



Lecture 09: SEED PRODUCTION TECHNIQUES IN PADDY VARIETIES

Phrenology:

Botanical Name	: <i>Oryza sativa</i>
Chromosome number [2n]	: 24
Family	: Poaceae
Inflorescence	: Panicle
Pollination	: Self-Pollination
Panicle Emergence	: 4 –5 days after boot leaf emergence
Flower Opening Pattern	: Tip of primary & secondary branches and proceeds downward
Duration of Flowering	: 6-8 days
Time of Anthesis	: 7.00 –10.00 A.M
Speciality with flowering	: Flower remain open for 10 minutes and afterwards it closes.
Anther dehiscence	: Either before or after flower opening [independent of spikelet opening
Temperature favorable for flowering	: 24 -28°C
Favourable RH for flowering	: 70-80%
Difference between day and Night temperature	: 8-10°C
Stigma receptivity	: 3 days
Pollen viability	: 10 minutes

Varietal seed production

Stages of seed production

In paddy depending on the demand 3 or 4 or 5 stages of seed multiplications are permitted under seed certification programme as follows.

- Breeder seed - foundation seed - certified seed
- Breeder seed - foundation seed stage 1- foundation seed stage 2 –certified seed
- Breeder seed - foundation seed stage 1- foundation seed stage 2 -certified seed 1- certified seed 2



Land requirement

The land should be free of volunteer plants (crop of previous season occur in this season) and the same crop or the other varieties of the same crop should not have been grown for the previous season, if it is the same crop it (previous) should be the same variety that has been certified. This selection is highly important for maintenance of genetic purity. They should have adequate irrigation and drainage facilities and the problem soils are not suitable for seed production.

Isolation

The crop should have 3meters of isolation at all sides of the seed production plot for maintenance of genetic purity.

Selection of seed

Seed should be from an authenticated source (SAU, NSC, State Department). For production of certified seed, foundation seed (FS) should be used as source seed which should be purchased with bill and tag (white for FS seed)

Seasons practiced at Tamil Nadu

In Tamil Nadu the availability of water in canals, depends on the monsoon. Based on this in different districts, different sowing seasons are adapted as follows:

Month of sowing	Seasons	Duration of varieties
December - January	Navarai	Below 120 days
April - May	Sornavari	Below 120 days
April - May	Early kar	Below 120 days
May - June	Kar	Below 120 days
June - July	Kuruvai	Below 120 days
July - August	Early samba	130 -135 days
August	Samba	130-135 & above 150 days
September - October	Late samba / thaladi / pishanam	130 - 135 days
November - October	Late thaladi	115 -120 days
November - October	Late pishanam	130 -135 days

Selection of season

Season should be selected based on duration of the variety and the water availability.



VARIETIES	SEASON	DURATION	POPULAR VARIETIES
Short duration varieties	November- December (Karthikai –Margazhi)	Below 120 days	TKM9 ,CO 36, ADT 36
Medium duration varieties	November (Iyyppasi- Karthikai)	130-135 days	Bhavani ,CO43,
Long duration varieties	August (Adi-Avani)	More than 135 days	White Ponni,
Upland rice	July –August ---on receipt of showers .TKM9 and IR 50 should be sown Before 15th of July (direct seeding)	All durations but variety specific	MDU1,PKM1 Co 43,IR 20
Rainfed rice	June-July and September – October	Specific to location	ADT 38 ADT39 (Medium Duration Varieties)

Seed Rate

It varies with varieties and type of cultivation.

Variety / type of cultivation	Seed rate
LOW LAND CULTIVATION (transplanting)	
Short duration varieties	60 kg /ha
Medium duration varieties	40kg /ha
Long duration varieties	30kg/ha
For low land cultivation by broadcasting	80-100 kg/ha
For rainfed rice	75-100 kg/ha

Seed Management Technique

Dormancy

Paddy exhibits dormancy which varies for duration of 0-30/45days depending on the variety. This could be broken by either soaking in KNO₃ 0.5 % for 16 hr or soaking in 0.1N HNO₃ for 16 hrs. However the duration and concentration vary with varieties (e.g.) ADT36 exhibit 20-30 days of dormancy period from days to physiological maturity period which could be broken by soaking the seeds in 0.5%KNO₃ for 16 hrs. Practically the intervening duration between the harvesting, and threshing, and further drying will remove the dormancy.



