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Short communication

Weed management approaches in transplanted rice in Mollisols of Uttarakhand

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Rice (*Oryza sativa* L.) is one of the most important cereal crops in India cultivated in 43.9 Mha area with the total production of 106.5 Mt and a productivity of 2.4 t/ha (Economic Survey, 2014-15). Rice as staple food has tremendous influence on agrarian economy of India since it contributes 45% of the total food grain production. Infestation of weeds is one of the most important causes for low yield of rice (Pandey 2009). Transplanted rice is infested with heterogeneous group of weeds comprising of grasses, broad-leaf weeds and sedges causing yield reduction up to 76% (Singh *et al.* 2004). Among different weed species, grassy weeds pose greater competition as they have an extensive and fibrous root system. Similarly, sedges grow in huge number and cause serious competition for nutrients as they dominate the surface feeding zone and obstruct nutrient flow to crop roots. Broad-leaf weeds being deep rooted explore the sub-surface zone for minerals and exert less competition for nutrients with rice (Puniya *et al.* 2007). Manual weeding is expensive, time consuming, labour intensive, tedious, back-breaking, difficult and often limited by scarcity of laborers in time. Herbicidal weed control offers an advantage to save labour and money, as a result, regarded as cost-effective (Ahmed *et al.* 2000). Application of herbicide mixture or sequential application of pre- and post-emergence herbicides or its integration with other methods of weed control may be effective for broad-spectrum management of weed flora in transplanted rice. Therefore, the present study was undertaken to quantify the effect of different weed control treatments either alone or in combination on weed abundance, growth parameters and yield performance of transplanted rice.

A field study was conducted at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand during rainy season of 2012. The soil of the experimental site was silty loam with a pH of 7.3 and EC of 1.16 dS/cm, high in organic carbon content (0.86%), low in available N (226.2 kg/ha) but medium in available P (22.8 kg/ha) and K (145.4 kg/ha). The experiment was laid out in a randomized block design with three replications and twelve treatments *viz.* pre-emergence (PE) application of pretilachlor 750 g/ha, post-emergence application of bispyribac-Na 20 g/ha, penoxsulam 20, 22.5 and 25 g/ha, pre-emergence application of pretilachlor 750 g/ha *fb* one hand weeding at 45 days after transplanting (DAT), post-emergence (PoE) application of penoxsulam 22.5 g/ha *fb* one hand weeding at 45 DAT and one mechanical weeding through conoweeder at 15 DAT *fb* one hand weeding at 45 DAT, PE application of pretilachlor with no irrigation up to one week, PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha, hand weeding twice at 20 and 40 DAT and untreated (weedy check). Pre-emergence application of pretilachlor was done at 3 DAT while PoE application of bispyribac-Na and penoxsulam was done at 14 and 20 DAT, respectively. Total five irrigations were given to the crop as and when needed. To all the treatments, irrigation was applied to saturation except PE application of pretilachlor with no irrigation up to one week and pre-emergence application of pretilachlor with no irrigation up to one week *fb* post-emergence application of bispyribac-Na 20 g/ha. In both of these treatments, irrigation was withheld up to initial one week after transplanting to provide aerobic condition that results in emergence of weeds, which were later effectively controlled by application of post-emergence herbicide. Thereafter, irrigation application was common to all the plots. The herbicide application was done as sole or sequential at the recommended rates using 500 L of water/ha for application of pre and post-emergence herbicides through knapsack sprayer fitted with a flat fan nozzle.

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Twenty five days old seedlings of rice variety "*Sarjoo 52*" were transplanted on July 6, 2012 at 20 x 10 cm apart using two seedlings per hill. All the plots (5 x 3 m) were fertilized with 120 kg N, 60 kg P_2O_5, 40 kg K_2O and 20 kg $ZnSO_4$/ha in the form of urea, NPK mixture (12:32:16) and muriate of potash. Full dose of P and K and half dose of N were applied uniformly as basal dose at the time of transplanting. Remaining half dose of N was top dressed in two equal splits, one-fourth each at active tillering (30-35 DAT) and at panicle initiation (60-65 DAT) stage of the crop. Weed sampling in experimental plots was done from a sampling area of 1.0 m^2 by using 50 x 50 cm quadrant at 60 DAT as maximum weed density and dry matter were recorded at this stage compared to other crop growth stages. Weeds were identified, counted species-wise and then biomass was weighed after drying at 70±2°C in electric oven till constant dry weights. The dominant weed species was determined based on the sum dominance ratio (SDR) values expressed as a percentage, computed by using the following equation (Janiya and Moody 1989).

