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Research Communication

Weed and nitrogen management effects on weed flora and productivity of transplanted rice (*Oryza sativa*) in North-Eastern region of India

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ABSTRACT

A field study was conducted during rainy (*kharif*) season of 2017 at Barapani, Meghalaya, to find out the effects of weed and nitrogen management on weed flora and yield of transplanted rice (*Oryza sativa* L.) in North-Eastern region of India. The experiment was taken in split-plot design with 3 replications. In the main plot, 4 weed management practices, viz. unweeded control; oxadiargyl 0.08 kg/ha followed by (*fb*) bispyribac-Na 0.02 kg/ha; oxadiargyl 0.08 kg/ha *fb* hand weeding (HW) at 40 days after transplanting (DAT), and 2 HW at 20 and 40 DAT was taken, while 4 N levels, viz. 0, 30, 60 and 90 kg N/ha were taken in sub-plots. At 60 DAT, total weed population and weed density were remained at par in HW at 20 and 40 DAT, oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT and oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha. The grain yield also followed the same trend and remained at par in HW at 20 and 40 DAT, oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT and oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha. However, in terms of net returns, application of oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha recorded the highest followed by oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT. Application of N at higher level reduced the total weed population at 60 DAT and a reverse trend was found with weed dry weight. Application of 90 kg N/ha recorded higher grain yield, net returns and benefit: cost ratio. It may be concluded that oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha with 90 kg N/ha could be an alternative for HW to enhance the productivity in transplanted rice for North-Eastern region of India.

Key words: Grassy weeds, North-Eastern Hill region, Rice, Weed dry-weight

In India, rice is the staple food and plays a major role in providing food and nutritional security to the vast Indian population. It occupies 43.8 million ha acreage with a production of 104.7 million tonnes and productivity of 2.3 t/ha (Economic Survey, 2016). However, in North-Eastern states, the total rice production is estimated to be around 5.5 million tonnes with an average productivity of 1.57 t/ha, which is far below than the national average. The major reasons behind the low productivity of rice in North-Eastern region could be the high dependence on uncertain monsoon rains without proper irrigation facilities, marginal lands with faulty agronomic practices (Ngachan *et al*., 2006). Inadequate weed and nitrogen management are the major one for the low productivity of transplanted rice. In transplanted rice, high weed infestation can cause yield reduction up to 33–44 % (Dass *et al*., 2017). Likewise, fertilizer usage is far below than the national average in these regions. The fertilizer consumption is very erratic ranging from 2.7–11.0 kg/ha in Arunachal Pradesh and around 72 kg/ha in Manipur (Economic Survey, 2016). Therefore, there may be a lot of scope to increase the grain yield of rice by 2–3 times by ensuring effective nutrient and weed management. However, very limited studies have been conducted on the weed and nitrogen management in transplanted rice under North-Eastern region of India. Further, effects of nutrient and weed management on the productivity and weed flora in transplanted rice is yet to be studied. Therefore, a research was conducted to assess the effects of weed and nitrogen management on weed dynamics and productivity of transplanted rice in North-Eastern region of India.

A field experiment was conducted at ICAR Research Complex for NEH Region, Barapani, Meghalaya (latitude of 25°30'N and longitude of 91°51'E and altitude of 950 m above the mean sea level) during rainy (*kharif*) season

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of 2017. Barapani in Meghalaya falls under high rainfall zone with subtropical type of climate. The total amount of rainfall received during the cropping season was 1285.6 mm. The soil of experimental site was sandy-clay loam in texture with *p*H 5.1, organic carbon 2.45% (Walkley and Black, 1934), alkaline $KMnO_4$ oxidizable–N 225 kg/ha (Subbiah and Asija, 1956), 0.5 M $NaHCO_3$ extractable–P 7.8 kg/ha (Bray and Kurtz, 1945), and 1 N NH_4OAc extractable–K 280 kg/ha (Hanway and Heidel, 1952). The experiment was conducted in a split-plot design with 3 replications. In main-plot, 4 weed management practices, viz. unweeded control; oxadiargyl 0.08 kg/ha followed by (*fb*) bispyribac- Na 0.02 kg/ha; oxadiargyl 0.08 kg/ha *fb* HW 40 DAT, and 2 HW at 20 and 40 DAT was taken. The various N levels viz., 0, 30, 60 and 90 kg N /ha were taken in sub-plots. A 30-days old seedlings of rice variety 'Shahsarang' were transplanted at row × plant spacing of 25 cm × 15 cm. Phosphorus (60 kg P_2O_5/ha) and potassium (40 kg K_2O/ha) were applied through single super phosphate and muriate of potash, respectively. Oxadiargyl at 0.08 kg/ha as pre-emergence (PE) was applied within one day of rice transplanting. Post-emergence (POE) application of bispyribac-Na at 0.02 kg/ha was done at 20 days after transplanting (DAT). The herbicides were sprayed with flood jet nozzle using 600 litres of water/ha. N as per the treatments was applied in 3 splits 50% as basal + 25% at tillering + 25% at panicle initiation of rice crop. However, P and K were applied at the time of transplanting. The crop was harvested from a net plot of 14 m^2. An area of one m^2 was marked in each plot for weed population samples and weed samples were dried at 75^{o}C for weed dry weight and expressed in g/m^2. The weed control efficiency was calculated by [(weed dry weight in control plot-weed dry weight in treated plot)/(weed dry weight in control plot)] × 100; and expressed in per cent. The data on weed were subjected to square root transformation ("×+0.5) and significance was calculated at 5 per cent (P=0.05) level of probability.