Seed Upgradation Technique (Egg Floatation Technique)

Either before processing or after storage or due to improper processing Paddy seed may have less vigorous seed such as immature, ill filled and insect damaged seed which may adversely affect the planting value of the seed. Removal of this seed will favour better establishment and higher production potential. These seed may be removed by adaptation of a simple water floatation technique based on specific gravity using salt water as a dissecting solution for separation of good quality seed from low quality seed, and egg is used as an indicator for specification of specific gravity measurement of 1.03 (120g of salt in 1000ml of water)

Methodology

A bucket of potable water has to be taken and in that water a fresh egg which sinks to the bottom has to be taken. To the potable water with egg outside slowly the common salt was added to a level at which the egg floats at top exposing 2.5 cm of its shell outside (check the egg floatation now and then on addition of salt to the solution). The egg is removed and the paddy seed are dropped into the solution which separates as sinker and floater. The sinkers are good seeds while the floaters are less vigorous and dead seeds. The floaters are removed and used as feed and sinkers are used for further multiplication.

Caution

- Egg is only for measurement of specific gravity and has no work to do with separation.
- If the density of water is more, more portion of egg will float if less egg will be inside the solution.
- If the density of water is more loss of quality seed may occur, lesser density the separation will not be perfect

Sprouting of seeds (pre germination)

Paddy seeds are sown at nursery in pre germinated condition for better establishment for supply of oxygen at waterlogged condition. Seeds are soaked in big tough for 24 h in gunny bags tied loosely for easy transmission of water and for ensuring soaking of each and every seed. Seeds are then tied tightly and incubated in dark for 12h (overnight). White protrusion of radices by the seed exposed to outside expresses the pre germination of seeds and these seeds are sown in nursery by broadcasting.

Hardening and other seed management techniques

- In case of implementation of fortification treatment, seed could be soaked in equal volume of water to ensure that none of the solution is left unimbibed by the seed



- For dry land and upland paddy, seed hardening with KCl (1%) and pelleting with *Azospirillum* (600g /ha) could be adopted (e.g.) MDU 1, Paramagudi1.
- Seed colour variation occurs due to bacterial infection at later stages of maturation. Seed coloring with polycoat @3g kg⁻¹ of seed could improve the initial quality and marketability of such discolored seed.
- Polymer coating of Seed also will help to identify the brand name of seed and to identify the varietal variation among the cultivars by even the illiterate labours.

Nursery Management

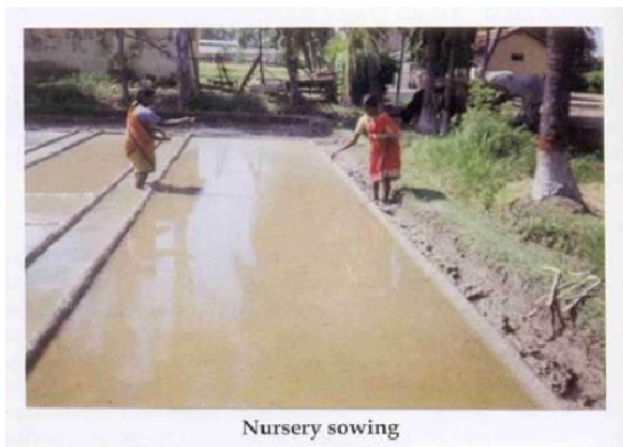
For raising one hectare of paddy, 20 cent (800m²) nursery is needed. The area should be prepared by floating the area one or two days before ploughing and allowed the water to soak in. The soil should be kept at shallow sub emergence. Before ploughing the water should be allowed to a depth of 2.5cm. Then the land is ploughed and brought to a puddling condition. The optimum size of the nursery bed will be 2.5 meters broad and with channels of 30cm width in between. In paddy, on raising more varieties in a same place **separate irrigation channels** are to be prepared for each variety to avoid the admixture of seeds and to maintain the genetic purity.

Nutrient Management

Before the last puddling apply 40kg of DAP and if not readily available apply straight fertilizers@16 kg of urea and 120kg of super phosphate.

Basal application is required (DAP) if the seedlings are to be pulled out at 20 to 25 days after sowing. If the seedling are to be pulled out after 25 days application of DAP is done 10 days prior to pulling out of the seedling.

Basal application of phosphorus to the nursery enables the seedling to store phosphorus and utilize it even in later stages of growth and application of DAP to the nursery is highly economical.



Nursery sowing

Sowing

A thin film of water should be maintained in the nursery, and the sprouted seeds of paddy should be sown uniformly on the seed bed.

Water Management

- Drain the water 18 to 24 hours after sowing and if there are pockets where water is stagnating, drain it into the channel as germination will be affected in the places where the water is being stagnated
- Allow the water to saturate the soil from the third to fifth day
- From the fifth day onwards increase the quantity of water to a depth of 1.5 cm depending on the height of the seedling
- Afterwards, maintain the water level to a depth of 2.5 cm

Weed Management

Apply any one of the pre emergence herbicides viz. butachlor 2l per ha, thiobencarb@2l/ha, pendimethalin @ 2.5l/ha on 8th day after sowing to control weeds in the low land nursery. Keep a thin film of water and allow it to disappear. Avoid drainage of water. This will control germinating weeds.

