Research Bulletin No. 42

PERFORMANCE OF BIOFORTIFIED AND CLIMATE SMART RICE VARIETIES FOR ASSAM UNDER DBT-SPONSORED BIOTECH-KISAN PROJECT

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भाकृअनुप - राष्ट्रीय चावल अनुसंधान संस्थान
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ICAR-National Rice Research Institute
Cuttack–753006, Odisha, India

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सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
बायोटेक्नोलॉजी विभाग
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Foreword

It is a matter of pride that the country has attained a record of rice production of 127.93 million tons during 2021-22. This has become possible due to right policy of the Government, technology back up provided by research institute, appropriate delivery mechanism and painstaking efforts of farmers. However, it remains challenging to sustain and further enhance the productivity in order to feed the ever-growing population which is expected to reach 1.6 billion by 2050. Rice being the staple crop in our country, any reduction of rice production in system will have negative impact in our food security. On the backdrop of this, Govt. of India, Ministry of Science and Technology, Department of Biotechnology (DBT) initiated Biotech-KISAN program, which is a farmer centric scheme with income & employment generation coupled with livelihood improvement. It is a Pan-India program, following a hub-and spoke model and stimulates entrepreneurship and innovation in farmers and empowers women. Biotech-KISAN features to identify and promote local farm leadership. Such leadership helps to develop science-based farming besides facilitating transfer of knowledge. Accordingly Regional Rainfed Lowland Rice Research Station under ICAR-NRRI also established one centre including 3 aspirational districts viz.Baksa, Barpeta and Darrang in Assam.

This technical bulletin on "Performance of Biofortified and Climate Smart Rice Varieties for Assamunder DBT-sponsored Biotech-KISAN Project" published by Regional Rainfed Lowland Rice Research Station, National Rice Research Institute, ICAR accesses the impact of the programme on production and productivity in the State of Assam. Convergence of extension functionaries and research scientist brought a significant change in the successful implementation of the programme.

I hope the bulletin will be useful to the policy makers, extension personal as well as researchers involved in agricultural development in Assam.

(Dr. Sanjay Mishra)

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PREFACE

Rice is life; rice is culture for millions of people throughout the world. Rice is used in different ceremonies, rituals and as staple food for half of the world population. Rice availability in India determines the food, nutritional and livelihood security. ICAR-NRRI, the then Central Rice Research Institute, was established on April 23, 1946at Cuttack by the Government of India to conduct and coordinate research on rice to help in making the country self-sufficient that will, in turn, aid in ensuring food security of the country. Having made yeoman contribution to rice research, RRLRRS Gerua was established in the year 1997 to help in expediting NRRI's efforts to develop suitable high yielding varieties of rice-the staple cereal for this part of North-Eastern India.

While formulating the project proposal for DBT Biotech-led KISAN Hub project, the concept of Biofortified rice varieties and Climate Smart rice varieties in Assam was not popular / aware among most of the grower and agricultural officials. The world's first ever Biofortified rice variety CR Dhan 310 was released in 2016 and CR Dhan 311& Climate Smart rice varieties CR Dhan 801 and CR Dhan 802 were released in 2019 by NRRI for different states of India where Assam was not included as a testing centre of AICRIP on Biofortification trials. To create awareness and popularity of these four rice varieties, a massive program was proposed in the project proposal and during implementation of the project, all these four rice varieties were well accepted by the farmers in Assam - particularly in Barpeta, Baksa and Darrang districts.

The demonstrations conducted as OFT, FLD and MLT of these four varieties during last two years 2020-21 & 2021-22 generated sufficient field data which helped to propose these four rice varieties for release in the state of Assam. On 6th of May, 2022 the State Seed Sub Committee of Assamrecommended these four rice varieties along with CR Dhan 307 from RRLRRS, Gerua to CVRC for area expansion in the state of Assam and on 88th CVRC meeting held on 17th June, 2022, the CVRC accepted all the proposals. Thus, the Biotech-led KISAN Project was instrumental in generating data from the multi-location trialsthat helped in release of these varieties for Assam.

This technical bulletin is prepared to elucidate the importance of the four rice varieties that are not only climate smart but biofortified for higher protein content. Theevaluation trials of these varieties were conducted in fifteen villages of three aspirational districts *viz*. Barpeta, Baksa and Darrang.

I hope this bulletin will be useful to all stakeholders associated with paddy cultivation in Assam especially the state department of agriculture in creating awareness about the four valuable rice varietiesamong the farmers so that it reaches to them. RRLRRS Gerua has already embarked on producing breeder and foundation seeds of these varieties which can be sourced from the RRLRRS, Gerua.

Rupankar Bhagawati

ACKNOWLEDGEMENT

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The authors duly acknowledge all the helps receives from the Director, ICAR-NRRI, Cuttack and other officials from ICAR-NRRI, Cuttack, Odisha and Assam Agricultural University, Jorhat, Assam during implementation of the project.

We express our gratitude to the Secretary, Department of Biotechnology for constant encouragement and support. We are also grateful to the Chairman and members of the Project Monitoring and Steering Committee (PSMC) for their constructive suggestions. Grateful thanks to Dr Md. Aslam, Ex-Senior Advisor, Dr Sanjay Mishra, Senior Advisor and Dr Sanjay Kalia (Scientist–E) for their support during the course this project.

R. Bhagawati
and
Co-authors

Introduction

The project area of Biotech KISAN Hub at RRLRRS, Gerua, is predominantly rainfed shallow lowland rice ecosystem in which it is a common feature of having both extremes of flood, followed by drought as a recurring problem which leads to heavy loss in rice production. Hence the varieties for the lowland ecology have to be submergence as well as draught tolerant. Seed dormancy, anaerobic germination ability, lodging resistance, tolerance to pre-harvest sprouting and to major biotic and abiotic stresses are crucial traits to be deployed in lowland rice varieties. Due to variation in water level, soil type and duration of the crop, this ecology is not suitable for raising any crop other than paddy. The anticipated change in climate, in future may, compel the farmers to produce rice even under the stressful conditions. Another challenge is the growing population, over exploitation of land and other natural resource due to urbanization, the pressure of feeding the burgeoning population will continue to rise. The state of Assam is identified as chronically flood affected and nearly 45%of its rice growing area comes under several flashes of flood followed by intermittent droughtin a season. Thus, rainfed ecology of Assam has remained untapped for higher production. Presently, the growth of rice production has become almost stagnant. Therefore, the viable option for increasing overall rice production of the state lies in improvement in productivity of rainfed lowland ecology. This ecology faces tough challenges during the cropping season with respect to kind and duration of stress. Overall, development of climate smart varieties possess the potential to fight against the challenges of this ecology.

Submergence and drought are two major abiotic stresses in rainfed rice cultivation. The shallow lowland faces intermittent drought during the crop growth period. The submergence has emerged as the most prominent issue in lowland ecology. Both the stresses are of extreme type and may occur in the same season resulting in severe yield losses.Besides, the duration of the variety plays an important role in increasing cropping intensity as long duration paddy varieties makes it impossible to go for subsequent second crop in time after harvest of the main crop of rice. Therefore, under this situation, medium duration of 120-125 days should be preferred to avoid pre-harvest sprouting of summer paddy and to have successful thermos-sensitive crops like mustard in time after harvest of *Sali* rice.

