



Influence of nutrient and weed management on weed dynamics and productivity of upland rice (*Oryza sativa*)

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The Asian countries share 90% of the total 158 mha world's area under rice (*Oryza sativa* L.). The total production of rice in India is 104.3 MT and the national productivity is 2.40 t/ha, whereas the area and production of rice in Jharkhand are 1.59 mha and 2.89 MT, respectively (Anonymous 2018). But, the productivity of Jharkhand remains 1814 kg/ha which is far below the national productivity of 2404 kg/ha. The rainfed upland ecosystem of rice (covering 7 mha across the country) helps in feeding poor farmers of India. But these areas are typically concentrated to the Eastern part in which the Eastern Plateau and Hills Region shares most of the acreage under upland ecosystem. In this part upland rice is being cultivated mostly as subsistence farming (Singh *et al.* 2014). The bottlenecks like water intensiveness, destruction of soil structure and hard pan formation due to intensive tillage conditions and ever-increasing labour costs have forced a paradigm shift from conventional low land transplanted rice ecosystem to upland direct seeded rice (DSR) ecosystem. DSR is gaining popularity due to its low input demand, rapidity and easiness in planting, shorter growing season of 7-10 days fitting well into the different intensive cropping system, lower methane emission and reduction of labour share on the total cost of cultivation (Chauhan 2012). Among the different constraints hindering the productivity of upland DSR, weeds are the major biotic constraint leads the serious yield decline. The vagaries of weeds of more than 50 species like *Cyperus* spp., *Leptochloa* spp., *Echinochloa* spp., *Eclipta* spp etc. may cause yield losses up to 80% (Sreedevi *et al.* 2016). Thus, the present investigation was carried out to find out the appropriate combination of nutrient management along with herbicides and other weed management practices for higher upland rice productivity.

A field experiment was conducted during *kharif* 2019 at

Shankarpura Farm at ICAR-NRRI-Central Rainfed Upland Rice Research Station (CRURRS) in the Hazaribagh, Jharkhand. located at 23°57'41" N and 85°21'48" E at 615 m amsl. With a warm and humid climate, the district's mean maximum and minimum temperature as per the long-term data analysis is about 31.4°C and 13.7°C, respectively with an average temperature of 23.7°C. The 79% of the total annual rainfall (1274 mm) is received between June to September. The soil has a clay-loam texture having a good water holding capacity with a pH of 6.6. The soil was medium in organic carbon (0.59%), low, medium and high in available N (158 kg/ha), P (10.82 kg/ha) and K (368 kg/ha), respectively. The field experiment was laid out in a split-plot design comprising 3 nutrient management practices, viz. recommended dose of fertilizer (RDF; 80:40:40 N₂:P₂O₅:K₂O kg/ha with all P and K as basal, 1/3rd as basal before sowing + 1/3rd at 25 DAS + 1/3rd at 45 DAS); Nutrient Expert ® guided NPK (80:40:40 N₂:P₂O₅:K₂O kg/ha with all P and K as basal, 24 kg/ha N at 10 DAS + 28 kg/ha N at 30 DAS + 28 kg/ha N at 50 DAS) and Leaf Colour Chart (LCC) guided N (N at 10 DAS + 42.5 kg/ha N at 46 DAS (when LCC reading <3) in the main-plots and 5 weed management practices, viz. weedy check, pendimethalin fb hand weeding, pendimethalin fb bispyribac-Na, brown manuring and weed free in the sub-plots. A drought tolerant rice variety namely Sahbhagi Dhan was sown with a seed rate of 80 kg/ha.