Pest Management (NURSERY)

INSECTS /DISEASES	CONTROL MEASURES
Army worm	Spray Chlorpyrifos 20EC 80ml or endosulphan 35 EC80ml during the evening
Thrips	Phosphamidon 85 WSC 25 ml (or) Monocrotophos 36 WSC 40ml (or) Endopsulfan 35 EC 80 MI
Green leaf hopper	As above or maintain 2.5 cm of water in the nursery and broadcast any one of the following Carbofuran 3g 3.5kg or Phorate 10G 1.0kg or Quinalphos 5g 2.0kg
Case worm	Mix kerosene in standing water and remove the cases and destroy and spray Monocrotophos 36 WSC 40ml (or) Quinalphos 25 EC 80 ml
White tip nematode	Sun drying of seeds for two days at 6h interval
Rice root nematode	Carbofuran 3g at 3.5kg / 20cents
Diseases	
Blast	Spray with insecticide Copper oxy chloride 100g or Mancozeb 80 g
Brown spot	Carbendazim 40 g
Tungro disease	Apply carbofuran 3g at the rate of 3.5 kg ten days after sowing or spray two rounds of Monocrotophos 36 WSC 40ml or Phosphamidon 85 WSC 25 ml

Age of transplanting

The age of transplanting vary with varieties as follows



DURATION OF VARIETIES	AGE OF TRANSPLANTING
Short duration varieties	18-22days
Medium duration varieties	25-30days
Long duration varieties	35-40days

Pulling out of seedling

- Pull out the seedling at appropriate time
- Do not remove the adhering soil with a hard surface
- Tie the seedling in convenient size for easy handling
- Do not allow the seedling to dry



Main field preparation

- Puddle the soil well
- Apply 12.5tonnes of FYM or compost per ha
- Incorporate green manure into the field by *in situ* ploughing
- Dig the corners and prepare the bunds well with plastering for effective stagnation of water
- Apply the phosphorus and potasic fertilizers at last ploughing for effective availability of nutrients to plants
- Keep a thin film of water at the time of transplanting and raise the water level to 2.5 cm on the next day



Fertilizer Requirement

CROP DURATION	FERTILIZER REQUIRMENT (Kg/ ha)		
	Nitrogen (N)	Phosphorus (P)	Potash (K)
Short duration	120	38	38
Long and medium duration	150	50	50
Bio-fertilizer	Azolla @ 1t/ha 3-5 days after weeding		

Transplanting

- Dip the root in phosphamidon 0.02 % against rice root nematode 20 minutes prior to planting
- Plant the seedling at optimum spacing and optimum depth
- Transplant the seedling at 4-5 leaf stage



Details on transplanting

Specifications	Duration of cultivars		
	Short	Medium	Long
No. of seedling per hill	2-3	2	2
Depth of planting (cm)	3	3	3
Spacing (cm)	20 x10	20 x15	20 x20
No. of hills/m2	50	33	25
Breeder seed multiplication	Adopt double row planting with a spacing of 15 x 10 cm for easy roughing		

- Adjust the sowing in such a way that harvesting does not coincide with rain



Weed Management

Pre emergence herbicide

Use butachlor 2.5l/ha or thiobencarb 2.5l/ha fluchloralin2l/ha or pendimethalin3l/ha as pre emergence on third day and is to be followed by hand weeding on 30-35days. On the failure of pre emergence application, hand weed at 15 days and spray 24Dsodium salt with a high volume sprayer 3 weeks after transplanting when the weds are in3-4 leaf stage

Gap Filling

It is to be taken up between 7-10days after transplanting

Pest and disease management

Insects	Control measures
Stem borer	Fenthion100EC @ 500ml
Thrips	Phosphamidon85 WSC @ 300ml
Brown plant hopper	MonocrotophosWSC @ 500ml
Leaf folder	Endosulfan 35EC @ 60ml
Stemborer (white ear 2 %)	Quinalphos 25EC @ 1000ml
Mealy bug	Phosphamidon85 WSC @ 300ml
Earhead bug	Quinalphos 25EC @1000ml
Rice root nematode	Carbofuran3g 16.25kgin standing water
Diseases	
Blast	Carbendazim @ 250g/ha
Brown plant hopper	Mancozeb @ 1000g/ha
Sheath rot	Carbendazim @ 250g/ha
Sheath blight	Difolatan @ 200
Bacterial leaf blight	Streptomycine Sulphate+Tetracycline@300g+Copper Oxychloride @ 1250g/Ha
Grain discolouration	Mancozeb@1000g/ha

Water Maintenance of Paddy

- 5cm of water should be stand in the field. Normally once ion 2 days for loamy soils and once in 3 days for clay soils.
- Excess water leads to yellowing of plant. So drain the water
- The critical stages of irrigation are primordial initiation, booting, heading and flowering



Top Dressing

Apply 25% of N and k as basal and remaining 75 % in 3 split doses at active tillering, panicle initiation, and at heading stage in equal proportion of 1:1.

