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Research Communication

Weed management in direct-seeded rice (*Oryza sativa*) in central India

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ABSTRACT

A field experiment was conducted in a split-plot design with 3 replications at Research Farm, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh), during the rainy (*kharif)* season of 2019, to evaluate the performance of different herbicides in direct-seeded rice (*Oryza sativa* L.). The experiment comprised of 2 main plots, viz. rainfed and irrigated, and 8 weed-control treatments, viz. bispyribac sodium at 25 g/ha, fenoxaprop-p-ethyl at 60 g/ha, fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha, cyhalofop + penoxsulam at 135 + 26.7 g/ha, bispyribac sodium + metsulfuron-methyl + chlorimuron ethyl at 25 + 4 g/ha, triafamone + ethoxysulfuron at 40 + 20 g/ha, hand-weeding twice and weedy check, in subplots. The dominant weeds associated with direct-seeded rice experimental field were mainly comprised monocot, viz. jungle rice [*Echinochloa colona* (L.) Link] and Bermuda grass [*Cynodon dactylon* (L.) Pers.], sedge, viz. nutgrass [*Cyperus iria* (L.)], and dicot weed such as sissoo spinach [*Alternanthera sessilis* (L.) R. Br. ex DC.]. The results indicated that, post-emergence application of bispyribac sodium at 25 g/ha at 20 days after sowing (DAS) recorded the highest weed-control efficiency (87.75%), followed by fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha. Higher grain yield (3.09 t/ha) was recorded with weed-free treatment which was at par with bispyribac sodium at 25 g/ha.

***Key words*:** Agro-ecosystems, Bispyribac sodium, Direct-seeded rice, Weeds, Weed management

Rice (*Oryza sativa* L.) is the prominent staple crop of India and accounted for 39.64% of total foodgrain production (284.83 million tonnes) during 2017–18 (DoES, GoI, 2018). In India, rice occupies an area of 43.1 million ha with productivity (2.6 t/ha) (India Stat, 2017–18). In the central region of India, manual transplanting is labour-intensive, and labour shortages during peak season forces farmers to move from transplanting to direct-seeded rice (Choudhary and Dixit, 2018). Direct seeding of rice (DSR) has more benefits than traditional transplanting, like easier planting, timely sowing, early crop maturity by 7 to 10 days, less water requirement, low production cost, and more profit. Despite these benefits of DSR, weeds cause significant production losses (50–100%) and are thought to be the main barrier in achieving the desired high yields (Rao *et al.*, 2015). Herbicides are low-priced, easy to apply and ensure timely weed control. Bijarnia *et al*., (2022) reported that, many herbicides have been evaluated to control the weed flora in DSR under the central region of the country. However, their selection and adoption need a specific approach to tackle the weed scourge in this region. Therefore, this study was conducted to assess the efficacy of different post-emergence herbicides in DSR.

The field experiment was conducted at a Research Farm of College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (23°90" N, 79°58" E, 411.78 m above mean sea-level) Madhya Pradesh. The soil of the experimental site was sandy clay loam (61.70% sand, 16.50% silt and 22.40% clay) and the Order of the soil was Oxisols. The soil *p*H was 6.48, medium in organic carbon (0.72%), available N (293.6 kg/ha), available P (17.5 kg/ha) and available K (257.4 kg/ha). The experiment was laid out in a split-plot design with 2 main plot treatments (rainfed and irrigated) and 8 subplot treatments, viz. bispyribac sodium at 25 g/ha, fenoxaprop-p-ethyl at 60 g/ha, fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha, cyhalofop + penoxsulam at 135 + 26.7 g/ha, bispyribac sodium + metsulfuron-methyl + chlorimuron ethyl at 25 + 4 g/ha, triafamone + ethoxysulfuron at 40 + 20 g/ha as post-emergence herbicides applied 20 days after sowing, hand-weeding twice at 20 and 40 DAS and weedy check, with 3 replications. The highest temperature (34.9°C) and lowest temperature (10.3°C) were recorded during the

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crop-growth season (July 2019 to November 2019). The crop received 1,396 mm rainfall in 48 rainy days which encouraged the rice crop to grow. The gross plot size was 16 m^2 (4.0 m × 4.0 m). Seeds of medium-duration (120–125 days) rice variety MTU 1010 was sown with seed-cum-ferti drill at 20-cm-row spacing at 3–4 cm depth by using a seed rate of 60 kg/ha. Hand-operated knapsack sprayer fitted with a flat fan-type nozzle was used for spraying the herbicides adopting a spray volume of 500 litres/ha. The data were tabulated and analysed statistically using the analysis of variance (ANOVA) technique.

The dominant grassy weed species were: jungle rice [*Echinochloa colona* (L.) Link] and Bermuda grass [*Cynodon dactylon* (L.) Pers.]. Among sedges, nutgrass [*Cyperus iria* (L.)] was the dominant one. In broad-leaf weeds, sissoo spinach [*Alternanthera sessilis* (L.) R. Br. ex DC.] was dominant.

