NRRI Research Bulletin No. 27

QUALITY SEED PRODUCTION IN RICE

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Correct Citation
RK Sahu, SSC Patnaik and RP Sah (2020). Quality Seed Production in Rice. NRRI Research Bulletin No. 27, ICAR-National Rice Research Institute, Cuttack 753006, Odisha, India. pp 58.

Published by
Director
ICAR-National Rice Research Institute
Cuttack 753006, Odisha, India

June 2020

Laser typeset at the Fingerprint, Bhubaneswar, Odisha, India and printed in India by the Print-Tech Offset Pvt. Ltd., Bhubaneswar 751024, Odisha, Published by the Director for ICAR-National Rice Research Institute, Cuttack 753006, Odisha.

Preface

Rice plays a pivotal role in the food and livelihood security of the people of India. It is the staple food for around 65% of the Indians, contributing approximately 40 % of the total food grains production of the country. Rice is grown in around 43 million hectares area in India, which is the highest in the world. But productivity wise it is far behind other countries. Considering that the rice production target increases every year and the country will have to produce this additional quantity of rice from the same available area, India needs to work on improving the productivity of rice.

Among the different factors responsible for a good production, quality seed is the vital factor that alone can enhance production by 20%; and without quality seed, other inputs and technologies are of little value. But as per the agricultural scientists and officials, 63% of seed supply to the farmers is taken care through formal seed system with quality seed and rest 37% is managed by informal seed sectors, mainly by unregistered seed growers and farmers, where the quality of the seed is doubtful. Keeping an eye on this, the best way to achieve a quantum jump in production and productivity is by targeting the quality seed. This can be well attended by creating awareness and spreading technical knowhow regarding quality seed production among the seed growers of the country to produce good quality seed.

Though lot of efforts are made from different forums to create awareness among the rice seed growers and farmers, still then, at the time of seed production, there is always a need to follow a written document in the form of a book on quality seed production in rice, which the seed producers can refer and follow at the time of seed production. The present book is a sincere effort by the authors to fulfil the above need.

This book is meant for all the Government and private seed growers, seed producing organisations and farmers. Starting from what is quality seed, this book has explained and discussed about the importance, types, production procedure, post production processes, quality safe-guarding and packaging of the quality seed very lucidly. Hope, this book will create a unique place for itself by supporting the noble efforts of the seed growers of our country in enhancing the production and productivity of rice crop and making the seed system of the country well organised, reliable and fool proof.

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CONTENTS

1. Introduction

Rice is grown in around 43 million hectares area in India with an average yield of 2.56 tons per hectare. For a good harvest, a good crop is required and to raise a good crop many factors like fertile land, quality seed, timely sowing, transplanting, irrigation, fertilizer application, weeding, protection from insects and diseases, harvesting, threshing, processing and storage are to be cared for. If there is any set back with any of these factors, that ultimately affects the crop production. Though all these factors contribute for a good crop yield, among them quality seed is a unique and important factor that alone can enhance the yield by 20%; and without this other factors fail to contribute to their potential. Therefore, the role of quality seed in enhancing crop production is very important.

Let us know and discuss all about quality seed production in rice in this book starting from the importance of quality seed to what is quality seed, from where to get, how to produce and what are the critical care to be taken.

2. What is the difference between Grain and Seed?

Generally, after harvest of the rice crop, the farmers preserve a part of the harvested grain and use that as seed for the next season. For them, there is no difference between grain and seed. But in reality, we use grain as our food for which we never care for the quality or germination percentage of it. But seed is a living grain which can produce a living plant and is used for crop production. Therefore, lot of importance is given on its physical purity, germination capacity, seed moisture and genetic purity of seed; and it is emphasized that, "every seed is a grain, but every grain is not a seed".

3. What is Quality Seed in Rice?

Quality seed is physically pure, healthy, true-to-the-type and genetically pure, which leads to a good production. Quality seed should have the following qualities:

- It should be genetically pure with the exact varietal features.
- It should be physically pure; that means physical impurities like soil particles, small stones, broken seeds etc. should not be there.
- Seed should be fully matured, healthy and of uniform size.
- Seeds of weedy grasses, other rice varieties or other crop should not be found mixed with it.
- Seed should be free from diseases.
- Seed should not be affected by insects.

Fig.1: Quality Seed

- Seed should have a maximum of 13% moisture content.
- Seed should have a minimum of 80% germination. Higher the germination percentage better is the seed quality.

4. Why to use Quality Seed?

It is an established fact, supported by the research and field data of the agriculture scientists, that among different factors responsible for a good crop production, quality seed alone can contribute for 5-20% higher yield. Among all the factors contributing to higher yield, quality seed alone contributes the maximum; and without this the contributions of other factors become negligible. Therefore, lot of importance has been given on use of quality seed for achieving higher yield in rice. Generally, the advantages of use of quality seed are:

- Genetic purity as per varietal features is obtained.
- Number of off-type plants becomes less.
- Requirement of seed quantity remains within the prescribed seed rate because of high germination percentage.
- Healthy seeds give rise to healthy seedlings which compete well with the weed/ grasses.
- Less disease and insect incidence are marked.
- Crop stand becomes uniform that flowers and matures uniformly and helps in higher yield.

5. Realization of importance of Quality Seed

Seed is the first input of crop production on which the performance and efficiency of other inputs depend. Use of quality seed alone can contribute to 5-20% of higher yield in rice crop. Therefore, in a crop production programme the role of good quality seed is very important. Let us open the pages of history to really know, how the importance of quality seed was realized.

5.1. World Scenario:

1886 : Channelized seed production began with the establishment of Swedish Seed Association. The Association was mainly involved in production and distribution of quality seed of forage crop varieties.

1900 : Dr. E. Helve established a seed testing laboratory in Denmark for seed testing and certification.

1917 : Dr. J.W. Robertson, a Canadian Scientist, proposed production of foundation seed.

1919 : International Crop Improvement Association (ICIA) was formed to see the development of procedures and standards for quality seed production and seed certification.

1946 : ICIA clearly defined 4 classes of quality seed for forage crop (breeder seed, foundation seed, registered seed and certified seed).

1968 : ICIA proposed to adopt the above 4 classes of quality seed for grain crops. The ICIA proposed minimum quality standard and procedure of 1946 was followed with appropriate modifications in different countries including India.

1969 : ICIA got renamed as Association of Seed Certification Agency.

5.2. Indian Scenario:

1900 : State Department of Agriculture of UP produced and distributed 150 tons of wheat seed. Limited seed testing facility was available at Kanpur.

1920 : Government of Uttar Pradesh emphasized the production and distribution of quality seed and initiated project for establishment of seed-godown in every sub- divisions/tehsils.

1925 : Royal Commission on Agriculture reviewed the production and distribution of seed in India.

1937 : Sir John Russel reviewed and made recommendation for seed situation in India.

1940 : Imperial Council of Agriculture Research made recommendations.

1944 : Dr. Barnes reviewed the seed situation in India.

1944 : The Famine Commission reviewed the seed scenario.

1944 : The Food-grains Policy Committee reviewed the seed scenario.

1945 : Private Seed Company like Sutton's entered the seed scenario and produced quality seed for temperate vegetables.

1946 : All India Seed Producer's Association was formed by private seed growers.

1952 : ICAR appointed a Standing Experts Committee on seeds, which formulated a programme for strengthening the seed production and distribution systems; as a result, Central Government provided financial assistance to the states.

1956-57 : State Seed Farm Project was initiated and states started producing foundation seed of cereals on their State Seed Farms.

1959 : Agricultural production team headed by Dr. Johnson recommended for uniform standards of seed certification, seed law and seed testing laboratories for each state.

1959 : Planning Commission appointed a Seed Multiplication Team to review the various aspects of seed programmes.

1960 : ICAR set up a committee to suggest ways for developing a strong seed production programme. The committee recommended for:
- Establishment of Central and State Agencies for the production of foundation seed
- Establishment of independent Seed Certification Agencies
- Enactment of National Seeds Act
- Creation of Agencies for enforcement of Seeds Act.
- Establishment of Private Seed Industry

1963 : National Seeds Corporation (NSC) was established.

1964 : The State Variety Release Committee was established.

1966 : Indian Seeds Act was enacted.

1966-67 : Seed production programmes for 2 crops, wheat and maize were taken up with NSC involvements.

1967-68 : Seed production programme for rice was taken up.

1968 : Government of India set up a Seed Review Team that recommended for involvement of Agricultural Universities in foundation seed production.

1969, October 2nd: Indian Seeds Act has been enforced in India.

5.3. Indian Seeds Act:

The Indian Seeds Act was enacted in 1966, and has been in force since October 2nd, 1969. The seeds act was amended on September 9th, 1972, which aims at regulating the quality seed sold for agricultural purposes through compulsory labelling and voluntary certification. The main features of the Indian Seeds Act (1966) and Indian Seeds (Amendment) Act (1972) are as follows:

Constitution of a Central Seed Committee by the Government of India to advice central and state government regarding the act.

- Establishment of Central Seed Laboratory.
- Establishment of State Seed Laboratory for seed quality analysis.
- Provision of notification of varieties by Government of India.
- Minimum limits of germination and purity of seeds and compulsory label fixing.
- For notified seed offered for sale, seed standard was fixed.
  - Must be identifiable as seed of the variety it claims.
  - Must have minimum prescribed purity and germination.
  - Seed container must bear labels containing correct particulars of the seed.
- Establishment of State Seed Certification Agency.
- Establishment of Central Seed Certification Board to advice the Government of India and State Government on all matters relating to certification.

- Appointment of Seed Analyst for seed analysis in State Seed Laboratory.
- Appointment of Seed Inspectors to collect seed samples of notified kind offered for sale for analysis.
- Forfeiture of property (seeds) belonging to any person convicted under this act due to contravention of the procedures under this act.

1977-78 : Establishment of National Seed Project (NSP) Phase-I was the first turning point in shaping an organized seed industry, which initiated the establishment of:

- State Farms Corporation of India (SFCI),
- 4 State Seeds Development Corporations (SSDCs)
- Breeder seed Production (BSP) units.

1985 : With establishment of National Seed Project (NSP) Phase-II, 13 additional SSDCs and 19 State Seed Certification Agencies were established for quality seed production.

1988-89 : New Seed Development Policy was formulated which gave access to the private individuals with strong R&D base for product development.

2002 : National Seed Policy, a regulatory system, was formed to safeguard the interests of Indian farmers and agro-biodiversity conservation and to guard the exploitation of farmers by unscrupulous elements

2004 : Seed Bill was proposed for regulating the production, distribution, quality of seeds for sale, import, and export and to facilitate production and supply of seeds of quality and for matters connected therewith or incidental thereto.

2010 : The government has proposed new amendments to the Seed Bill in April 2010 and November 2010, accepting most of the recommendations given by the Standing Committee.

5.4. Highlights of the Seed Bill (2004):

- All varieties of seeds for sale have to be registered
- The seeds are required to meet minimum standards
- Transgenic varieties only be registered after clearance certificate as per the Environment (Protection) Act, 1986
- Exemption of farmers from the requirement of compulsory registration
- Farmers are allowed to sow, exchange or sell their own seed and planting material without any formalities required by registered seeds but, farmers cannot sell seed under a brand name
- Provision for claim of compensation in case a registered variety of seed fails to perform to expected standards

6. Generation System of Seed Multiplication

Continuous efforts by rice scientists lead to development of new varieties for different agro-climatic situations as per the requirement of the farming community. This effort of the scientists can be fruitful only when the quality seed of these newly developed varieties is produced and available with the farmers; which requires an organised seed multiplication system.

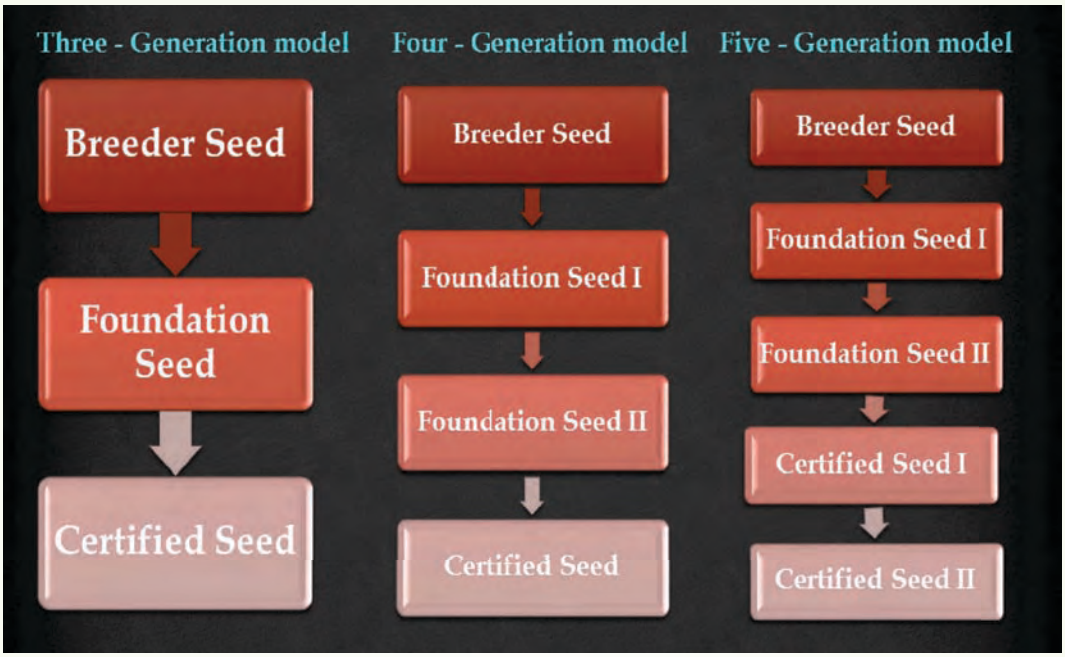


Fig.2: Generation System of Seed Multiplication

Generation system of seed multiplication is the production of a particular class of seed from specific class of seed up to certified seed stage. In normal situation, seed multiplication system is a three-generation system, where the seed production moves from breeder to foundation to certified seed, safe-guarding the quality of seed at different production levels. It is a robust and fool-proof system. But in exigencies, when a particular class of seed is in short supply in the seed chain, a four-generation or even a five-generation system may be followed (as depicted in the figure.2) to take care of the seed chain.