The predominant weed flora observed in the experimental plots were *Echinocloa cruss-galli, Echinochloa colona, Paspalum conjugatum, Ludwigia linifolia, Monochoria vaginalis, Eclipta alba,* and *Cyperus iria.*

The weed population was significantly influenced by different weed management practices at 60 DAT (Table 1). In general, the population of broad leaf weeds (BLWs) was higher compared to sedges and narrow leaf weeds (NLWs). A low population of BLW was observed in the hand weeding (HW) at 20 and 40 DAT followed by oxadiargyl at 0.08 kg/ha followed by (*fb*) HW at 40 DAT and oxadiargyl at 0.08 kg/ha *fb* bispyribac-Na at 0.02 kg/ha. In case of NLW, all the weed management practices were remained at par at 60 DAT. The population of sedges at 30 DAT was the lowest in oxadiargyl at 0.08 kg/ha *fb* bispyribac-Na at 0.02 kg/ha. The heavy rainfall received during the early crop growing period resulted in submerged conditions. Therefore, NLW such as *Echinochloa* sp. was found predominant at soil saturation levels, which occurred at late season during the crop. Besides this, NLWs and sedges possess a characteristic of different modes of propagation like tubers, stolons, rhizomes etc., and even though removal of weeds by hand weeding cannot completely remove the weeds along with their propagative material. They can able to re-grow from their propagative materials, and moreover vegetative mimicry of NLW weeds and sedges escaped from hand weeding. Therefore, application of oxadiargyl at 0.08 kg/ha *fb* bispyribac-Na at 0.02 kg/ha found effective in controlling these weeds compared to HW at 20 and 40 DAT. The unweeded control recorded the highest weed population. N application significantly influenced the weed population at 60 DAT. In general, the population of BLW, sedges and total decreased with the increased N levels. Application of 90 kg/ha recorded the highest NLW population followed by 60 and 30 kg N/ha.

The weed management practices significantly influenced the weed dry weight at 60 DAT (Table 1). In general, dry weight of broad leaf weeds (BLWs) was recorded higher compared to narrow leaf weeds (NLWs) and sedges at 60 DAT**.** The dry weight of BLWs was found the lowest with HW at 20 and 40 DAT compared to other treatments at 30 and 60 DAT. The dry-weight of NLWs and sedges was found lower in oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha, followed by oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT at DAT. Application of N favoured the crop growth and therefore suppressed the weed growth by shading (Singh and Tripathi, 2008). Thus, weed dry weight decreased with the increased N levels at 60 DAT. Application of 60 and 90 kg N/ha recorded the lowest weed dry weight of BLWs, sedges and total. However, application of 90 and kg N/ha recorded the highest weed dry weight for NLW, while the lowest weed dry weight at 0 and 30 kg N/ha. The population and dry weight of NLW increased with increased N dose as these weeds can compete better with rice compared to BLW and sedges (Walia *et al.*, 2009). The dry weight of BLW and sedges decreased with the increased N levels from 0 kg N/ha to 90 kg N/ha. The application of oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT, oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha and 2 HW recorded similar values for weed-control efficiency (WCE) (80–83%). The WCE was not influenced with N management practices at 60 DAT.

