

CROP PRODUCTION

PACKAGE OF PRACTICES FOR HYBRID RICE SEED PRODUCTION

The seed production technology for hybrid rice is quite different from that of high yielding varieties. The hybrid seed is not only required to be produced every year but it is necessary to maintain more than 99% genetic purity of the F_1 seeds to realize its maximum yield potential.

IDEAL CONDITIONS

- Season** *Rabi* season is better for seed production than *kharif* season. The daily mean temperature of 24–30°C and clear sunny days during flowering are most ideal.
- Site** Fertile land with good irrigation and drainage facilities are suitable for seed production. Preferably select a site where previous crop was not rice, to avoid the problem of voluntary plants.
- Isolation** Provide space isolation of more than 100 m or a time isolation of 21 days. No other rice variety should be grown on all sides of the field within 100 meters. In case of time isolation, there should be a difference of at least 21 days between its flowering and other varieties grown in the vicinity.



Monitoring team visiting a seed production field of a farmer

Sowing

Since the parental lines differ in their duration, differential seeding should be adopted to synchronize the flowering of two parental lines for seed production. If the flowering male parent is ten days late as compared to that of the female parent, the male parent (R line) is sown first with two dates of seeding, with a gap of 4–5 days. Then the female line is sown only once, 10 days after the first seeding of R line.

Seed Rate	
	Seed
Female line seed	15 kg
Male line seed	8 kg

Day-1	Day-5	Day-10
Male line (R-1) (4 kg)	Male line (R-2) (4 kg)	Female line (15 kg)

Nursery Management

- Sow the seed of parental lines sparsely at the rate of 20–25 m² to obtain strong, healthy and multi-tiller seedlings in 20–25 days.
- Prepare wet beds of one meter width and of convenient length with good drainage facility. Total nursery area required for sowing 23 kg of seed is 1000 to 1200 m².
- Apply 250 kg of farmyard manure, 1 kg Nitrogen, 0.4 kg Phosphorus and 0.5 kg Potash per 100 m² nursery area.
- Soak the parental line seed for 12–15 hours. Treat the pre-soaked seeds with Carbendazim (50% WP) @ 4 g per kg of seed. Incubate the seeds in gunny bags for 1 to 2 days for better sprouting.
- Sow the sprouted seeds sparsely and uniformly on well prepared seed beds. Maintain a thin film of irrigation water without allowing the beds to dry at anytime.
- Topdress the nursery beds after 15 days of sowing with 0.6–0.8 kg of Nitrogen per 100 m² area.
- Adopt appropriate plant protection measures, if necessary.

Main Field Management

Field Preparation and Nursery Raising

Prepare the main field thoroughly by repeated ploughing followed by puddling and apply the recommended dose of farmyard manure, two weeks before transplanting. Apply 50% of recommended Nitrogen and 75% of Potash, and full dose of Phosphorous a day before transplanting, followed by thorough leveling.

Transplanting

When seedlings of the second sowing of male parent are 25 days old, uproot first and second sown seedlings of male parent and mix them properly and transplant in paired rows, leaving a space for 8 rows in between to plant female seedlings. Plant 3–4 seedlings of male parent per hill. Subsequently, pull out the seedlings of female parent and transplant 1–2 seedlings per hill in 8 rows between the rows of male parent.

Transplant male seedlings at a spacing of 30 × 15 cm, and female seedlings at a spacing of 15 × 15 cm in the row ratio of 2 male: 8 female. Keep 20 cm spacing between a row of male line and female line.

Weed Management

Mix 2.5–3.0 kg of Butachlor in 50–70 kg of sand and apply in one hectare area after 5–6 days of transplanting. Ensure uniform level of 2 cm of standing water in the field for 3–4 days. Need-based hand weeding may be undertaken to ensure healthy crop.

Nutrient Management

It is recommended to apply 150 kg Nitrogen, 60 kg Phosphorus, 80 kg Potash and 15 tonnes Farm Yard Manure/ha. In addition, 50 kg/ha Zinc Sulphate (once in three years) be also applied. Apply 25% of the recommended dose of Nitrogen in the form of Urea at 30–35 days after planting and the remaining 25% Nitrogen and 25% of Potash at 70–75 days after transplanting at panicle initiation stage. Full dose of Phosphorus and Zinc Sulphate should be applied as basal.

Water Management

Maintain a thin film of water for initial 30 days and later on increase the water level to 4–5 cm when the crop reaches maximum tillering stage. Drain out irrigation water for 4 to 5 days after maximum tillering stage, so that emergence of late tillers can be suppressed. Drain out water completely from the fields at least 10 days before harvest.

SPECIAL SEED PRODUCTION OPERATIONS

Roguing

Roguing is a process of removal of unwanted rice plants from the seed production plots. It is very important to maintain the purity of hybrid seed. Therefore, remove off-type plants at different stages starting from sowing to harvest. Though roguing is a continuous process throughout the crop season, it should specifically be carried out at three distinct stages viz., during vegetative phase at maximum tillering, before and during flowering, and just before harvesting. The important characters

based on which rouging should be done during the crop growth stages are given below.

Stage	Characters
Vegetative	Morphological characters such as plant height, plant type, leaf shape and colour, pigmentation of stem, leaf, leaf sheath etc.
Before and during flowering	Early and late types, panicle type, presence or absence of awns, panicle exertion, spikelet shape, anther colour etc.
Before harvesting	Extent of seed set on female parent (if the seed set on female parent is more than 70% such plants need to be checked thoroughly), grain type, grain shape, etc.