7. Regulation of Seed System

The national seed requirement is taken care of through Formal Seed System (FSS) and Informal Seed System (ISS). Formal Seed System is characterized by large scale production of seed of officially released varieties with strict quality assurance mechanism. This system is well organized and systematic, usually starts with development of different types of varieties/hybrids. The principles in the FSS

are to maintain varietal identity, purity and to produce seed of optimal physical, physiological and sanitary quality. Formal Seed System is managed by Government body (Government Institutions, State Government Farms, University farms & KVKs) and registered seed growers (NGOs, Private Companies) whereas Informal Seed System (ISS) is managed by farmers and sometimes private seed growers.

Varietal deterioration may happen with the repeated multiplication of the same variety year after year. This deterioration accommodates mixture of seeds, undesirable pollination or outcrossing, occasional mutation and genetic drift. This overall affects varietal genetic purity and crop performance. This deterioration is taken care of in the FSS through production of nucleus, breeder, foundation and certified seed; but in ISS it is not well guarded. Therefore, it is required to create awareness among the farmers/seed growers to produce quality seed in their field for their own use.

8. Indian Seed System:

Indian seed system is a robust and fool proof system where so many organisations are formed which are involved in safe-guarding the seed quality and producing different classes of seed so that the seed chain moves smoothly and our farmers get a continuous supply of quality seed. Presently, the Indian Seed System consists of the following number of organisations.

- 2 National Organisations (National Seed Corporation & State Farm Corporation of India)
- 15 State Seed Corporations
- 21 State Seed Certification Agencies
- 2 Central Seed Testing Laboratories
- 90 State Seed Testing Laboratories (in 28 states)
- 187 registered Private Seed Companies

9. Different Types of Quality Seed and their Production Procedure

Higher yields can be achieved through rapid and systematic multiplication of improved and newly released high yielding varieties immediately after they are notified, production of quality seed of these varieties and their distribution to the farmers. Seeds of these improved varieties are produced in several stages where each stage generates a particular class of seed. Different classes of seed are recognized in the seed system only to safe-guard the quality level of the seed and also to ensure a continuous production and supply of quality seed.

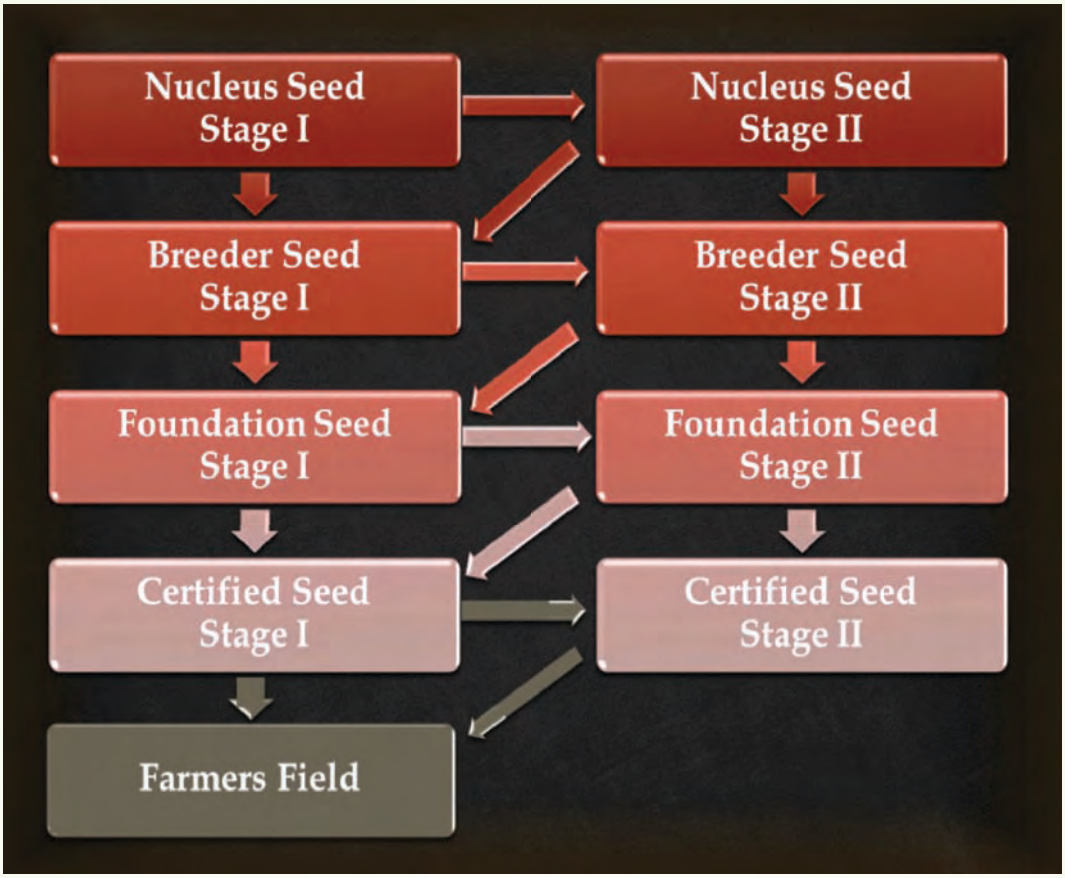


Fig.3: Classes of Quality Seed

9.1. Nucleus seed

Nucleus seed refers to the seed produced by the breeder who developed the variety. This is the initial seed of a particular variety used for the purpose of maintaining that variety by the originating breeder.

Once a new variety is released and notified, different seed producing organisations indent for breeder seed of that variety through Department of Agriculture and Cooperation (DoAC), Government of India. The Crop Coordinator for Rice compiles all the indents of the country and prepares a variety wise requirement sheet which is discussed and finalised in the All India Coordinated Rice Improvement Programme Meeting/Workshop. Then the indent sheet is arranged institute wise, and the breeder seed target for the coming year is sent to the individual institute. This is called Breeder seed Proforma-I (BSP-I). Breeder seed is the progeny of nucleus seed; that means nucleus seed is required for producing breeder seed. So, keeping an eye on the demand of breeder seed, required quantity of nucleus seed is to be produced before-hand.

Nucleus seed can only be produced by the Institute from where the variety has been developed. If it is produced by the same breeder who has developed the variety, then

it's good. But for any reasons, if the original breeder is unable to produce it, then it can be produced under direct supervision of another breeder of the same Institute who knows about the variety well or who is well acquainted with the variety.

Depending on the situation and for that, production procedure, nucleus seed can be of two sub-classes,nucleus seed stage-I and nucleus seed stage-II. Nucleus seed stage-I is produced by panicle progeny rows method where seeds of progeny rows are bulked to get the required seed. But in nucleus seed stage-II, seeds from true-to-the-type progeny rows are grown in separate progeny plots where true-to-the-type progeny plots are selected and seeds of these selected progeny plots are bulked to obtain nucleus seed stage-II seed. Nucleus seed stage-II is produced only when demand of nucleus seed is high and cannot be met with nucleus seed stage-I.

Nucleus seed is qualitatively the purest seed having very high physical purity, 100% genetic purity and high standards of all other quality parameters. The different quality parameter standards for nucleus seed stage-I and nucleus seed stage-II are similar.

The nucleus seed monitoring team inspects/monitors the nucleus seed plots. The team consisting of the Breeder, Nodal officer Seed of the Institute, Head of Genetics & Plant Breeding and a Rice Breeder of a nearby Organisation/Institution, confirms the planting layout, isolation distance and other quality parameter standard of the nucleus seed plot after which the crop is harvested and seed is processed. After confirming the seed quality norms through seed quality testing by the institute the seed is designated as nucleus seed.

9.2. Nucleus seed Production Procedure

For starting a nucleus seed production programme the two pre requisites are the bulked nucleus seed maintained by the breeder and sufficient number (around 500) of true-to-the-type panicles selected from the original source crop based on the morphological identity, uniformity and genetic purity of the variety. Before start of sowing, each true-to-the-type panicle is to be threshed by hand and kept in separate paper packets so that it can be sown readily.

In normal situation, nucleus seed produced is the one which is also called as nucleus seed stage-I. Here, nucleus seed stage-I production procedure is discussed first.

9.2.1. Production Procedure of Nucleus Seed Stage-I:

- Prepare one-meter width dry seed bed as per its preparation procedure.
- First sow the bulk Nucleus seed in rows which will be transplanted as border row around the plot.
- Sow the seed of each true-to-the-type panicles (threshed and kept in paper packets), one line.
- Irrigate the seed beds after sowing.
- Guard the seed beds from bird damage.
- Take care of the seed bed. Irrigate as per requirement. Take plant protection measures if needed. Apply fertilizer if the plot is not fertile enough.

- If any line is affected by disease/insect, the line can be discarded.
- Prepare the nucleus seed plot well.
- Once the seedlings become 21-28 days old, it is ready for transplanting. While transplanting, plant one seedling per hill.
- Nucleus seed plot is transplanted in a particular design. Therefore, it is required to mark the plot as per layout (Fig.5).
  - Leave a 30 cm space from the bund of the plot at all the four sides.
  - The direction from which transplanting starts, mark a space of 140 cm for 8 lines border row with a line to line distance of 20 cm.
  - At both sides of the plot keep space for 8 hills (105 cm) border row with a plant to plant distance of 15 cm.
  - Once four sides of the plot are marked with 8 hills/8 lines border row, leave a 60 cm space all around.
  - Divide rest of the plot area into 4.5 meters width ranks; so that at least 30 hills will be there in one line of the rank during transplanting.
  - Mark a space of 60 cm in between two ranks.
  - Once the nucleus seed plot is marked as per planting procedure, uproot both bulked nucleus seed and seedling of panicle progeny rows. Seedling of each panicle progeny row is to be bundled-separately.

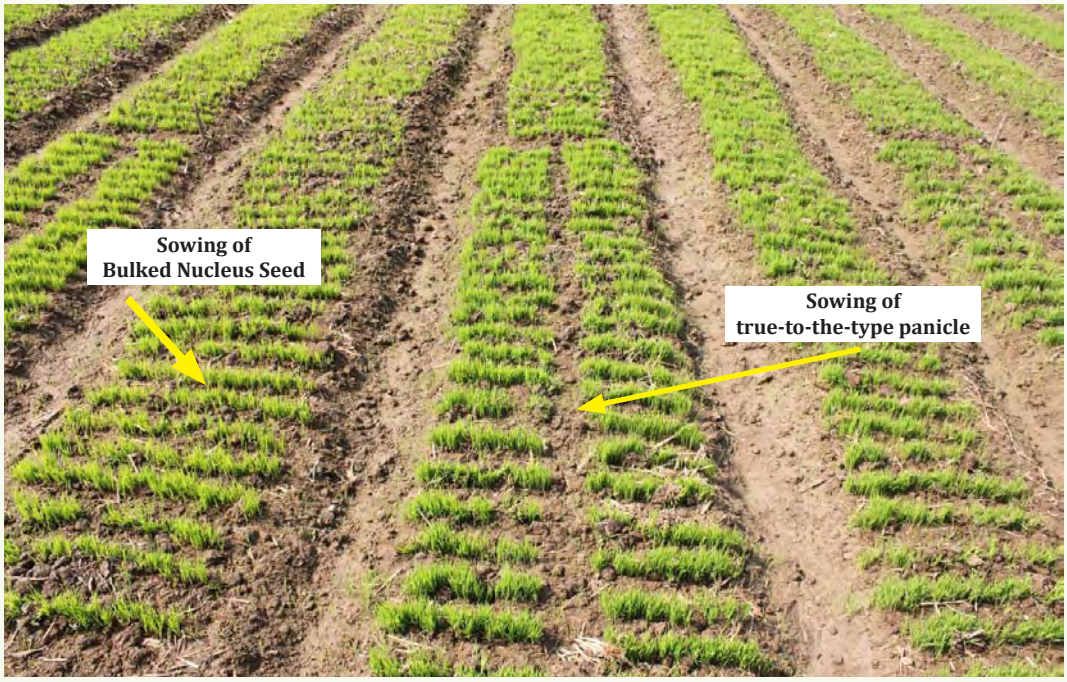


Fig.4: Sowing for Nucleus Seed Production

- First of all, start the transplanting with 8 continuous lines of border row with the seedlings from the bulked nucleus seed. After that there will be a gap of 60 cm after which ranks will start. Now for every rank,take the seedlings raised from a single panicle and transplant it individually in two rows with 20x15 cm spacing. After transplanting two rows, destroy the left-over seedlings. Then after giving a 40 cm gap, transplant the next panicle progeny seedlings in two rows. Proceed with transplanting like this.
- At both sides of the plot, transplant the 8 hills border row continuously with 20x15 cm spacing till the end of the plot.