Crop production systems should include nutrition-sensitive approaches and be aligned with the production of micronutrient-enriched (biofortified) staple foods for the target populations. Most of the staple foods like rice, wheat and maize are inherently low in micronutrients and cannot meet the recommended daily intake of micronutrients. This is especially true for rice

which is inherently low in micronutrients and when processed, extensively before consumption such as polishing, steaming and parboiling it loses protein bogies in the aluron layer of the endosperm. Therefore "Biofortification" of rice is intended as a sustainable, cost-effective and food-based means of delivering target micronutrients to population,which do not have access to or cannot afford diverse diets and other existing interventions such as fortified foods and supplementation. Biofortified rice varieties *viz*. CR Dhan 310 and CR Dhan311 are like value added paddy varieties, which will provide not only food and livelihood security but nutritional security at the same time to the population which depend on rice and rice-based food items.

CR Dhan 310 (IET 24780: CR2829-PLN-37)

A high protein rice variety, CR Dhan 310, was developed by ICAR-National Rice Research Institute, Cuttack with an average 10.3% protein in milled rice, by improving the popular high yielding variety Naveen and released by CVRC (Central Varietal Release Committee) as the first high protein rice variety in the country with an average grain yield of 4.5 t/ha and protein content of 10.3%. The variety is suitable for both rainfed and irrigated ecosystem in both *kharif* and *boro* season.

Figure 1: Field view of CR Dhan 310

The research on developing the high protein rice started, when the ICAR-National Rice Research Institute, Cuttack identified one accession (ARC10075) from Assam Rice Collection as high grain protein content (GPC) donor and used in three repeated backcrossing with recurrent parent, Naveen followed by generation advancement and selection for identification of introgression lines. Ten high yielding introgression lines were grown in the same experimental plot at the experimental farm of the National Rice Research Institute in *rabi*2014 and *kharif* 2014 under standard agronomic package and practices. All lines had significantly higher GPC and protein yield than their corresponding high yielding parent with acceptable grain quality. Among these lines, CR Dhan 310 (IET 24780) was identified as high protein rice variety with an average GPC of 10.3% in milled rice in multi-locational testing (under AICRIP-Biofortification trial).

The average grain yield of this variety at national level in the multi-locational testing was 4483 kg/ha, where in it outperformed the yield-check, Samba Mahsuri by registering yield superiority of 6.81%. It performed at par with the other national check IR 64. It has more than 10% protein content in polished grain which is much higher than high yielding parent (Naveen) and other checks and qualifying checks in the trial as reported in AICRIP trial and independently verified by CIFA, Bhubaneswar. The variety has been found better or at par with the checks with regard to its response to important biotic stresses. It was found tolerant or moderately tolerant to leaf blast, brown spot, sheath rot, stem borer, gall midge biotype 1 and leaf folder. This variety has very high head rice recovery (69.7%) and it has good cooking qualities as realized from its alkali spreading value (5) and intermediate amylose content (25.1%). This high protein line having high yielding ability has been released for Odisha, Uttar Pradesh and Madhya Pradesh by the Central Variety Release Committee in 2016, this year this promising variety was proposed for the state of Assam and in its 88th CVRC meeting held on 17.06.2022, it has accepted the proposed for release in Assam.

CR Dhan 310 is now found promising for Assam with 4589 kg/ha and 4820 kg/ha grain yield at FLD programme in Assam and at station trial at RRLRRS, Gerua station, respectively with around 5-19% advantage in grain yield and 33% advantage in protein yield over the checks. The release of CR Dhan 310, the high protein rice variety in Assam which may help in achieving the nutritional security where rice the staple food for majority of the population.

It is medium early (123 days) with semi-dwarf (110 cm), compact plant type and has good initial growth and tillering ability. The variety has very high head rice recovery (65%) and good cooking quality with an alkali spreading value of 4 and intermediate amylose content (24.7%). It also contains moderate level of Zn (15 ppm) in milled rice. This variety is higher in glutelin fraction and essential amino acids such as lysine and threonine compared to its parent, Naveen, which ensures better nutritional value and gut function in human. As this is not only a high yielding variety, but also rich in protein, it would prove to be a good source of nutrition for the people who mainly depend on rice for their nourishment.

Figure 2: RRLRRS Gerua scientists visited village Bangalpara, Kamrup District to monitor performance rice variety CR Dhan 310 in farmers field (inset- crop cutting in FLD programme of CR Dhan 310).

Figure 3: Field view of proposed variety IET 24780 (CR2829-PLN-37) with its parent (Naveen)

ARC10075 (HP-2) has been identified and reported from ICAR-CRRI, Cuttack as donor for high grain protein content (~12%). This was crossed with a high yielding popular variety, Naveen. A population (BC_3F_2) from this cross was developed by three consecutive backcrossing with recurrent parent Naveen, followed by pedigree selection for simultaneous trait introgression into the recurrent parent background for GPC. The proposed variety, IET 24780 (CR2829-PLN-37), a derivative of this cross belongs to BC_3F_5 generation.

Morphological features of the variety CR Dhan 310: IET 24780 (CR2829-PLN-37) in comparison with Naveen (Parent)

S. No.	Characteristics	Characteristic value of CR Dhan 310	Reference variety Naveen
1	Basal leaf: Sheath colour	Green	Green
2	Leaf: Pubescence of blade surface	Absent	Absent
3	**Leaf: width of blade**	**Narrow**	**Medium**
4	Leaf: Anthocyanin colouration of collar	Absent	Absent
5	Leaf: Shape of ligule	Acute	Acute
6	Leaf: Colour of ligule	Green	Green
7	**Flag leaf: Attitude of blade (early observation)**	**Erect**	**Semi-erect**
8	Spikelet: Colour of stigma	White	White
9	Stem: Anthocyanin colouration of internodes	White	White
10	Panicle: Exertion	Exerted	Exerted
11	Time of maturity	Medium	Medium
12	Decorticated grain: Shape	Medium	Medium
13	Decorticated grain: Colour	White	White
14	Endosperm: Content of amylase	Medium	Medium
15	Decorticated grain: Aroma	Absent	Absent

Package of practices of the variety CR Dhan 310 (CR2829-PLN-37) (IET 24780)

This variety is suitable for cultivation in favourable rainfed medium land and irrigated lands during *kharif* and irrigated land during *boro/rabi* season. It has a semi-dwarf plant type (100-110 cm) and matures in 120 days in *kharif* under transplanted conditions. During *rabi,* it matures in 125-130 days under transplanted conditions. The variety has medium slender grain with 69.7% head rice recovery. It average yields 4.50 to 5.0 t/ha paddy during *kharif* and 5.0to 6.0 t/ha paddy during *rabi*.

Recommended Cultural Practice

Land situation

***kharif* Season:** Favourable rainfed upland, lowland, medium lands and irrigated lands.

***rabi/boro*/dalua seasons:** Irrigated lands

Seed bed preparation

Dry seed bed

- Select suitable land near a water source in middle of June and December for *kharif* and *rabi* crops, respectively.
- Plough the soil 3-4 times by using rotavator to fine tilth and level properly. Apply fertilizer at the rate of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O with 5 t/ha of FYM/compost.
- Make raised beds of 1 meter width of any convenient length keeping a gap of 30 cm between the beds. About one tenth of area of the main field to require as the seed bed.

