Biological Forum – An International Journal **15(8a): 161-163(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Economic viability of Rice (*Oryza sativa L*) varieties to different Levels of Nitrogen under Wetland Rice Cultivation of Mizoram

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(Received: 15 June 2023; Revised: 27 June 2023; Accepted: 29 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: On the subject of the economic sustainability of rice (*Oryza sativa* L) types to various levels of nitrogen under wetland rice agriculture, a field experiment was carried out in Champhai in 2019 and 2020. With 'CO-52' at 80 kg N/ha, plant height and dry matter output were at their maximum. Panicles/m^2, full grains/panicle, production of grain and straw (4.50 tons/ha), as well as the uptake of nitrogen by grain and straw, were all noticeably greater with "CO-52". Rising nitrogen levels increased the number of panicles/m^2, the number of filled grains per panicle, the yield of grains and straw, and the amount of nitrogen taken up by grains and straw only up to 80 kg N/ha. The maximum grain production and economics were observed with "CO-52" at 80 kg N/ha, and it was discovered to be the ideal combination for wetland rice agriculture. Varieties and nitrogen levels interacted considerably.

Keywords: Rice, Split dose, WRC, LAI, Panicle, yield.

INTRODUCTON

According to the FAO (2001) the demand for rice will rise by 25% between 2001 and 2025 in order to keep up with population growth. The area of rice grown in wetlands is expanding; however this is due to a lack of lowland-appropriate cultivars and adequate nitrogen-level technologies. To meet the rising demand for rice with the limited resources available, it is vital to boost yield per unit area using improved varieties. Due to rivalry among agricultural, industrial, and home users, a water crisis is on the horizon. In Asia, rice is irrigated with more than 50% of the irrigation water (Bouman *et al.*, 2006). By farming enhanced cultivars in wetlands, it is possible to reduce the weed population and increase crop output by flooding the crops during the growing season (Tuong *et al.*, 2005).

The main nutrient that restricts the production of rice is nitrogen. The nitrogen-use efficiency of lowland rice ecosystems is roughly 30%, whereas it would range from 40 to 60% for upland rice, whether it is rainfed or irrigated (Dubeye *et al.*, 1983). However, it is necessary to measure the amount of nitrogen needed for wetland rice, taking into account the cultivars, environment, and management practises. There is a severe paucity of trustworthy knowledge on the crucial agro-techniques for effective wetland rice farming in this area. The goal of the current study was to locate the most productive enhanced cultivars for wetland conditions and to calculate the ideal nitrogen dose.

MATERIALS AND METHODS

The field study was carried out in the highlands of Mizoram during the rainy (kharif) seasons of 2019 and 2020 at the wetland of the instructional farm, Krishi Vigyan Kendra, Champhai (23°31'30.36" N 93°09'40.32" E at 1187 m above mean sea level). The soil had a coarse texture and had low levels of accessible nitrogen, phosphate, and potassium as well as organic carbon (0.40%). Three varieties—'CO-52', 'CAU-R1', and 'Gomati'—were placed in the main plots of the experiment while three nitrogen levels—25, 50, 75, and 100 kg/ha—were placed in the sub plots. The experiment was set up using a split plot design. At the stages of active tillering, panicle initiation, and grain filling, nitrogen was supplied in three equal splits. All plots received a consistent basal dose of 50 kg K_2O/ha and 60 kg P_2O_5/ha. To achieve the desired tilth, the experiment area was power tilled twice. On June 4 and 6, 2019 and 2020, rice seed was directly placed in nurseries to raise seedlings. The seed was treated with the fungicide carbendazim at a rate of 1g/kg seed, immersed in water for 12 hours, held for 24 hours to allow for good sprouting, and then distributed in the nursery. All of the plots underwent transplanting at 25 DAS with a 25 × 10 cm row to row and plant to plant spacing. To control weeds, hand weeding was done twice, at 25 and 45 DAS. In both 2019 and 2020, the crop was harvested on October 31. Following the conventional statistical analysis of variance approach, the data collected on the different growth and yield metrics of the rice crop were examined.

RESULT AND DISCUSSION

A. Growth parameters

In comparison to "Gomati," the rice cultivars "CO-52" and "CAU-R1" showed noticeably higher plant height and leaf-area index (LAI) values (Table 1). 'Gomati' was linked to the LAI that was the lowest. 'CO-52' followed by 'CAU-R1' resulted in noticeably greater dry matter. 'Gomati' generated the least amount of dry matter. Only up to 75 kg N/ha did plant growth metrics such plant height, LAI, and dry matter increase; at 100 kg N/ha, these indicators drastically reduced.

The ability of "CO-52" to produce the maximum growth stature under wetland conditions may be what accounts for this. "CAU-R1," on the other hand, would produce low growth, especially under wetland conditions. With regard to all growth metrics, including plant height, LAI, and dry matter production, the highest stature was observed at 75 kg N/ha and the lowest at 25 kg N/ha (Kumar *et al.*, 1996). Higher dry matter was not produced despite applying nitrogen at its greatest rate.

Table 1: Growth and yield attributes of rice varieties as influenced by different levels of nitrogen (pooled data of 2 years).