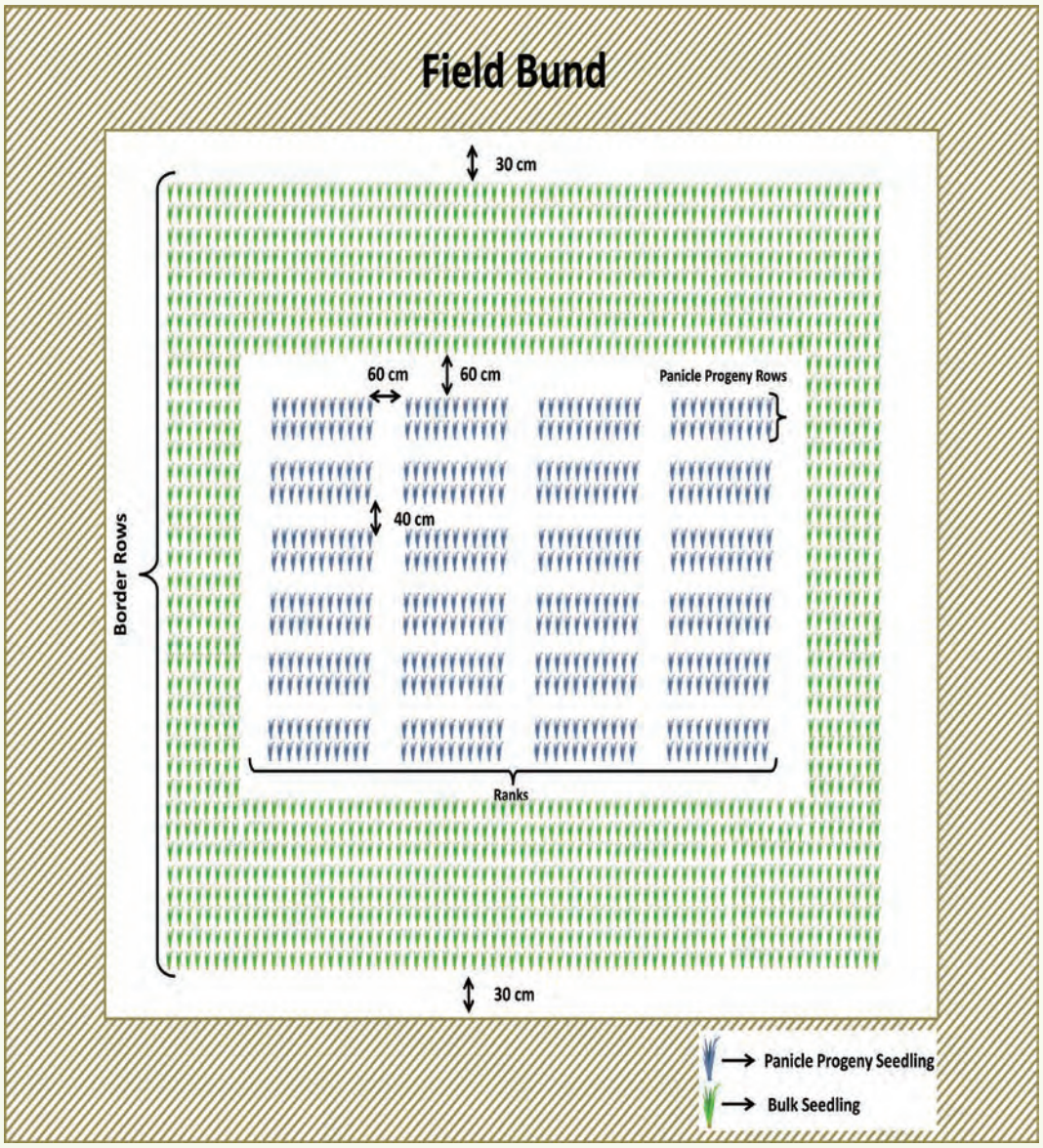


Fig.5: Field layout of Nucleus Seed Transplanting Plot (Panicle Progeny Rows)

- At the last part of the field, again transplant 8 lines border row with the bulked nucleus seed seedlings.
- Now in the nucleus seed production plot you will see a continuous 8 lines/8 rows border row all around the plot. In each rank 2 rows panicle progeny followed by the next panicle progeny rows with in between gap of 40 cm will be marked. This is called panicle progeny rows procedure.
- After transplanting allot a serial number to each of the panicle progeny and note it in the field note book.
- There should not be any gap-filling in the seed plot, even when the seedling mortality is high.
- Inspect the plot regularly. If any off-type plant is found in the border row, then cut/uproot and throw that plant. But if any off-type plant is observed in a progeny line, then cut the two progeny rows. Off types in progeny row means that the panicle was not pure; so it is required to reject the panicle; and here cutting two rows of a progeny line means the rejection of that particular panicle only.
- When an off type is detected after flowering stage, the off type showing progeny rows and the progeny rows on either side of the rows showing off type are also to be rejected to minimize contamination if any from the off-type plants. Thinking that the pollen from the off-type plants might have fallen on the nearby plants resulting in cross fertilization, these both sides progeny rows are rejected here.
- Once the off-type plants are removed, allow the crop to mature.
- From the left out true-to-the-type rows around 500 panicles are selected for the next cycle of nucleus seed production. Here, select the panicle/panicles from the progeny rows, keep it in a paper packet and mention the progeny row number on it.
- While harvesting, harvest the border row from the four sides first. Bundle it and keep it at one side. This is not kept as seed.
- Now fix labels with panicle progeny row number written in all the progeny rows, and then harvest each panicle progeny rows separately, bundle it separately and take it to the threshing floor.
- Thresh each panicle progeny row bundles separately and keep the threshed seed separately in cloth bags. Put the panicle progeny number on the cloth bags and keep it for drying.
- Till now, all the inspections of the nucleus seed plot were taken up in the field under the scorching sun and in the field mud. There is always a chance of mistake when you work in an unfavourable situation like this. Therefore, there is one more way of checking quality of seed that is called “Table top examination”. Here, the testing of the seed lot is done in the seed laboratory. For this, take samples from each of the cloth bags and test its purity (colour, shape and size of seed) on the purity board. If any doubt arises on the quality of seed, then reject that

number and note the number in the field note book. Now, bulk these seeds of all the panicle progeny rows (kept in cloth bags) which passed the purity test, dry it to a minimum of 13% moisture level, pre clean, process and grade it and then bag it with label (with relevant information written on it).

- Now draw samples and test the quality of the seed in the seed testing laboratory of the Institute. The seed should confirm to the quality standard of the different quality parameters. This is the Nucleus seed.
- If true-to-the-type panicle is collected from any serial number of the panicle progeny row, which cannot pass during table top examination, then that panicle is to be rejected.
- Quality wise, nucleus seed is the purest seed. So, the best possible crop management practices must be taken for the nucleus seed production.
- To minimize/restrict unwanted cross fertilization, an isolation distance of 3 meters in between different varieties is recommended in the field. Besides, time isolation can be practised where taking duration of the varieties into account, the varieties are planned/arranged in the field in such a way that, the nearby varieties do not flower at the same time, which automatically restricts the chance of cross fertilization.
- For production of nucleus seed for MAS-bred varieties, while growing panicle progeny rows, it is advised to collect leaf samples from each progeny row and go for DNA fingerprinting to ascertain the presence of the particular transferred gene in the panicle progeny.

Fig.6: Panicle Progeny Rows

9.2.2. Production procedure of Nucleus Seed Stage-II

- For production of nucleus seed stage-II, seeds from the true-to-the-type progeny rows are harvested separately and grown in separate progeny plots.
- Uniform and pure looking true-to-the-type progeny plots are selected and their seeds are bulked to produce nucleus seed stage-II.

9.3. Breeder Seed

Strictly speaking breeder seed is the progeny of nucleus seed. But it can also be the progeny of nucleus seed or breeder seed itself. Depending on the situation and for that, production procedure, breeder seed can be of two sub-classes, breeder seed stage-I and breeder seed stage-II.

When Breeder seed is the progeny of nucleus seed, it is called breeder seed stage-I. But when it is the progeny of breeder seed stage-I, it is called breeder seed stage-II.

Production of breeder seed stage-II is allowed by the Seed Certification Agency only when they realize that the breeder seed is in extremely short supply and it is very much required to produce breeder seed stage-II for sustenance of seed chain and for meeting the seed demand.

Breeder seed can only be produced by the institute from where the variety has been developed. If it is produced by the same breeder who has developed the variety, then it is good. But for any reasons, if the original breeder is unable to produce it, then it can be produced under direct supervision of another breeder of the same institute who knows about the variety well or who is well acquainted with the variety.

If the variety developing Institute expresses its inability to produce full quantity of breeder seed of their variety, the same is discussed in the AICRIP workshop and the responsibility of the left-over quantity breeder seed production is given to other agreeable institute. Here, the developing institute is asked to supply the required quantity of nucleus seed for the purpose. Again, the breeder of the developing institute is requested to visit the breeder seed plot of the other institute and help in quality inspection.

The minimum seed standard for breeder seed stage-I and stage-II are same. Breeder seed is the best quality seed of the seed chain. The genetic purity of the breeder seed should be maintained at 100 percent. The breeder seed tag is golden yellow in colour which is stitched to each bag. Relevant information and quality norms for the breeder seed are indicated in the tag attached to the seed bag.

Quality of the breeder seed is strictly controlled by two monitoring teams. All the Rice Research Institutes involved in rice varietal development and nucleus and breeder seed production of the developed varieties are the members of National Seed Project (NSP) of the Indian Council of Agriculture Research, Government of

India. A central monitoring team of NSP monitors the seed production process and facilities of the breeder seed production centre. Besides, the breeder seed plot is also monitored by a joint monitoring team headed by the State Seed Certification Agency. Here, the team consists of Director State Seed Certification Agency, representative of State Seed Corporation, representative of NSC, representative of State Agriculture Department, ADR Seed of the Agriculture University, Breeder/ Head of Breeding Department of the Agriculture University, Nodal Officer Seed of the Institute and Head Crop Improvement Division of the Institute, who inspects the breeder seed production plots.

9.4. Breeder Seed Production Procedure

Breeder seed is produced from nucleus seed or breeder seed stage-I. When produced from nucleus seed, it is called breeder seed stage-I and when produced from breeder seed stage-I, it is called breeder seed stage-II. The production procedure for breeder seed stage-I and breeder seed stage-II are same except the fact that the initial seed source for breeder seed stage-I is the nucleus seed whereas the initial seed source for production of breeder seed stage-II is the breeder seed stage-I.

Once a new variety is released and notified, different seed producing organisations indent for breeder seed of that variety through Department of Agriculture & Cooperation (DoAC), Government of India. The Crop Coordinator for Rice compiles all the indents of the country and prepares a variety wise requirement sheet which is discussed and finalised in the All India Coordinated Rice Improvement Programme Meeting/Workshop. Keeping varietal release in mind, (i.e. from which Institute which variety is released) the institute wise breeder seed indent for the coming year is prepared by the Crop Coordinator of Rice and sent to different Institutes in the Breeder Seed Proforma-I (BSP-I) format. This information on seed indent is uploaded in the seed net portal. Now, as per this BSP-I, each Institute plans their breeder seed production programme.

For production of breeder seed the following procedures can be followed:

- Prepare the seed bed (preferably dry seed bed) and sow the arranged nucleus or breeder seed stage-I seed in lines, cover well with soil and irrigate.
- Take good care of the seed bed. Irrigate in time and apply fertilizer as per requirements. If there is any insect or disease attack, apply insecticide or other medicines as per the advice of the plant protection experts.
- Prepare the field well and once the seedlings become 21-28 days old, arrange for transplanting. While transplanting, follow plant to plant 15 cm and line to line 20 cm distancing and transplant one seedling per hill.
- Breeder seed plot is transplanted in a particular field-procedure/design. Therefore, it is required to mark the layout before going ahead with the transplanting. Please see the write up and look at the breeder seed field layout sketch (Fig.7) for the plot layout.

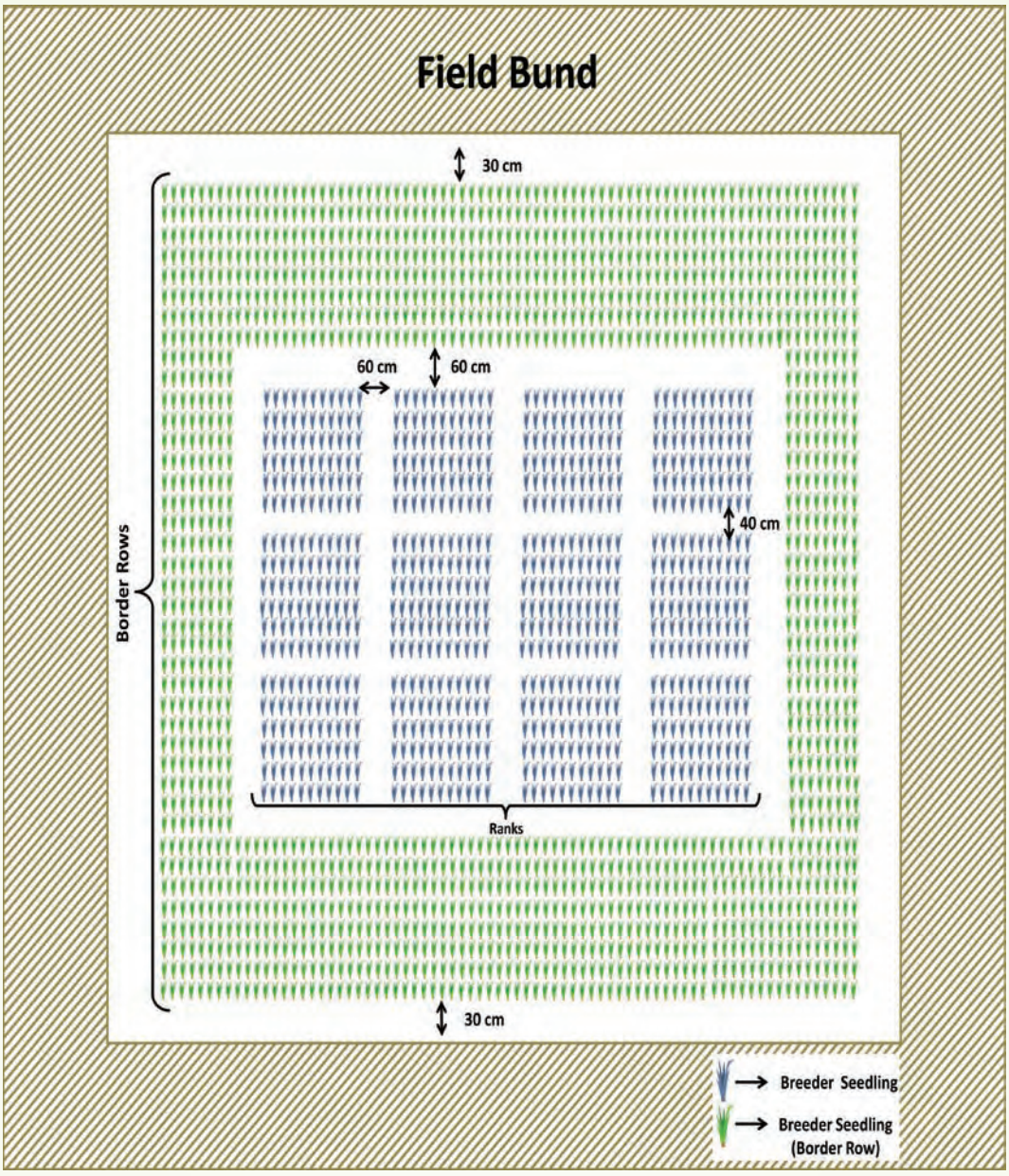


Fig.7: Field layout of Breeder Seed Transplanting Plot

- Leave 30 cm gap from the field bund all around the plot.
- Mark after 105 cm at both sides of the field to plant a border row of 8 hills (with plant to plant distance of 15cm).
- The direction from where transplanting will start, give a mark after 140 cm to transplant 8 lines (with line to line distance of 20 cm) as border row and in the very same way mark at the end for planting of 8 lined border.

