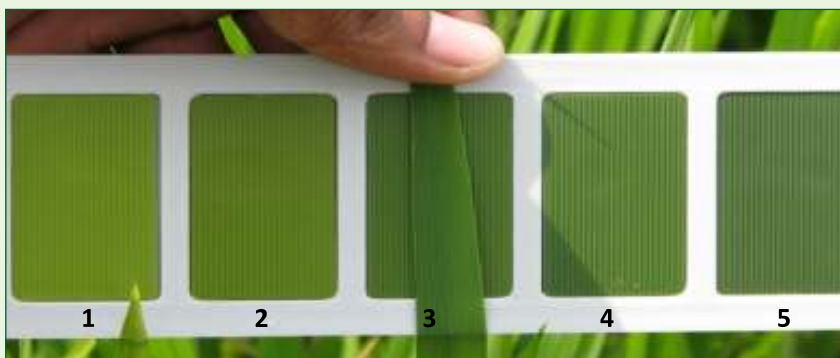


- Spraying of monocrotophos at 1.5 litre/ha or Imidachlopid 0.5 litre/ha mixed in 500 litre of water is recommended against plant hoppers, leaf folder and case worm.
- Bacterial blight is the most important disease that occurs due to prevalence of cloudy weather. It can be controlled by spraying of Streptocycline + copper oxychloride at 75+500 g/ha in 500 litre of water. Spraying of Validamycin at 2.5 ml/litre of water after the appearance of disease symptoms is recommended for the control of sheath blight.
- Keep the field bunds clean to minimize the infestation of diseases and insect pests.

### Harvesting and storage

- Roughing should be done at 120-125 days after transplanting to avoid seed mixtures, especially in seed production fields.
- Drain out the water from the field 15 days before harvesting to avoid lodging.
- Harvest the crop at physiological maturity when 80% of the grains in panicles have got matured to avoid loss due to shattering.
- After threshing and proper cleaning, dry the grains under sun until it reaches 14% moisture content and pack it properly before storing. Store the grain in cool and dry

### CLCC of CRRI



## CRRI High-yielding rice varieties for coastal saline areas

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# High-yielding rice varieties of CRRI for coastal saline areas

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Abiotic stresses represent one of the most important constraints affecting rice productivity in the coastal region of eastern India. These regions are mostly rainfed and mono-cropped with rice during wet season. The rainfed rice crop often suffers from drought and salt injury at the early stage or at reproductive stage and submergence due to intense rain that occurs frequently in this fragile ecosystem during the monsoon period (June-October) because of cyclonic disturbances over Bay of Bengal. Salinity affects the growth of rice in varying degrees at different stages of plant growth from germination to maturity. Rice is relatively tolerant to salinity during germination and active tillering. However, young seedlings at 3<sup>rd</sup> leaf stage and plants at flowering are highly sensitive. The stress varies from location to location and interaction between soil stresses and other environmental factors influence the plant's response to that stress. Such complexities are responsible for the slow adaptability of high yielding rice varieties. It is, therefore, necessary that salt tolerant genotypes must be grown at target sites in order to improve the productivity from this fragile ecosystem.

CR Dhan 402 (Luna Sampad, IET 19470) and CR Dhan 403 (Luna Suvarna, IET 18697) were developed at the Central Rice Research Institute (CRRI), Cuttack and released by the Odisha State Sub-Committee on Crop Standards (State Varietal Release Committee) in 2010. They were found promising in testing under the All India

