2020

Organic Seed Production Technology of Lowland Rice

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Correct citation: **Amit Kumar, Jayanta Layek, Anup Das, Krishnappa R, Utpal Dey, K.P. Mohapatra and Basant K Kandpal. 2020**. Organic Seed Production Technology of Lowland Rice. ICAR Research Complex for NEH Region, Umiam – 793 103, Meghalaya, India

Cover Design:
Dr. Amit Kumar
Mr. Banshanlang Rynjah

Photo credits: Dr. Jayanta Layek, Dr. Utpal Dey

Published by:
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ICAR Research Complex for NEH Region
Umroi Road, Umiam – 793 103, Meghalaya, India
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Acknowledgement

The authors of this bulletin entitled "**Organic Seed Production Technology of Lowland Rice"** would like to place on record the deep sense of gratitude and indebtedness to Dr. Basant K Kandpal, Director, ICAR Research Complex for NEH Region, Umiam, Meghalaya, for his keen interest in the subject and providing all the support for publication of this bulletin. We are deeply thankful to the ICAR-Indian Institute of Farming System Research, Modipuram for sponsoring the Network Project on Organic farming (NPOF) to the ICAR Research Complex for NEH Region, Umiam, Meghalaya, India.

The authors are also thankful to all the staffs of Division of Crop Production, ICAR Research Complex for NEH Region, Umiam, Meghalaya for all necessary support to carry out field experiments and documentation of the results. Authors are hopeful that this publication will be helpful to the various stakeholders as a guide for rice seed production for improving rice productivity and resource use efficiency under organic conditions.

Authors

Rice is the most important food crop of Meghalaya and its cultivation is practiced on more than 30 per cent of the cultivable area. Based on the agro- ecological conditions, rice growing areas of this region has been grouped basically into lowland and upland rice which spread across low (<750 m), mid (750-1100 m) and high (>1100 m above mean sea level) altitudes of Meghalaya.

Organic farming is unique system of agriculture suitably practiced in many states of North eastern region (NER) with the major aim of sustaining the health of ecosystem, agro-biodiversity and biological cycles. It essentially emphasizes the use of natural materials by completely avoiding the use of synthetic raw materials, transgenic plants, animals or microorganisms or seed materials derived from genetic modification. It also endorses quality product management, which entails careful maintenance of integrity and authenticity of organic crop products at every processing step. The North Eastern Hill Region (NER) region of India is having large potential for organic rice production due to very low use of fertilizers and pesticides, plentiful availability of organic biomass and manures, relatively high soil organic carbon content, rich biodiversity and wisdom of the people to practice environmentally safe agriculture. Thus, this system can be described as a specialized form of farming practice which has immense potential for NER to produce quality food with reduced cost of production without additional investment for procurement and usage of extraneous agrochemicals. A prerequisite for farmers following organic rice cultivation is that they should use organically grown rice seeds in their fields. However, certified organic rice seeds are not commonly available in the markets especially in the NER of India. Therefore, farmers from this region should be trained in production of quality rice seed organically in their farm and certify to meet the ever-increasing demand. In this scenario, this bulletin is being prepared with the detailed techniques of rice seed production under organic management practices for NER of India.

Fig 1. Rice cultivation in valley land

Details of the technology

Choice of varieties

Organic rice production can be feasibly adopted for both lowland and upland rice varieties. However, under upland condition, as removal of weed is quite problematic and untenable, it is advisable to go for organic cultivation for lowland rice varieties. Brief description of lowland rice varieties suitable for organic seed production is presented in Table 1.

Table. 1. Important rice cultivars and their morphological and yield potential in Meghalaya

Sl no.	Varieties	Days to 50% flowering	Plant height (cm)	Number of tillers per plant	Crop yield (t/ha)
For Mid altitudes					
1.	Shahsarang-1	102-106	102	13-15	3.9-4.5
2.	Lampnah	105-110	100	10-12	3.1-3.3
3.	Megha SA 2	105-110	135	12-13	3.8-4.2
For Higher altitudes					
4.	NEH Megha Rice 1	155-160	115	9-12	3.1-3.3
5.	NEH Megha Rice 2	150-155	120	10-13	3.2-3.5

Seed rate

For medium to fine type rice variety, a seed rate of 15-20 kg/ha and for bold type 20-25 kg/ha will be sufficient for transplanting one hectare of land when rice cultivated under Integrated crop management (ICM).