- After marking for 8 hills or 8 lines all around, give a gap of 60 cm.
- Partition the rest of the area of the plot into small ranks of 8 meter width.
- Give a space/gap of 60 cm in between the ranks.
- Now the breeder seed plot is marked as per Breeder seed planting procedure; and so transplanting can be done.
- Transplanting of the breeder seed production plot is taken up as per the layout already marked in the field. The procedure followed are:
  - First of all transplant 8 lined border row. There will be no gaps in the border row. This border row works as a barrier for the unwanted pollens of nearby varieties. After border row, there is a 60 cm gap marked.
  - After the gap, transplant 8 lines in each rank and give a skipped row (leave one line) after every 8 lines. One skipped row allows a gap of 40 cm that facilitates easy space for the movement of scientists and technicians in the field for roguing (removal of off type plants). It is to be mentioned here that, the skipped row practice after every 8 row is only to facilitate the easy access to reach nearer to the plants so that the roguing will be effective. While moving along this gap, the officer doing roguing inspects 4 lines plants at either side of the gap and then proceeds to the next gap. It is observed that, during roguing of tall varieties it becomes difficult to inspect 4 lines at one side. Therefore, in tall varieties this skipped row can be practiced after every 6 rows. If this issue is further analysed, then it is felt that, it is better to practice skipped row after every 6 rows for all varieties so that roguing will be much effective. Proceed with transplanting.
  - At both the sides, border row of 8 hills will be transplanted all along without any gaps. It will be continuously transplanted with the same 20 cm spacing between rows.
  - Again, transplant 8 lines border row at the end part of the plot.
- If there is seedling mortality, means if some seedlings die in the line, then do not transplant fresh seedlings at those gaps, keep it empty. If fresh seedlings are transplanted, while flowering of the crop these late planted plants will flower late, giving an impression of off type plants. So, there should be no gap filling in any seed production plots.
- Breeder seed is the best quality of seed in the seed chain. Therefore, the best possible crop management practices like timely irrigation, weeding, fertilizer application, plant protection measures etc. are to be followed in the breeder seed production plots.
- Keep an isolation distance of 3 meters around your seed plot. Though rice is a self-pollinated crop, still to restrict chance cross fertilization due to wind and insects, keeping this isolation distance is mandatory. With isolation distance if time isolation can be practised, then it is much better.

- Remove off type plants from the plot, which is called roguing. Here any plant that looks different than the main seed crop plant is to be uprooted and thrown away. Continue roguing till harvesting.
- Keep contact with Central Monitoring and State Monitoring Teams and see that your breeder seed plots confirm to the field level quality parameter norms. Prepare the monitoring report (BSP-III) as per the format with signatures of all the monitoring team members.
- Once the crop matures, harvest the 8 lined border first, bundle it and keep it separately; it is not used as seed. Then harvest rest of the plot, bundle it, take it to the threshing floor for threshing, dry it to a minimum of 13% seed moisture and grade it.
- Collect the seed sample and test it for different quality parameters in the seed testing laboratory of the Institute. If this seed confirms to the quality standard norms, then this is designated as the breeder seed. Then the concerned scientist issues tags for the bags.
- Breeder seed is generally packed in 30 kg or 20 kg bags. Each bag is stitched with a breeder seed tag that carries all the relevant information regarding the seed lot.

9.5. Foundation Seed

In strict sense, foundation seed is the progeny of breeder seed. But it can also be the progeny of breeder seed or foundation seed itself. Depending on the situation and for that, production procedure, foundation seed can be of two sub-classes, foundation seed stage-I and foundation seed stage-II.

When foundation seed is the progeny of breeder seed, it is called foundation seed stage-I. But when foundation seed is produced from foundation seed, it is called foundation seed stage-II. Only foundation seed stage-I can be used for production of foundation seed stage-II. Foundation seed stage-II cannot be used to produce foundation seed. It can only be used for production of certified seeds.

It is the prerogative of the State Seed Certification Agency to decide whether the seed chain requires the production of foundation seed stage-II to meet the demand of the state when actually there is a shortage of breeder seed to support the foundation seed production programme. If more quantity of foundation seed is required which cannot be produced from the available breeder seed, then the State Seed Certification Agency decides to allow the production of foundation seed stage-II.

The minimum seed standard for foundation seed stage-I and stage-II are same. The genetic purity of the foundation seed should be maintained at 99.5 percent. The foundation seed tag is white in colour and it carries all the relevant information about the foundation seed lot packed in the bag.

Foundation seed can be produced by all the State Seed Corporations, State Farm Corporation of India (SFCI), National Seed Corporation (NSC), Government Farms, Agriculture Universities, Krishi Vigyan Kendras (KVK), registered seed producer organisation or registered growers.

The production of foundation seed is supervised by the Seed Certification Agency and the seed is to maintain genetic identity and genetic purity of the variety besides confirming the values of different quality parameters as per the prescribed seed standards.

9.6. Foundation Seed Production Procedure

The production procedure for foundation seed stage-I and foundation seed stage-II are same except the fact that the initial seed source for foundation seed stage-I is the breeder seed whereas the initial seed source for production of foundation seed stage-II is the foundation seed stage-I.

For foundation seed production, the following procedure may be followed:

- Procure required quantity of breeder seed of the choice variety. Bring the cash memo, breeder certificate and breeder tag with the seed. Sow the seed in the seed bed. Both dry and wet sowing can be practised.
- Apply to the Seed Certification Agency for registration for foundation seed production.
- Prepare the field well and transplant one seedling per hill in lines, in time. For early varieties, keep plant to plant 10 cm and line to line 15 cm distance; and for medium and late varieties keep plant to plant 15 cm and line to line 20 cm distance.
- Keep an isolation distance of 3 meters all around the seed plot to restrict unwanted cross fertilization.
- If there is seedling mortality in some plots, do not transplant those hills/lines, keep that empty. If new seedlings are transplanted there, during flowering in the seed plot these late transplanted plants flower late bringing confusion of off type plants.
- Crop management practices in the seed production should be practised timely.
- Remove off type plants, objectionable wild rice and weeds and diseased plants from the seed plot.
- Arrange timely inspection of the seed plots by the Seed Certification Officer.
- Do harvesting, threshing and drying timely.
- Pack the seed in new bags after processing and grading.

- Arrange for seed testing through Seed Testing Laboratory of the state; and if the seed lot confirms as per the prescribed seed standard, then the Seed Certification Agency will award the quality certificate and the tags.
- For further details on the process of certification by Seed Certification Agency please refer to the Chapter 38.2.
- For certification standards for field level quality parameters and for certification standard for seed quality parameters, please refer the Table No. 2 and 3.

9.7. Certified Seed

In strict sense, certified seed is the progeny of foundation seed. But it can also be the progeny of foundation seed or certified seed itself. Depending on the situation and for that, production procedure, certified seed can be of two sub-classes, certified seed stage-I and certified seed stage-II.

When certified seed is produced from the foundation seed it is called certified seed stage-I; but when certified seed is produced from certified seed stage-I it is called certified seed stage-II. Certified seed stage-II cannot be used for any other seed production purposes.

Production of certified seed stage-II is taken up only when it is felt by the State Seed Certification Agency that the available foundation seed is not enough in the seed chain and to cater the immediate need of the farmers it is required to produce the certified seed stage-II.

The minimum seed quality standard for certified seed stage-I and stage-II are same. The genetic purity of the certified seed should be maintained at 99 percent. The certified seed tag is blue in colour and it depicts all relevant information about the certified seed lot packed in the bag. This is the commercial seed which is available to the farmers for crop production.

Mainly certified seed is produced by registered seed producer organisation, KVKs, NGOs and registered growers and advance farmers.The certified seed production is supervised by the Seed Certification Agency and monitored by the Seed Certification Officer. Once the field level quality parameters and the seed quality parameters confirm to the fixed quality standard norms of that particular class of seed, quality certificate & tags are awarded.

9.8. Certified Seed Production Procedure

The production procedure for certified seed stage-I and certified seed stage-II are same except the fact that the initial seed source for certified seed stage-I is the foundation seed whereas the initial seed source for production of certified seed stage-II is the certified seed stage-I.

Certified seed production procedure is more or less similar to that of foundation seed production. However, both the production procedures differ on the following points.

- The initial seed source for certified seed (certified seed stage-I and certified seed stage-II) differs from that of foundation seed (foundation seed stage-I and foundation seed stage-II)
- The field level standard and seed standard in respect to different quality parameters for certified seed is different than that of foundation seed.
- For seed certification standard for field level quality parameter and for seed quality parameters, please refer Table No.2 and 3.
- For further details on the process of certification by Seed Certification Agency, please refer Chapter 38.2.

9.9. T.L Seed (Truthfully Labelled Seed)

Leaving aside breeder, foundation and certified seed, another type of quality seed named as Truthfully Labelled seed (TL seed) is available for crop production. When other quality seeds like breeder, foundation and certified seed can be produced only after the new variety gets notified, here TL seed can be produced just after the release of the variety without looking at its notification status.

TL seed can be produced by using breeder seed, foundation seed, certified seed or TL seed of the specific variety. It is mainly produced by Government Research Organisations, Agriculture Universities and registered Private Companies for use by the farmers in crop production purposes.

TL seed production procedure is similar to that of certified seed production. However, it is not monitored or certified by the Seed Certification Officer. All the seed quality parameters must be written on the specific opel green coloured tags which should be stitched with the bags by the producing organisation. The quality standard of TL seed is atleast of the same standard of certified seed.

Only Seed Inspectors can check the quality of the TL seed, as they have the authority to check the quality of any type of seed which is on sale. If the Seed Inspector has any sort of doubt on quality of this seed, he can draw the samples and send the same to Seed Testing Laboratory for quality checking; and can stop the sale of that particular seed till the test report is available. If the quality testing report signifies its quality as per requirement, then it gets clearance for sale; but if the quality testing shows lower values than the prescribed standard, then the seed sale has to be totally stopped.

9.10. Difference between Certified and TL Seed

Both certified and TL Seed are supposed to be of the same quality because their quality standard criteria are same. But both the types of seeds differ on certain points in the process of their production and sale system. The differences are depicted in Table No.1

Table No.1: Difference between certified and TL seed

Sl. No.	Certified seed	Truthfully Labelled Seed
1	Certification is voluntary	Truthful labelling is compulsory for notified kind of varieties
2	Applicable to notified kinds only	Applicable to both notified and released varieties
3	It should satisfy both minimum field and seed standards	Tested for physical purity and germination
4	Seed Certification officer and Seed Inspectors can take samples for inspection	Seed Inspectors alone can take samples for checking the seed quality.

10. Field and Seed Standard in Foundation and Certified Seed

For seed certification, the Seed Certification Officer (SCO) visits the foundation and certified seed production plots at least twice within 50% flowering to harvesting and once to the processing unit.

While inspecting the field, the SCO verifies whether different quality parameters are according to the standard fixed for the particular class of seed or not. If the field standard adheres to the required set-standard (Table No. 2), then the seed production programme passes the field level inspection. Again, after processing, the seed sample is collected and sent to the Seed Testing Laboratory, where if the sample adheres to the seed quality norms (Table No. 3) prescribed for that particular class of seed, the seed gets certified, and the seed certificate and tags are presented.

While producing quality seed it is very essential for the producer to know the ranges of field level quality parameters for different class of seed so that before inspection by the SCO, he can safe-guard the quality of the plots.

Table No.2: Field standard for different quality parameters

Class of Seed	Off-type plants	Inseparable other crop plants	Objectionable weed plants	Diseased plants
Certified seed	0.2	0.05	0.02	0.5
Foundation seed	0.05	0.01	0.01	0.1

Table No.3: Seed standard for different quality parameters

Class of Seed	Pure seed % (min)	Inert matter % (max)	Other crop seeds / kg (max)	Total weed seeds/ kg (max)	Objection-able weed seeds/ Kg (max)	Germina-tion % (min.)	Moisture % (max.)	ODV/ kg (max)
F	98	2	10	10	2	80	13	10
C	98	2	20	10	5	80	13	20

11. Different types of Tags for Quality Seed

On the basis of quality, there are different types of seed. These different types of quality seed are marked with different tag colours and tag sizes. These tags are stitched to the seed bags during sale. Different tag colours and sizes of different types of quality seed are depicted in the Table No. 4.

Table No. 4: Tag colour and sizes of different types of Seed

Sl. No.	Seed category	Label colour	Size
1	Breeder seed	Golden yellow	12 cm X 6.0 cm
2	Foundation seed	White	15cm X 7.5 cm
3	Certified seed	Blue	15cm X 7.5 cm
4	Truthfully Labelled seed	Opel green	15cm X 10 cm

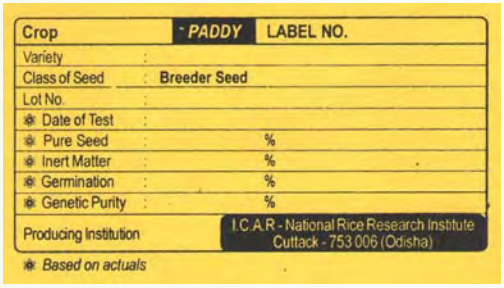


Fig.8: Breeder Seed Tag

Fig.9: Foundation Seed Tag

Fig.10: Certified Seed Tag

Fig.11: Truthfully Labelled (TL) Seed Tag

12. Information on the Breeder Seed Tag

While supplying the Breeder seed as per DoAC allotment, a golden yellow colour tag is stitched with the bag with certain mandatory information's written on it. The mandatory information are as follows:

1. Name of the crop
2. Tag No.
3. Name of the variety
4. Class of seed
5. Lot No.
6. Date of test
7. Pure seed (%)
8. Inert matter (%)
9. Germination (%)
10. Genetic purity (%)
11. Source
12. Signature of the Breeder
13. Seal

13. Isolation Distance

Rice is a self-pollinated crop. Both male and female organs are present inside one flower for which fertilization occurs within the flower. So, it is easy to maintain genetic purity. Though strictly self-pollinated, windy conditions and movement of insects from one plant to other result in around 2-5% cross pollination effected by the pollen of other varieties planted nearby.

While producing quality seed, an isolation distance is maintained between variety to variety to avoid the unwanted cross fertilization. In case of rice, this isolation distance is 3 meters which is to be maintained during production of breeder, foundation, certified and TL seed. As per this, there should not be any other varieties within 3 meters distance all around the seed production plot.

There is another way to restrict this unwanted cross fertilization in the seed production plots; which is called time-isolation. While following time-isolation,taking their crop duration into account, the nearby other varietal plots are arranged in such a way that the nearby varieties do not flower at the same time. So, there will be no chance for cross pollination.

