CRRI Technology Bulletin No.238

Standard Operating Procedure for Nucleus Seed Production of Pureline Varieties at ICAR-CRRI

RP Sah, K Chattopadhyay, MK Kar, BC Marndi, M Chakraborti,
RL Verma, SK Dash, LK Bose, J Meher, S Sarkar, Reshmi Raj K.R,
L.K Singh, D Moharana, S Samantaray,
GAK Kumar and AK Nayak

ICAR-Central Rice Research Institute
Bidyadharpur, Cuttack

Correct Citation

Sah RP, Chattopadhyay K, Kar MK, Marndi BC, Chakraborti M, Verma RL, Dash SK, Bose LK, Meher J, Sarkar S, K.R. Reshmi Raj, Singh L.K, Moharana D, Samantaray S, GAK Kumar, Nayak A.K. (2025). Standard Operating Procedure for Nucleus Seed Production of Pureline varieties at ICAR-CRRI. CRRI Technology Bulletin no.:238. ICAR-Central Rice Research Institute, Cuttack, Odisha.

Published by:

Director

ICAR-Central Rice Research Institute,

Cuttack, Odisha

Disclaimer: ICAR-Central Rice Research Institute is not liable for any loss arising due to improper interpretation of the scientific information provided in the technology bulletin.

P R E F A C E

Rice is a staple food for nearly 65% of India's population and plays a crucial role in food security and agricultural sustainability. Despite having the largest rice cultivation area globally, India's productivity is less than the other nations and required efforts to increase the yield. One of the most critical factors influencing rice production is the availability of high-quality seeds, which alone can improve yields by up to 20%.

Nucleus seed production is the foundation of the seed multiplication chain, ensuring the highest levels of genetic purity and varietal integrity. As the primary source for all subsequent seed classes, maintaining strict production protocols at this stage is crucial. Any deviation can compromise seed quality, affecting productivity and uniformity in future generations.

This Standard Operating Procedure (SOP) for Nucleus Seed Production provides a detailed approach to ensure high genetic purity and seed quality standards. It covers all essential aspects, including variety selection, field management, rouging, harvesting, post-harvest handling, and quality testing. This SOP is intended as a practical guide for research institutions, seed-producing agencies, and growers, helping them standardize production practices and maintain the nucleus seed purity

By following these established guidelines, developers can enhance the efficiency of nucleus seed production, ultimately contributing to a well-organized and robust seed system that supports higher rice productivity and food security.

Authors

Introduction

The ICAR-Central Rice Research Institute has developed 180 inbred and 6 hybrid paddy varieties to enhance rice productivity and sustainability. To ensure genetic purity and quality, nucleus seed production is essential as the foundation of the seed production chain.

This Standard Operating Procedure (SOP) outlines guidelines for nucleus seed production, covering seed selection, land preparation, sowing, transplanting, field management, rouging, harvesting, post-harvest processing, and quality testing. Maintaining strict purity standards at this stage is crucial to preserve varietal integrity and sustaining superior agronomic traits.

Applicable to research institutions and developers, the SOP establishes systematic monitoring protocols to prevent genetic contamination and ensure high seed vigor. Adherence to these practices will enhance the reliability of nucleus seed production, ultimately improving rice productivity and food security.

Objective

The objective of developing this Standard Operating Procedure (SOP) is to establish a clear, standardized, and reproducible framework to produce nucleus seed in rice to maintain its genetic purity and quality.

Scope

This SOP applies to all activities involved in the production of nucleus seed of paddy from seed sowing to harvesting seed, seed sampling, seed testing, and seed packaging. It is intended for use by research institutions to standardize time to time monitoring of nucleus seed and its production.

Stages	Standard operating procedures
Seed Source	• Obtain the seed from the developer of the variety mandatorily in the form of true-to-type panicle as primary source of seed. • Collect copy of notification proposal, varietal characteristics with the signature of the developer(s) along with photograph of the variety. For MAS derived varieties, obtain information on the foreground markers present in the variety along with gel picture/SNP information sheet duly signed by the developer(s). The gel pictures must have standard DNA ladders in both sides of the gel. All the details of markers, genotypes and DNA ladders should be indicated in footnote. The DNA ladders should be marked properly to find out approximate allele sizes. • The collected panicles for each variety should be of 500 numbers. • Ensure that the collected panicles should be free from any insect pest attack or disease and should be healthy. • Reject the panicles where the grain count is less than 100.