Foliar Spray

- Spray FeSO₄ 0.5% to prevent yellowing of plants in calcareous soils.
- Spray DAP 2% to enhance seed set in paddy cultivars (BEST).
- Spray GA3 three times at panicle initiation stage for complete exertion of panicle (hybrids).
- Spray panchakavya 1% for organic seed production to enhance seed set.
- Spray 0.5 % zinc sulphate thrice during crop growth on 20th 30th and 40th day of planting for short duration varieties or 30th 40th and 50th day for medium and long duration varieties in case of zinc deficient soils.

Rouging

- Is important to maintain for maintenance of genetic purity.
- Remove all off types (deviant of the variety) and rouges (variant of the variety).
- Remove when suspected is the thumb rule of rouging.
- Rouging should be done from the sowing up to harvest and remove the as and when it come across.

Physiological maturity

- Seeds attain maturity with the visual symptom of turning of ear heads to golden yellow color and when the ear heads exhibit drooping symptoms. i.e 28 days after 50% flowering in short and 31 days in medium and 35 in long duration.
- When 80% of the plants are exhibiting the symptom the crop is ready for harvest
- The moisture content of the seed will be 18-20-%.

Pre-harvest Sanitation Spray

Ten days prior to harvesting spray endosulphan 30EC 70ml / ha against storage pests. Spraying of 10 % prosopis leaf extract is recommended against grain discolouration.

Harvesting

- Lodged plants should not be selected for seed purpose.
- Withhold irrigation one week before harvest.
- Delayed harvest may lead to heavy shattering
- Bundled plants should be stacked as ear heads facing outside to avoid heat damage.



- Threshed produce should be clean and free of admixture in cracks and crevices.
- Birds scaring are also practiced in places of requirement.

Threshing

- Thresh the seed by beating the plants on a hard surface ,but take care that the seeds are not mechanically damaged.
- In tractor and machine threshing avoid mechanical damage by proper adjustment of speed/ machine setting.
- Thresh at proper moisture content to avoid crushing / cracking (16-17 per cent).
- Clean the floor, equipment, containers to avoid genetic and physical mixture.

Winnowing and Drying

Threshed produce are cleaned and winnowed to remove the dirt and other unwanted physical material. Winnowing should be done in a cleaned surface. The seeds are dried in a threshing floor with adequate stirring which is known as tempering. The seeds are dried to 13 % moisture for better storage .On drying in a threshing avoid drying between 12 noon to 2pm to avoid the ill effects of ultra violet rays of noon sun. Through not for bulk for prolonged storage this practice should be adopted. Seeds are also can be dried in mechanical driers in places of high humidity like areas of sea shore.

Grading

The bulk seeds are normally processed through seed cleaner cum grader and the seeds of middle sieve are selected for seed purpose.

Size of seed	Sieve size
Long slender (Ponni, whitePonni)	= 1/16 x 3/4 " (1.3mm x 19 mm)
Slender - IR 50	= 1/15 x 3/4" "
Medium slender (IR 20, CO 43)	= 1/14 x 3/4" (1.5 mm x 19 mm)
Short bold (ADT 36, 37,38,39, TKM 9,Ponmani)	= 1/13 x 3/4" (1.8 mm x 19 mm)

Seed Treatment

Normally paddy seeds are not treated with chemicals owing to their economic utility. But for long term storage, treat it with captan or thiram or bavistin @ 2-4g / kg of seed, Halogen mixture treatment (Chlorine based halogen mixture @3 g /kg of seed) is a eco-friendly treatment. As a prophylactic measure seed can be fumigated with celphos @ 3-6g/m³. But the moisture content of the seed should not be above 10-12% which may interfere with the seed quality in terms of germination.



Seed Yield

The yield of crop varies from 3000 to 7000 kg /ha depending on genotypes, location, season management practices and pest infestation.

Storage

Paddy is a good storer. Generally paddy seeds store well up to 12-36 months depending on the genotypes but heavy infestation of storage pests reduce the storability of seed even to a month or two. For prolonged storage HDPE and polylined gunny bags are used, while for normal storage jute canvas bags are used. However the bags should not be stirred for more than 8 bags height to avoid pressure on seeds of lost bag which may cause damage to the seed. Polythene bags of 700 gauge is not highly preferable for paddy as the sharp edge may pierce the bag and convert moisture vapor proof container as moisture pervious container.