Weed density was significantly influenced by different precision nutrient and weed management options in direct seeded upland rice. Under precision nutrient management, Nutrient Expert ® guided NPK recorded lesser weed density (7.76, 8.07 and 8.62) at all three stages (Table 1). Pendimethalin fb hand weeding recorded a weed density of 7.72, 7.29 and 7.34 at 25, 60 DAS and at harvest. The application of pendimethalin fb bispyribac-Nawas found better over brown manuring. Nutrient Expert ® guided NPK resulted in minimum weed dry weight (3.99, 7.48 g/m² at 25 and 60 DAS and 10.11 g/m² at harvest). However, RDF was recorded maximum weed dry weight at all three stages

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Table 1 Weed density, weed dry weight and weed index as influenced by precision nutrient and weed management in direct seeded upland rice

Treatment	Weed density (no./m ²)			Weed dry weight (g/m ²)			Weed index (%)
	25 DAS	60 DAS	At harvest	25 DAS	60 DAS	At harvest	
N ₁	8.3(87)*	8.4(93)	9.1(107)	4.6(27.3)	9.0(112.2)	13.9(258.4)	26.5
N ₂	6.8(61)	7.0(70)	7.2(72)	4.0(20.7)	7.5(82.7)	10.1(152.5)	25.0
N ₃	7.7(76)	8.1(87)	8.6(96)	4.5(25.1)	8.6(102.1)	12.7(220.6)	19.1
SEm±	0.2	0.21	0.19	0.08	0.17	0.29	
LSD (P=0.05)	0.55	0.57	0.51	0.21	0.47	0.81	
W ₁	13.4(180)	15.5(241)	15.2(230)	8.2(66.4)	17.4(302.6)	24.0(577.0)	76.7
W ₂	7.7(60)	7.3(54)	7.3(54)	4.06(15.3)	7.0(50.1)	9.9(100.8)	6.6
W ₃	7.8(62)	8.0(64)	8.7(78)	4.1(16.8)	7.9(62.6)	12.2(156.9)	13.7
W ₄	8.5(74)	7.6(58)	9.6(95)	4.9(23.2)	8.9(79.6)	14.4(217.7)	20.7
W ₅	0.7(0)	0.7(0)	0.71(0)	0.71(0.0)	0.71(0.0)	0.7(0.0)	0.00
SEm±	0.26	0.26	0.24	0.12	0.24	0.36	
LSD (P=0.05)	0.53	0.53	0.49	0.25	0.50	0.75	

Data were subjected to square root transformation ($\sqrt{x+0.5}$). *Figures in the parentheses indicate original values

compared to other nutrient management.

Pendimethalin fb hand weeding and bispyribac-Na were found effective in reducing the weed biomass over brown manuring. Under brown manuring, the weed biomass of 4.85, 8.86 and 14.4 g/m² was noticed at 25 and 60 DAS and at harvest. The minimum weed index (WI) was obtained in LCC followed by Nutrient Expert and RDF and among weed management options, the order of WI was minimum pendimethalin fb hand weeding, pendimethalin fb bispyribac Na, brown manure and weedy check. The efficacy of controlling emerging weeds with pendimethalin and selective weed control by bispyribac-Na as a post-emergence herbicide resulted in superior weed control in rice. The establishment of aerobic weeds vis-à-vis small-

seeded broad leaf weeds can be effectively controlled by the application of pendimethalin (Rathore *et al.* 2012 and Shekhawat *et al.* 2020). One hand weeding at 25 DAS considerably removes the weeds from the field which facilitate rapid increase in the crop growth and vigour due to synchrony of second splits of nitrogen as top dressing where the newly emerging weed found to be less competitive. Bispyribac Na, remains less effective against some weeds flora which became dominant after nitrogen application. Bispyribac Na is a potent herbicide to knock down typical rice weeds like *Echinochloa* sp, but cannot suppress weeds like *D. aegyptium* (Chauhan 2012) in DSR. As there was no application of any pre-emergence herbicides in brown manuring treatment, thus early flush of weed infestation was

Table 2 Growth, yield attributes, yield and harvest index as influenced by precision nutrient and weed management in direct seeded upland rice