$$\text{SDR of a species} = \frac{\text{Relative density (RD)} + \text{Relative dry weight (RDW)}}{2}$$

Where,

$$\text{RD} = \frac{\text{Density of a given species}}{\text{Total density}} \times 100,$$

$$\text{RDW} = \frac{\text{Dry weight of a given species}}{\text{Total dry weight}} \times 100$$

Rice crop was harvested manually on November 3, 2012 with help of sickle at height of 10-15 cm from ground level to leave rice stubbles for residue incorporation into the soil.

The untreated (weedy check) plots were infested by 8 weed species representing 5 families; 4 from Poaceae, and 1 from each of Asteraceae, Cyperaceae, Lythraceae and Amaranthaceae (**Table 1**). Among the weed flora, 4 were grasses, 3 were broad-leaved weeds and 1 sedge. Based on SDR, grasses were the most dominant weeds which occupied more than 60% SDR of which *Leptochloa chinensis* (SDR 19.8%) and *Echinochloa colona* (SDR 19.1%) were the most prominent weeds. Broad-leaved weeds were next to grasses accounting for about 27.7% SDR of which *Caesulia axillaris* (SDR 13.2%) and *Ammania baccifera* (SDR 10.3%) were most dominant while Sedge was the least dominant accounting merely 12.2% SDR.

Table 1. Sum dominance ratio (SDR) based on different weed species at 60 DAT in transplanted rice

Weed species	Family	Weeds type	SDR (%)
Leptochloa chinensis	Poaceae	Grassy	19.8
Echinochloa colona	Poaceae	Grassy	19.1
Ischaemum rugosum	Poaceae	Grassy	14.2
Caesulia axillaris	Asteraceae	Broad-leaf	13.2
Cyperus difformis	Cyperaceae	Sedge	12.2
Ammania baccifera	Lythraceae	Broad-leaf	10.3
Echinochloa crus-galli	Poaceae	Grassy	7.2
Alternanthera sessilis	Amaranthaceae	Broad-leaf	4.2

At 30 DAT and harvest, no significant difference in plant height was observed among all the treatments due to less competition between crop and weeds (**Table 2**). At other growth stages, shorter plants were observed in weedy check compared to other integrated and alone application of herbicides. This might be due to the inter plant competition for longer period which inhibited the plants to become taller in weedy check. At 45 and 60 DAT, the maximum plant height was recorded with the PoE application of penoxsulam 22.5 g/ha *fb* one hand weeding at 45 DAT. This might be due to minimum crop-weed competition with application of penoxsulam due to broad spectrum control of weeds and greater weed control efficiency (91.4%) over rest of the treatments.

Number of shoots plays a vital role in determining grain yield in rice since it is closely related to number of panicles per unit ground area. At all the crop growth stages, no significant difference in number of shoots was observed among all the treatments except at 60 DAT (**Table 2**). In general, shoot population increased up to 45 DAT and thereafter, decreased at subsequent stages irrespective of treatments. Among weed control treatments, higher number of shoots was recorded with PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha followed by PoE application of bispyribac-Na g/ha alone compared to other treatments. Higher number of shoots/m^2 with PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha might be attributed to less crop-weed competition and better utilization of resources (nutrient, solar radiation and space) at the time of tillering due to effective control of complex weed flora. Similar result was also reported by Bhanumathy (1987). Chandra (1994) also reported that the shoot number and crop dry weight was significantly affected by various weed control treatments whereas, plant height did not reached up to the significant level.

No significant difference was observed in crop dry matter accumulation by rice at all the crop growth stages except at harvest (**Table 3**). At harvest, significantly highest dry matter accumulation was observed with PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha, followed by PoE application of penoxsulam 22.5 g/ha supplemented with one hand weeding at 45 DAT and PoE application of bispyribac-Na 20 g/ha while significantly lower dry matter accumulation was recorded with PE application of pretilachlor with no irrigation up to one week. Higher dry matter accumulation with PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha might be due to better weed control and higher leaf area index (LAI).