Mid storage Correction

Seeds from storage are given with mid storage correction when the seed standard reduce to 5-10% lesser than recommended. The seeds are soaked in double the volume of disodium phosphate solution (3.60g dissolved in 100l of water) for 16h and the seeds are dried back to original moisture content (12-13 percent).

Seed Certification

Land Requirement

The previous crop should not be the same crop and if to be the same crop it has to be the same variety and should be certified and has to be accepted for certification. The field should not have any volunteer plants.

Number of Inspections

A minimum of two inspections is needed, one at the time of flowering and another at the time of or before harvest.

Field Standards

General: Paddy field should be isolated from contaminants as follows

Contaminants	Minimum distance(meters)	
	Foundation stage	Certified stage
Fields of other varieties	3	3
Fields of same variety not confirming to varietal purity requirements for certification	3	3

Specific standard: These are verified at the final inspection

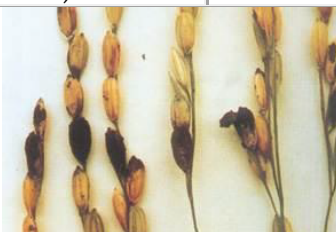


Factor	Maximum permitted (%)	
	Off types	0.050
Objectionable weed plants*	0.010	0.020

*Objectionable weeds are Wild rice (*Oryza sativa* L. var. *fatua* Prain
(Syn. *O. sativa* L. f. *spontanea* Rosch.)

Seed Standard

Factor	Standards for each class	
	FOUNDATION	CERTIFIED
Pure seed (maximum)	98.0%	98.0%
Inert matter (maximum)	2.0%	2.0%
Huskless seed (maximum)	2.0%	2.0%
Other crop seed (maximum)	10/kg	10/kg
Other distinguishable varieties (maximum)	10/kg	10/kg
Total weed seed (maximum)	10/kg	10/kg
Objectionable weed seed (maximum)	2/kg	2/kg
Seeds infected with paddy bunt (<i>Neovossia horrida</i> (Tak.) (maximum)	0.10% (By number)	0.50% (By number)
Germination (Minimum)	80%	80%
Moisture (maximum)	13.0%	13.0%
For vapour proof containers (maximum)	8.0%	8.05%



Paddy Bunt



Lecture 10: HYBRID SEED PRODUCTION IN PADDY

Breeding technique for commercial

Hybrid seed production : *Cytoplasmic geneic male sterility system*

Stages of seed production for certification : Breeder seed – foundation seed certified

Seed Multiplication work at different Stages

Breeder Seed stage : A (AxB), B, R lines are raised separately under isolation.

Foundation Seed stage : A (AxB) and R lines raised separately under isolation.

Certified seed stage : A and R line are crossed under isolation to get hybrid.

Systems of hybrid seed production

- Three line method or CGMS system (popular)
- Two line method or environmental genetic male sterility (EGMS) system that involve PGMS (photosensitive genetic male sterility) and TGMS (Thermosensitive male sterility system was developed in China and low temperature hilly areas of Tamil Nadu

Popular hybrids

CORH1 : (IR 62829A x IR 10198- 66-2R)

CORH2 : IR 58025A x C 20R

CORH3 : TNAU CMS 2A X CB 87 R (110-115 days)

ADTRH1 : IR 58025A x IR 66R

Genes involved in EGMS

- One or two pairs of recessive nuclear genes (cytoplasm involved)

Advantages of EGMS system

- Maintainer lines are not involved
- Choice of parents are more.
- No negative effect on sterile cytoplasm

Genes for fertility restoration in CGMS system : Rf1 and Rf2



COMMERCIAL SEED PRODUCTION TECHNIQUE

Land requirement : similar to variety

Isolation

- Space isolation : Foundation seed stage : 20 Certified seed stage : 100 m
Time isolation : 20 days either earlier or later for other varieties compared with MS line.
Barrier isolation : • 30m of wood lot / tall crops
• plastic sheets of 2m height

Season

- Kharif (May- June sowing)
Rabi (December- January sowing)
Rabi is more suitable than kharif.

Favourable climatic conditions during flowering for higher seed set.

- Daily mean temperature 24 - 30°C
- Relative Humidity 70 - 80 %
- The difference between day and night temperature should be 8-10°C.
- Sufficient sunshine and moderate wind velocity of 2-3 m / second.
- Free from continuous rain for above 10 days during peak flowering season.

Seed set and seed yield will be affected if temperature is below 20°C and above 35°C during the time of flowering. In Tamil Nadu, ideal time for sowing during kharif is 2nd fortnight of May and during rabi 2nd fortnight of December.