The grain yield and economics of transplanted rice were significantly influenced with weed and nitrogen management practices (Table 1). The grain yield was

Table 1. Effect of weed and nitrogen levels on weed parameters, grain yield and economics in transplanted rice during 2017

Treatment	Weed population (nos./m^2) at 60 DAT				Weed dry weight (g/m^2) at 60 DAT				Weed-control efficiency (%) at 60 DAT	Grain yield (t/ha)	Gross returns (×10^3 ₹/ha)	Net returns (×10^3 ₹/ha)
	BLWs	NLWs	Sedges	Total	BLWs	NLWs	Sedges	Total				
Weed management												
Unweeded control	4.81 (22.6)	4.64 (21)	4.96 (24)	8.27 (68)	11.74 (138)	7.98 (66)	7.56 (57)	16.14 (261)	0.00	1.63	24.81	-6.04
Oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha	2.32 (5)	1.97 (3.5)	2.27 (4.8)	3.70 (13.3)	7.29 (58)	4.47 (19)	5.32 (28)	10.30 (105)	80.46	3.85	58.41	24.04
Oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT	2.07 (4)	1.81 (3)	2.42 (5.5)	3.59 (12.5)	6.92 (47)	5.57 (31)	6.48 (42)	10.97 (120)	81.61	3.88	58.85	21.20
HW at 20 and 40 DAT	1.84 (3)	2.05 (3.7)	2.33 (5)	3.50 (11.9)	5.81 (33.5)	6.44 (41)	6.88 (47)	11.04 (121)	82.52	4.02	61.01	19.37
SEm±	0.12	0.10	0.09	0.11	0.16	0.26	0.15	0.29	1.05	0.08	1.26	1.26
CD (P=0.05)	0.43	0.33	0.31	0.38	0.57	0.91	0.53	0.99	3.62	0.29	4.37	4.37
Nitrogen level (kg/ha)												
0	3.03 (10)	2.36 (6.5)	3.24 (11.2)	4.93 (27.8)	8.89 (84.4)	5.53 (31.2)	7.13 (51)	12.71 (166)	59.77	2.41	36.73	1.66
30	2.80 (9)	2.52 (7.3)	3.08 (10.5)	4.78 (26.8)	8.03 (69.7)	6.06 (37.9)	6.85 (47)	12.21 (154)	61.88	3.27	49.60	13.46
60	2.77 (8.6)	2.66 (8)	2.89 (9)	4.71 (25.6)	7.85 (65.7)	6.46 (43.5)	6.32 (40)	12.00 (149)	60.66	3.81	57.70	21.22
90	2.43 (7)	2.92 (9.5)	2.77 (8.6)	4.63 (25.2)	7.41 (58)	6.42 (44)	5.94 (35.7)	11.52 (138)	62.29	3.89	59.04	22.24
SEm±	0.10	0.09	0.06	0.07	0.14	0.23	0.07	0.13	0.71	0.06	0.83	0.83
CD (P=0.05)	0.30	0.27	0.17	0.21	0.42	0.68	0.22	0.38	NS	0.16	2.42	2.42

DAT, Days after transplanting; BLWs, broad leaf weeds; NLWs, narrow leaf weeds; Figures in parentheses are original values

higher with HW at 20 and 40 DAT which remained at par with oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT and oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha application. Unweeded control recorded the lowest yield of grain. The less infestation of BLW, NLW and sedges with HW at 20 and 40 DAT resulted in less competition for the resources such as light, space and nutrients (Zhang *et al*., 2009). Therefore, the growth of rice crop was high and the grain formation was high compared to rest of treatments. Among N levels, 90 kg N/ha and 60 kg N/ha observed significantly the higher grain yield followed by 30 and 0 kg N/ha. N plays an important role in the dry matter accumulation through the photosynthesis in the rice crop. A higher application of N resulted in high growth and vigour of crop compared to no N application (Dass *et al.,* 2017). The highest gross returns were observed with HW at 20 and 40 DAT followed by oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT and oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT (Table 1). However, the highest net returns and benefit: cost ratio were found with oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha, followed by oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT. Application of 90 kg N/ha recorded the highest net returns and benefit: cost ratios.

It can be concluded that application of oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha and oxadiargyl 0.08 kg/ha *fb* HW at 40 DAT was found comparable to 2 HW at 20 and 40 DAT in terms of weed flora and grain yield. However, in terms of net returns, oxadiargyl 0.08 kg/ha *fb* bispyribac-Na 0.02 kg/ha with application of 90 kg N/ha was found optimal for higher productivity and profitability and could be an alternative of HW in North-Eastern region of India.

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