By following both, isolation distance and time isolation methods, the unwanted cross fertilization can be restricted to a greater extent in the quality seed production plots.

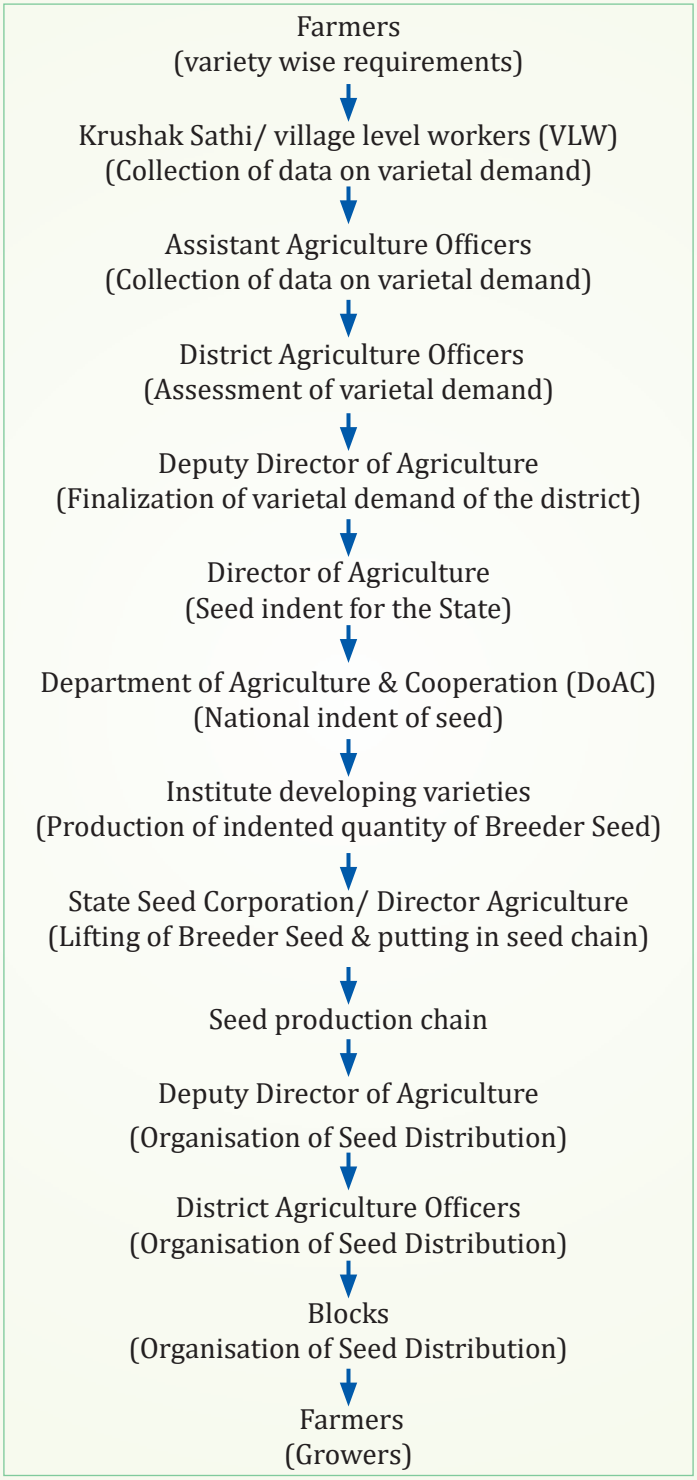
Fig.12: Isolation Distance between two varieties

14. Seed Indent Chain

Once a new variety is released and notified, the Institute demonstrates the variety through Front Line Demonstration (FLD) and distributes minikits of the new varieties to the farmers of different area for its popularization. If the farmers become happy with the performance of this variety, then a demand for its quality seed is created, and now this variety is to find a place in the list of indented breeder seed. Let's see, how the seed indent chain moves in the country.

Once the farmer requires seed of a particular variety in a village/ gram panchayat/ block/ sub-division/ district, the message of its demand is supposed to pass through VLW or Krushak Sathi to the Assistant Agriculture Officer (AAO) from where it moves to District Agriculture Officer (DAO) and Deputy Director Agriculture (DDA). DDAs control the Agriculture system at the District level. The DDAs of different Districts inform the Director of Agriculture regarding choice/ demand/ requirement of varieties in their district. This information is compiled first district wise and then for the entire state in the office of Director of Agriculture and seed indent plan of the state for the ensuing year is prepared. The variety wise seed indent for the state is submitted to the DoAC. The Crop Coordinator of Rice compiles the total indent for the country, and keeping an eye on the varietal release, prepares the Institute wise variety indent list which is sent to all the breeder seed producing institutes as BSP-I. As per the demand, the Research Institutes produce the Breeder seed and submits the production report (BSP-IV) to DoAC. Now DoAC keeping an eye on the BSP-IV allots the seed to different centres/organisations as per their demand/indent; which is displayed in the seed net portal and conveyed to all. Now every states lift their allotted breeder seed through their State Seed Corporation and go ahead with their seed multiplication programme through the seed production chain where breeder to foundation and foundation to certified seeds are produced. This certified seed is the commercial seed which moves to the district through DDAs and is sold to the farmers through the blocks for crop production.

The flow chart for this seed indent chain describes the path of creation of demand to availability of the desired seed with the farmers.



15. Seed Rate

Seed rate explains the quantity of seed required for transplanting of a fixed area. For quality seed production, transplanted rice with line transplanting is more suitable because it is easy to safe-guard purity in this system. Agriculture scientists have already confirmed the plant to plant and line to line distance for different duration rice varieties, taking into account the optimum utilization of sunlight for yield. Again, for quality seed production, it is always advisable to transplant one seedling per hill, otherwise while roguing in one hill you may find half of the tillers off type and other half real type, which will create unnecessary confusion. Taking all the above points into consideration, the Agriculture Scientist have calculated that, for quality seed production in 1 hectare area 30 kg seed will be required or in other words for 1 acre area 12 kg seed will be required.

16. Seed Multiplication Ratio

Certified seed is the commercial seed which is used by the farmers for crop production. This certified seed is produced from foundation seed and in turn, foundation seed is produced from breeder seed. These three types of quality seed represent the seed chain of the country. It is very much required to provide required quantities of certified seed to our farmers every year for a better production.

All the states of our country always plan the need/necessity of their farmers two years ahead and accordingly they indent for breeder seed, so that they can multiply it to foundation and certified seed in two years and can provide the same to the farmers. For going with this back calculation, it is important that we know the seed multiplication ratio of rice.

The rice scientist of our country has confirmed that, the seed multiplication ratio for paddy is 1:80. That means, if you use 1kg seed, then you will get back at least 80 kg of paddy.

Now, if we go with an example, say we have a target of 6400 quintals of certified seed requirement after 2 years. Then for coming year we will have to produce 80 quintals of foundation seed and for this foundation seed we will have to start this year with 1 quintal breeder seed.

17. Seed Replacement Rate (SRR)

Seed is the key in a crop production programme, where only use of quality seed can enhance the yield up to 20%. Not only its own contribution, quality seed is the main factor responsible for a higher yield on which the performance and efficacy of other yield enhancing factors depend. Therefore, it is the responsibility of the Agriculture Scientists not only to develop new and improved high yielding varieties but also to assure a continuous supply of quality seed of these varieties to the farmers on a regular basis.

Generally, the farmers of our country either do not get quality seed due to shortage in supply or they fail to afford due to their financial condition, and use farm saved seeds for their crop production. This practice is to be discouraged and farm saved seed is to be replaced by the quality certified seed to make an impact on yield. For this, it is important to really assess the total area under quality seed and it is required to move ahead with a year wise targeted plan for increasing the use of quality seed.

Seed Replacement Rate (SRR) is the percentage of area sown out of the total area of crop planted in the season by using certified/quality seeds other than farm saved seeds.

$$\text{SRR (\%)} = \frac{\text{Area planted by using certified seed}}{\text{Total area of crop}} \text{ X } 100$$

SRR gives a picture on percentage of area covered by the quality seed and allows us to express our target of replacement of farm saved seeds quantitatively.

18. Varietal Replacement Rate (VRR)

With the advancement of civilization, the rice cultivation area is not increasing, but the production target is increasing because of population growth. This trend will continue in the future also. To handle the situation well, productivity of rice is to be enhanced so that we will produce more from the same area of land.

For increase in productivity, the use of new improved high yielding varieties possessing higher yield potential is to be encouraged. Presently, the country has released around 1200 rice varieties. Every year new varieties are identified, released and notified. These new varieties are getting released only because they are showing appreciable yield or other advantages over and above the old varieties of the same ecosystem. Then obviously, these new varieties should replace the older ones, and this should be encouraged.

Varietal replacement Rate (VRR) is the rate at which the varieties presently in cultivation are getting replaced by the new varieties. It expresses the adoption/ use of new varieties in a quantitative way.

For example, in Rice number of varieties in the seed chain are 293 having total indent of 4720 quintals Breeder seed, out of which 68 are released within last 5 years having a share of 705.3 quintals which shows a 14.8% share in total indent. If considered up to 10 years older variety then, 129 varieties having a share of 2264.1 quintals indent shows 47.7% share in total indent. (From ICAR, AICPR on National Seed Project (Crops), 2018).

Varietal Replacement gives an overview on the number of new varieties used in the seed chain in a particular span of time and this data facilitates the Agricultural strategist to plan their programme and for fixing a target.

19. How to arrange Seed for Quality Seed Production?

Breeder seed is produced only by the research organisations from where the variety has been developed; and the required nucleus seed for production of breeder seed is also produced there in the same research organisation. Leaving aside breeder seed, the other types of quality seeds like foundation and certified seeds are generally produced by different Government Farms, Krishi Vigyan Kendras, registered Seed Producer Organisations and seed growers and Non-Government Organisations.

If you are interested in producing foundation seed, then you will have to get the breeder seed from the research organisation from where the variety has been developed. Otherwise, you can get the breeder seed from the State Seed Corporation, which in turn, collects that particular breeder seed from the Institute which has developed the variety. The breeder seed bag bears a golden yellow tag stitched with the packet.

If you are interested in producing certified seed, then you will have to arrange foundation seed of the variety which you can get from some Government Farms, KVKs and State Seed Corporation. The foundation seed bags used to be stitched with a white tag on which information regarding name of variety, lot number, seed production time, purity and germination percentage etc. used to be mentioned.

If you are requiring seed for your crop production, then you will have to arrange certified seed of the variety which can be available from Block office. On the certified seed packet, blue colour tag with required information about the seed used to be stitched. For your own crop production, you can also have TL seed which can be available from Research Institutes, Agriculture University, and registered Seed producing Organisations. These TL seed bags used to be stitched with an opel-green tag with required information about the seed lot written on it.

20. How to select suitable Land for Quality Seed Production?

For selection of a field/land for seed production, the following points are to be taken care of:

- Select a fertile field which will produce good quality and healthy seed.
- Select a field where rice was not grown in the previous season. This is to restrict off type plants arising out of drop out seeds of the last season.
- If the land was used in the previous season for rice cultivation, then do a summer plough, leave if for around 15 days, then water the plot and allow the soil to get soaked well and drop out seeds to germinate, then do wet plough (all germinated plants will die) and leave it for 4-5 days, finally do the final puddling and laddering and go for transplanting.
- Select a field in such a way that you have provision of 3 meters isolation distance all around the plot. This is required for restricting unwanted cross fertilization due to wind and insects.

21. Cultivation Procedures for Quality Seed Production

Rice can be grown by direct seeding as well as by transplanting methods. But for seed production, transplanted rice is always better because in this method off type plants can be better restricted.

Cultivation procedure mainly depends on the land type. In upland situation direct seeding is preferred while in medium land transplanting method is prevalent. But in low land situation mostly direct seeding and in some parts transplanting is practiced.

In the selected plots the following methods can be followed:

- First go for a summer ploughing and leave the field for 15-20 days. Through this, the soil layer gets altered, some of the drop out rice seeds of the last season rice crop and grasses get deep inside the soil and eggs of the insects gets spoiled.
- Then water the plot and keep water for a week so that the soil will get completely soaked and the drop out rice seeds will either germinate or get decayed.
- After seven days, do a wet plough (initial puddling) by which the germinated rice seeds will get spoiled and the soil will open up.
- After 3-4 days, do the final puddling, level it through laddering and transplant.
- As seed yield mostly depends on the cultivation procedure, it is very much required to perform different agricultural operations like, field preparation, sowing, transplanting, fertilizer application, weeding, inter-cultural operations, insect/disease control measures, roguing, harvesting, post-harvest processing etc. all in time and all in best possible way.

22. Seed Bed Preparation & Sowing

Seed bed is the place where seed is sown and seedlings are raised for transplanting. To get healthy seedling for transplanted rice, it is important to prepare a good seed bed. For seed bed preparation always a sandy soil is better. Again, it is required to select a land where no rice crop was there. Generally, persons/organisations involved in regular seed production keep their seed bed area fixed and keep the land fallow after seedlings are uprooted. This is a good practice. Only precaution to be taken here is, do not allow the left-over seedlings to flower and mature there, plough the area and destroy the leftover seedlings.

There can be dry seed bed or a wet seed bed depending upon the climate and soil condition. Preparation and sowing procedures differ in these two types of seed bed.

❖ ***Dry Seed Bed:***

- The selected seed bed plot is to be thoroughly ploughed and the soil is to be powdered by the use of rotavator (if possible).
- Prepare a 40 cm width drain at 4 sides of the plot and see that through this channel excess water can be drained out (if required).

Fig.13: Seed bed preparation with Rotavator

- From one side, prepare 1 meter width bed one after another and keep 30 cm drain in between two beds. When the soil of the drain is put on the bed, you will find the beds a bit raised with furrows in the form of drain at both the sides. It is called ridge and furrow method.
- If length of the bed is more, prepare a drain of 40 cm width in the middle, centrally i.e. in all beds. It will make the drainage smooth during excess water due to rain or other factors.
- Now dress the soil of the bed and level it and sow the seed in 2 cm depth in lines drawn. In between lines, keep 10 cm distance. Cover the sown lines with soil.
- After sowing, irrigate the plot. While irrigating, see that the water flows in the drainage channels only. If water flows over the bed, seeds from the bed will flow with the water current and it may get mixed with the other beds.
- Now guard the seed beds from bird damage for 4-5 days. Now-a-days bird scaring ribbons are available, which if you put around the seed beds tied to 4 poles at four corners, can guard your seed bed from birds. Otherwise, you will have to engage human resource to guard the seed bed.
- After 4-5 days, seeds will germinate and seedlings will come up. Irrigate the seed bed as per requirement.