- CORH 1 - 110-115 days (May-June, Dec - Jan)
- CORH 2 - 120-125 days (Rabi)
- ADTRH 1 - 110-115 days (kharif)

Seeds

Seed selection: Purchase from authenticated source with tag and Bill
For Foundation stage - (A & B lines)
For Certified stage - (A & R lines)

Seed rate

Female : 20 kg /ha
Male : 10 kg /ha



Nursery Management

- Keep irrigation channels separately for the parental line
- For Dec-Jan sowing take up staggered sowing for male twice or thrice with the interval of 10-15 days (3,10,15 days for effective seed setting)
- Keep the nursery area free of weeds.
- Apply DAP @ 2 kg / cent as basal to get vigorous seedlings.
- For April-May sowing sow the male 5 and 10 days after female line
- Even split application of fertilizer N is favourable for production of vigorous seedlings.

Main field Transplanting

Spacing

Between A line - (15 x 15cm)

(20 x 15cm)

Between R line - (30 x 15cm)

Between A and R line -

Age of transplanting

A line : 25 days

R line : 14,18,20 days

Fertilizer

Hybrids : 150:60:60

N & K applied in 3 splits

(1) during basal (2) active tillering (3) Panicle initiation.

Staggered sowing of parents for synchronization

As the seed set on CMS line depends on cross pollination it is most important to synchronize the heading date of the male and female parents, especially for the hybrid combinations having parents with quite different growth duration.

In addition, in order to extend the pollen supply time, the male parent is usually seeded twice or thrice at an interval of 4-5 days.

The following 3 methods can be used to determine the differences in seedlings date for synchronization between male and female parents.

- Growth Duration Difference (GDD) method
- Leaf Number Difference (LND) method
- Effective Accumulated Temperature (EAT) method

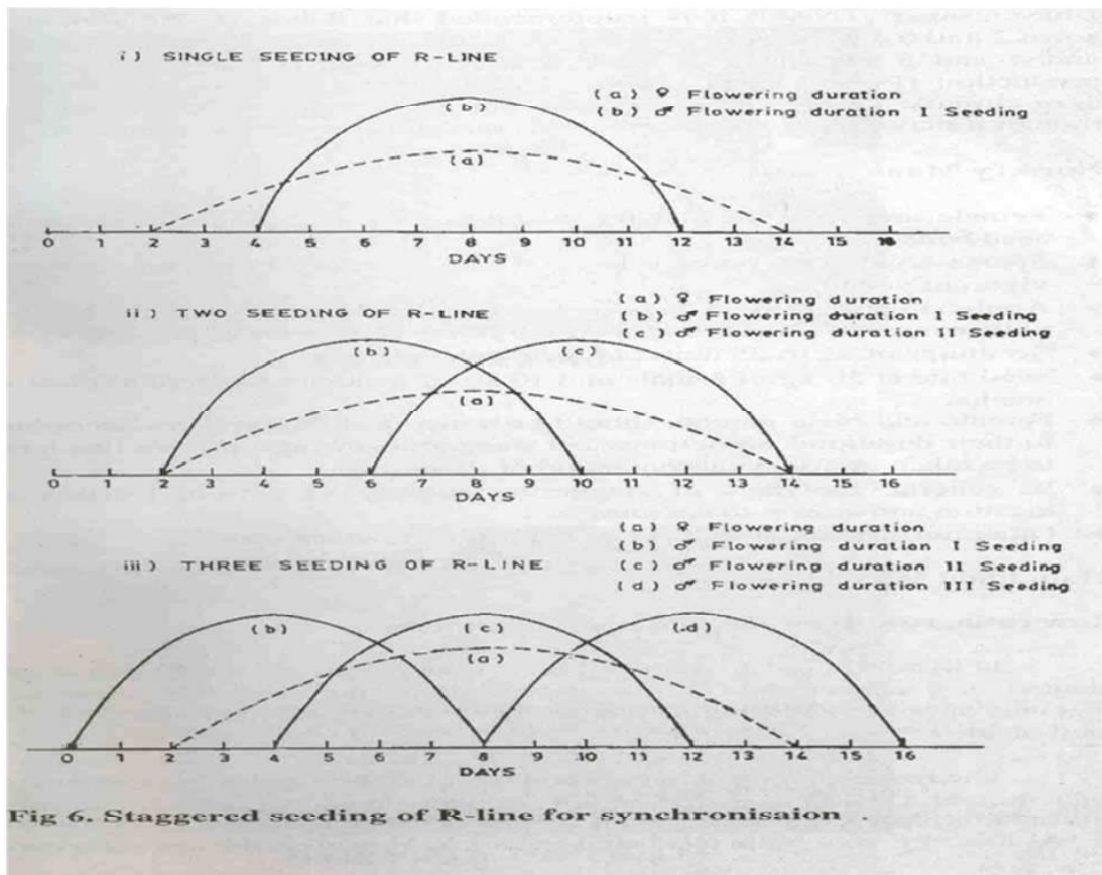
Among these 3 methods though the LND method is more reliable one, the GDD method is mostly followed since it is rather simple and easy to adopt. In GDD method by checking the



previous data on the difference in duration from seedling to heading between male and female parents, the proper seeding date of both parents in current season can be determined. This method is suitable in seasons or regions where the temperature fluctuation is small.