Wet seed bed

- Plough the land 4-5 times at 3-4 days interval for a fine puddle.
- Divide the plot into sub-plots of 1 m x 10 m size by making drainage channels on all the four sides. Make well-leveled and bunded seed bed for better water retention.
- Apply fertilizer at the rate of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O with 5 t/ha of FYM/compost.

Seed Rate and treatment

- 40-50 kg seeds/ha for transplanting and 50-60 kg/ha for direct seeding are recommended or use seed drill or pneumatic seeder may reduce seed rate to 25 kg/ha. Treat the seed using Bavistin @ 2g/kg seed. In the wet seed bed condition this can be done at the time of seed soaking.

Sowing time

- *Kharif*/wet season: Direct seeding in uplands by the first fortnight of June.
- For transplanting: Sowing by the first week of June in nursery bed.
- Dry/*boro*/dalua seasons: End of November to mid-December.

Nursery management

- After 24 hours of seed soaking drain the water, and cover the seed in gunny bag for germination.
- After 2-3 days when grains germinate, sow seeds on the nursery bed.
- Apply carbofuran (Furadan 3G) at 15 days after nursery sowing.
- Top dress the nursery bed, 7 days before uprooting.

Land preparation

- Puddle the field twice, give a gap of at least 7-8 days between initial and final puddling for better weed control and nutrient availability. Level the land with leveler to maintain uniform water level throughout the plot.

Spacing and stand establishment

- Transplant by mid-July with 20 cm x 15 cm spacing in *kharif* and by mid-January with 15 cm x 15 cm in *rabi* season.
- 18-20 days old seedlings should be transplanted in puddled field with 2-3 seedlings/hills. Gap filling once 7 days after planting, if required.

Fertilizer dose

- Wet season (Irrigated ecology): 80:40:40 NPK kg/ha + 5 t/ha FYM.
- Dry season: 40:20:20 NPK kg/ha + 5 t/ha FYM.
- Apply zinc sulphate @ 25 kg/ha in zinc deficient areas as basal application.
- Leaf Colour Chart (LCC) based N application may be followed for increasing N use efficiency.

Fertilizer application

- Apply half of total N, entire amount of P and three fourths of K as basal after draining out the standing water but before final puddling.
- Top dress the remaining N in two equal splits each at tillering (3 weeks after transplanting) and at panicle initiation. Also apply remaining one fourth of K at panicle initiation.

Weed management

- Spraying of early post-emergence herbicide, Pyrazosulfuron ethyl at 200 g /ha 3-5 days after transplanting controls the weed effectively. The post-emergence herbicide, Almix is found effective at 20 g/ha applied 18 -20 days after transplanting when infestation of sedges and broadleaf weeds are quite high as happened during dry season. Spraying should be done in thin film of water after draining out of excess water from crop field. The recommended dose of herbicide should be mixed in 500 litre of water for one hectare of land.

Water management

- Keep the field under saturated condition for a week after transplanting for establishment and growth of roots.
- Maintain a water level of 3-5 cm during the entire crop growth period. After that, the field should be drained prior to top dressing. Irrigate after 24-36 hours.
- Drain out water 15 days after milk formation stage.

Insect and disease control

- This variety is generally free from major pests and diseases. Soak the seedlings with 0.02% Chlorpyriphos overnight before transplanting.
- Stem borer is an important insect-pest. Generally, two broods are coming during January-February and March-April. Application of Furadan at 33kg/ha or Cartap at 25 kg/ha twice during 20 and 50 days after transplanting protects the crop.
- Brown plant hopper generally appears during the month of February-March. It can be controlled by spraying Monocrotophos (1.5 litre/ha) or Imidachloprid (500 ml/ha).
- If Sheath Blight appears avoid N application Spray Sheathmar 3 (Validamycin), Tilt or any other recommended fungicide @ 2.5 ml/litre at the appearance of disease symptoms or spray solution immediately after first top-dressing.
- Use 500 liter of water/ha for spraying pesticide and keep the field bund clean to minimize disease and pest attack.

Harvesting, drying and milling

- Harvest the crop when 80% of the grains in panicles are ripened.
- Thresh immediately after harvesting and dry gradually under shade up to 12% moisture content for seed purpose and 14% for milling.

Crop rotation

- As this variety is harvested early in the wet season, crops such as *rabi* rice, ground nut, maize, potato, vegetables and mustard can be grown after rice.
- It fits very well into the intensive three crop rotations like rice-rice-rice, rice-maize-cowpea, rice-potato-sesamum, rice-sunflower-green gram.

Figure 4. *Single plant and panicle of CR Dhan 310 (IET 24780: CR2829-PLN-37)*

Table 1: Performance of *boro* paddy var. CR Dhan-310, Season 2020-21 (District: Barpeta)

	Villages under Barpeta District, Season *Boro* 2020-21				
Rice Parameters	**Jalikhata**	**Barbila**	**Keotkuchi**	**Banglipara (Jania)**	**Check Variety**
Variety	CR Dhan 310	CR Dhan 310	CR Dhan 310	CR Dhan 310	**Naveen**
Duration	118 days	112 days	115 days	113 days	**118**
Av yield (q/ha)	46.8	47.1	47.4	48.2	**44.2**
Return from grain yield	64,350.00	64,762.00	65,175.00	66,275.00	**60,775**
Return from straw/ha	15,000.00	15,000.00	15,000.00	15,000.00	**13,000.00**

	Villages under Barpeta District, Season *Boro* 2020-21				
Rice Parameters	**Jalikhata**	**Barbila**	**Keotkuchi**	**Banglipara (Jania)**	**Check Variety**
Gross return	79,350.00	79,762.00	80,175.00	81,275.00	**73,775.00**
Net return	39,350.00	39,762.00	40,175.00	41,275.00	**33,775.00**
Benefit : Cost ratio	1.98	1.99	2.004	2.031	**1.84**
Disease and pest incidence (all stage)	Rice gundhi bug, Brown spot of rice	Rice gundhi bug	Rice gundhi bug, Brown spot of rice	Rice gundhi bug	Hispa, brownspot

N.B: *Cost of cultivation (Rs/ha) = 40,000.00, Selling price of per q of paddy: Rs. 1375.00*

Table 2: Performance of *sali* paddy var. CR Dhan-310, Season 2021-22 (District: Barpeta)

	Villages under Barpeta District, Season *Sali* 2020-21				
Rice Parameters	**Jalikhata**	**Barbila**	**Keotkuchi**	**Banglipara (Jania)**	**Check Variety**
Variety	CR Dhan 310	CR Dhan 310	CR Dhan 310	CR Dhan310	**Naveen**
Duration	123 days	122 days	125 days	125 days	**120**
Av yield (q/ha)	46.2	48.3	47.1	48.1	37.0
Return from grain yield	66,065.00	63,720.00	65,940.00	65,450.00	50,875.00
Return from straw/ha	15,000.00	15,000.00	15,000.00	15,000.00	13,000.00
Gross return	81,065.00	78,720.00	80,940.00	80,450.00	63,875.00
Net return	41,065.00	38,720.00	40,940.00	40,450.00	23,875.00
Benefit : Cost ratio	2.02	1.93	2.02	2.01	1.5
Disease and pest incidence (all stage)	Rice gundhi bug, Brown spot of rice	Rice gundhi bug	Rice gundhi bug, Brown spot of rice	Rice gundhi bug	Hispa, Gundhi Bug