Fig.14: Dry Seed Bed

Fig.15: Seedlings in Dry Seed Bed Sowing

❖ ***Wet seed bed:***

- The selected seed bed area is to be properly ploughed, watered and kept for 7-8 days for soil to get soaked.
- Do initial puddling, leave it for 4-5 days and then do a final puddling followed by laddering.
- Drain the water completely.
- Make a drain of 40 cm width all around the seed bed area. Then from one side prepare seed bed of 1.5 meter width one after another, giving 30 cm gap between two beds. Put extra soil of the drain on the beds so that the beds will be slightly raised. Length wise cut the beds after every 3 meters, and prepare a drain of 30 cm width. Now many seed beds of 1.5 meter x 3 meter size will be prepared.
- Now dress the soil with hand ladder and level it and sow the pre-germinated seeds by dribbling.
- Now guard the seed beds from bird damage for 4-5 days. Now a days, bird scaring ribbons are available which if you put around the seed beds tied to 4 poles at four corners, can guard your seed bed from birds. Otherwise, you will have to engage human resource to guard the seed bed.
- After 2-3 days seedlings will come up.
- Irrigate the seed bed as per requirement.
- For preparing pre germinated seed for wet sowing the procedure followed is as follows:
    - Fill seed up to ¾th of a gunny bag, close the bag opening by tying a rope and completely submerge it for 20-24 hrs. Extra space is kept in the gunny bag because the seed under water will swell and require more space.
    - After around 24 hours take out the seed bags from water and keep it at a higher place so that the water will flow out of the bag.

- Keep the bag on the floor with gunny bag at the bottom and above as cover to give a bit of warmth.
- Inspect every day; if the outer side of the gunny bag dries off then spray water to keep it wet.
- After 2-3 days seeds will start germinating. Once the seeds get germinated, use this pre germinated seed for dribbling in the wet seed bed.

Fig.16: Preparation of Wet Seed bed

Fig.17: Seedlings of Wet Seed bed

23. What should be the Age of Seedling for Transplanting?

To get a good seed production, the age of seedling also plays an important role. If very young seedlings are used, it creates problem during transplanting because to hold it by hand for transplanting becomes difficult. In slight unfavourable situation seedling mortality affects the crop stand and also the yield. Transplanting with older seedlings restrict the vegetative growth and tillering habit to some extent resulting in lower yield.

Generally, basing on the duration, the varieties are grouped into 3 categories like, early duration varieties, medium duration varieties and late duration varieties. Keeping an eye on the variety duration, seedling age has been finalized. As per varietal duration, the seedling age which will give a good crop is depicted in the Table No. 5.

Table No. 5 Seedling age vs Duration of Crop

Variety	Seedling age
Early Duration	13-21 days
Medium Duration	25-30 days
Late Duration	35-40 days

24. Field Preparation for Transplanting

While preparing field for seed production the following procedure is to be followed.

- Open the field with a summer plough.
- Leave the field for 15-20 days after a summer plough.
- Water the field so that soil will soften and the drop out rice grains will either germinate or decay.
- After 10-12 days, do the first wet ploughing (puddling) so that weed and grasses will go under the soil and decay.
- After 5-7 days do the second wet ploughing (puddling) followed by laddering.
- Now the field is ready for transplanting.

Fig.18: Summer Ploughing

Fig.19: Wet Ploughing

Fig.20: Laddering of Seed Production Plot

25. Seedling Uprooting

Before seedling uprooting, water the seed bed well so that the soil will soften and uprooting will be smooth and easy. Generally, seedling uprooting from sandy seed bed is easy where seedling damage is minimum; but where the seed bed is not sandy, there more time is required for softening of the soil after irrigation and there is more chance of seedling damage. Here, due care is to be taken to employ seasoned agriculture workers who are used to do the job and see that root damage and plant damage are minimum.

Fig.21: Uprooting of Seedlings

26. Transplanting

For transplanting in seed production plots, the following points are to be taken care of:

- Seed production plots must be line transplanted. Crop management is easier in line transplanted plots.
- In early duration varieties, line to line 15 cm and plant to plant 10 cm distance is to be maintained. But for medium to late duration varieties there must be line to line 20 cm and plant to plant 15 cm gap.
- In seed production plots transplant one seedling per hill.
- Complete transplanting before the scheduled time; which differs a bit as per agro-climatic zone.
- Keep 2-3 cm of water in the field after transplanting.

Fig.22: Transplanting in Seed production Plots

Fig.23: Line Transplanting view in Seed production Plots

27. Weed Control in the Seed Production Plots

To avail food and water from the soil, grass and other unwanted voluntary plants compete with the rice plant. If grass and other weeds are not controlled in the rice plot from the beginning, then it affects the crop growth and results in penalty in yield. For controlling weed, the following procedures can be followed.

- Proper preparation of plot for transplanting suppresses the initial weed growth to a considerable limit. For this, the field preparation schedule to be followed are:
    - Open the field with summer plough and leave the plot exposed to sun for 15-20 days.
    - Water the plot and keep water for a week so that the soil will get completely soaked and the drop out rice seeds will either germinate or decay.
    - Do the first wet plough or puddling so that the grasses will go under the soil and germinated rice seed will decay.
    - After 4-5 days, do the second wet plough or final puddling followed by laddering so that the soil will open up and the field will be levelled.
- While laddering the plot, remove the left-over root portions of the previous year crop manually.
- Keep the irrigation channels clean and weed free.
- Keep water in the field to a particular level as advised, which will reduce weed.
- While growing rabi-rice, weedicide application will be the best option for weed control. For this, enquire about the effective weedicide from the weed scientist and apply the same as per his advice. Otherwise, do a manual hand weeding after 30-35 days of transplanting.
- If possible, use of mechanical weeder will also control the weeds.
- Later, go for manual hand weeding as per need.

Fig.24: Hand Weeding in Seed Production Plot

Fig.25: Mechanical Weeding in Seed Production Plot

28. Water Management in the Seed Production Plots

In comparison to other crops, rice cultivation requires more water. Therefore, effective irrigation as per requirement of the crop results in higher yield.

- After transplanting maintain 2-3 cm depth of water in the field for a month. It will restrict weed growth. Do not keep more water that will affect the normal tillering of the rice plant.
- Once tillers come up, maintain 3-5 cm depth water in the field till milking stage of the panicles. Shortage of water during panicle initiation and milking stage leads to more chaffy grains in the panicle.
- After milking stage, reduce the water level in the field to 2-3 cm only.
- Once tips of panicle ripen or before 15 days of harvesting drain the total water from the field and allow it to dry.

29. Fertilizer Management in the Seed Production Plots

For smooth and effective fertilizer management, soil testing is very much required. Now-a-days soil testing of the farmer's field is carried out in large scale through Government involvement and "Soil Health Cards" are also provided to the farmers. Fertilizer management should be taken up keeping an eye on the soil testing report.

- Use Nitrogen, Phosphorous and Potash at the rate of 60:40:40 kg per hectare. Application of higher dose of fertilizer in the seed production plots leads to higher vegetative growth and tallness which in later stage becomes responsible for lodging. Lodged crop is not suitable and discarded as seed.
- Apply the total Phosphorous, ¾th of potash and ⅓rd of the Nitrogen fertilizer at the time of transplanting as basal dose.
- Apply second ⅓rd of Nitrogen after 45-50 days of crop growth and last ⅓rd part of Nitrogen during booting or flowering initiation stage.

- Apply the left-over ¼th Potash at the time of flowering initiation stage of the crop. This helps in producing full and healthy seeds. This ¼th Potash can be applied mixed with the last dose of Nitrogen.

Fig.26: Fertilizer Application in Seed Production Plot

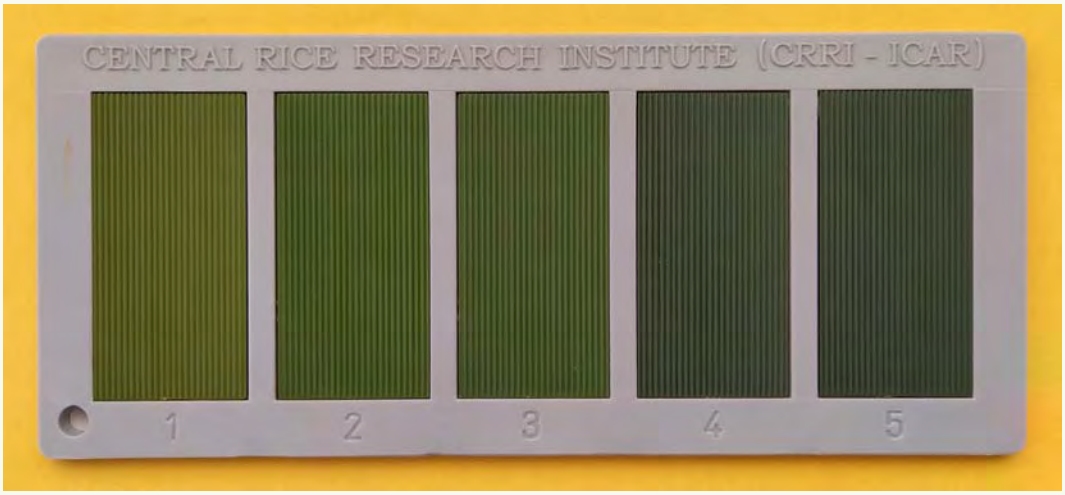


Fig.27: Leaf Colour Chart

- For effective Nitrogen management in the seed plots, it is always advisable to use "Leaf colour chart".

30. How to control Insects and Diseases in Seed Production Plots?

Many types of insects and diseases attack the rice crop during different crop growth stage which affects the crop yield. Therefore, for a good yield, it is very much important to identify insect or disease and to take effective measures at the right time.

Fig.28: Pheromone Trap

Fig.29: Light Trap

To restrict or control insects and diseases in the crop field, do a summer ploughing in the field, use treated seeds, keep the field bunds and irrigation channels clean and if possible, install Pheromone trap & light-traps in the field to identify insects. If there is insect or disease attack, then take the advice of Agriculture Officer or Plant Protection Scientists and apply the medicines as per requirement.

If you are unable to contact Agriculture Officers or Plant Protection Scientists for correctly identifying and advising for insect/disease attack, then take the help of "Rice Xpert App" developed by ICAR-National Rice Research Institute, Cuttack. For the purpose, go to "Google Play Store" of your android mobile and download Rice Xpert App. Open the app, select language and again select the insect pest icon. You will find/

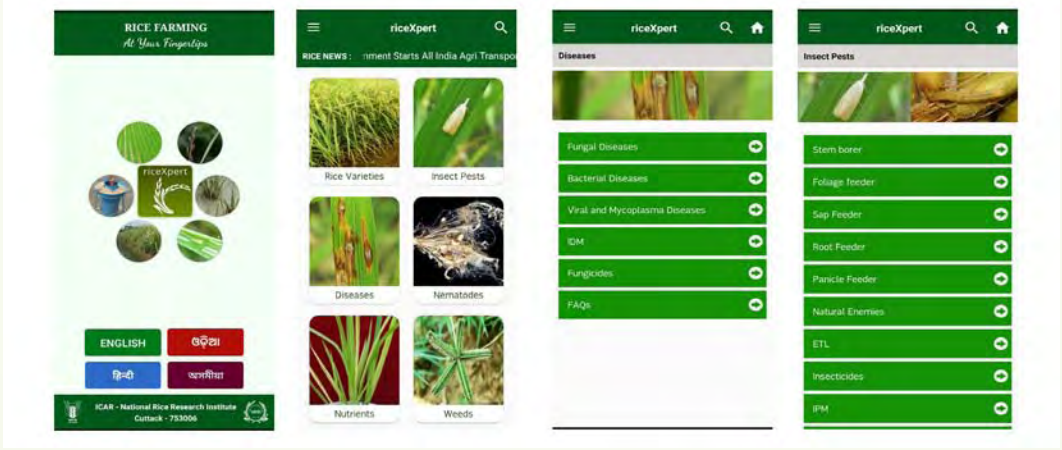


Fig.30: Rice Xpert App Developed by ICAR-NRRI, Cuttack

see the names and photographs of the entire rice insect pests. If you can identify the insect of your field with the help of these photographs/descriptions, then you will find the prescribed insecticide name also in the app; and you can very well apply the insecticide with prescribed dose. In the very same way, once you click the "disease" icon, you will find all information regarding rice diseases and can control the same.

Fig.31: Insecticide Spraying in the Seed production Plot

It is to be noted here that, please do not apply any insecticide/medicines just with the advice of the shopkeeper selling the insecticides. Always take advice from the plant protection specialists.

31. How to remove Off -type Plants from Seed Production Plots (Roguing)

For different reasons off types do appear in the seed production plot. Removal of these off types is called roguing. To raise a pure seed crop it is important to remove these off types from the seed production plots. Though off types marked in any stage of crop growth are to be removed but generally active roguing starts just before booting stage and practised till harvesting.

For identifying the off types in the field, it is important that you should know the variety you are growing for seed production well. By this it becomes easy to identify the off-type plants which are different than the varietal morphology. For roguing, the following points are to be taken care of by which off types can be removed easily.

- If any plant is taller or shorter than the variety.
- If there is difference in leaf characters like, leaf size, shape and colour.
- If any plant flowers much earlier or much later than the variety.
- If there is difference in flag leaf shape, size and position.
- If the type of panicles differ from the original crop.

Fig.32: Off-type plant in Seed Plot

- If the grains differ than the original grain of the variety.

Once proper roguing is complete, the seed production plots get field level purity. It is an important factor for seed certification.

Fig.33: Removal of Off-type plant (Roguing)

32. Harvesting in Seed Production Plots

Generally, rice crop is harvested after 25-35 days after flowering; i.e. for early varieties it is after 25 days and for late variety it is after 35 days. Otherwise, if we look at it, the crop becomes ready for harvesting when the grains become yellow and hard after getting dried. However, while harvesting the following points are to be cared for:

- Some varieties are easy threshing type where grains from the panicle dislodge easily; and some varieties are difficult threshing type where the grains from the panicles do not dislodge that easily. To know this, take 4-5 panicles in your palm and close your palm bit tightly. If more grains are coming, then the variety is easy threshing type and if fewer grains are coming, then the variety is difficult threshing type. If your variety is easy threshing type, then do not delay in harvesting the variety; if it is delayed then while harvesting, bundling and carrying lot of grains will fall down on the field. In this case when tip of the panicle dries with lower

part grain a bit greenish, it can be harvested. This panicle has already achieved its physiological maturity; so after harvesting and drying it can be used as seed. Slight late in harvesting of difficult threshing type varieties is tolerable/manageable.