Organic rice cultivation techniques

1. Land preparation

For transplanting: Prepare the demarcated land thoroughly by removing weeds and levelling with peripheral bunding. Puddling should be done 3-4 times to make it weed free and water retentive. Apply farm yard manure (FYM) @ 15 t/ha or FYM @ 7.5 t/ha + vermicompost (VC) @ 2.5 t/ha with 150 kg/ha rock phosphate at 20 days before last ploughing. Incorporate and recycle all the organic residues into the soil. Application of lime @ 450-500 kg/ha at the time of

ploughing is necessary to obtain good yield but it is advocated to apply at least 10-15 days before transplanting.

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(a) Peripheral bunding (b) Puddling (c) Planking and levelling

Fig 2. Land preparation practices for rice transplanting

2. Methods of raising nursery

Generally raised beds of 10-15 cm height, 1 to 1.5 m width and of convenient length are prepared in a suitable location for preparing nursery beds. The area should be tilled properly to ensure uniform bed preparation. A buffer zone of at least three meters need to be maintained between conventional and organic management land. Around, $1/10^{th}$ of the total area to be planted in main field is required for raising rice nursery.

Fig 3. Raising of rice nursery on raised beds

a. Wet method

The wet method can be adopted in areas where water is sufficiently available. Raised beds of 10-15 cm height, 1 to1.5 m width and of convenient length with drainage channels between the beds are appropriate. The total seedbed area should be 1000 m^2 for each ha of

Fig 4. Uprooting of 20 days old rice seedlings for transplanting

the field to be transplanted. Apply vermicompost @ 500g / m^2 and rice husk ash @ 100 g/m^2 of the nursery bed and mix well with the soil at the time of preparation of nursery bed. Application of vermicompost substantially helps in reducing the incidence of thrips. If vermicompost is not available, one can apply compost or cattle manure @ 1 kg/m^2 and 100 g of rice husk ash/m^2 of the nursery bed and mix well with the soil at the time of preparation of the field. Bio-fertilizers can also be applied and mixed well in nursery @ 2 kg/1000 m^2 before the sowing.

b. Dry method

This method is practiced in areas where sufficient water is not available and the time of planting is delayed. Prepare raised beds of 1to 1.5 m width, 10-15 cm height and of convenient length. As similar to wet method, apply vermicompost @ 500 g/m^2 and rice husk ash @ 100 g/m^2 of the nursery bed. If vermicompost is not available, apply compost or cattle manure @ 1 kg/m^2 and 100 g of rice husk ash/m^2 of the nursery bed and mix well with the soil at the time of preparation of the bed. Sow the treated seeds as described under wet seed treatment method, evenly over the bed and cover with fine sand/soil.

3. Seed treatment

It is advisable to use sound and healthy seeds after proper inspection. To get healthy seeds, soak them in 25 per cent salt solution i.e. 250 g of common salt in 1 liter of water and discard the floating ones. The seeds should be washed in clean water immediately and dried in shade. Seed can be treated with *Trichoderma viride* + *Pseudomonas fluorescens* @ 5-10 g/ kg seed for effective prevention of root rot diseases. Root dipping of seedlings in a solution prepared by mixing of 10-15 g each biocontrol agents (*Trichoderma harzianum* + *Pseudomonas fluorescens*) in 1 litre of water for 15-30 minutes can manage the soilborne pathogens. Hot water treatment at 60-62°C for 10 minutes is beneficial against seed borne bacterial diseases.

Fig 5. Root dipping of rice seedlings

4. Transplanting

The optimum time of transplanting is first fortnight of July for low and mid altitude. Time of transplanting should be adjusted to avoid exposure to low temperature during flowering especially in higher altitudes (above 1300 m). Therefore, under high altitude, transplanting should be completed within 15th June or preferably by first week of June. Seedling age of 20-22 days with 20 × 20 cm spacing and 2 seedlings/hill is considered to be better for timely transplanted crop (ICM method). For mid and low altitude valley land, transplanting can be done till 3rd week of July with closer spacing (15 × 10 cm) with 35-40 days old seedlings.