The density of weed species varied significantly at 60 days after sowing (DAS) due to different weed control treatments (Table 1). The total weed density of grasses, sedges and broad-leaf was minimum by applying bispyribac sodium at 25 g/ha and was significantly superior to the rest of the herbicidal treatments under both the agro-ecosystems. Because bispyribac sodium is a systemic herbicide, it inhibits the synthesis of branched-chain amino acid. It effectively suppresses various weeds by interfering with the enzyme acetolactate synthase (ALS), which is responsible for growth (Bhattacharya *et al*., 2022; Verma *et al*., 2022a).

Among all the herbicidal treatments, application of bispyribac sodium at 25 g/ha resulted in significantly minimum total weed dry matter as compared to the other treatments (Table 1). There was a considerable reduction in weed emergence at the initial crop-growth stage due to the vigorous seedling establishment. However, the later-emerging weeds were effectively controlled by bispyribac-sodium at 25 g/ha. At the same time, unweeded checks recorded significantly higher weed dry weight under both the agro-ecosystems (Verma *et al*., 2022b).

The weed-control efficiency was maximum under hand-weeding twice at 20 and 40 DAS. However, bispyribac sodium at 25 g/ha recorded the highest weed-control efficiency among herbicidal treatments (Table 1).

Among the weed-control treatments, there was 53.1% yield reduction in weedy check which was significantly higher than the other weed-control treatments. Weed index of the plot treated with bispyribac sodium at 25 g/ha was significantly lowest (10.6%) and was statistically superior to others (Table 1). The lower weed index in the plot treated with herbicides indicates a higher yield than that of the control plot.

The data pertaining to the number of tillers/m^2 and grains/panicle varied significantly among the weed-management practices (Table 2). The highest value for the number of tillers/m^2 was noted with bispyribac sodium at 25 g/ha, followed by fenoxaprop-p-ethyl at 60 g/ha and bispyribac sodium + (metsulfuron-methyl + chlorimuron-ethyl) at 25 + 4 g/ha over the weedy check. Similarly, the

Table 1. Effect of weed-control treatments on total weed density, dry weight and weed-control efficiency in direct-seeded rice

Treatment	Weed density (No./m^2) 60 DAS	Weed dry weight (g/m^2) 60 DAS	Weed-control efficiency (%) 60 DAS	Weed index
Agro-ecosystems				
Rainfed	5.32 (34.60)	5.81 (41.05)	–	–
Irrigated	5.04 (30.82)	5.64 (38.66)	–	–
SEm±	0.23	0.13	–	–
CD (P=0.05)	NS	NS	–	–
Weed-management practices				
Bispyribac sodium at 25 g/ha	3.62 (13.38)	4.28 (18.33)	87.7	10.6
Fenoxaprop-p-ethyl at 60 g/ha	5.43 (29.53)	6.03 (36.71)	75.0	35.0
Fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha	4.32 (18.70)	4.87 (23.90)	84.2	18.4
Cyhalofop + penoxsulam at 135 + 26.7 g/ha	4.66 (22.01)	5.11 (26.50)	82.2	24.4
Bispyribac sodium + metsulfuon methyl + chlorimuron ethyl at 25 + 4 g/ha	5.21 (27.25)	5.71 (32.36)	77.9	32.2
Triafamone + ethoxysulfuron at 40 + 20 g/ha	4.89 (24.36)	5.24 (27.63)	81.3	29.1
Twice hand-weeding	2.29 (4.78)	2.38 (5.30)	96.2	0.0
Weedy check	11.04 (121.71)	12.18 (148.13)	0.0	53.1
SEm±	0.32	0.35	–	–
CD (P=0.05)	0.93	1.02	–	–

Square root (X+0.5)-transformed values; values in the parentheses are original values; DAS, days after sowing

Table 2. Effect of weed-control treatments on growth parameters, yield attributes and yield of direct-seeded rice

Treatment	Tillers/m^2 (60 DAS)	Grains/ panicle	Grain yield (t/ha)	Harvest index (%)	Net returns (×10^3 ₹/ha)
Agro-ecosystems					
Rainfed	328.2	68.7	1.58	–	–
Irrigated	333.0	81.7	3.00	–	–
SEm±	0.39	0.33	4.2	–	–
CD (P=0.05)	2.59	12.19	27.7	–	–
Weed-management practices					
Bispyribac sodium at 25 g/ha	353	77.5	2.76	39.3	34.5
Fenoxaprop-p-ethyl at 60 g/ha	311	72.5	1.99	37.6	19.3
Fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha	345	76.5	2.50	38.8	27.4
Cyhalofop + penoxsulam at 135 + 26.7 g/ha	334	75.8	2.30	38.7	23.3
Bispyribac sodium + metsulfuon methyl + chlorimuron ethyl at 25 + 4 g/ha	313	74.5	2.09	38.2	20.0
Triafamone + ethoxysulfuron at 40 + 20 g/ha	329	75.5	2.18	38.5	20.6
Twice hand-weeding	360	79.5	3.09	40.5	30.5
Weedy check	296	70.5	1.41	36.0	8.2
SEm±	0.77	0.89	0.04	–	–
CD (P=0.05)	2.25	2.60	0.11	–	–

DAS, days after sowing

highest value of number of grains/panicle was recorded with bispyribac sodium at 25 g/ha (Padhan *et al*., 2021).