Coordinated Rice Improvement Programme (AICRIP), participatory varietal selection (PVS) and other on-farm trials conducted in rainfed coastal saline areas of Odisha. The average grain yield of Luna Suvarna recorded over the four years of testing in Jagatsinghpur, Kendrapara and Puri districts of Odisha was 4.6 t/ha. It had shown an average 17% yield superiority over the national check CST 7-1 in the All India Coordinated trial. The variety was also found promising in Gosaba, Basanti and Sandeshkhali blocks in the Sundarban area of West Bengal. Luna Sampad also out yielded CST 7-1, the national check and Lunishree in all India Coordinated trial. It is well accepted by farmers of Basudevpur of Bhadrak, Marshaghai of Kendrapara and Puri districts of Odisha with average yield with 3.6 to 4.2 t/ha. Another rice variety, Luna Barial (CR Dhan 406, IET 19472), developed at the CRRI, Cuttack was released by the Odisha State Sub-Committee on Crop Standards in 2012. This variety was ranked first (3908 kg/ha) in eastern zone in the All India Coordinated trial. Under multilocation trials, it has shown yield superiority with 3.7-4.5 t/ha over national and local checks in Ganjam, Cuttack, Balasore and Khurda districts of Odisha. All the three varieties can be grown along the coastal belt of eastern India with medium salinity stress (EC 5-8 dS/m). The parentage and important features of these varieties are listed in Table 1.

**Table 1. Parentage and important features of rice varieties**

Features	Luna Sampad (CR Dhan 402)	Luna Suvarna (CR Dhan 403)	Luna Barial (CR Dhan 406)
Cross	Mahsuri / Chakrakanda	Mahsuri / Ormundakan	Jaya / Lunishree
Maturity duration (days)	135-140	145-150	150-155
Plant height (cm)	120-125	130-135	125-130
Grain type and cooking qualities	Short bold grain, high head rice recovery (67.8%) and good cooking qualities with intermediate alkali spreading value (5), high amylose content (26%) and medium gel consistency (47 mm).	Medium slender grain, high head rice recovery (68%), good cooking qualities with intermediate alkali spreading value (5), intermediate amylose content (25%) and medium gel consistency (36 mm).	Short bold grain, high head rice recovery (65%), good cooking qualities with intermediate amylose content (23.7%) and medium gel consistency (49mm).
Reaction to insect pests and diseases	Tolerant to yellow stem borer, brown plant hopper, leaf folder and blast and moderately resistant to sheath blight and brown spot under natural infestation.	Moderately resistant to yellow stem borer, leaf folder, leaf blast and sheath blight	Moderately resistant to sheath blight and brown spot
Level of salinity tolerance	Tolerant to moderate salinity stress (EC 5-8 dS/m)	Tolerant to moderate salinity stress (EC 5-8 dS/m)	Tolerant to moderate salinity stress (EC 5-8 dS/m)

standing water at varying depth during early stage. However, in rainfed shallow lowlands where standing water can be drained out during early crop stage, post-emergent herbicides can be applied for weed control.

- Spraying of Pyrazosulfuron ethyl at 20 g a.i./ha (Saathi at 200 g/ha) within 0-3 days of sowing is recommended for controlling early emergent weeds in rice nursery.
- For controlling early emergent grassy weeds and sedges, spray Bispyribac sodium at 30 g a.i./ha (Nominee Gold or Macho at 300 ml/ha) at 8-10 days after transplanting (DAT).
- To control broad spectrum of weed flora in field with 1-3 cm standing water, apply Bensulfuron methyl + Pretilachlor granule (sand-mix) at 60+600 g a.i./ha (Londax Power or Eraze Strong + at 10 kg/ha) at 8-10 days after transplanting (DAT).
- For controlling late emergent broad spectrum of weeds, spray Azimsulfuron at 35 g a.i./ha (Segment at 70 g/ha) at 3-4 leaf stage of weeds or 15 days after transplanting (DAT).
- Spraying should be done in the presence of thin film of water after draining out excess water from the field. The recommended dose of herbicides should be mixed in 350 litres of water for application in one hectare of land. In case of sand-mix application, mix with 30 kg sand for application in one hectare of land.

## Control of insect pests and diseases

- Stemborer is the most important insect pest in this ecosystem. Generally, the peak period of its brood emergence is September-October. Application of Carbofuran (30 Kg/ha) twice at 20 and 50 DAT protects the crop against stemborer. The insecticide should be applied when 1-2 yellow stemborer moths or one eggmass are found in 1.0 m<sup>2</sup> area.
- Insecticides are more effective when there is a thin layer of standing water. However, spraying of monocrotophos at 1.5 litre/ha or Chlorpyrifos at 2.5 litre/ha mixed in 500 litre of water twice at a weekly interval during peak emergence of the insect moth is recommended in areas with standing water of more than 7-10 cm.



puddling and the remaining 1/3<sup>rd</sup> potassium should be given along with nitrogen during final top dressing.

