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Short communication

Chemical control of weeds in dry-seeded rice

Tej Pratap*, V. Pratap Singh and Rekha
G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand 263 145

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Rice (*Oryza sativa* L.) is the principal crop of India cultivated in an area of 43.95 million hactares annually with a production of 106.65 million tonnes, with an average productivity of 2.4 t/ha (Ministry of Agriculture 2015). The conventional system of rice production *i.e* transplanting under puddled conditions is mainly followed by farmers. However, it is water, labour and energy intensive. Therefore, to assure sustainability of rice production, more resource efficient alternative methods of rice cultivation are needed. The dry seeded rice (DSR) technology being water, labour, energy efficient and having eco-friendly characteristics, received much attention as a potential alternative to transplanting under puddle conditions (Kumar and Ladha 2011). However, weed control is major limitation for the success of DSR as compared to transplanted rice (Chauhan and Yadav 2013). In DSR, weeds emerge simultaneously with crop seedlings and grow more quickly in moist soil than in puddled transplanted rice, resulting in severe competition for resources to the crop. Therefore, weeds present in the field are the main biological constraint to the success of DSR and failure to control weeds result in yield losses ranging from 50 to 90% (Chauhan and Opena 2012). Therefore, an experiment was conducted to study the sequential application of pre- and post-emergence herbicides and their combination along with hand weeding for weed control in dry seeded rice.

A field experiment was conducted at N.E.Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology Pantnagar, Uttarakhand during *Kharif* seasons of 2012 and 2013 to evaluate the efficacy of herbicides alone or in combination to control the weed flora in dry-seeded rice. The experiment consisted of ten treatments was laid out in randomized block design with three replications.The experimental site was silty clay loam in texture, medium in organic carbon (0.66%), available phosphorus (27.5 kg/ha) and potassium (243.5 kg/ha) with P^H 7.3. Rice variety '*Narendra-359*' was sown at a row spacing of 20 cm on June 22, 2012 and June 14, 2013.The crop was raised with recommended package of practices. Pre-emergence herbicides were applied within 3 days of sowing using 750 liter water/ha whereas post–emergence herbicides were applied at 20 days of sowing by using a knapsack sprayer fitted with flat fan nozzle using water volume of 500 liter per hectare.The observations on density and weed biomass were taken at 60 DAS. Weed biomass was recorded and expressed in g/m^2. The data on weed density and weed biomass were analyzed after subjecting to square root transformation by adding 1.0 to original values prior to statistical analysis. Weed control efficiency (WCE) was calculated on the basis of weed biomass. Yield and yield attributes were recorded at the time of harvesting. Each experimental plot was threshed by paddy thresher to determine grain yield and it was presented as t/ha.

***Corresponding author:** drtpsingh2010@gmail.com

Weed flora

The dominant weeds were *Echinochloa colona* and *Leptochloa chinensis* in grassy, *Ammania baccifera* and *Caesulia axillaris* in broad-leaved weeds and *Cyperus rotundus* among sedges.

Weed density, dry weight, weed control efficiency

The density of weeds was significantly influenced by weed control treatments in both the years at 60 DAS (**Table 1**). All herbicides reduced the growth of weeds compared to those observed in control. Among the herbicidal treatments total weed density was significantly reduced in pendimethalin1000 g/ha *fb* bispyribac-Na 25 g/ha + one hand weeding at 45 DAS, which was found statistically similar to pendimethalin 1000 g/ha + one hand weeding at 30 DAS and pyrazosulfuron 20 g/ha *fb* bispyribac-Na 25 g/ha, bispyribac-Na 20 g/ha + ready mix of chlorimuron-ethyl + metsulfuron-methyl 4 g/ha and bispyribac-Na 25 g/ha than other herbicidal treatments.