Prediction and Adjustment of Flowering

Perfect synchronization of male and female flowering is a pre-requisite for getting higher seed yield. For ideal synchronization, female parent should come to heading 2–3 days prior to heading of male parent. Synchronization can be predicted by observing the stages of young panicle development in female and male lines. There are eight stages in panicle development.

Stage No.	Developmental stage	Approximate days before flowering	Approximate panicle length (mm)
I	Panicle primordial	30	0.2
II	Primary branch primordial	27	0.4
III	Secondary branch primordial	24	1.5
IV	Stamen and pistil primordia	20	2.0
V	Pollen mother cells	17	10–25
VI	Meiotic division	12	80
VII	Mature pollen	6	190–250
VIII	Ripe stage of pollen	4	260

When female line is earlier than male line in growth duration (like in case of DRRH-1), the male line should be one stage earlier than female line during the first 3 stages of panicle development. Both female and male lines should be in the same stage during next three stages of panicle development. If the difference between male and female flowering is about 7–8 days, synchronization can be adjusted by two methods, viz., water management, and by spraying nutrient solution.

Water management is effective for adjusting flowering of male parent. To delay flowering of male parent, completely drain out the irrigation water for 4–5 days. For hastening flowering of male parent, maintain a water level of 4–5 centimeters. Application of nutrient solution can be adopted for adjustment of flowering in both parental lines. Application of 2% Urea as foliar spray will delay the flowering and the use of 1% Phosphatic fertilizer will enhance flowering. Depending upon the situation and severity of the problem, any one or both the methods can be used to attain proper synchronization. In rare cases, if the difference between male and female flowering is more than 10 days, synchronizing the flowering of early parent by removing the main panicles and by spraying 2% Urea or by applying Nitrogenous fertilizer at the rate of 30–40 kg/ha may be adopted.

Flag Leaf Clipping

Flag leaf clipping at a right stage helps in better pollen dispersal. At booting stage, cut the upper one-third to one-half of the flag leaf uniformly with a sharp sickle. Flag leaf clipping is not advisable when the field is infested with bacterial leaf blight, as this may spread the disease further.

Application of Gibberellic Acid (GA₃)

In all the CMS lines currently being used in commercial seed production, panicle exertion is not complete, as 20 to 25% of the panicle remains inside the flag leaf. Hence almost one-fourth of the spikelets are not available for out crossing. GA₃ application helps in improving panicle exertion, stigma exertion and overall seed set. Right stage for GA₃ application is at 5–10% initial heading (when 5 to 10 out of 100 tillers show initial heading). Dissolve recommended dose of GA₃ in a little quantity of 70% alcohol and use it for spraying as per the given schedule.

Spray schedule	Type of sprayer	
	Knapsack	ULV
GA ₃ dose (g/ha)	50	25
First Spray (first day)	20 g in 500 litres of water	10 g in 20 litres of water
Second Spray (next day)	30 g in 500 litres of water	15 g in 20 litres of water

Spray GA₃ uniformly on both female and male lines during morning or evening hours on a sunny day by using either Knapsack or ULV sprayer as per convenience.

Supplementary Pollination

As rice is a self-pollinated crop, pollen dispersal and consequently extent of natural crossing is low. To increase out crossing and the seed set, supplementary pollination is adopted. Move in between male rows and shake the plants with the help of two long (2 to 3 m) bamboo sticks during peak anthesis period. Depending on weather conditions, the time of peak anthesis varies, the plants reach peak anthesis after half an hour after the opening of first few spikelets in a panicle. Carry out supplementary pollination 3 to 4 times in a day starting from 9.00 to 11.30 AM at peak anthesis period depending on weather conditions and locations.

Disease and Insect Pest Management

Like other rice varieties, hybrids are also damaged by insect pests and diseases. Control measures for some of the common insect pests and diseases have been given under Package of Practices for Cultivation of Hybrid Rice.

Harvesting and Threshing

- Drain out irrigation water from the field when the grains in the lower portion of the panicle in male parent are in dough stage (approximately 20 days after 50% flowering). Allow the grains to harden. Initiate harvesting 30–35 days after flowering when stalks are not completely dried to avoid shattering of grains.
- Harvest the male rows first. Dry after threshing and remove the produce from threshing floor and store separately. Critically examine the field for any of the panicles of male parent falling on the ground or on the plants of female lines.

- Take up the final rouging in the female lines, specifically looking for seed set higher than 70%. All the panicles having seed set more than 70%, should be removed, as these may be selfs or off types.
- Harvest and thresh the female rows separately, after cleaning the thresher thoroughly. The seed borne on female parent is the hybrid seed.
- Dry the harvested seed for 1–2 days, to ensure that moisture percentage is reduced to 12–14. Clean and bag the seed in well aerated gunny bags. If old gunny bags are used, these should be properly cleaned before using for bagging.

YIELD

With good planning and ideal management, average seed yields of 1.5 to 2.0 tonne/ha can be obtained.

ECONOMICS

By adoption of the above recommended package of practices, average seed yields obtained in large scale seed production areas are 2.0–2.5 t/ha. At the average procurement price of Rs 30–40 per kg, the gross returns are Rs 60,000 to 80,000 per hectare. The cost of cultivation is around Rs 25,000–30,000 per hectare. Hence the net profit by undertaking hybrid rice seed production works out to be Rs 35,000 to 50,000 per hectare.

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