N.B: Cost of cultivation (Rs/ha) = 40,000.00, Selling price of per q of paddy: Rs. 1375.00

Table 3: Performance of *boro* paddy var. CR Dhan-310, Season 2020-21 (District: Baksa)

	Villages under Baksa District, Season *Boro* 2020-21	**Check Variety**
Rice Parameters	Barimakha & Barbilla	
Variety	CR Dhan 310	Naveen
Duration	128 days	120 days
Av yield (q/ha)	46.4	38.0
Return from straw yield	15,000.00	11,000.00
Return from the grain yield	63,800.00	45,600.00
Gross return	78,800.00	56,600.00
Net return	38,100.00	15,900.00
Benefit : Cost ratio	1.93	1.39
Disease and pest incidence (all stage)	Rice Gundhi Bug, Hispa	Stem Borer, Hispa, Gundhi bug

** Gross cost of cultivation Rs/ha4 40,700; Selling price of Paddy @ Rs 1200/q*

Table 4: Performance of boro paddy var. CR Dhan-310, Season 2020-21 (District: Darrang)

	Villages under Darrang District, Season *Boro* 2020-21			
Rice Parameters	**Bihudia**	**Rangamati**	**Chereng Chapari**	**Check Variety**
Variety	CR Dhan310	CR Dhan310	CR Dhan310	Naveen
Duration	118days	115days	113days	119
Av yield(q/ha)	38.0	42.5	45.7	41.1
Return from grain yield	52,250	58,437.5	62,837.5	56,512.5
Return from straw/ha	11,000	11,000	12,000	10,000
Gross return	63,250.0	69,437.5	74,837.5	66512.5
Net return	28,250.0	34,437.5	39,837	31,512.5
Benefit:cost	1.80	1.98	2.13	1.90
Disease and pest incidence (all stage)	Rice gundhi bug, Rice hispa	Rice gundhi bug, Rice hispa	Rice gundhi bug, Rice hispa	Hispa, Gundhi bug

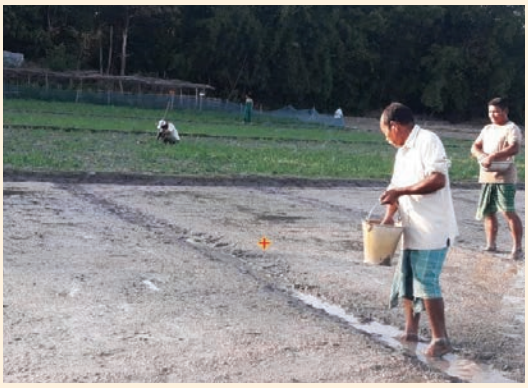
N.B: Cost of cultivation (Rs/ha)=35,000.00, selling price of per q of paddy : Rs.1375.00

Table 5: Performance of *sali* paddy var. CR Dhan-310, Season 2021-22 (District: Darrang)

	Villages under Darrang District, Season *Sali* 2021-22				
Rice parameters	**Bihudia**	**Rangamati**	**Khataniapara**	**Gargari**	**Vareity**
Variety	CR Dhan 310	CR Dhan 310	CR Dhan 310	CR Dhan 310	Naveen
Duration	122	125	120	122	120
Av Yield (q/ha)	37	43	44	42	40
Return from straw/ha	11,000	12,500	12,700	12,000	11,000
Return from grain yield	50,875	59,125	60,500	57,750	55,000
Gross return	61,875	71,595	73,200	69,750	66,000
Net return	22,865	32,585	34,190	30,740	26,990
Benefit:Cost Ratio	1.59	1.84	1.88	1.79	1.69
Disease and pest incidence (all stage)	Gandhi bug, chaffy grains	-	Gandhi bug	Gandhi bug	-

N.B: Cost of cultivation (Rs/ha) = 39,010.00, selling price of per q of paddy: Rs. 1375.00

Field photograph (CR Dhan 310)



Sowing of Summer Rice variety CR Dhan-310
Village: Barimakha
Date: 21-12-2020

Transplanting of Summer Paddy Variety CR Dhan 310
Village: Bunbari
Date: 28-01-2021
Coordinates: 26.6202651 N, 91.3656464E

Field Day on Boro Rice var. CR Dhan 310
Village: Barimakha
Date: 29-05-2021

CR Dhan 311 (IET 24772)

Rice is the main source of calories for billions of people in Asia-Pacific region. This cereal contributes 29% dietary protein for this population. But in general rice is deficient in protein. Therefore, a large section of the world population suffers from protein malnutrition. Backcross breeding procedure has been

Figure 5:Field view of Mukul (CR Dhan 311)

followed to transfer high grain protein content to var. Naveen, a popular high yielding variety for irrigated & rainfed ecosystem.

The rice variety Mukul (CR Dhan 311), IET 24772, a derivative of the cross, ARC10075/Naveen belongs to BC_3F_5 generation. This variety is medium early with semi-dwarf, compact plant type and has good initial growth and tillering ability.

In national level, the variety yielded at par with national checks, IR 64 and Samba Mahsuri in IVT and AVT-1 Biofortification trials. It had 10.10% protein in polished grain, which was much higher than the quality checks in the AICRIP Biofortification trials in 2014-2015. Under the same trials, it also reported to contain moderately high level of Zn (21 ppm) in 10% polished grain. This is significantly important to combat the micronutrient (Zn) malnutrition in people dependent on rice-based diet. The rice variety has been found at par with the checks with regard to its response to important biotic stresses.

Mukul (IET 24772) showed tolerance to leaf blast, glume discoloration, brown spot, RTD and bacterial leaf blight and moderate tolerance against brown plant hopper, gall midge and stem borer.

The variety has very high head rice recovery (60.15%) and good cooking quality as evident from its alkali spreading value (5) and intermediate amylose content (23.67%). It performed at par with its parent, Naveen in station and state trials.

Mukul (CR Dhan 311) is now found promising for Assam with 4710 kg/ha and 4914 kg/ha grain yield in station trial and at FLD programme in Assam, respectively. The protein content and protein yield of the variety, Mukul (CR Dhan 311), were found significantly higher than Naveen under station trial at RRLRRS, Gerua, Assam under FLD programme over the location in Assam. The protein content of this line and check, Naveen was independently verified by CIFA, Bhubaneswar.

The proposal for this nutrient rich rice variety Mukul with high protein and moderately high zinc content is submitted after approval from SVRC for release in Assam which may help in achieving the nutritional security where rice the staple food for majority of the population and CVRC accepted the proposal in its 88th meeting on 17-06-2022.

Package of practices for Mukul (CR Dhan 311)

This variety is suitable for cultivation in favourable rainfed medium land and irrigated lands during *kharif* and irrigated land during *boro/rabi* season. It has a semi-dwarf plant type (110-120 cm) and matures in 122-127 days in *kharif* under transplanted conditions. During *rabi,* it matures in 130 days under transplanted conditions. The variety has long bold grain with 60.15% head rice recovery. It yields 4.40-4.75 t/ha. The highest yield was recorded in N:P:K of 120:60:60 kg/ha in station trial.

Recommended Cultural Practise

Land situation

Wet/*kharif* Season: Favourable rainfed upland, lowland, medium lands and irrigated lands.