- Harvesting much earlier than the expected date leads to harvesting of some half-matured grains. This reduces the yield.
- Much delayed harvesting leads to the breaking of panicles from the plant. It creates difficulty during threshing and leads to yield loss.
- The safest way of harvesting safe-guarding the quality is to harvest the seed crop manually by sickle.
- Mechanical harvesting by reaper or combine harvester is not advisable in seed plots because these processes do not safeguard the quality. Practically if you look at it, then it is true that during roguing, while removing off types from the seed plots, all use to cut the off types from the bottom and throw it because uprooting it from the soil becomes very difficult. In the later phase, small ratoons come out of these stubbles and small rudimentary panicles also arise bearing hardly 10-20 grains. As this was from the plant which we had rejected, these grains are also mixed ones. Now while harvesting, these small ratoon plants are not visible from outside, what we see is the top canopy of the variety. So in mechanical harvesting these plants also get harvested and the mixed type grains, gets mixed up with the variety; making it impure. But during manual harvesting, the workers know that these plants were off types for which it was cut or discarded, so they do not harvest it with the main crop.

Fig.34: Manual Harvesting

- In line with the farmer's practice, the harvested crop can be laid in the field for 2-3 days for better drying and later can be brought to the threshing floor. But before practicing it, it is to be ascertained that the field is totally dry. But if there is soil moisture, then seed will absorb soil moisture and the seed quality will deteriorate. In this case after harvesting, the crop bundles can be taken directly to the threshing floor.
- Due to shortage of manual labour, if there is no other way except to go for mechanical harvesting, then care must be taken for two things.
    - While removing the off-type plants from the seed production plots, uproot all the off types from the soil so that there will be no chance of ratooning of the off-type plants.
    - While using combine harvester, ascertain that the machine is cleaned properly and no grains of other rice varieties are struck up inside the harvester drum (the drum of the combine harvester is the vulnerable point).

33. Threshing of Harvested Crop

Fig.35: Threshing by power thresher

Threshing is the process of dislodging rice grains from the panicle. Once the crop is harvested, threshing should be done immediately unless the harvested material is laid in the field for 2-3 days for further drying. In that case, threshing may start after 3 days. For threshing of seed material following care must be taken.

- For threshing purpose, a concrete threshing floor is always good. If it is not available, then clean an area, dress it with cow-dung paste and use it.
- Bring one variety at a time for threshing so that there will be no chances of mixing. Once threshing of one variety is over, clean the threshing floor and the threshing machine etc. and then bring the next variety for threshing.
- Threshing is mostly carried out by paddle thresher or electric thresher. However, the rice bundles can also be threshed by old methods like biting the rice plant on log of wood. But note that, biting the harvested crop on stone piece or iron plate are not allowed because by this some of the grains break inside as stone and iron plate lack sponginess. So, germination percentage of the seed lot decreases.
- Seed crop is never threshed under tractor wheels or bullock legs. Here, though the threshed seed looks perfect from outside, inside the husk the seeds break and germination goes down.
- Before using thresher, please check that the machine is cleaned properly.

34. Drying of Seed

During harvesting the seed moisture used to be in the range of 20-23%. After threshing and cleaning this seed should be dried to a moisture level of 13% or less so that the seed can be stored. If not properly dried, the seed gets infested with insects early and the germination percentage of the seed lot deteriorates fast.

For better drying, care must be taken to follow the guidelines discussed here.

- After threshing, the threshed seed use to have a lot of plant debris. Therefore, just after threshing the seed is dried under the sun for atleast half day by which plant debris get dried and gets separated through cleaning.

Fig.36: Winnowing using Fan

Fig.37: Mechanical Winnowing

- After one drying, clean the seed manually by hand winnow or mechanically by winnower machine. During cleaning by winnower major portion of the plant debris is cleaned so that the drying will be better effective.
- After cleaning, the seed is again dried. Dry the seed on the clean threshing floor in 3 cm thick layer. After every 30 minutes, alter the seed so that both sides of the seed get equally exposed to sunlight. If not altered properly, then one side of the seed will be fully dried and will shrink a bit, and on the other side a crack will develop; which will affect the germination percentage.
- Generally, dry the seed from 9 am to 12 noon and 2 pm to 5 pm. In between after drying upto 12 noon make a heap of the seed and cover it so that the heat will spread equally and drying will be good.
- It is better to dry the seed on a tarpaulin so that it becomes easy to gather the seed into a heap and cover it; and if rain comes at once (as it happens in coastal belt), the tarpaulin cover can save the seed from getting wet.

Fig.38: Drying of Quality Seed

- The seed should be dried to 13% or less moisture level. The seed moisture can be checked by seed moisture meter. If seed moisture meter is not available, the seed grower can use the age-old practice of knowing the seed moisture by biting. Yes, take a dried grain and bite it under front teeth, if it breaks to two pieces making a small noise, then it has dried properly. If this can be again checked by the seed moisture meter, you will find a reading within 12 to 13% only.

35. Grading of Seed

After threshing, pre-cleaning and drying, the next step of post-harvest processing of quality seed is grading of the seed. Grading is the removal of smaller and shrivelled seeds from the well filled healthy seeds. Air and screen machine are extensively used for cleaning and grading of rice seed.

Processing by grading machine cleans the seed lot and the processed seed looks healthy and of uniform size. During grading, straw particles, gravels, soil etc. come out through the first exit, while chaff comes out through the second exit. Through the third exit half-filled shrivelled grain and smaller size seed are screened out while through the ultimate exit clean, healthy and uniform sized seeds are delivered.

Fig.39: Seed Grader

36. Quality Testing of Seed

Seed quality has a major role in crop yield which has to be safe guarded as per their seed standard norms against the particular class of seed. Therefore, after seed production of a particular class/type of seed, it is required to test the quality of the produced seed; and if it confirms to the seed standard norms, then only it gets designated to that class of seed.

- Seed tests are designated to determine the quality of seed. Presently there are 90 Seed Testing Laboratories in 28 states and 02 Central Seed Testing Laboratories in India. Besides, the rice research institutes/organisations do also possess the seed testing facilities.

- Seed tests are conducted on small samples, generally drawn from the processed seed lots. It is essential that the samples used for seed tests are representative of the seed lot. For this the sampling procedure may be well defined so that, the collected sample represents the entire seed lot.
- The sample size of a seed sample in rice is 400 gms. However, while testing different quality parameters, it is sub-divided into working samples of around 25 gms weight.

Generally, to determine the quality of seed the following tests are important.

- Purity test
- Germination or Seed Viability test.
- Moisture content test.

36.1. Purity test:

Purity records the percentage of pure seed (by weight) belonging to the variety under testing. The working sample is closely examined to classify it into the following components.

- Pure seed (seed of variety under testing)
- Seeds of other varieties of the same crop
- Seeds of other crops
- Seeds of weeds/ objectionable weeds
- Inert matter (sand, straw, stones and soil)
- Defective seed (Broken, shrunken, diseased and insect infested seeds)

Fig.40: Seed Purity Board

- Here, leaving aside pure seeds, all other categories are the impurities in the seed lot. There is a maximum permissible limit for each of these impurities depending upon the class of seed. The method of calculating the percentage of these components are as follows:

$$\text{Pure seed (\%)} = \frac{\text{weight of Pure Seed}}{\text{Total Weight of the Working Sample}} \times 100$$

Likewise, individual impurities parameters can be calculated.

- The purity test is conducted on two or more samples from the same seed lot to ascertain the reliability of the test.

Cultivar purity test

Determination of purity of a particular cultivar can be ascertained by comparing the sample of the seed lot with that of the authentic sample. The Cultivar purity test can be well judged with the following tests:

1. Examination of seed in the laboratory
2. Grow out Test
3. Molecular Method for Cultivar Purity Test

1. Examination of seed in the laboratory:

This is done by examination of morphological features of seeds, such as length, width, thickness, shape, weight, colour etc. and comparing them with those of the authentic samples.

2. Grow out test:

- Determines the genetic purity of a given seed lot of a released cultivar and the extent to which the submitted sample confirms to the prescribed standards.
- The authentic sample is planted after every 10 test samples for a close comparison.
- Plot size and spacing varies depending on the duration of the variety.
- Observations are recorded both on qualitative and quantitative traits of the test and the authentic sample plots during the entire growing period.
- The frequency of the off types plants is to be recorded. The maximum Permissible off-type frequency varies with the number of plants observed.
- Size of the submitted sample for grow out test for paddy is 500 grams.

3. Molecular Method for Cultivar Purity Test

Cultivar purity test through DNA fingerprinting is the most reliable and fool proof method. Now-a-days it is mandatory to provide the marker information and the DNA fingerprints of the varieties during submission of release proposal, so that it will be easy to confirm the authenticity of the varieties with the same set of markers.

36.2. Germination or seed viability test:

Germination is the ability of seeds that produce or are likely to produce seedlings under a suitable environment which is expressed in percentage. This can be well determined with the following two methods.

Wet filter paper method:

- Seeds are germinated on wet filter paper placed in petri-dishes. The petri-dishes are kept under controlled conditions for germination.
- Germinated seeds are counted and percentage of germination is calculated.
- Generally, 4 samples are plated for a reliable test.

$$\text{Germination}\,(\%) = \frac{\text{Total number of Seeds germinated}}{\text{Total number of Seeds Plated}} \times 100$$

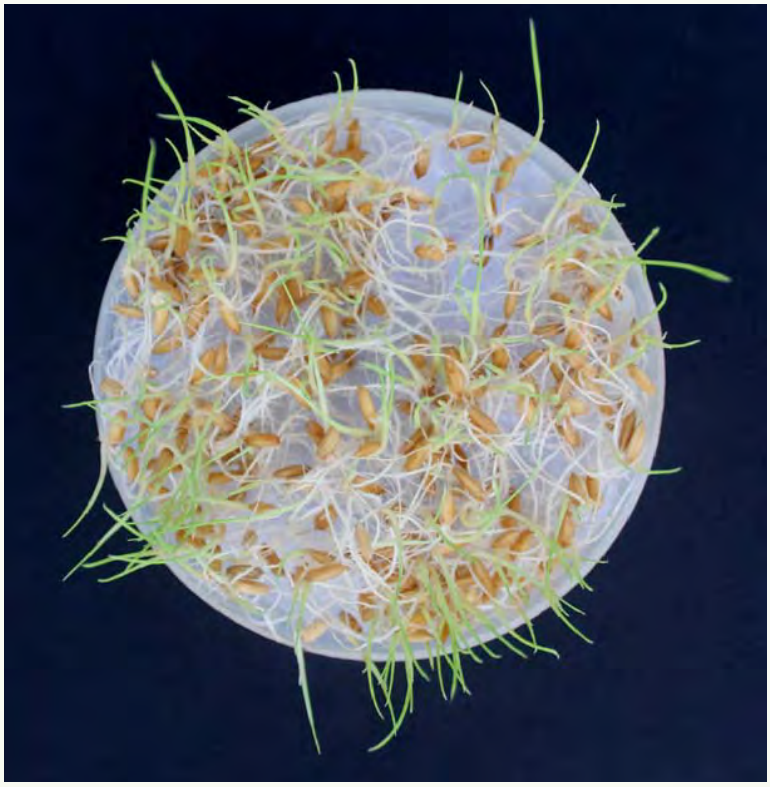


Fig.41: Wet Filter Paper method of Germination

Tetrazolium Method:

- The chemical 2,3,5-triphenyl tetrazolium chloride (or Tetrazolium chloride in short) is colourless, but it develops intense red colour when it is reduced by living cells.
- Soak seeds overnight in tap water

- Split all seeds longitudinally by a scalpel so that a portion of the embryo is attached with each half of the seed
- Place one half of each seed in a petri dish and cover with 1% aqueous solution of tetrazolium chloride for 4 hours
- Wash seeds under tap water
- Count the seeds in which the embryo is stained red

$$\text{Viable Seed (\%)} = \frac{\text{No. of Stained Half Seed}}{\text{Total no. of Half Seeds}} \times 100$$

- Method is faster, cheaper and requires no controlled environment.

36.3. Moisture content test:

Moisture content is determined as percent of water content of seeds by oven method or by moisture meter.

In oven method:

- Weighed seed samples are dried at 130 ˚C for 90 minutes in an oven; and the dried seeds are weighed again. The loss in weight represents the weight of water lost due to drying.

$$\text{Moisture Content (\%)} = \frac{W_1 - W_2}{W_2} \times 100$$

Where, W1 = Weight of seed sample before drying

W2 = Weight of seed sample after drying

Moisture meter method:

The seed moisture meter measures the moisture content of seeds very efficiently. It measures the resistance of seeds to an electrical current that varies with the moisture content.

Fig.42: Seed Moisture Meter

Fig.43: Portable Seed Moisture Meter

37. Seed Storage

Seed has life and from pure seed an exact replica of the mother plant is produced. So, pure seed is supposed to have some specific quality parameters. Keeping seed from one cropping season to other with all the seed qualities intact is known as seed storage.

For better storage of seed, the following procedure may be followed:

- Keep the processed and well dried seed in a gunny bag and stitch the opening. Prepare a wooden rack 15 cm above the floor level and stack the seed bags. Do not make the stacks more than 8-10 ft high and see that the seed bags do not touch the side wall. This will restrict the moisture from the floor and wall.
- If the seed is well dried, then it can also be kept in moisture proof polythene bags. Once seed is kept in these bags, there will be no movement of air and humidity through it, so there will be less chance for insect attack and the germination percentage will not deteriorate. If these bags are stored in cool and dry place, then the viability of the seed stays for longer period. For using this moisture proof polythene bags, fill seed in the polythene bag, remove air from the empty space and seal the bag so that no air movement is possible. Then put this polythene bag inside a gunny bag, tie string at the opening and stack these bags on the rack.
- Do not make the stacks high; because pressure of all the bags on the lowest bag may affect germination.
- The seed storage room should be airy and rat proof.
- Once the seed is packed and stored, put one tag inside the bag and the other tied outside the bag with the information like variety name, production date, season etc. so that the seed can be tracked back easily.