Grower selection	• To be assigned to the both developer/maintenance breeder of the variety and the Nodal officer of Seed at CRRI main campus of the released variety. At-least one set of all varieties developed at regional stations will be produced at Cuttack under supervision of Nodal officer of Seed at CRRI main campus. At the same time the developer/maintenance breeder at regional station will also maintain the nucleus seeds • Developer/ maintenance breeder for the CRRI released variety to be part of the production/monitoring team. • The true-to-type panicle samples must be collected and kept in a sealed packet with signature of the developer of the variety. The developer should also provide a certificate from CRRI-gene bank in charge that at least 500g seed of the variety was deposited in MTS module of CRRI gene bank.
Land Selection	• Choose well-drained, fertile land with adequate irrigation to promote healthy crop growth. • Ensure the field is free from other crop plants, residues of previous seasons, and weed infestations. • Conduct soil health testing before sowing to assess nutrient availability and ensure optimal soil conditions.
Seed Treatment (before sowing)	Panicles should be treated with recommended doses of fungicides/insecticides/ other chemicals before the panicles are shown.
Nursery bed preparation and sowing	• Sow the Nucleus seed of the released varieties for the kharif season within 1st week of June while for the Rabi season the within 1st Week of December. • Prepare an elevated, well-drained seed bed for nursery sowing to prevent water stagnation. • Prepare the nursery beds with a fine tilth and enriched with well-decomposed organic manure. • Prepare the bed with 1.0-meter width, 15 cm height, and length as per field condition with lined rows with a gap of ~10 cm. • Apply the fungicidal seed treatment to protect the seedlings from the seed-borne diseases. • Sow the seed of each true-to-type panicles in each rows of the seed bed. • Irrigate the seed beds after sowing as well as per the requirement of the seedling. • Guard the seed beds from bird damage. • If any line is affected by disease/ insect, the line can be discarded.
Isolation	Time isolation (Maturity duration of varieties) or Distance isolation (3 meters) to be followed
Transplanting	• Transplant healthy seedlings following a 20 cm × 15 cm paired panicle row design to ensure proper aeration and light exposure. • Adopt row planting for easier monitoring, mechanical weeding, and rouging. • Transplant seedlings at 21-28 days of age for optimal establishment. • Use single seedling per hill to prevent genetic admixture, avoiding off-type contamination, ensuring uniform growth. • Maintain paired rows for each panicle to track variations in growth stages. • Complete transplanting by July 15 for the kharif season and January 15 for the rabi season.

Irrigation	Maintain uniform soil moisture throughout the crop growth period, with special attention during tillering and flowering stages. Avoid waterlogging, as it may lead to poor root development and disease proliferation.
Weeding	Conduct hand weeding or mechanical weeding (one at a interval of 14 days after transplanting and 2nd at the tillering stage).
Fertilizer application	Apply basal dose of fertilizer of recommended dose (60:40:40), Top-dressing fertilizer doses at critical growth stages (tillering and panicle initiation) for optimal yield.
Pest and Disease Control:	1. Conduct regular inspection for major pests and diseases such as stem borer, leaf folder, brown planthopper, sheath blight, bacterial leaf blight and apply recommended insecticide with recommendation of the entomologist or pathologist. 2. Implement integrated pest management (IPM) strategies, including biological control, pheromone traps, and judicious pesticide application.
Rouging	1. Rouging should be conducted at least three times during the crop cycle—once at the vegetative stage, once at the flowering stage, and finally before harvesting. Indicators for identifying off-types include variations in plant height, leaf shape, flowering time and grain characteristics. 2. First rouging: At the vegetative stage, identify and remove off-types based on leaf characteristics and plant height. 3. Second rouging: During the flowering stage, remove plants with different flowering patterns. 4. Final rouging: Before harvesting, eliminate plants with undesirable grain traits to maintain seed purity. *Note: If any variation is found in any plant in the paired row of the variety then the complete paired row must be rejected to ensure the nucleus seed quality.*
Monitoring	1. The monitoring team constituted should consists of the Nodal officer seed, the chairman Institute seed committee, the chairman seed monitoring committee, breeder, entomologist, pathologist. 2. The nucleus seed of should be monitored minimum three times during a crop cycle to ensure the high quality of the seed. 3. Any variation if detected in the variety will be rejected by the monitoring team stating the reason for the rejection. 4. After monitoring, the monitoring report to be submitted to the Head, Crop Improvement Division.
Collection of True to type panicle:	1. Identify the true to type panicle from the paired progeny rows. Tag selected plants before flowering to monitor uniformity. 2. Perform final selection at full maturity by carefully observing panicle characteristics. 3. Harvest selected panicles separately for next generation nucleus seed production. 4. Bulk the remaining nucleus seed plants for breeder seed production.