Table 1. Effect of weed management on total weed density, total weed dry weight , weed control efficiency at 60 DAS, yield attributes and grain yield of dry-seeded rice (pooled data of 2012 and 2013)

Treatment	Total weed density (no./m^2)	Total weed biomass (g/m^2)	Weed control efficiency (%)	No. of panicles /m^2	No. of grains /Panicle	Grain yield (t/ha)
Bispyribac-Na (25 g/ha)	7.9 (62.3)	7.4 (54.6)	82.4	222	146	3.6
Pendimethalin *fb* bispyribac-Na (1000 *fb* 25 g/ha)	11.0 (122.1)	4.1 (16.8)	94.6	274	170	5.3
Oxadiargyl *fb* bispyribac-Na (100 *fb* 25 g/ha)	9.5 (90.0)	5.1 (26.1)	91.6	269	159	5.2
Pyrazosulfuron *fb* bispyribac-Na (20 *fb* 25 g/ha)	7.7 (58.6)	6.4 (40.5)	87.0	238	158	4.1
Pendimethalin *fb* bispyribac-Na + hand weeding (45 DAS) (1000 *fb* 25 g/ha)	5.6 (31.7)	3.5 (12.0)	96.0	291	192	5.7
Pendimethalin + hand weeding (30 DAS) (1000 g/ha)	6.0 (35.3)	5.4 (29.5)	90.5	261	158	4.9
Bispyribac-Na + CME + MSM (20 + 4 g/ha)	7.6 (57.3)	7.0 (49.7)	84.0	210	145	3.6
Mechanical weeding (cono weeder) (20, 40 and 60 DAS)	6.2 (38.0)	11.5 (131.4)	57.7	193	137	3.4
Hand weeding (20, 40 and 60 DAS)	4.2 (17.3)	3.6 (12.7)	95.9	284	175	5.5
Weedy check	16.0 (247.7)	17.6 (310.6)	-	183	130	1.3
LSD (p=0.05)	2.5	2.0		51.1	28.5	0.32

Values within parentheses are original. Data are subjected to square root transformation $(\sqrt{x+1})$, CME+MSM- chlorimuron-ethyl + metsulfuron-methyl

Weed control treatments brought about significant variation in the total weed biomass at 60 DAS during both the years.The lowest weed biomass was recorded with pendimethalin 1000 g/ha *fb* bispyribac-Na 25 g/ha + one hand weeding at 45 DAS, which was significantly at par with thrice hand weeding at 20,40 and 60 DAS, pendimethalin1000 g/ ha *fb* bispyribac - Na 25g/ha, oxadiargyl 100 g/ha *fb* bispyribac 25 g/ha and pendimethalin 1000 g/ha + one hand weeding at 30 DAS as compared to other herbicidal treatments. Among the herbicidal treatments, maximum weed control efficiency was recorded with pendimethalin 1000 g/ha *fb* bispyribac-Na 25 g/ha + one hand weeding at 45 DAS (96.0%) followed by pendimethalin 1000 g/ha *fb* bispyribac-Na 25g/ha, oxadiargyl 100 g/ha *fb* bispyribac 25 g/ha and pendimethalin 1000 g/ha + one hand weeding at 30 DAS than rest of the herbicidal treatments.

Yield

All the weed control treatments resulted in significantly more panicles/m^2 and number of grains/ panicle as compared to weedy check. Application of pendimethalin 1000 g/ha *fb* bispyribac-Na 25 g/ha + one hand weeding at 45 DAS resulted in highest value of panicles/m^2 and number of grains/panicle over rest of the treatments (**Table 1**). The highest grain yield (5.7 t/ha) was recorded with pendimethalin 1000 g/ha *fb* bispyribac-Na 25g/ha + one hand weeding at 45 DAS, which was statistically at par with thrice hand weeding at 20, 40 and 60 DAS as compared to rest of the herbicidal treatments.Uncontrolled weeds in weedy check plots caused on an average 76.1% reduction in grain yield when compared with pendimethalin1000 g/ha *fb* bispyribac-Na 25 g/ha + one hand weeding at 45 DAS mainly due to highest density and weed biomass. Similar results were also reported by Bhat *et al*. (2013).

SUMMARY

Application of pendimethalin 1000 g/ha as pre-emergence *fb* bispyribac-sodium 25 g/ha as post-emergence + one hand weeding at 45 DAS was found most effective in controlling weeds resulted in higher weed control efficiency and grain yield.

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