Dry/*rabi*boro/dalua seasons: Irrigated lands

Seed bed preparation

Dry seed bed

- Select suitable land near a water source in middle of June and December for *kharif* and *rabi* crops, respectively.
- Plough the soil 3-4 times by using rotavator to fine tilth and level properly. Apply fertilizer at the rate of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O with 5 t/ha of FYM/compost.
- Make raised beds of 1 meter width of any convenient length keeping a gap of 30 cm between the beds. About one tenth of area of the main field to required as the seed bed.

Wet seed bed

- Plough the land 4-5 times at 3-4 days interval for a fine puddle.
- Divide the plot into sub-plots of 1 m x 10 m size by making drainage channels on all the four sides. Make well-leveled and bunded seed bed for better water retention.
- Apply fertilizer at the rate of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O with 5 t/ha of FYM/compost.

Seed Rate and treatment

- 40-50 kg seeds/ha for transplanting and 50-60 kg/ha for direct seeding are recommended or use seed drill or pneumatic seeder may reduce seed rate to 25 kg/ha. Treat the seed using Agroson GN or Bavistin @ 2 g/kg seed.

In the wet seed bed condition this can be done at the time of seed soaking.

Sowing time

- *Kharif*/wet season: Direct seeding in uplands by the first fortnight of June.
- For transplanting: Sowing by the first week of June in nursery bed.
- Dry/*boro*/dalua seasons: End of November to mid-December.

Nursery management

- After 24 hours of seed soaking drain the water, and cover the seed in gunny bag for germination.
- After 2-3 days when grains germinate, sow seeds on the nursery bed.
- Apply carbofuran (Furadan 3G) at 15 days after nursery sowing.
- Top dress the nursery bed, 7 days before uprooting.

Land preparation

- Puddle the field twice, give a gap of at least 7-8 days between initial and final puddling for better weed control and nutrient availability. Level the land with leveler to maintain uniform water level throughout the plot.

Spacing and stand establishment

- Transplant by mid-July with 20 cm x 15 cm spacing in kharif and by mid-January with 15 cm x 15 cm in rabi season.
- 18-20 days old seedlings should be transplanted in puddled field with 2-3 seedlings/hills. Gap fill once 7 days after planting, if required.

Fertilizer dose

- Wet season (Irrigated ecology): 80:40:40 NPK kg/ha + 5 t/ha FYM.
- Dry season: 80:40:40 NPK kg/ha + 5 t/ha FYM.
- Apply zinc sulphate @ 25 kg/ha in zinc deficient areas as basal application.
- Leaf Colour Chart (LCC) based N application may be followed for increasing N use efficiency.

Fertilizer application

- Apply half of total N, entire amount of P and three fourths of K as basal after draining out the standing water but before final puddling.
- Top dress the remaining N in two equal splits each at tillering (3 weeks after transplanting) and at panicle initiation. Also apply remaining one fourth of K at panicle initiation.

Weed management

- Spraying of early post-emergence herbicide, Pyrazosulfuron ethyl at 200 g /ha 3-5 days after transplanting controls the weed effectively. The post-emergence herbicide, Almix is found effective at 20 g/ha applied 18 -20 days after transplanting when infestation of sedges and broadleaf weeds are quite high as happened during dry season. Spraying should be done in thin film of water after draining out of excess water from crop field. The recommended dose of herbicide should be mixed in 500 litre of water for one hectare of land.

Water management

- Keep the field under saturated condition for a week after transplanting for establishment and growth of roots.
- Maintain a water level of 3-5 cm during the entire crop growth period. After that, the field should be drained prior to top dressing. Irrigate after 24-36 hours.
- Drain out water 15 days after milk formation stage.

Insect and disease control

- This variety is generally free from major pests and diseases. Soak the seedlings with 0.02% Chlorpyriphos overnight before transplanting.
- Stem borer is an important insect-pest. Generally two broods are coming during January-February and March-April. Application of Furadan at 33kg/ha or Cartap at 25 kg/ha twice during 20 and 50 days after transplanting protects the crop.
- Brown plant hopper generally appears during the month of February-March. It can be controlled by spraying Monocrotophos (1.5 litre/ha) or Imidachloprid (500 ml/ha).
- If Sheath Blight appears avoid N application Spray Sheathmar 3 (Validamycin), Tilt or any other recommended fungicide @ 2.5 ml/litre at the appearance of disease symptoms or spray solution immediately after first top-dressing.
- Use 500 liter of water/ha for spraying pesticide and keep the field bund clean to minimize disease and pest attack.

Harvesting, drying and milling

- Harvest the crop when 80% of the grains in panicles are ripened.
- Thresh immediately after harvesting and dry gradually under shade up to 12% moisture content for seed purpose and 14% for milling.

Crop rotation

- As this variety is harvested early in the wet season, crops such as *rabi* rice, ground nut, maize, potato, vegetables and mustard can be grown after rice.
- It fits very well into the intensive three crop rotations like rice-rice-rice, rice-maize-cowpea, rice-potato-seasamum, rice-sunflower-green gram.

Figure 6: Single plant of the proposed variety (CR 2829-PLN-100) and its recurrent parent, Naveen

Figure 7. Single panicle, grains and kernel of proposed variety CR 2829-PLN-100 (IET 24772)

Table 6: Performance of *boro* paddy var. CR Dhan-311, Season 2020-21 (District: Barpeta)

	Villages under Barpeta District, Season *Boro* 2020-21				
Rice Parameters	**Jalikhata**	**Barbila**	**Keotkuchi**	**Banglipara (Jania)**	**Check Vareity**
Variety	CR Dhan 311	CR Dhan 311	CR Dhan 311	CR Dhan311	**Naveen**
Duration	118 days	112 days	115 days	113 days	118
Av yield (q/ha)	47.4	47.7	48.0	48.4	45.2
Return from grain yield	65,175.00	65,587.00	66,000.00	66,550.00	62,150.00
Return from straw/ha	15,000.00	15,000.00	15,000.00	15,000.00	15,000.00
Gross return	80,175.00	80,587.00	81,000.00	81,550.00	77150.00
Net return	40,175.00	40,587.00	41,000.00	41,550.00	37,150.00
Benefit : Cost ratio	2.004	2.001	2.025	2.038	1.90
Disease and pest incidence (all stage)	Rice gundhi bug, Brown spot	Stem borer	Rice gundhi bug, Brown spot	Rice gundhi bug	Hispa Gundhi bug

N .B: *Cost of cultivation (Rs/ha) = 40,000.00, selling price of per q of paddy: Rs. 1375.00*

Table 7: Performance of *sali* paddy var. CR Dhan-311, Season 2021-22 (District: Barpeta)

	Villages under Barpeta District, Season *Sali* 2021-22				
Rice Parameters	**Jalikhata**	**Barbila**	**Keotkuchi**	**Banglipara (Jania)**	**Check variety**
Variety	CR Dhan 311	CR Dhan 311	CR Dhan 311	CR Dhan311	**Naveen**
Duration	120 days	123 days	123 days	123 days	**120**
Av yield (q/ha)	47.1	47.2	46.8	47.5	37.3
Return from grain yield	64,112.00	63,145.00	65,119.00	64,598.00	51,287.50
Return from straw/ha	15,000.00	15,000.00	15,000.00	15,000.00	13,000.00
Gross return	79,112.00	78,145.00	80,119.00	79,598.00	64,287.50