- In case of Sesbania green manuring, seeds are to be sown at 25 kg/ha in the last week of May or early June and 40-45 days old Sesbania plants is to be incorporated into the soil during puddling.
- For Azolla dual cropping, Azolla can be multiplied in small ponds and ditches and fresh Azolla at 1 t/ha are to be applied in rice field one week after transplanting.
- Farmers can also use 'Customised Leaf Colour Chart (CLCC)-based nitrogen application technique' for increased N-use efficiency.

### How to use Customised Leaf Colour Chart (CLCC)

- Monitor leaf colour continuously from 21 days after transplanting (DAT) /28 days after sowing (DAS) at weekly interval until one week after panicle initiation for varieties and up to flowering for hybrids.
- Reading should be taken in the morning (8-10 AM) or in the afternoon (2-4 PM) preferably by the same person.
- Ten topmost fully expanded leaves should be selected randomly from disease-free rice plants for taking CLCC reading.
- Leaf colour should be measured under the shade of the body by placing the middle part of the leaf on the top of the colour stripe for comparison, care should be taken to avoid direct sun light.
- If six or more leaves have reading below the critical CLCC value apply N as per the

**Table 9. Recommendation for N application as per CLCC reading**

Ecologies	Initial application	Start of CLCC reading	Next application	No of application
Rainfed favourable lowland	Apply 17 kg urea/acre	21DAT/21DAS	17 kg urea/acre as and when LCC<3*	3 (including initial)
Submerged and flood affected	Apply 17 kg urea/acre	21DAT/21DAS	17 kg urea/acre <sup>5</sup> as and when LCC<3*	2 (including initial)

\*4 for varieties with dense green leaf colour such as Swarna; 5 when water level reaches to 5-10cm depth; DAT: days after transplanting; DAS: days after sowing

### Weed management

- Manual weeding twice at 20-25 and 40-45 days after transplanting controls the weeds effectively, but it involves huge labour cost.
- Chemical control by using low-dose herbicide with broad spectrum of weed control is least expensive. But, the herbicides are most effective only when there is a thin layer of water in rice field during application time. There is very little scope to use herbicides for controlling weeds in intermediate lowlands due to presence of

**Table 2. Physicochemical properties of rice varieties**

Traits	Luna Sampad	Luna Suvarna	Luna Barial
Milling (%)	71.6	66.4	68.2
Head rice recovery (HRR) (%)	67.8	62.9	64.5
Kernel length (mm)	5.17	6.21	5.5
Kernel breadth (mm)	2.39	2.22	2.3
Kernel length : breadth ratio (L/B)	2.16	2.79	2.3
Grain Type	SB	MS	SB
Grain Chalkiness	A	A	VOC
Alkali spreading value	5	5	5
Amylose (%)	25.98	25.08	23.7
Gel consistency (mm)	47	36	49

### Recommended Cultural Practices

#### Land preparation

- Leaving the land fallow during dry season aggravates the problem of salinity. So, if feasible, a second crop should be raised after the harvest of wet season rice.
- Initial ploughing after the harvest of wet season rice, followed by summer ploughing after the first pre-monsoon shower, helps to reduce the salt accumulation in surface soil.
- Final land preparation should be done by puddling twice at 7-10 days interval followed by laddering after the accumulation of adequate rainwater.
- Proper land levelling and bunding are important for proper leaching of soluble salts.

#### Seed selection and treatment

- If farmers use their own seed, proper roughing should be done by removing off-type plants and disease-free crop needs to be selected for seed purpose.
- Seed should be properly cleaned, dried and stored in airtight containers.
- Before sowing, seed should be dipped in 2% salt solution to remove the floating materials, partially filled grains and weed seeds.
- Selected seed is then properly washed in fresh water, dried and treated with Bavistin at 2.0 grams per g/kg of seed.
- 30-35 kg seed is required for transplanting of one hectare land.

