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Assessment of protein rich rice varieties CR Dhan-310 and CR Dhan-311 at different agro-climatic zones of Odisha

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Abstract

An On-Farm multilocational trial was carried out at farmers field in 4 districts of Odisha during Kharif 2020-21 and 2021-22 to evaluate the performance of protein rich rice varieties CR Dhan-310 and CR Dhan-311 which were compared to the farmers variety Lalat. CR Dhan-310 recorded the highest plant height (108.2 cm), effective tillers plant⁻¹ (13.1), no of panicles m⁻² (311.7), 1000 grain weight (23.64 g) with yield of 44.6 q ha⁻¹ followed by variety CR Dhan-311 recorded plant height 107.5 cm, no. of effective tillers plant⁻¹ was 11.42, no. of panicles m⁻² was 281.2, 1000 grain weight 22.2 g with yield of 41.3 q ha⁻¹ followed by farmers variety Lalat with plant height 93.1 cm, effective tillers plant⁻¹ is 10.1, no of panicles m⁻² was 270.8, 1000 grain weight 20.8 gm with yield of 39.3q ha⁻¹. The variety CR Dhan-310 gave a higher gross return of Rs. 85,360/- with a benefit cost ratio of 1.7 and additional net return of Rs.36,660/- as compared to CR Dhan-311 and farmers variety Lalat. CR Dhan-310 recorded higher Grain Protein contain (GPC) of 10.2 followed by CR Dhan-311 of GPC 10.1 followed by farmer variety Lalat with (GPC 5.3).

Keywords: Protein, rice, rich and multilocational

Introduction

Green revolution significantly enhanced the production and productivity and achieve the food security problems of developing nations like India, but in terms of dietary diversification it is far away from the developed nations. Rice covers about 69% of the cultivated area and is the major crop covering about 65.83% of the total area under food grains. Milled rice grains generally contain 6-7% protein which is the lowest among the cereals including wheat 12-14% and maize 8-9%. However, rice protein is considered to be the best among the cereal's protein due to higher quality because it contains essential amino acid like lysine. Rice is the staple food of 70% of the Indians. Therefore, the impact of increasing the protein content in rice would be enormous, particularly in the scenario where more than a third of world children are affected by protein-energy malnutrition. In India 80% children under 5 years age are under nourished for whom the recommended intake of protein is 13-19 g/day. Odisha is a poor state with around 32.59% of the population living below poverty line, so malnutrition is one of the major problems.

So, keeping in view of such problems and after detailed survey on-farm multilocational trials was conducted with an objective to evaluate growth & yield parameters of newly released promising high yielding short duration protein rich rice varieties CR Dhan-310 and CR Dhan-311 through farm testing for the suitability in the existing farming situation of old variety- Lalat.

Materials and Methods

The trial was carried out in four locations in farmers field during kharif 2020-21 and 2021-22 at Kultakhali village in Boudh, Nuapada village in Sonapur, Nuagaon village in Deogarh and Jamala village in Balasore under different climatic zones of Odisha with an objective to evaluate

the performance of medium duration protein rich rice var. CR Dhan-310 and CR Dhan-311 in comparison to the farmers practice Lalat. Standard package of practices was followed under the guidance of KVK scientists.

The tested HYV CR Dhan-310 was released at national level as first high protein rich rice variety for the state of Odisha, Uttar Pradesh & Madhya Pradesh in the year 2016. It has medium duration 120-125 days, semi-dwarf plant type 110cm with average 10.2% protein in polished rice. Whereas CR Dhan-311 has high protein content 10.1%, medium duration 120-125 days semi-dwarf 115 cm with long bold grain and good cooking and eating quality. Both the varieties are suitable for irrigated and shallow rainfed areas.

The treatment Lalat (T₁), CR Dhan- 310 (T₂) and CR Dhan-311(T₃) were replicated 7 times in a randomized block design in each location. The crops were transplanted during 1st week of July and harvested in last week of October. 7 different farmers each having 0.05 ha of land cultivated the paddy variety Lalat (T₁), CR Dhan- 310 (T₂) and CR Dhan-311(T₃) with standard Package of practices. Observation on different growth and yield parameters were taken time to time. Economic analysis was also done calculating cost of cultivation, gross return, net return and B:C ratio. Final crop yield (grain & straw) was recorded and the gross return were calculated on the basis of prevailing market

price of the produce.