The grain and straw yield of rice was influenced significantly due to various weed control treatments. All the weed control treatments registered significantly higher rice grain and straw yield over the weedy check (**Table 3**). Among different treatments, PE application of pretilachlor with no irrigation up to one week *fb* PoE application of bispyribac-Na 20 g/ha recorded significantly higher grain and straw yield over PE application of pretilachlor 750 g/ha alone, PE application of pretilachlor 750 g/ha with no irrigation upto one week and one mechanical weeding through conoweeder at 15 DAT supplemented with one hand weeding at 45 DAT but remained at par with rest of the treatments. Pre-emergence application of pretilachlor 750 g/ha with no irrigation up to one week and one mechanical weeding through conoweeder at 15 DAT supplemented with one hand weeding at 45 DAT recorded lower straw and grain yield, respectively. Similar results were also reported by Uma *et al.* (2014). The higher straw yield might be

Table 2. Effect of weed control treatments on number of shoots and plant height at different stages of crop growth

Treatment	Dose (g/ha)	Number of shoots/m^2				Plant height (cm)			
		30 DAT	45 DAT	60 DAT	At harvest	30 DAT	45 DAT	60 DAT	At harvest
Penoxsulam	20.0	174.2	173.3	170.0	135.8	61.6	80.3	97.0	106.2
Penoxsulam	22.5	179.2	175.8	176.7	151.7	64.8	81.6	99.3	106.4
Penoxsulam	25.0	186.7	192.5	177.3	152.5	63.3	81.3	98.6	106.5
Bispyribac-Na	20.0	175.8	188.3	198.3	129.2	60.9	79.0	99.5	112.7
Pretilachlor	750	165.8	189.2	161.7	126.7	59.9	79.3	97.3	106.9
Pretilachlor *fb* 1 HW (45 DAT)	750	179.2	180.8	179.2	131.7	63.6	79.5	98.7	106.5
Penoxsulam *fb* 1 HW (45 DAT)	22.5	180.8	202.5	178.3	135.0	63.5	81.7	99.8	107.6
Pretilachlor with no irrigation up to one week	750	160.0	162.5	160.0	130.0	60.3	78.7	96.1	106.3
Pretilachlor with no irrigation up to one week *fb* bispyribac-Na	750 *fb* 20.0	200.8	195.0	205.8	161.7	66.5	81.1	99.0	110.6
One mechanical weeding through conoweeder *fb* 1 HW	15 *fb* 45 DAT	213.3	205.0	159.2	158.3	67.4	80.7	98.6	111.3
Hand weeding twice	20 and 40 DAT	164.2	180.0	183.3	136.7	63.2	79.7	98.1	110.0
Untreated (weedy check)	-	161.7	149.2	124.2	110.0	58.9	75.3	94.3	101.1
LSD (p=0.05)	-	NS	NS	18.0	NS	NS	3.1	2.3	NS

Table 3. Effect of weed control treatments on crop dry matter at different stages of crop growth, yield, HI and grain/straw ratio at harvest

Treatment	Dose (g/ha)	Crop dry matter (g/m^2)				Grain yield (t/ha)	Straw yield (t/ha)	Grain/ straw ratio	HI
		30 DAT	45 DAT	60 DAT	At harvest				
Penoxsulam	20.0	14.6	32.8	112.1	381.4	4.90	7.24	0.68	40.44
Penoxsulam	22.5	20.0	40.2	117.5	414.8	5.16	7.45	0.70	41.05
Penoxsulam	25.0	21.8	45.4	128.0	430.8	5.26	7.50	0.71	41.38
Bispyribac-Na	20.0	18.6	37.0	136.9	436.3	5.62	7.86	0.72	41.66
Pretilachlor	750	20.6	40.0	106.4	399.1	4.84	6.82	0.71	41.53
Pretilachlor *fb* 1 H.W (45 DAT)	750	24.1	43.7	140.2	421.6	5.39	7.51	0.72	41.80
Penoxsulam *fb* 1 H.W (45 DAT)	22.5	21.9	30.9	139.4	437.7	5.36	7.56	0.72	41.59
Pretilachlor with no irrigation up to one week	750	20.1	37.6	111.6	317.1	4.63	6.50	0.72	41.64
Pretilachlor with no irrigation up to one week *fb* bispyribac-Na	750 *fb* 20.0	27.6	59.2	149.6	440.3	5.73	8.38	0.69	40.64
One mechanical weeding through conoweeder *fb* 1 HW	15 *fb* 45 DAT	18.5	31.8	129.3	337.3	4.48	6.74	0.66	39.94
Hand weeding twice	20 and 40 DAT	20.5	40.4	141.7	338.1	5.62	7.76	0.73	42.03
Untreated (weedy check)	-	12.9	23.8	98.2	295.1	2.29	3.96	0.59	36.89
LSD (p=0.05)	-	NS	NS	NS	43.4	0.70	1.22	NS	NS

