		Dry weight of weeds (q/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 50 EC at 3-5 DAT	1.5	12	21	9.5	20.3	56.73	65.10	0.02	0.05	9.43	12.38	2.25	1.49
Penoxsulam 24 SC at 0-5 DAT	0.0225	18	25	14.85	23.85	49.11	61.07	0.05	0.07	13.14	14.37	1.18	1.15
Penoxsulam 24 SC at 0-5 DAT	0.0250	10	9	7.33	10.66	59.82	76.03	0.01	0.01	5.08	7.41	3.51	3.46
Penoxsulam 24 SC at 8-12 DAT	0.0200	35	45	26.6	43.38	32.39	38.91	0.16	0.24	23.08	23.63	0.28	0.35
Penoxsulam 24 SC at 8-12 DAT	0.0225	22	29	18.3	25.8	44.20	58.86	0.07	0.09	17.49	16.67	0.72	0.94
Two hand weeding at 20 and 40 DAT	-	5	4	3.15	3.7	65.77	83.93	0.00	0.00	0.00	0.00	-	-
Non weeded control	-	81	92	70.25	88.13	-	-	-	-	30.53	34.72	-	-
S.E. ±		0.8	1.0	1.85	0.99						-		
C.D. at 5%		2.6	3.0	5.44	2.99								

Table 2 : Effect of penoxsulam on yield attributes and yield of transplanted rice

Treatments	Doses (a.i. kg/ha)	No. of panicles		panicle weight (g)		Grain yield (t/ha)		% increase in yield		Straw yield (t/ha)		Harvest Index (%)	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Butachlor 50 EC at 3-5 DAT	1.5	275	257	3.63	3.5	5.85	5.48	30.37	34.22	7.94	7.47	42.40	42.30
Penoxsulam 24 SC at 0-5 DAT	0.0225	266	251	3.51	3.46	5.61	5.35	25.04	31.18	7.91	7.21	41.50	42.60
Penoxsulam 24 SC at 0-5 DAT	0.0250	284	276	3.74	3.71	6.13	5.79	36.63	41.84	8.64	8.29	41.50	41.10
Penoxsulam 24 SC at 8-12 DAT	0.0200	250	232	3.32	3.3	4.97	4.77	10.72	16.99	7.09	6.81	41.20	41.20
Penoxsulam 24 SC at 8-12 DAT	0.0225	258	248	3.45	3.42	5.33	5.21	18.77	27.65	7.30	6.96	42.20	42.80
Two hand weeding at 20 and 40 DAT	-	293	293	4.06	3.96	6.46	6.25	43.95	53.19	8.73	8.46	42.50	42.50
Non weeded control	-	236	204	8.17	3.12	4.49	4.08			6.73	5.61	40.00	42.10
S.E.±		6.18	3.11	0.06	0.04	0.11	0.07			0.15	0.16	0.78	0.80
C.D. at 5%		18.21	9.35	0.17	0.13	0.35	0.21			0.45	0.48	2.30	2.34

of experimentation, respectively. The lower density and biomass of weeds due to the fact that penoxsulam inhibit the plant enzyme acetolactate synthase (ALS), which is 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).

Effect on crop :

Perusal of the Table 2 revealed that the increasing rates of herbicides did not influence the weed density by markedly increase the dry matter of weeds. 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 tha^{-1}) was obtained with hand weeding twice at 20 and 40 DAT and among the herbicide tested penoxsulam 24 SC at 0.0250 kg a.i. ha^{-1} applied at 0-5 DAT gave significantly higher gain yield (6.1and 5.8 t ha^{-1})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 24 SC at 0.0250 kg a.i. ha^{-1} (at 0-5 DAT) resulting in 36-41 per cent increase 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 there findings are in close conformity with the findings of Mishra *et al.* (2004) and Pal *et al.* (2009). Based on the results of present investigation, it can be concluded that penoxsulam 24 SC at 0.0250 kg a.i. ha-1 applied at 0-5days 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 *Kharif* rice.

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