Harvesting, Post-Harvest Processing and storage	1. Harvest the crop when grains attain physiological maturity (20-22% moisture content, grains turn golden brown), ensuring that grains are fully developed and have maximum dry matter accumulation. 2. Manual harvesting should be practised to avoid mechanical damage and maintain genetic purity. 3. Uniform and pure true-to-type progeny for individual variety (500 panicle for each variety) from the nucleus seed plots must be selected, harvested, dried and stored separately. Select the panicle from the progeny rows and keep it in paper packet and mention the progeny row number on it. 4. Bulk seed of individual varieties from the nucleus seed plots must harvested, threshed, dried and stored separately. 5. The developer/maintenance breeder of the variety will compare the seed panicles maintained by him/her/them with those maintained by the Nodal officer of Seed at CRRI main campus. He/she/they will certify that the harvested panicles are same as the variety maintained by hime/her/them. 6. After a gap of three years, seedlings from the seeds preserved in NRRI gene bank will be grown as check rows with the nucleus seeds to compare.
Transportation	The panicles should be transported with utmost care to avoid physical damages and should be packed in the cloth or gunny bags.
Record maintenance	Detailed records of all activities related to seed production, including field history, seed source, planting details, crop management practices, rouging, harvesting, processing, and bagging should be maintained. It must be made available to monitoring teams on demand.
Sampling and Testing	1. Inspect the collected panicles of different nucleus seed varieties by the tabletop examination method. 2. Conduct laboratory tests for physical purity, germination and moisture content as per prescribed standards. 3. Use molecular marker for varietal identification and grow-out tests to confirm genetic purity. 4. Retain seed samples for future reference and genetic confirmation.
Special requirements for trait-specific varieties and NILs	1. In case of near isogenic lines (NILs) or varieties with known genes for specific traits, random samples should be drawn from collected panicles and tested with markers. If there is deviation, the seed lot should be rejected. 2. For herbicide tolerant (HT) verities, spraying of respective herbicides at recommended dose as mentioned in package of practices will be mandatory during seed production. 3. Seed samples from every pack of HT-varieties needs to be tested for herbicide tolerance through grow-out tests and certified accordingly and the signed tags should be attached in the bag in such a way that it can't be tampered. 4. Strict monitoring of NILs and HT varieties under supervision of respective breeders is essential.

Conclusion

The successful production of nucleus seed requires strict adherence to standard operating procedures to ensure genetic purity, physical quality, and overall seed health. This SOP outlines essential steps from land selection to storing, covering critical aspects such as nursery management, transplanting, field monitoring, pest and disease control, rouging, and post-harvest handling. Each stage is designed to maintain the highest standards of varietal integrity and seed viability, ensuring that the nucleus seed remains the foundation for future seed production programs.

By implementing systematic monitoring, tagging, and testing protocols, research institutions can uphold the purity of elite rice varieties, minimizing genetic contamination and maximizing seed purity. The integration of molecular markers for varietal authentication further strengthens the reliability of the produced nucleus seed. These standardized practices will contribute significantly to the sustainability of rice breeding programs, supporting higher crop productivity and food security initiatives.

Annexure I

Checklist for Nucleus seed monitoring in fields

Name of variety: Grower details:

Year of release: Nucleus Seed production plot:

Stage	Parameters
Nursery Transplanting	Variety details record as per the proposal
	Nucleus Seed Purity Certificate from the developer
	Sowing to be completed as per the SOP for both seasons.
	Whether True to-type panicle used for sowing?
	Seed Treatment done before sowing
	The plot selection for Nucleus Seed done as per the SOP?
	Sowing Plan (Date of Sowing, Number of Panicle Shown, Number of lines shown for each variety)
	Seedling health
	Specific remark
	Transplanting Time as mentioned in the SOP for both seasons followed or not.
	Isolation: Time isolation/ isolation distance maintained or not.
	SOP for Nucleus Seed transplanting to be followed.
	Seedling age at the time of transplanting
	Date of Transplanting?
	Planting method and row spacing as per the SOP.
Field management	Irrigation, Weeding and Fertilizer application as per the SOP

Rouging	How many times the variety has been rouged out.
Monitoring	What was the flowering status in the field?
	Off type plants present or not.
	Whether management details after transplanting recorded?
	What is the disease and insect-pest status in the field?
	Specific remarks, if any?

Annexure II

Proforma for Nucleus Seed Monitoring Report

Variety	:	
Transplanted Area (m^2)	:	
No. of rows with length (m)	:	
Crop Stage at monitoring	:	
Monitoring report	:	Satisfactory/ rejected
Insect Pest Incidence (if any)	:	
Expected Yield (kg)	:	
Remarks (if any)	:	

Cuttack-753006, Odisha, India
(An ISO 9001: 2015 Certified Institute)
Phone: 0671-2367757, Fax: 0671-2367663
Email: director.nrri@icar.gov.in, directorcrricuttack@gmail.com
Website: http://www.icar-nrri.in