Net return	39,112.00	38,145.00	40,119.00	39,598.00	24,287.50
Benefit : Cost ratio	1.97	1.95	2.0	1.98	1.6
Disease and pest incidence (all stage)	Rice gundhi bug, Brown spot	Stem borer, Rice gundhi bug	Rice gundhi bug, Brown spot	Rice gundhi bug, Brown spot	Hispa Gundhibug

N.B: *Cost of cultivation (Rs/ha) = 40,000.00, selling price of per q of paddy: Rs. 1375.00*

Table 8: Performance results of ***boro*** paddy var. CR Dhan-311, Season 2021-22 (District: Darrang)

	Villages under Darrang District, Season *Boro*2021-22			
Rice Parameters	**Khataniapara**	**Rangamati**	**Chereng Chapari**	**Check Variety**
Variety	CR Dhan 311	CR Dhan 311	CR Dhan 311	Naveen
Duration	118days	115days	113days	119
Av. yield(q/ha)	49.5	54	56	45.1
Return from straw/ha	12,000	11,000	12,000	10,000
Return from Grain yield	68,062.50	74,250.00	77,000.00	62,012.50
Gross return	80,062.5	85,250.0	89,000.0	72,012.5
Net return	45,062.5	50,250.0	54,000.0	37,012.5
Benefit: Costratio	2.28	2.43	2.5	2.05
Disease and pestIncidence (allstage)	Rice gundhi bug	Rice gundhi bug	Rice gundhi bug	-

N.B: *Cost of cultivation (Rs/ha)=35,000.00, selling priceofperqof paddy: Rs.1375.00*

Field Photograph Mukul (CR Dhan 311)

CR Dhan 801

The elite line IET 25667 was developed from the breeding materials of cross the IR81896-B-B-195/2*Swarna-*Sub1*//IR91659-54-35. CR Dhan 801 (IET25667) entered the Co-ordinated testing programme under the name of IET 25667 during WS 2015 under NIL trial. It has consistently out-performed the recipient parent under drought and submergence condition in AICRIP

testing. The variety has already been released in the states of Andhra Pradesh, Telangana, Odisha, UP and WB.

The variety showed excellent performance for submergence and drought trait along with yield at par with Swarna-Sub1.The variety is weakly photosensitive with average maturity duration of 140-145 days. It possesses short bold grain with a test weight of 20.5 g. It is resistant to stem borer (both dead heart and white ear heads), leaf folder and case worm while moderately resistant to bacterial blight and rice *tungro* virus.CR Dhan 801 was found to response higher dose of fertilizer application compared to the checks and qualifying varieties. CR Dhan 801 has good hulling, milling and head rice recovery as like the recipient parent and qualifying varieties. It possesses intermediate amylose content, Short bold grain and other desirable grain quality parameters. The variety, CR Dhan 801 has been released in the flash flood and drought affected state of Assam.

Figure 8: Field view of the variety, CR Dhan 801 (IET 25667) at maturity stage

Figure 9: Panicles and Grains of CR Dhan 801

Package of Practices

- **Suitability of the variety for the area-agro- climatic zone**

Variety CR Dhan 801 is promising for cultivation in the states of Assam, Odisha, WB, AP and Telanganaintheflash flood and drought ecologies.

- **Selection of field/land preparation practices.**

Plough the land immediately after the harvest of wet season rice, preferably with a mould board plough. One or two summer ploughings after pre-monsoon rain during April-May and ploughing before sowing makes the soil to a fine tilth.

- **Seed treatment: rate and timing/chemical**

Select genetically pure seed of the variety having more than 80% germination.

- **Sowing time**

For direct-seeding, optimal time is during the first fortnight of June. For transplanting, sow the seeds in nursery by the 1st week of June.

- **Seed rate/sowing method-line sowing with row to row and plant to plant distance/direct sowing**

Use 30 kg seeds/ha.Treat the seeds with Agrosan GN or Ceresan (dry) or Bavistin at the rate of 2 gm/kg of seed before sowing.

- **Fertilizer doses with timing per acre**

Apply N: P: K @ 80:40:40 kg/ha in case of poor soil fertility status (based on soil test results). Apply half N, full P and three fourths K as basal in the furrows in the line sown rice with farm yard manure at the rate of 5 t/ha.

- **Weed control- chemicals with doses & timing**

Weeding operations are to be completed which is around 45-60 days after seeding. Spray herbicide bispyribac sodium at the rate of 30 g a.i/ha in direct seeded rice for control of major grasses, sedges and broad leaf weeds. This is a post-emergence herbicide and it can be applied after 12 days of sowing.

- **Disease and pest control- chemicals with doses & timing**

Apply Streptocyclin (150mg) + Copper Oxychloride (1g) in one litre of water for controllingbacterial leaf blight disease. For controlling sheath rot disease, soak the seeds in 0.05%-0.1% Bavistin for 30 minutes before sowing. After raising the crop, minimize the disease by foliar spray of 0.05%-0.1% Bavistin or 0.4% Dithane M-45 or 0.1% Hinosan. For controlling the insect attack, spray is not feasible due to deepwater situation. Use of bio- control method is preferable. Release of *Trichogrammajaponica*, an egg parasite at the rate of 50,000 numbers/ha is recommended for control of the pest. If water level reduces apply Monocrotophos at the rate of 0.5 kg a.i/ha or apply granular

insecticides Carbofuran 3G at the rate of 33 kg/ha or Cartap 4G at the rate of 25 kg/ha on the basis of ETL (One egg mass/ m^2 or 5% dead heart)

- **Irrigation schedule**

Rainfed crop

- **Harvesting**

Harvest the crop at 25-30 days after flowering. Thresh immediately after harvesting and dry gradually under shed up to 12% moisture content for seed purpose and up to 14% moisture for milling.

- **Quality characteristics of the variety**

Short bold grain, very occasionally grain chalkiness present, 4.0 alkali spreading value and intermediate amylose content.

Table 9: Performance of *Sali* paddy var. CR Dhan-801, Season 2021-22 (Barpeta)

	Villages under Barpeta District, Season *Sali*2021-22					
Rice parameter	**Jalikhata**	**Kuchiajhar**	**Barbila**	**Keotkuchi**	**Banglipara**	**Check variety**
Variety	CR Dhan 801	CR Dhan 801	CR Dhan 801	CR Dhan 801	CR Dhan 801	**Swarna Sub 1**
Duration	131 days	130days	132days	131 days	135days	**130**
Av Yield (q/ha)	46.38	48.02	47.23	47.35	41.1	**43.0**
Return from grain yield	63,772.5	66,027.5	64,941.25	65,106.25	56,512.5	59,125
Return from straw yield	13,000.00	14,000.00	13,500.00	13,500.00	10,000.00	12,000.00
Gross profit	62,122.50	66,027.50	64,941.25	65,106.25	5,6512.50	**69,125.00**
Net profit	**22,122.50**	**26,027.50**	**24,941.25**	**25,106.25**	**16,512.50**	**29,125.00**
Cost: Benefit	1.55	1.65	1.62	1.62	1.41	**1.7**
Disease and pest	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	-