The grain yield was significantly influenced by weed-management practices. The grain yield is the function of some yield-attributing characters like number of tillers/m^2, grains/panicle. The highest grain yield (2.76 t/ha) was observed in bispyribac sodium at 25 g/ha-treated plots as compared to the other treatments, followed by fenoxaprop-p-ethyl + penoxsulam at 60 + 26.7 g/ha. Higher grain yield under herbicidal application owing to the effective control of grassy and broad-leaf weeds enhanced the values of yield attributes and ultimately increased the grain yield (Yogananda *et al*., 2022). The lower yield (1.41 t/ha) in weedy check might be due to competition from weeds (Table 2).

Bispyribac sodium applied at 25 g/ha registered the highest harvest index compared to the other treatments. Similarly, net returns were the maximum with bispyribac sodium at 25 g/ha (₹34,506), followed by hand-weeding (₹30,533), while weedy check recorded the lowest net returns. These results are in line with the results of Satapathy *et al*., (2020).

Bispyribac sodium at 25 g/ha was found effective in controlling weeds in direct-seeded rice based on the vegetation and economic analysis and also recorded significantly higher grain yield than other treatments.

REFERENCES

Bhattacharya, Urjashi, Ghosh, Alindip, Sarkar, Smritikana and Maity, Shrabanti. 2022. Response of rice (*Oryza sativa* L.) to weed management methods in the lower Gangetic Plain Zone. *Indian Journal of Agricultural Research* DOI: 10.18805/IJARe.A-5919.

Bijarnia, Harish Kumar, Bijarnia, Shankar Lal, Bhan, Manish, Bijarnia, Anju, Meena, Ajit Kumar and Bijarnia, Arjun Lal. 2022. Effect of crop establishment methods and weed-control treatments on yield, weed density, weed dry weight, weed index and weed-control efficiency in rice. *Agricultural Mechanization in Asia, Africa and Latin America* **53**(1): 5,425–5,432.

Choudhary, V.K. and Dixit, A. 2018. Herbicide weed management on weed dynamics, crop growth and yield in direct-seeded rice. *Indian Journal of Weed Science* **50**(1): 6–12.

DoES, GOI. 2018. *Pocket Book of Agricultural Statistics-2018*. Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare. Government of India, New Delhi.

India Stat. 2017–18. http://www.indiastat.com/defaul t.aspx.

Padhan, Smruti Ranjan, Rathore, S.S., Prasad, Shiv Mangal, Shekhawat, Kapila and Singh, V.K. 2022. Influence of precision nutrient and weed management on growth and productivity of direct-seeded upland rice (*Oryza sativa*) under Eastern Plateau and Hills Region. *Indian Journal of Agronomy* **66**(3): 47–50.

Rao, A.N., Wani, S.P., Ramesha, M. and Ladha, J.K. 2015. Weeds and weed management of rice in Karnataka State, India. *Weed Technology* **29**: 1–7.

Satapathy, B.S., Duary, B., Saha, S., Munda, S., Singh, T. and Chatterjee, D. 2020. Yield and economics of drum-seeded rice (*Oryza sativa*) as influenced by broadspectrum herbicides and herbicide mixtures. *Indian Journal of Agronomy* **65**(1): 41–46.

Verma, Badal, Bhan, Manish, Jha, A.K., Singh, Vikash, Patel, Rajendra, Sahu, M.P. and Kumar, Vijay. 2022a. Weed man-

agement in direct-seeded rice through herbicidal mixtures under diverse agroecosystems. *Agricultural Mechanization in Asia, Africa and Latin America* **53**(4): 7,299–7,306.

Verma, Badal, Bhan, Manish, Jha, A.K., Khatoon, Shahiba, Raghuwanshi, Monika, Bhayal, Lalita, Sahu, M.P., Patel, Rajendra and Singh, Vikash. 2022b. Weeds of direct-seeded rice influenced by herbicide mixture. *Pharma Innovation* **11**(2): 1,080–1,082.

Yogananda, S.B., Thimmegowda, P. and Shruthi, G.K. 2022. Performance of sequential application of pre- and post-emergence herbicides for management of weeds in aerobic rice (*Oryza sativa*). *Indian Journal of Agronomy* **67**(1): 12–19.