Staggered seeding of R line for synchronization.

- Single seeding of R line
- Two seeding of R line
- 3 seeding of R line.



Row ratio: 8:2 or 10:2

Factors influencing row ratio

- Plant height of the pollinator
- Growth and vigour of the pollinator
- Size of the panicle and amount of residual pollen
- Duration and angle of floret opening in CMS lines
- Stigma exertion of CMS line.

Layout for transplanting

To facilitate out crossing, the rows of male and female in the seed production plot should be perpendicular to the prevailing wind direction expected at flowering time of the parents.

Practically a row ratio of 8:2 (A x R) is currently adopted for hybrid seed production and the transplanting sequence for 8:2 row ratio is as follows:

Transplanting of the 'R' line

Transplant the seedlings of 'R' line in paired rows of 30 cm apart.

In case of 2 staggered seedlings of R line, the first and second sown R line seedlings may be planted in two separate rows at 15 cm spacing or the 1st sown seedlings may be planted in both the rows with 30 cm spacing and 2nd sown seedlings may be planted in the middle of two seedlings in both rows. Whereas in three staggered seedlings of R line all the seedlings may be pulled out separately, mixed together thoroughly by spreading one over the other and planted in the two paired rows @ 2-3 seedlings per hill with 15 cm spacing within the rows. It is more convenient, easy and labour saving method incase of large scale seed production. By proper synchronization, higher seed set and yield have been recorded in 3 staggered seedlings of R line. Leave a 145 cm or 110 cm wide block between paired rows of R line seedlings for transplanting 8 rows blocks of A line seedlings.

Row ratio, row direction, spacing and planting pattern for hybrid rice seed production.

R	R	A	A	A	A	A	A	A	A	R	R
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○
○	○	x	x	x	x	x	x	x	x	○	○



R	R	A	A	A	A	A	A	A	A	R	R
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Female: Male ratio = 8:2

wind direction :

Transplanting of the 'A' line

Transplant the 'A' line seedlings in blocks of 8 rows in between the paired rows of 'R' line seedlings. Transplant with one or two seedlings per hill with inter and intra row spacing of 15 x 15 cm in 145 cm wide block or 10 x 15 cm in 110 cm wide block according to the fertility of field. Leave a 20 cm spacing between the 'A' line rows and the nearest 'R' line rows.



Prediction of heading date

The method, which is widely used and found to be effective, is by examining the development of young panicles. Based on the morphological features, the young panicles are classified into 8 development stages. The synchronization in flowering can be predicted by using such criteria. In practice, about 30 days before heading, the male and female parents in the seed production field are sampled and their young panicles within the main clumps and tillers are carefully observed with a magnifying lens every three days. Usually female and male parent will take 27 and 32 days respectively from panicle initiation to heading in 8 stages.



Method of observing panicle initiation

- Select the main tiller (the longest one) and cut at the base where stem and root join.
- Make a longitudinal slit from the base upto the top of the tiller
- Open the slit just above the nodal portion
- Observe the developing panicle with the help of a magnifying lens.

Adjustment of flowering date

If it is found during the first 3 stages of panicle differentiation that synchronization of flowering will not be attained, the earlier developing parent should be applied with quick releasing nitrogen fertilizer (2% urea spray) or apply 35 kg /ha of urea with knapsack sprayer at 500 lit /ha and the later developing parent should be sprayed with 2% solution of DAP. By this measure a difference of 4 to 5 days may be adjusted.

If it is found during the later stages of panicle differentiation that synchronization of flowering will not be attained a difference of 3-4 days may be adjusted by drainage or irrigation because the R lines are more sensitive to water than CMS lines. For instance, if R line is found to be earlier, draining water from the field will delay the panicle development. On the other hand if R line is found to be late, higher standing water would facilitate rapid panicle development.



If the difference in flowering period between the two parents reaches 10 days or more it is necessary to remove the panicles from early developing parent and apply nitrogen fertilizer subsequently, thus making it late emerging tillers or unproductive tillers bear panicles and subsequently achieve synchronization of flowering.

Further during the **flowering stage** if the blooming time is found not to be synchronized (usually the R line flowers earlier than CMS line) adjustments can be made in blooming time by improving the microclimate in the field through drainage, removing dew drops from the CMS plants and spraying cold water to the R lines.