Fig 6. Line transplanting of rice at 20×20 cm square planting

Fig 7. Application of FYM before transplanting

5. Nutrient management practices for main field

All the available weed biomass and crop residues of previous crop can be incorporated within the field, to improve the fertility of soil and also to reduce the requirement for organic manure application. Apply 10-12 t of FYM before 20 days of transplanting and 250-300 kg neem cake during transplanting of rice crop or apply 5-6 t of vermicompost before 20 days of transplanting and 250-300 kg neem cake

Fig 8. 20 days after transplanting

during transplanting of rice crop. Application of 5 t FYM + 2 t vermicompost + 3 t green manures / weed biomass (*Eupatorium/Ambrosia*) before 20 days of transplanting and 250-300 kg neem cake during transplanting of rice crop are suggested to be the best options for proper nutrient management. Rock phosphate @ 150 kg/ha may be applied for better phosphorus nutrition.

Green manuring: Some of leguminous green manures used in rice-based cropping system include *Sesbania aculeata, Sesbania rostrata, Sesbania speciosa* and *Crotalaria juncea*. These are grown during the pre-rice season between April and June and the biomass is incorporated into the soil 8-10 weeks before rice is being transplanted. Wherever limited irrigation facilities are available, grain legumes such as green gram, black gram and cowpea can be grown in *rabi* season.

Bio-fertilizers and their application methods

A. *Azospirillum*

Seed treatment: Mix the carrier-based inoculum of 200 g in 200 ml of rice gruel to make consistent slurry which is sufficient to treat 10 kg of seed. The seeds are mixed in the slurry so as to have a uniform coating of the inoculum over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. Bio-organic RF 79 developed at ICAR Complex, Umiam @ 40 ml/L for seed treatment has been found to increase the rice productivity to the tune of 15%.

Main field application: Two kilogram *Azospirillum* is mixed with 50 kg of dried powdered farm yard manure and then broadcast in one ha of main field just before transplanting.

B. Phosphorus Solubilising Bacteria (PSB): Carrier based phosphobacteria can be applied as seed treatment and field application as in the case of *Azospirillum.*

C. Azolla: *Azolla* spp. (*A. caroliniana* performs well under cool hill climate, whereas, *A. pinnata* is suitable for low altitudes) can be applied as green manure for rice before transplanting. For this, *Azolla* is grown for 15-20 days before transplanting of rice by applying 1-2 t of fresh inoculum per ha in a well prepared field. Rock phosphate @ 62.5 kg/ha is applied in three equal splits at an interval of seven days. After the formation of thick mat, water is drained out and the field is ploughed for uniform incorporating of *Azolla*.

6. Water Management

Continuous sub-emergence of 2-5 cm during crop growth (transplanting to physiological maturity) ensure higher yield and also this practice helps to suppress weed growth right from the beginning. The depth of water should not exceed 5 cm in the field particularly at the tillering stage of the crop. Higher depth of water during tillering reduces the number of tillers/hill causing reduction in yield. After the completion of tillering, the field should be drained out for a week and re-irrigated again. This will help in retaining higher number of effective tillers/hill. In any case, there should not be any water stress during panicle initiation to grain filling stage. Moreover, only 2-3 cm standing water is required to maintain from tillering up to panicle initiation. Intermittent wetting and drying until panicle initiation stage is effective and desirable to avoid build up of high humidity which may increase insect- pathogen infestation. However, the period of drying and wetting can range from 2-7 days.

7. Weed management

Economical rice production is impossible under organic condition without well-planned weed management strategies. Only use good clean seed (free of weed seeds) and use conoweeder in criss cross direction for 2 times (25 DAT and 50 DAT). Two hand weeding is recommended (25 DAT & 45 DAT) in the absence of any cono weeder availability. Maintain 5cm depth of water continuously from rooting stage till 15-20 days before harvesting to in check weed growth. Prevent weeds from growing along bunds and irrigation canals and always use well-decomposed organic manure.

Fig 9. Weed management with *cono weeder*

8. Disease and pest management

Even though rice crop grows robustly across the different ecosystem it faces an unanticipated attack by numerous pests and diseases whose management through organic products is very cumbersome. However certain organic management options for some important diseases and insect pests are listed below.