38. Role of State Seed Certification Agency in Quality Seed Production

Indian seed system is a three-generation system in normal situation. So, in the seed chain of the country mainly 3 types of seeds are produced namely, breeder seed, foundation seed and certified seed. To control the quality of these seeds, fixed quality parameters are prescribed and the State Seed Certification Agencies (SSCA) play an important role in monitoring and certifying the quality during the production of these seeds.

The first class of seed in the seed chain is breeder seed which is produced in the Institution/Organisation from where the variety has been developed. It is produced under the direct supervision of a breeder scientist of the institute. The seed produced by using breeder seed is called foundation seed which is mainly produced by Government Farms, Krishi Vigyan Kendras, registered Seed Producing Organizations and registered seed growers. Seed produced by using foundation seed is called certified seed which is mainly produced by the registered seed growers and advanced farmers.

The role of the State Seed Certification Agency in production of breeder seed is different than that of foundation & certified seed. This is discussed in details here.

38.1. Role of State Seed Certification Agency in Breeder Seed Production:

- Keeping an eye on the Breeder seed Proforma I (BSP-I) seed indent and other obligatory indents the production of breeder seed is planned. Accordingly, sowing and transplanting operations are completed.
- Once transplanting is over, BSP-II is prepared, where as per the proforma, variety name, indented quantity, date of sowing/transplanting, date of monitoring, expected date of harvest and expected date of supply are mentioned. One copy of this BSP-II goes to the State Seed Certification Agency for monitoring of the breeder seed plots.
- The State Seed Certification Agency fixes a date for monitoring the breeder seed crop as per the request of the producing organization.
- The Monitoring team (Director State Seed Certification Agency, representative of State Seed Corporation, representative of NSC, representative of State Agriculture Department, ADR Seed of the Agriculture University, Breeder/Head of Breeding Department of the Agriculture University, Nodal Officer Seed of the Institute and Head Crop Improvement Division of the Institute) visits the breeder seed production plots and monitors the crop in the field as per quality standard of different quality parameters.
- BSP-III is the monitoring report format. After field visit the monitoring report is prepared which is signed by all the members. If the crop confirms the breeder seed field quality standards norms then only it can be processed as breeder seed.
- Afterwards, the crop gets harvested, threshed, dried, processed, packed and checked for seed quality. If the seed confirms all the quality parameters of breeder seed it is supplied as per DoAC allotment.

Thus, the State Seed Certification Agency plays a pivotal role in breeder seed production where they actually monitor the breeder seed production plots and on the basis of different quality parameters data the monitoring team can reject or pass the seed production plot which is documented in the monitoring report.

Fig.44: Inspection of Breeder Seed Plot by Monitoring Team

38.2. Role of State Seed Certification Agency in Foundation and Certified Seed Production:

The State Seed Certification Agency plays a much bigger role in the production of foundation and certified seed. Starting from registration for seed production to whether quality seed was produced or not, everything comes under their responsibility; and the agency systematically controls the seed production programme. Seed certification is carried out in 6 broad phases:

i. Receipt and scrutiny of application.

ii. Verification of seed source, class and other requirements.

iii. Inspection of the seed crop in the field to verify its conformity to the prescribed field standards.

iv. Supervision at post-harvest stages.

v. Drawing samples and quality testing.

vi. Grant of certificate and issue of tags.

The activities for production of foundation and certified seed can be best described through the below mentioned points.

- Generally, some Government Farms, registered Seed Producer Organizations and some seed grower farmers come forward for foundation and certified seed production. For Foundation seed production programme breeder seed is the primary requirement which will be available from the institute/organization from which the variety has been developed; or otherwise the seed corporation supplies it after procuring the same from that institute/organization. For certified seed production foundation seed is the primary requirement which will be available from State Seed Corporation, Government Farms, KVKs and some registered seed growers.
- For foundation and certified seed production arrange the required class of seed first. While procuring the seed bring breeder certificate, tags and cash memo from the organization.
- Purchase the application form (3 copies) from the State Seed Certification Agency office and fill it up properly.
- Submit the duly filled application form in the State Seed Certification Agency office 10 days before sowing or within 10 days of sowing. For this, deposit registration fee and visiting fee and get the receipt. Now with the application form, attach the identity card, list of farmers, declaration, land position map, seed purchase cash memo, seed tag and payment receipts of registration fee and visiting fee and submit the same.
- The Seed Certification Officer (SCO) checks the applications and informs the organisation whether the application has been accepted or not.
- Once the application is accepted, the SCO schedules his visits to the seed plot. Generally, the Seed Certification Officer is supposed to pay two visits within 50% flowering stage to harvesting stage of the crop.

- As per schedule, the SCO visits the seed plot and looks for physical and genetic purity of the variety at field level. He also inspects regarding isolation distance, off type plants, wild rice plants and seed borne diseases and records the data. If the seed plot depicts quality as per the fixed quality standards then it gets accepted. The quality parameters data observed are generally recorded in the field monitoring report.
- For certain obvious reasons, if the seed production plots get rejected, in that situation, if time is there, the seed producer is given a second chance. After doing due correction as per the SCO remarks, the seed producer can invite the officer again to visit/monitor the plot. For this the producer will have to deposit the visiting charges again. During this repeat visit, if the seed plot justifies the varietal quality as per the set quality standards, then the seed plot qualifies for certification.
- Once the crop matures, it is harvested, then threshed and dried with pre- cleaning. Here, the SCO checks the seed lot in the threshing floor and issues the "threshing floor certificate" to the seed producer. Now when the seed is sent for grading, this threshing floor certificate is taken as the identity of the seed.
- Now the seed is taken to the seed processing unit, where it is processed through grader machine. For better processing in some cases pre cleaner and gravity separator are also used for processing. The processed seed is packed in new bags.
- Now labels with detailed information regarding seed are fixed/tied to each bag and the bags are arranged in stacks. Stacking is to be done as per Seed Certification Agency's prescribed norm.
- In consultation with Seed Certification Agency authorized technicians come and collect the seed sample for testing. Generally, from each stack they collect 3 samples which after labelling they seal it. Out of the 3 samples one goes to the seed testing laboratory, second one stays with the seed producer while the third one stays with the certification agency.
- Testing of the samples in the seed testing laboratory takes around 20-30 days. During seed testing, the sample is tested for physical purity (pure seed, seeds of other crops, grass seed, other varietal seed, impurities and diseased seed) genetic purity, seed moisture and germination percentage.
- Once the testing is over the report is conveyed to the producer. If the seed testing report recorded are within the prescribed seed standard norms then the seed is accepted and seed certificate and tags are issued.
- The seed certification agency follows some particular rules which all the seed producer should know. They are:
    - The released variety can enter the seed chain only after it gets notified. In other words, breeder seed, foundation seed and certified seed of a variety can be produced only when the variety is notified by Government of India.
    - Seed production plot of a variety must be a combined area of 10 hectare or 25 acres. Here, distance between fields must not be more than 50 meters.

- If the seed production is more than 25 acres, then another registration is required. Likewise, if the seed production plots are in more than 50 meter distance, it requires one more registration payment.
- After processing/grading the pure and clean seed is stored in stacks in the seed godown from where the Seed Certification Agency collects samples for seed testing. As per the standing rules of the agency, in one stack a maximum of 200 quintals paddy seed can be stored. Again, it is advised to keep a maximum of 13 bags one after another in one stack. This much height does not obstruct collection of seed samples for seed testing; and again the weight of seed bags at the top may hamper germination percentage of the bottom bag.
- For seed quality testing in rice, the each collected sample size is 400 grams.
- If a Seed Producer Organisation has registered to produce seed through individual farmers, then they will have to submit the list of the farmers with information on which farmer will grow how much area and how much seed has been taken by individual farmers.
- If the Seed Producer Organisation is using less quantity of seed than recommended, they will have to take permission from Seed Certification Officer during distribution of seed; otherwise it will not be acceptable/accepted.

- At the time of initial certification, the validity period of the certificate shall be 9 months from the date of test. The validity period could be extended for 6 months provided on retesting the seed conforms to the prescribed standards in respect of physical purity, germination and insect damage.

39. How Farmers can keep Good Quality Seed from their Crop Production Plots?

In our country the number of small and marginal farmers is very high, those who cannot even buy certified seed every year due to poverty. Again, the country is unable to supply good quality seed to around 37 % of farmers due to shortage in production of this seed through the seed chain. In this condition, many of our farmers use their own saved grain as seed for crop production. These farmers do not see any difference between grain and seed.

When a farmer gets/arranges a good quality seed, the first question he asks is, "for how many years can I use this seed?" In general, mostly the answer comes like, "yes, you can use this seed for 3-4 years". But when a seed scientist comes across this question, his answer becomes a bit different than the others like, "you can use this seed for 3-4 years if you keep the seed as seed, otherwise it will lose its purity within two years".

Now question comes, "How to keep seed as seed?" For this, let us follow the ways of life of these small and marginal farmers of our country. Taking one example, let us say, a farmer had one acre of land where he cultivated rice and got 32 bags of paddy. He thought of keeping his own seed. So, he kept one bag for his seed purpose. Then thinking about his consumption need, he separated 16 bags and rest 15 bags he sold

in the market. Now, let us think, the one bag the farmer kept for his seed purpose, did he really know or tried to know anything regarding the purity of seed of this bag? As the plot was for crop production, obviously no roguing was done in the field. In that case the purity of the bag is questionable. And think of continuing this practice for one more year, the seed will lose its identity and purity to a greater extent. Therefore, it is told, keep seed as seed.

Let's see, how to keep seed as seed, or what care a farmer should take for keeping good quality seed from his crop production plot.

- Select an area from your crop, from where you want to keep your own seed; and see that from that much area you will get the quantity required. Select the area in such a way that this will be in the middle of the field surrounded by the same variety all around.
- Now fix 4 bamboo poles in the four corners of the marked area and connect all poles with a twine rope. This area is now marked as the area from where the farmer will keep his own seed. Whenever the farmer will go to the field, this marked area will remind him about the seed. Now, think, why to mark it? For example, let us think that the farmer has grown one acre rice crop. If he thinks to keep his own seed from this plot, then he will have to remove off-type plants from 1 acre area which requires more number of workers and so more expenditure. Again while removing off-type plants, the farmer rejects and throws away a good number off type plants with half matured panicles incurring loss. Therefore, the farmer does not do the roguing properly. But once the area is marked, the area from which the off-types are to be removed becomes small. So expenditure wise or grain loss wise the farmer can afford; and will afford thinking that this seed will be the starting material for his next year crop.
- Remove all the off-type plants from the marked area.
- Harvest the marked area first, process it and keep this as seed.
- Harvest rest of the area; keep required quantity for your consumption and the rest you sell it.

If the farmer can keep his own seed following these discussed procedures, then he can very well use his own farm saved seed for 3-4 years and can get good yield.

40. How Farmer can know the Seed Quality of their own Seed?

For reasons like non-availability of enough certified seed or financial problems, many of our farmers are not able to procure certified seed every year; and use their own produced grain as seed. In this situation, the seeds used by these farmers should at least be pure, healthy and with good viability. If they try a bit, they can also ascertain the quality of their seed which they are going to use for the coming crop season.

To screen for clean, healthy and heavy seed, prepare a salt solution taking 60 gm salt in 1 litre water ratio. Put your seed in this solution. Remove the debris, insect

bitten or diseased seed, half filed grains and chaff etc., which will float on the water surface. Now take out the seed which was drowned in the salt solution, wash it well, dry properly and then use. This is the clean, healthy and good quality seed. This is a very simple way through which farmers can know by themselves the quality of their farm saved seed or the seed they have arranged for crop production.

Farmers use to arrange their seed much before the start of the season. After arranging the seed, some farmers even use to open the bag and check the physical purity also. But none of them think about the viability or germination percentage of this arranged seed. Due to misfortune, if seed of a farmer does not germinate, then he knows about it only after a week when his seed do not germinate in the seed bed. After that, hurriedly he arranges fresh seed, prepares fresh seed bed and does the sowing. All these repeated jobs cost him around 15 days, that means he becomes late by 15 days in comparison to his other farmer friends. In agriculture, 15 days delay is not a small thing; this even can affect the final crop yield. To overcome this type of situation arising out of seed viability problem, it is required for the farmers to know the germination percentage of his seed much before sowing, which they can know themselves by a simple process.

To test the germination percentage, take two medium sized plates. Cut a plate size thick paper and place it on the plate. Now on each plate place some quantity (approximately seed number should be more than 100) of seed well scattered on the paper, pour some water, cover the plate and keep it near slight sun shine area. Decant the water daily and add fresh water. After 4-5 days the seed will start germinating. After 7 days count the total number of seed put for germination and the number of seed germinated in each plate. Now you can easily calculate the germination percentage of your seed.

If the germination percentage of your seed is more than 80%, then you can use it and can practise the usual prescribed seed rate for your crop production. Here, when the seed viability is much more than 80%, like when it reads 93 or 95% it is better. If the germination percentage is lower than 80% then you will have to increase the quantity of seed above prescribed seed rate while sowing, so that you will have enough seedlings for transplanting.

While testing the germination percentage of the seed lot, we use to calculate the germination percentage at the end. Keeping this in mind, some people take exactly 100 seeds per plate for testing and that makes the percentage calculation very simple. But, do not practice it. See, when you count for 100 numbers of seeds, if a broken seed, insect bitten seed or half filed seed or a diseased seed comes while counting, we usually separate it, do not put it for germination. If such is the case, then we are not only counting but selecting and taking 100 seeds. This result obviously will not give you the exact picture of your bag because your sample does not represent your seed stock. Therefore, do not take counted seed for germination test.

41. Conclusion

Increase in the productivity of rice is the only answer to the constant increase in target of rice production arising due to population growth. “Good seed harvests good crop”. Use of quality seed alone can enhance the crop yield up to 20%; and quality seed is not only the main factor in yield increase, but also the factor on which other yield enhancing factors depend for their performances and efficiency. But till now around 37% of our farmers do not get quality seed mainly due to shortage in production; and they depend on farm saved seed. Therefore, it is now time to energise our seed production system to produce more quality seed.

This book is written for and dedicated to all the members of the rice seed system viz; Agricultural Scientists, Government Officials, Seed Grower’s Organisations, NGO friends and farmers of our country. The technical knowhow on quality seed production explained and discussed in this book will certainly support the endeavour of this group in accelerating the seed production programmes of the country, which in turn will ultimately enhance the productivity and production of rice in the country.





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