N.B: *Cost of cultivation (Rs/ha) = 40,000.00, selling price of per q of paddy: Rs. 1375.00****

Table 10: Performance of *Sali* paddy var. CR Dhan-801, Season 2021-22 (Baksa)

Rice Parameters	Villages under Baksa District, Season *Sali*2021-22			Check Variety
	Barimakha	Bunbari	Thanguri	Swarna Sub 1
Duration (days)	137	137	135	132
Yield (q/ha)	57.20	57.56	56.72	45
Return from grain yield	80,080	80,584	79,400	63,000
Return from straw yield	15,000	15,000	15,000	12,000
Gross return (Rs/ha)	95,080	95,584	94,400	75,000
Net return	49,800	50,384	49,200	29,800
B : C ratio	2.11	2.11	2	1.6
Disease-pest incidence	Stem borer at maximum tillering	Stem borer at maximum tillering	Stem borer at maximum tillering	Hispa, Stem borer

Selling price of per q rice grain: Rs. 1400.00, Cost of Cultivation: Rs 45200

Table 11: Performance of *Sali* paddy var. CR Dhan-801 in four villages of Darrang district, 2020-21

	Villages under Darrng District, Season *Sali*2020-21				Check Variety
Rice parameters	Bihudia	Rangamati	Khataniapara	Gargari	Swarna Sub 1
Duration	139	145	145	142	130
Av Yield (q/ha)	48	55	52	53	47
Return from grain yield	66,000	75,625	71,500	72,875	64,625
Return from straw	13,000	16,000	15,000	15,000	1,2500
Gross return	79,,000	91,,625	86,,500	87,875	77,125
Net return	39,990	52,615	47,490	48,865	38,115
Benefit:Cost Ratio	2.03	2.35	2.22	2.25	1.97
Disease and pest incidence (all stage)	Gundhi bug,	-	-	-	

N.B: Cost of cultivation (Rs/ha) = 39,010.00, selling price of per q of paddy: Rs. 1375.0

Field Photograph (CR Dhan 801)

CR Dhan 802

The elite line IET 25673 (CR3925-22-7) was developed from the breeding materials of cross Swarna-*Sub1**4 /IR81896-B-B-195. Near isogenic lines (NILs) were developed at NRRI, Cuttack. Also, selection, evaluation and testing of the NILs were done at ICAR-National Rice Research Institute, Cuttack, Odisha with the objective to breed high yielding variety with tolerance to submergence and drought condition.CR Dhan 802 (IET25673) entered the co-ordinated testing programme under the name of IET 25673 during WS 2015 under submergence & drought-NIL trial.

It has consistently out-performed better or at par with the recipient parentand sensitive check underdrought and submergence condition in AICRIP testing on overall basis. **CR Dhan 802 is recommended for release in 2017 annual AICRIP workshop at Jorhat, Assam**. The average yield of the culture on overall (all locations) was 2,344 kg/ha under drought stress and 6,508 kg/ha under normal condition.The genotype is weakly photosensitive with average maturity duration of 135-145 days. It possesses short bold grain with a test weight of 19g.It is resistant to stem borer (both dead heart and white ear heads), leaf folder, plant hopper and case worm while moderately resistant to bacterial blight, sheath rot and rice *tungro* virus. As compared to the checks and qualifying varieties, IET 25673 was found to be responsive to higher dose of fertilizer application.

CR Dhan 802 has good hulling, milling and head rice recovery as like the recipient parent and qualifying varieties. It possesses intermediate amylose content, **Short bold grain** and other desirable grain quality parameters. The variety, CR Dhan 802 is released in the state of Bihar, Madhya Pradesh and Assam.

Figure 10: Field view of the variety, CR Dhan 802

Figure 11:Panicles of CR Dhan 802

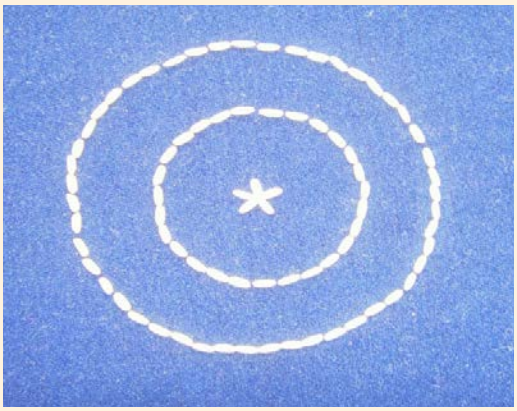


Figure 12:Grain of CR Dhan 802

Package of Practices

- **Suitability of the variety for the area-agro- climatic zone**

Variety CR Dhan 802 is promising for cultivation in the zone III in shallow lowland ecology and flash flood and drought prone rice ecologies in Assam.

- **Selection of field/land preparation practices.**

Plough the land immediately after the harvest of wet season rice, preferably with a mould board plough. One or two summer ploughings after pre-monsoon rain during April-May and ploughing before sowing makes the soil to a fine tilth.

- **Seed treatment: rate and timing/chemical.**

Select genetically pure seed of the variety having more than 80% germination.

- **Sowing time**

For direct-seeding, optimal time is during the first fortnight of June. For transplanting, sow the seeds in nursery by the 1st week of June.

- **Seed rate/sowing method-line sowing with row to row and plant to plant distance/direct sowing**

Use 50-60 kg seeds/ha. Treat the seeds with Agrosan GN or Ceresan (dry) or Bavistin at the rate of 2gm/Kg of seed before sowing.

- **Fertilizer doses with timing per acre**

Apply N: P: K @ 80:40:40 kg/ha in case of poor soil fertility status (based on soil test results). Apply half N, full P and three fourths K as basal in the furrows in the line sown rice with farm yard manure at the rate of 5 t/ha.

- **Weed control- chemicals with doses & timing**

Weeding operations are to be completed which is around 45-60 days after seeding. Spray herbicide bispyribac sodium at the rate of 30 g a.i/ha in direct seeded rice for control of major grasses, sedges and broad leaf weeds. This is a post-emergence herbicide and it can be applied after 12 days of sowing.

- **Disease and pest control- chemicals with doses & timing**

Apply Streptocyclin (150mg) + Copper Oxychloride (1g) in one litre of water for controllingbacterial leaf blight disease. For controlling sheath rot disease, soak the seeds in 0.05%-0.1% Bavistin for 30 minutes before sowing. After raising the crop, minimize the disease by foliar spray of 0.05%-0.1% Bavistin or 0.4% Dithane M-45 or 0.1% Hinosan. For controlling the insect attack, spray is not feasible due to deepwater situation. Use of bio- control method is preferable. Release of *Trichogrammajaponica*, an egg parasite at the rate of 50,000 numbers/ha is recommended for control of the pest. If water level reduces apply Monocrotophos at the rate of 0.5 kg a.i/ha or apply granular insecticides Carbofuran 3G at the rate of 33 kg/ha or Cartap 4G at the rate of 25 kg/ha on the basis of ETL (One egg mass/ m^2 or 5% dead heart)

- **Irrigation schedule**

Rainfed crop

- **Harvesting**

Harvest the crop at 25-30 days after flowering. Thresh immediately after harvesting and dry gradually under shed up to 12% moisture content for seed purpose and up to 14% moisture for milling.

- **Quality characteristics of the variety**

Medium slender grain, very occasionally grain chalkiness present, 4.0 alkali spreading value and intermediate amylose content.