HI - Harvest index

attributed to more plant height and dry matter accumulation due to reduced crop-weed competition. Among the different doses of penoxsulam, penoxsulam 25 g/ha applied as PoE recorded higher grain yield followed by PoE application of penoxsulam 22.5 g/ha owing to higher number of panicles/m^2 and grains/panicle. These findings are in conformity with the results of Khare *et al.* (2014). Post-emergence application of penoxsulam alone 22.5 and 25 g/ha was found statistically at par with PoE application of bispyribac-Na 20 g/ha. Integration of one hand weeding with pretilachlor or penoxsulam did not improve the rice grain and straw yield significantly over their sole application. The grain/straw ratio and HI were not influenced significantly due to various weed control measures (**Table 3**).

SUMMARY

The present study was carried out during *Kharif* season of 2012 at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The dominant weed flora observed in the experimental plots were *Echinochloa colona, E. crus-galli, Leptochloa chinensis, Ischaemum rugosum* among grasses and *Ammania baccifera, Alternanthra sessilis* and *Caesulia axillaris* among broad-leaf weeds and *Cyperus difformis* among the sedges. Grasses were the most dominant weeds which occupied more than 60% of SDR followed by broad-leaved weeds (27.7%) and sedges (12.2%). Pre-emergence application of pretilachlor at 0.75 kg/ha with no irrigation up to one week *fb* PoE application of bispyribac-Na at 20 g/ha was the most promising treatment which recorded higher rice grain and straw yield as compared to other weed control treatments.

REFERENCES

Ahmed GJU, Mamun AA, Hossain SMA, Mridha AJ and Hossain ST. 2000. Agro-economic study of weed control in direct seeded us rice in the farmer's field. *Annals of Bangladesh Agriculture* **8**(2): 111-118.

Bhanumathy VV. 1987. *Integrated Weed Management in Drum Seeded Rice*. Ph.D. thesis, T.N.A.U, Coimbatore (T.N).

Chandra M. 1994. *Effect of 2,4-D Formulations on Transplanted Rice and Associated Weeds*. M.Sc. Ag. (Agronomy) thesis, G.B. Pant University of Agriculture and Technology, Pantnagar.

Economic Survey 2014-15. *Agriculture Economics*. Directorate of Economics and Statistics, Department of Agriculture and Cooperation. Available at http://eands.dacnet.nic.in/

Janiya JD and Moody K. 1989. Weed populations in transplanted wet seeded rice as affected by weed control method. *Tropical Pest Management* **35**: 8-11.

Khare TR, Sharma R, Singh SB and Sobhana V. 2014. Penoxsulam for weed management in direct-seeded and transplanted rice (*Oryza sativa* L.). *Pesticide Research Journal* **26**(2): 212-216.

Pandey S. 2009. *Effect of Weed Control on Rice Cultivars Under the System of Rice Intensification (SRI)*. M.Sc. Thesis submitted to the Tribhuvan University Institute of Agriculture and Animal Science Rampur, Chitwan, Nepal. Retrieved from http://sri.ciifad.cornell.edu/countries/nepal/Nepal_SPandey_MSc_thesisIAAS09.pdf.

Puniya R, Pandey PC, Bisht PS and Singh DK. 2007. Nutrient uptake by crop and weeds as influenced by trisulfuron, trisulfuron+ pretilachlor and bensulfuron-methyl in transplanted rice (*Oryza sativa* L.). *Indian Journal of Weed Science* **39**(3&4): 239-240.

Singh VP, Singh G and Singh M. 2004. Effect of fenoxaprop-p-ethyl on transplanted rice and associated weeds. *Indian Journal of Weed Science* **36**: 190-192.

Uma G, Ramana MV, Pratap A, Reddy K and Prakash TR. 2014. Evaluation of low dose herbicides in transplanted rice (*Oryza sativa* L.). *International Journal of Applied Biology and Pharmaceutical Technology* **5**(4): 96-100.