Treatment	Plant height (cm) at harvest	Number of tillers/m ² at harvest		Dry matter accumulation (g/m ²)		1000 grain weight	Grain yield (t/ha)	Harvest index (%)
		60 DAS	At harvest	60 DAS	At harvest			
N ₁	80.7	193.8	242.5	242	800.9	22.4	3.0	36.9
N ₂	97.4	232.7	290.3	307.5	927.3	22.7	3.6	37.7
N ₃	87.3	217.3	273.1	276.4	852.8	22.5	3.4	38.6
SEm±	3.03	7.31	11.18	12.01	23.95	0.84	0.1	1.08
LSD (P≤0.05)	8.40	20.29	31.03	33.33	66.50	NS	0.3	NS
W ₁	72.2	162.3	204.0	164.6	359.7	21.4	1.0	29.1
W ₂	97.6	240.5	297.2	304.1	1014.5	22.9	4.1	40.4
W ₃	87.9	220.3	276.8	295.1	960.1	22.7	3.78	39.4
W ₄	84.7	196.3	246.6	264.3	882.8	22.7	3.5	39.4
W ₅	100	253.5	318.6	348.4	1084.6	23.0	4.4	40.6
SEm±	3.93	9.58	13.66	13.99	27.56	1.14	0.12	1.34
LSD (P≤0.05)	8.10	19.78	28.19	28.88	56.89	NS	0.24	2.78

uncontrolled making the treatment high in weed density as well as weed dry weight.

Data (Table 2) reveals that the application of pendimethalin fb hand weeding showed maximum plant height, which remained at par with the weed free treatment (100 and 97.6 cm) and was significantly higher than pendimethalin fb bispyribac-Na (87.9 cm), brown manuring (84.7 cm) and weedy check (72.7 cm). The number of tillers/m², Nutrient expert guided fertilizer application shows at par result (~232.7 and 290.3) with that of LCC (~217.3 and 273.1) but were significantly higher than the RDF (~193.8 and 242.5) at both the stages, i.e. 60 DAS and at harvest, respectively. The dry matter accumulation/m² was found to be significantly higher in Nutrient Expert (307.5 and 927.3g/m²) at harvest. The 1000-grain weight was not affected significantly ($P \leq 0.05$) neither by the weed management aspects nor by the nutrient management options. Similarly, the harvest index was also not significantly affected by the nutrient management options. Among the nutrient management practices, Nutrient Expert ® guided NPK resulted in maximum grain yield (3.63 t/ha), followed by Leaf Colour Chart (LCC) guided N + Full P & K (3.41 t/ha), which was significantly higher over RDF. Among the weed management options, at par grain yield was obtained with pendimethalin fb hand weeding and bispyribac-Na (4.09 and 3.79 t/ha), but significantly higher over brown manuring (3.48 t/ha) and weedy check (1.03 t/ha). These trends may be due to the superior yield attributing characters in the similar trend and yield attributing characters directly influence the grain, straw as well as the biological yield. Generally, weeds are found to be more competitive in nature and occupy all the factors at a very faster rate required for crop growth and development (Das *et al.* 2012 and Shekhawat *et al.* 2017). The nutrient expert shows superiority in all the aspects because of the proper application as per the “4R stewardship” concept (Das *et al.* 2012 and Shrestha *et al.* 2018).

Based on finding of the experiment it can conclude that the judicious application of nutrient either through Nutrient Expert and LCC along with pendimethalin fb hand weeding or bispyribac-Na as a weed management option was found to be more viable option for weed management in direct seeded upland rice.

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SUMMARY

The field experiment was conducted during *khari* 2019

at ICAR-CURRS-NRRI at Hazaribagh, Jharkhand. The experiment was conducted to evaluate precision nutrient management and weed management practices for achieving minimum weed menace and maximum crop productivity. Under precision nutrient management, Nutrient Expert ® guided NPK recorded lesser weed density (7.76, 8.07 and 8.62) at all three stages. Pendimethalin fb hand weeding resulted in comparatively lesser weed density (7.72, 7.29 and 7.34 at 25, 60 DAS and at harvest). Nutrient Expert ® guided NPK resulted in maximum grain yield (3.63 t/ha), followed by Leaf Colour Chart (LCC) guided N + Full P & K (3.41 t/ha), which was significantly higher over RDF. Among the weed management aspects, pendimethalin fb hand weeding and bispyribac-Na were observed with significantly higher grain yield (4.09 and 3.79 t/ha). Hence Nutrient Expert ® guided NPK and pendimethalin fb hand weeding can be recommended for better weed management and enhanced productivity.

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