## Seedbed preparation

- Seedling should be raised in less saline fields as far as possible. An area of 1000 m<sup>2</sup> is required for transplanting one hectare of land.

- Farmers may prefer dry or wet nursery as per their convenient.

## Dry nursery

- Land with higher elevation should be selected for dry nursery.
- Field should be ploughed twice during April-May after the pre-monsoon showers. Use rotavator after two ploughings for obtaining fine tilth and level the field properly.

- Seedbeds of about 1.0 metre width, 10-15 cm height and convenient length are to be prepared, leaving 40 cm wide channel between two beds.



- Seed should be sown during the first fortnight of June using a seed rate of 40-50 g/m<sup>2</sup>. A fertilizer dose of 10 kg each of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ha is recommended along with FYM / compost at 50 q/ha.

- Raised seedbed technique should be practiced in fields with high soil salinity where seed beds of 20-30 cm height are prepared with small bunds at the top on all sides for holding rainwater that will facilitate leaching of salts. Seeds are to be sown after 2-3 showers during first fortnight of June. It will also help to protect seedlings from damage due to sudden waterlogging.

## Wet nursery

- Field should be ploughed twice during late May to early June. Puddling should be done twice at 7-10 days interval after accumulation of rainwater in the field during middle of June. Standing water in the field between two puddlings will facilitate leaching of soluble salt as well as decomposition of weeds.

- Divide the plot into sub-plots of 1.0 meter width with convenient length with drainage channels between two beds. The field should be well-leveled and banded to facilitate water retention.

- Incorporation of well decomposed FYM or Azolla compost at 50 q/ha during the land preparation along with 10 kg each of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ha are recommended for robust and healthy seedlings.

- Pre-sprouted seeds at 30-40 g/m<sup>2</sup> square metre should be sown on saturated moist soil and seed treatment with Bavistin can be done at the time of seed soaking.

## Crop establishment

- Early transplanting by mid-July using 40-day old seedlings at a spacing of 15 x 15 cm is recommended in shallow lowlands. In intermediate lowlands, transplanting by the end of July using 50-day old seedlings at a closer spacing of 15 x 10 cm ensures better crop establishment.

- Delayed transplanting during August significantly reduces the crop yield due to poor crop establishment under higher water depths and occasional submergence.

- In general, 2-3 seedlings per hill are planted. If required, gap filling should be done within 10-12 days after transplanting.

## Nutrient management

- Application of 80 kg of nitrogen along with phosphorus and potassium fertilizers at 40 kg/ha is recommended. 'N' should be applied in three splits, half as basal before transplanting and one-fourth each at active tillering and panicle initiation stages.

- However, integrated nutrient management by combining chemical fertilizers with organic manures is important for improving and sustaining the crop productivity in saline soil.

- In shallow lowlands, *Sesbania* green manuring followed by urea top dressing at 20 Kg N/ha at panicle initiation stage is recommended.

- In lowlands where chances of rain water accumulation is less, *Azolla* dual cropping along with urea application at 20 and 12 kg N/ha as basal before transplanting and at active tillering, respectively, is as effective as the recommended dose of 80 kg N/ha through chemical fertilizer. In case of *Azolla* dual cropping, 10-15 kg of phosphate/ha through single superphosphate should be applied in three equal splits at weekly intervals starting from the day of *Azolla* inoculation.

- In intermediate lowlands, *Sesbania* green manuring or application of FYM at 50 q/ha + 20 kg N/ha as basal has been found promising.

- Phosphorus and potassium fertilizers at 40 kg/ha of phosphate (P<sub>2</sub>O<sub>5</sub>) and potash (K<sub>2</sub>O) are recommended. In case of *Azolla* dual cropping, the phosphorus fertilizer used for growing *Azolla* is a part of that recommended for rice. The rest of phosphorus along with 2/3<sup>rd</sup> of potassium should be applied at the time of final