Treatment	Plant height at harvest (cm)	Leaf-area index at 60 DAS	Dry matter production at harvest (t/ha)	Panicles/m^2	Filled grains/panicle
Variety					
‘CO-52’	95.5	5.1	14.5	188.0	145.0
‘CAU-R1	85.2	4.2	11.4	174.0	123.0
‘Gomati’	90.0	4.8	13.2	180.0	133.0
SEm+-	1.1	0.1	0.2	1.4	2.0
CD (P=0.05)	3.6	0.4	0.8	5.1	7.1
Nitrogen (kg/ha)					
25	85.2	4.2	15.2	170.2	117.5
50	88.4	4.6	16.3	180.0	133.2
75	90.2	5.3	17.0	186.2	143.5
100	90.5	4.8	16.3	181.2	137.4
SEm+-	0.9	0.1	0.1	1.4	1.7
CD (P=0.05)	2.8	0.2	0.5	4.0	5.0

B. Yield attributes and yield

Compared to all other types, "CO-52" generated noticeably more panicles/m^2 and full grains/panicle (Table1). The quantity of panicles with "CAU-R1" was comparable to that of "Gomati," nevertheless. The variety "Gomati" had the fewest panicles and filled grains per panicle.

The number of panicles/m^2 and filled grains/panicle considerably increased when nitrogen levels were increased up to 75 kg N/ha. 25 kg N/ha was recorded as the lowest. The maximum number of filled grains/panicle suggests that assimilates were effectively translocated to the sink, which led to sound filling of grains (Prasad, 2011). The yield attribute with the lowest condition was 25 kg N/ha. The results of Maheswari *et al.* (2007); Dubey *et al.* (1983) are supported by better performance under 75 kg N/ha in terms of yield attributes of rice under highland conditions.

The CO-52 variety outperformed all other kinds in terms of grain yield, by a wide margin (Table 2). The yield of grains from "CAU-R1" and "Gomati" was comparable. Nitrogen additions gradually increased grain output up to 75 kg N/ha before the yield started to drop. With 75 kg N/ha, grain yield was much higher than with other doses. This finding is in corroboration with the findings of Guang *et al.* (2005) and Haque, (1988).

Table 2: Yield, nitrogen uptake and economics of rice varieties as influenced by different levels of nitrogen (pooled data of 2 years).

Treatment	Grain yield (t/ha)	Nitrogen uptake by grain (kg/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Benefit: cost ratio
Variety					
‘CO-52’	4.20	28.4	48050	26600	1.95
‘CAU-R1’	3.50	21.6	38780	23520	1.70
‘Gomati’	3.80	24.2	43100	20700	1.58
SEm+-	0.10	0.7	0.86	0.82	0.06
CD (P=0.05)	0.37	2.4	2.96	2.86	0.21
Nitrogen (kg/ha)					
25	3.30	24.2	36520	15600	1.38
50	4.00	28.2	43650	21300	1.70
75	4.20	31.0	47200	25400	1.90
100	4.05	29.5	44500	22700	1.65
SEm+-	0.09	0.5	0.92	0.92	0.07
CD (P=0.05)	0.27	1.5	2.65	2.65	0.19

C. Nitrogen uptake

The CO-52 variety greatly outperformed all other types in terms of grain nitrogen uptake (Table 2). The types with the maximum nitrogen uptake were CO-52 and CAU-R1, respectively. On "Gomati," grain uptake of nitrogen was found to be the lowest. Uptake of nitrogen increased with increasing nitrogen levels until it reached 75 kg N/ha, after which it began to fall. At 75 kg N/ha, which was much more than the other nitrogen levels, grain absorbed the most nitrogen. Due to its weak LAI and low dry-matter production, the absorption of nitrogen was decreased at 25 kg N/ha. Similar result in rice was observed by Belder *et al.* (2005); and Mhaskar *et al*. (2005).

D. Economics

With different cultivars and nitrogen levels, rice production under upland conditions had considerably different gross, net returns, and benefit: cost ratios (Table 2). The variety "CO-52" achieved the highest benefit: cost ratio compared to all other kinds, with significantly greater gross and net returns. However, "CAU-R1's" gross and net returns and benefit: cost ratio were comparable to "Gomati." Adoption of any improved agro-technique has a major part in the production of remunerative economic returns. 'CO-52' and nitrogen level of 75 kg/ha were determined to have the highest gross and net returns as well as benefit: cost ratios in the current study.

Therefore, variety "CO-52" with application of 75 kg N/ha was shown to be optimal for rice produced in wetland conditions as it has led to the growth of wetland rice and improved productivity in addition to boosting profitability.

CONCLUSIONS

The study's conclusions showed that the variety "CO-52" with a 75 kg N/ha treatment was ideal for rice grown in wetland conditions since it promoted wetland rice development, increased productivity, and boosted profitability. Among the three different varieties CO-52, CAU-R1 and "Gomati"—with the three different nitrogen concentrations, namely 25, 50, 75, and 100 kg/ha.

Acknowledgement. The authors acknowledge the support extended by ATARI Zone VII and Directorate of Govt. of Mizoram.

Conflict of Interest. None.

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How to cite this article: Om Prakash, Santosh Kumar and Rohit Shukla (2023). Economic viability of Rice (*Oryza sativa L*) varieties to different Levels of Nitrogen under Wetland Rice Cultivation of Mizoram. *Biological Forum – An International Journal*, *15*(8a): 161-163.