- **Expected yield of the variety**

The average yield of the culture on overall (all locations) was 2344 kg/ha under drought stress and 6508 kg/ha under normal condition.

Table 12: Performance of Sali paddy var. CR Dhan-802, Season 2021-22 (Barpeta)

	Villages under Barpeta District, Season *Sali*2021-22					**Check Variety**
Rice parameter	**Jalikhata**	**Kuchiajhar**	**Barbila**	**Keotkuchi**	**Banglipara**	**Swarna Sub 1**
Duration	132 days	129 days	131 days	134 days	132 days	132
Av Yield (q/ha)	45.18	47.55	46.28	47.11	37.1	43.1
Return from grain yield	62,122.5	65,381.25	63,635	64,776.25	51,012.5	59,262.5
Return from straw yield	13,000	13,000	13,000	13,000	1,0000	11,000
Gross return	75,122.5	78,381.25	76,635	77,776.25	61,012.5	70,262.5
Net return	**35,122.5**	**38,381.25**	**36,635**	**37,776.25**	**21,012.5**	**30262.5**
Cost: Benefit	1.8	1.95	1.91	1.94	1.52	1.75
Disease and pest	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	Rice gandhi bug, brown spot	**Hispa, Gundhi bug**

N .B: *Cost of cultivation (Rs/ha) = 40,000.00, selling price of per q rice grain: Rs. 1375.00*

Table 13: Performance of Sali paddy var. CR Dhan-802, Season 2021-22 (Baksa)

Rice Parameters	Villages under Baksa District, Season *Sali*2021-22		Check Variety
	Barbalisiha	Khatpara	Swarna Sub 1
Maturity duration (days)	133	132	**130**
Yield (q/ha)	57.60	57.25	**46**
Return from grain yield	**80,640**	**80,150**	**64,400**
Return from straw yield	15,000	15,000	**12,000**
Gross return	95,640	95,150	**76,400**
Net return	**50,440**	**49,950**	**31,200**
B : C ratio	2.1	2.1	**1.69**
Disease-pest incidence	Stem borer at maximum tillering	Stem borer at maximum tillering	**Hispa, Gundhi bug**

N.B.:*Selling price of per q rice grain: Rs. 1400.00;* **Gross cost: Rs 45200**

Table 14: Performance of Sali paddy var. CR Dhan-802, Season 2020-21 (Darrang)

	Villages under Darrang District, Season *Sali*2020-21				
Rice parameters	**Bihudia**	**Rangamati**	**Khataniapara**	**Gargari**	**Check Variety**
Variety	CR Dhan 802	CR Dhan 802	CR Dhan 802	CR Dhan 802	**Swarna sub 1**
Duration	136	143	145	138	132
Av Yield (q/ha)	43	45	49	52	44.2
Return from grain yield	59,125	61,875	67,375	71,500	60,775
Return from straw	12,000	13,000	14,000	15,000	12,500
Gross return	71,125	74,875	81,375	86,500	73,275
Net return	32,115	35,865	42,365	47,490	34,265
Benefit:Cost Ratio	1.82	1.91	2	2.2	1.87
Disease and pest incidence (all stage)	Gandhi bug, chaffy grains	-	-	-	Gundhi bug

N.B: Cost of cultivation (Rs/ha) = 39,010.00, selling price of per q rice grain: Rs. 1375.00

Field Photograph (CR Dhan 802)

Table 15: Overall performance of rice varieties in three aspirational districts under the project

Variety	District	Village	Beneficiary numbers	Season	Area (ha)	Yield (t/ha)	Check Variety	Yield of check (t/ha)
CR Dhan 310	**Baksa**	Barimakha	21	*Boro*	10.00	4.60	Naveen	3.80
	Barpeta	Jalikhata Barbilla Banglipara Keotkuchi Kuchiajhar	17	*Sali*	4.53	4.74	Naveen	3.70
		Jalikhata Barbilla	25	*Boro*	1.48	4.74	Naveen	4.42
	Darrang	Bihudia Rangamati Chereng-chapari Khataniapara	16	*Sali*	4.22	4.15	Naveen	4.31
CR Dhan 311	**Barpeta**	Jalikhata Barbilla Banglipara Keotkuchi Kuchiajhar	22	*Sali*	6.13	4.71	Naveen	3.73
		Banglipara Keotkuchi	20	*Boro*	1.48	4.78	Naveen	4.52
	Darrng	Chereng-chapari Khataniapara	35	*Boro*	9.35	5.32	Naveen	4.51
CR Dhan 801	**Baksa**	Barimakha	20	*Sali*	2.66	5.70	Swarna Sub 1	4.60
	Barpeta	Jalikhata Barbilla Banglipara Keotkuchi Kuchiajhar	29	*Sali*	7.00	4.61	Swarna Sub 1	4.70
	Darrang	Bihudia Rangamati Chereng-chapari Khataniapara	32	*Sali*	8.50	5.20	Swarna Sub 1	4.63

Variety	District	Village	Beneficiary numbers	Season	Area (ha)	Yield (t/ha)	Check Variety	Yield of check (t/ha)
CR Dhan 802	**Barpeta**	Jalikhata Barbilla Banglipara Keotkuchi Kuchiajhar	24	*Sali*	7.20	4.46	Swarna Sub 1	4.52
	Darrang	Bihudia Rangamati Chereng-chapari Khataniapara	32	*Sali*	8.50	4.72	Swarna Sub 1	4.63

Summary

The Biotech-KISAN project operating at RLRRRS, Gerua was formulated with an aim to evaluate the performance of the four elite varieties of rice, which were not evaluated earlier and released for commercial cultivation in Assam especially lower Assam where age-old varieties were cultivated. Having evaluated these newly developed varieties with higher protein content and higher level of climate resilience; have now been recommended for commercial cultivation in Assam. RLRRRS, Gerua has undertaken large scale production of breeder seeds of these four varieties and have encouraged seed growers to multiply them to produce Foundation seed. It is now expected that the state department of agriculture will take up the responsibility from here and spread them among the farmers of Assam especially in the districts of lower Assam. Thus, DBT sponsored Biotech-KISAN project has served the purpose of not only taking the proven agricultural technology to the end users but also helped in extending the recommendation domain of the newly developed Biofortified and climate resilient rice varieties. This will help the farmers in enhancing their income through increased productivity along with higher protein content that will help in reducing protein malnutrition among the farmers as well as consumers of Assam. In addition, due to shorter duration, these varieties will facilitate in taking next crop resulting in increased cropping intensity.

This project demonstrates many other dimensions by strengthening the social bonding in the community through participation of SHGs, FPOs, FIGs etc. and spreading of scientific knowledge as well as rational thinking in adopting new technologies. Having been impressed with the progress, the 7th meeting of the Project Steering and Monitoring Committee agreed to extent this project for another several months and encouraged us to publish this technical bulletin on Novel Rice Varieties and their performances in Assam.

Source:

1. https://icar-nrri.in/icar-nrri-cuttack-releases-high-protein-rice-variety-cr-dhan-310
2. https://icar-nrri.in/wp-content/uploads/2019/06/2.-leaflet_highprotein_final.pdf
3. https://icar-nrri.in/wp-content/uploads/2019/06/1.-leaflet_climatesmart_final.pdf

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