Harvest Index is the relationship between economic yield and biological yield. It was calculated by using the below formula

$$\text{Harvest index (\%)} = \frac{\text{Economic yield} \times 100}{\text{Biological yield}}$$

Protein Content: Estimation of Grain Protein Content in rice:

Micro-Kjeldahl method- Total Nitrogen content was determined by the method of FAO (1970). Exactly 200 mg of rice grain was digested with concentrated H₂SO₄ followed by distillation using 5 ml of 4% boric acid and 10 ml of 40% NaOH solution and titration against standard 0.01 NHCl solution. Amount of nitrogen in the sample was calculated using the following formula:

$$\% \text{ N} = (\text{ml HCl in sample}) - (\text{ml HCl in blank}) \times \text{normality of acid} \times 14.01 \times 100 / \text{weight of sample (mg)}$$

$$\text{Percentage of GPC} = \% \text{ N} \times 5.95$$

Results and Discussion

Table 1: Effect of different treatments on growth and yield parameters (pooled data of 2 years)

Treatments	Plant height (cm)	No. of effective tillers /plant	No. of panicle/m ²	1000 grain wt. (g)	Protein contain
Lalat	93.17	10.1	270.8	20.8	5.3
CR Dhan-310	108.2	13.1	311.7	23.6	10.2
CR Dhan-311	107.5	11.4	281.2	22.2	10.1
S.Em (±)	0.726	0.60	5.82	0.32	0.93
CD at 5%	2.23	1.85	5.3	0.99	0.28

Yield attributes: Analysis of pooled data (Table-I) indicate that higher plant height (108.2cm), effective tiller/plant (13.1), No. of panicle/m² (311.714) 1000 grain weight (23.6 g), protein contain (10.2) were recorded in CR DHAN-310 followed by plant height (107.5 cm) effective tiller/plant (11.4), No. of panicle/m² (281.2) 1000 grain weight (22.2 g), protein contain (10.1) in rice variety-CR Dhan-311. The lowest plant height (93.1 cm), effective tiller/plant (10.1), no. of panicle/m² (270.8) 1000 grain weight (20.8 g), protein contain (5.3) in farmers variety Lalat, which is much lower as compared to CR Dhan-310 in term of yield attributing characters. The number of grains per unit area and test weight of seeds are two important

parameters which has direct bearing with yield per plant and production per unit area. The number of grains is directly dependant on number of panicles m² and number of grains panicle⁻¹. It might due to higher uptake of N by CR Dhan-310 which led to a positive source-sink gradient of photosynthates translocation. Similar results were also reported by Coumaravel and Bhaskar (2010) [4] and Ghosh *et al.* (2012) [5]. CR Dhan-310 rice variety naturally have higher protein content due to their genetic makeup. Breeding programs have also developed rice strains with enhanced protein levels to improve nutritional quality (Kusuma *et al.*, 2020) [6].

Table 2: Effect of different treatments on yield (pooled data over 2 years)

Treatments	Yield(q/ha)	Cost of cultivation	Gross Return (₹ ha ⁻¹)	Net Return ((₹ ha ⁻¹)	B: C ratio	Harvest index
Lalat	39.3	47500	76,242	28742	1.6	47.1
CR DHAN-310	44.0	48700	85360	36660	1.7	52.2
CR DHAN-311	41.0	48500	80122	31,622	1.65	50.4

Yield and Production economics

An economic analysis of the pooled data of two years (Table 2) revealed that rice cv. CR Dhan-310 produced a higher grain yield of 44.6 q ha⁻¹ than rice Var. CR Dhan-311 of 41.0 q ha⁻¹ and farmers variety Lalat with 39.3 q ha⁻¹. This significant improvement in yield is attributed to the cultivar's high genetic potential, better adaptability to the environment, and effective utilization of inputs. The enhanced yield is critical for farmers aiming to maximize productivity per unit area (Kusuma *et al.*, 2020) [6]. It also revealed that rice cv. CR Dhan-310 recorded a higher gross return of ₹ 85360/- ha⁻¹ with a benefit-cost ratio of 1.7 and an additional net return of 33660/- as compared to

farmers' practice which gave a net return of ₹28,742 and B: C 1.6. The higher gross return is directly linked to increased yield, while the better net return and B:C ratio indicate efficient input usage.

Conclusion

Based on findings, it was concluded that rice variety CR DHAN-310 recorded higher grain yield, with higher tillering capacity, higher return and B: C. It was also found that protein content in CR DHAN-310 is higher in comparison to Variety CR DHAN-311 and Farmers variety Lalat. This protein rich rice var- CR Dhan-310 can replace cultivated medium duration var- Lalat to

mitigate malnutrition and improve productivity.

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