Application of Gibberellin (GA3)

GA3 plays an important role in rice hybrid seed production. It can adjust physiological and biochemical metabolism of rice plant especially stimulating the elongation of young cells.

About 25-30% spikelets of a panicle are inside the flag leaf sheath in most of the indica CMS



lines than that of the Japonica CMS lines. GA3 has a definite role in exertion of panicle. In general, it is recommended that 50 g /ha with knapsack sprayer in two split doses, i.e. spray on 15-20% earhead emergence and 2nd spray in the next day for enhanced seed set. GA3 will not dissolve in water and hence it should be dissolved in 75-90% alcohol (1g in 20-25 ml of alcohol) and make the required solution. Spraying should be done at 8 to 10 a.m. and 4-6 p.m.

Advantages of GA3 application

- Enhances panicle and stigma exertion
- Adjust plant height of seed and pollen parents
- Speed up the growth of later tillers and increases the effective tillers
- Sets uniform panicle ear.
- Flag leaf angle is increased
- Increases 1000 grain weight
- Reduces unfilled grains
- Remarkably enhances seed setting and seed yield

Supplementary pollination

Natural outcrossing was recorded less than 10% by Ramlingam et al. (1994). However, this depends upon the wind direction and its velocity.

Shaking the R line panicles by rope pulling at panicle level or rod driving during anthesis can make their anthers dehiscence and spread the pollen widely and evenly thus the outcrossing rate could be increased. It is more effective especially on calm or breezy days.

Generally, supplementary pollination is carried out at 30 minutes interval for 5 times daily both morning and evening during peak anthesis (10-12 am and 2-4 p.m.) until no pollen remains on the R line. It is not needed when the wind is greater than moderate breeze.



Foliar spray
Foliar spray of

2% DAP increases yield and qualities of seed



- Short duration: Ist Spray on 60 DAS
 II nd " 80 "
- Medium duration: Ist Spray on 80 DAS
 II nd " 100 "

Roguing

Remove the undesirable plants either in A or R line rows that differ from plants that are true to type. The pollen shedders and off types are removed.

The undesirable plants come from many sources. They may be volunteer plants from the previous cropping.

The most important stages for roguing are at maximum tillering, at flowering and just before harvesting.

Roguing in hybrids

In A line remove pollen shedders. In A line only 40-50% of seed set is possible. If > 60-70% seed is noticed and the panicle is drooping it would be R line (or) other varieties.

Plants to be removed	A line	B line	R line
Diseased plants	All	All	All
Parental lines	R line & B line	A line & B line	R line & A line
Early flowering plant	All	All	All

Rogues / off types : Based on variation in phenotypic Characters

Harvesting, threshing & drying

- Turning of 90% green seeds to straw yellow colour is the stage of physiological maturity
- Moisture content will be 17-20%.
- Male parent should be harvested first .
- Care should be taken to avoid admixture of male line with female line while harvesting.
- The female parent should be threshed at 16-17% moisture content separately in a well cleaned threshing floor.
- The threshed seed should be winnowed and dried to reduce the seed moisture content to 12%
- The seed should not be dried under direct sun between 12 to 3.00 p.m. during hot sunny days.



Seed treatment

Seeds are treated with thiram / captan @ 4 g/kg. or with 5 gm halogen mixture. The halogen mixture is prepared by mixing $\text{CaOCl}_2 + \text{CaCO}_3$ for 1 week in air tight container.

Storage

- For short term storage use gunny bag or cloth bag.
- For long term storage use polythene bag of > 700 gauge and dry the seeds to 8% moisture content.
- When compared with varieties, the hybrids and parental lines A & B lines are poor in storability.
- The order of the storage potential is $R > F1 > B > A$.

Others - As in variety

Seed Yield

Hybrid yield (F1) : 800-1200 kg ha⁻¹

General Tips

- Nursery period, spacing, seed rate, fertilizer dose and days to maturation vary with short, medium and long duration varieties.
- Grain of paddy could be (visual) graded as long slender, short, medium bold based on shape but could not be separated on mechanical grading machine.
- Textures variation though not permanent exists in paddy seeds.
- Seeds of paddy have carbohydrate as the main storage reserve in the form of amylose and amylopectin which differentiates the japonica and indica varieties.
- **SPLIT HUSK:** Problem of split husk occur in hybrid rice seed production where the lemma and palea are not closed properly at tip portion. Occurrence is claimed to nutrient deficiency synchronization defects and genetic factors, as it
- Occurs more in female line than male line. Split husk reduces the germination due to heavier load of fungal colonies. Seed multiplication ratio 1:152

Seed renewal period: three times