- Growing of recommended tolerant and high yielding varieties is most appropriate.
- Regular monitoring of the pests in the field with the help of pheromone traps or sticky traps etc is quite effective. Use of pheromone traps at about 25 no/ha is very useful in managing gundi bug problem in rice.
- Alternate wetting and drying of rice field to reduce the infestation of brown plant hoppers
- Clipping of leaf tips before transplanting to reduce the infestation of stem borer and rice hispa *Tricho-cards* containing *Trichogramma* larvae, which parasites other rice insect pests like leaf roller and stem borer.
- Spraying of botanical pesticides viz., Azadirachtin 0.15% EC @3ml/litre of water or Nimbicidine 0.03EC @ 2ml/l for thrips, stem borer, brown plant hopper and leaf folders.
- Spraying of cow dung slurry @2 kg/10 litre water can reduce the incidence of bacterial blight.
- Application of fermented suspension (2 liter cow urine, 2 kg cow dung, 2 kg crushed neem leaves in 100 litres of water for 4-5 days) will help in managing rice blast disease.
- The frequent occurrence of blast disease in organic rice can be controlled by root dipping of seedlings in a solution prepared by mixing 10 g of *Trichoderma harzianum*+ *Pseudomonas fluorescens* in 1 litre of water for 15-30 minutes.
- For the management of pests in nursery, neem cake @ 3q/ha and biocontrol agent mixture (4-5 kg/ha mix with farm yard manure) should be applied 10-12 days before sowing.

Fig 10. Rice leaf blast

Fig 11. Bacterial blight

Fig 12. Sheath blight

Fig 13. Brown spot

Fig 14. False smut

Fig 15. Rice leaf folder

Fig 16. Rice gundhi bug

Fig 17. Blister beetle

9. Roguing

Purity of the seed is one of the most priorities for quality seed production. The rice seed of a particular variety should not be mixed with other varieties of rice. Roguing is the process of removal of undesirable rice plants/cultivars in the standing crop in field. Off-type plants can be identified by their different morphological characters (eg. height,

Fig 18. Roguing of unwanted rice cultivars

leaf shape and colour, panicle shape, pigmentation etc.) and by the timing of flowering. These off-type plants in the rice seed production areas should be identified and removed by uprooting and cutting at vegetative to flowering stage. It also reduces the chance of seed setting and falling in the field for subsequent germination in the next year.

9. Harvesting & Yield

Rice attains maturity at around 30 days in early and 40 days in medium to late maturing varieties after 50 per cent flowering (heading stage) in low and mid altitude areas. Harvest the crop when 5-10% of the grains at the bottom of the panicle are still to dry but the rest of the grains (more than 80%) on the panicle are fully matured. Rice is harvested by simple hand tools like sickle 15-25 cm above ground level, the harvest is put together in bundles to improve handling and then dried in the field. The manual system of harvesting is very effective in lodged crop conditions; however, it is labor intensive. Threshing is the process of separating the grain from the straw. It can be either done by hand, by using a paddy thresher or mechanized by using a machine. A well-managed rice crop with suitable variety can produce yield of 4.0-4.5 t/ha under organic conditions.

10. Drying of rice grain and storage

It is very much necessary to dry the rice seed before storing for future use. Gradual drying of paddy should be done in sunlight to bring the moisture level to 12-13% for better milling and storage of the produce. Store paddy in proper storage structures after adequate drying. Take precautions to avoid infestation by the stored grain insects and the fungal infections. Use of locally available organic insect repellents like neem leaf etc. so as to prevent damage from insect and rats are also suggested**.**

11. Organic Certification

Certification is a process in which entire process of production are monitored by the accredited certifying agency. Without this certificate, even the organically produced commodities cannot be sold outside or exported with organic tag. Mission Organic Value Chain Development for North East Region (MOVCD-NER) is a Central Sector Scheme, launched by the Ministry of Agriculture and Farmers Welfare for implementation in the states of North East

India. It aims to development of certified organic production in a value chain mode to link growers with consumers. **Participatory Guarantee Systems (PGS) Certification** is an internationally applicable organic quality assurance system [like ISO 9000] implemented and controlled by the committed organic farmer-producers through active participation, along with the consumers, in the process based on verifiable trust. The "Local Group" of five or more organic farmers is the fulcrum of the self-regulatory support system of PGS. The quality assurance standards are harmonized by the PGS Organic Council, which permits the use of its PGS label on a product as a mark of quality. At the national level, the National Centre of Organic Farming (NCOF) under the Ministry of Agriculture began to operate the PGS-India as a voluntary organic guarantee programme with the PGS-National Advisory Committee as the apex decision making body.

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