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## **A Practical Guide for Successful Hybrid Seed Production in Rice- A Profitable Venture**

Ramlakhan Verma, Jawahar L. Katara, Sanghamitra Samantaray, Bhaskar C. Patra, R.K. Sahu, S.S.C. Patnaik, Annie Poonam, Baidnath Hembram, R.N. Rao, Onkar Nath Singh and T. Mohapatra

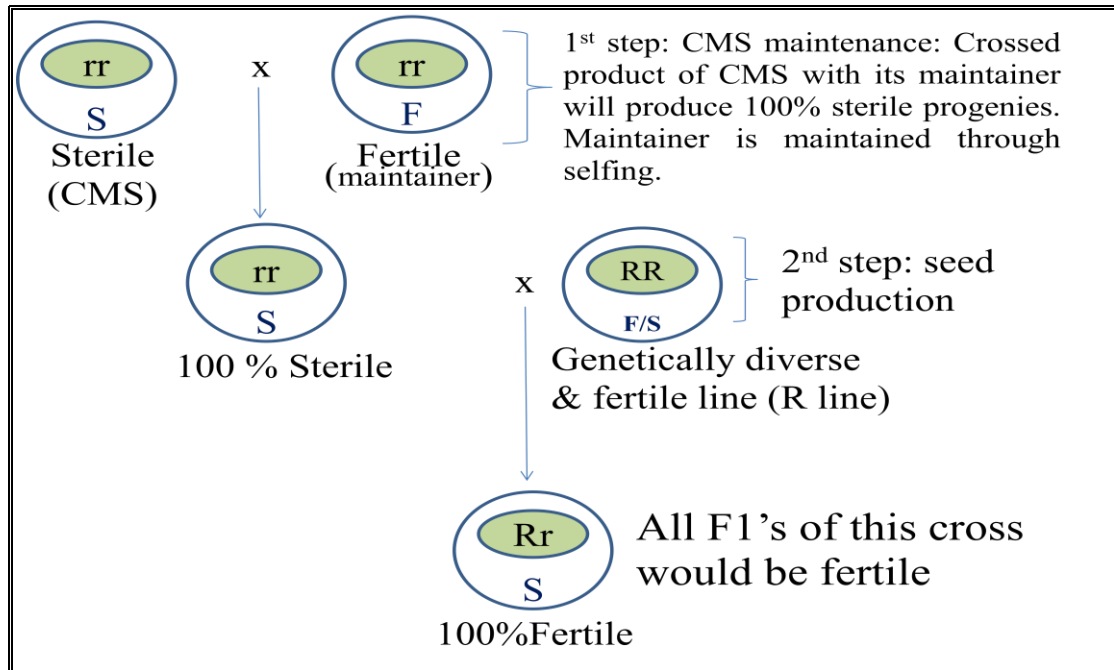
ICAR-National Rice Research Institute, Cuttack, Odisha-753006

Hybrid technology exploits heterosis in crop plants for economic advantage. Rice hybrid is the F<sub>1</sub> cross of two genetically distant pureline genotypes, having ability to produce 20-30% more yield than HYVs (**Virmani *et al.*, 1981**). Development of hybrids in rice was first initiated during early 1970s in China. In India, this was started in a systematic way by the Indian Council of Agricultural Research (ICAR) involving twelve network centres in 1989. During this period from 1994 to 2015 India developed and released a total of 78 rice hybrids (1994-2015) for different durations and rice ecosystems. At present, hybrid rice area is around 25 lakhs hectares, which is about 5.6% of total rice area in India.

Success of this technology depends upon efficient and economically viable large scale seed production. It is reported that the yield of F<sub>1</sub> hybrids and parental lines will decrease by 0.8% (100 kg./ha) and 45%, respectively, when the seed purity decreases by 1% (**Mao, 1998**) and inappropriate management (**FAO-2001**) in seed production field. So it is very important to establish a system of seed production to ensure the seed purity of the parental lines and the hybrid. In India, the commercially cultivated rice hybrids are based on three line system. This system involves three parental lines viz., cytoplasmic male sterile line (CMS or 'A'), maintainer ('B') and restorer ('R') lines for developing hybrids. Hybrid seed production using the CMS system involves the following two steps.

- Maintaining 'A' line (by crossing A line with the B line)
- Production of hybrid seed (by crossing A line with the R line)

The 'B' and 'R' lines are multiplied in the same way as inbred varieties. Whereas, A line multiplication and hybrid seed production are different. The above two system are schematically presented in the figures 1 & 2.



**Figure 1: Schematic presentation of hybrid rice seed production technology**



**Figure 2: Field view of hybrid seed production**

Rice is a self-pollinated crop, where the extent of natural out-crossing ranges from 0.3 to 3.0% (Kumar, 1996). The success of hybrid seed production however demands higher out-crossing rate to obtain high seed yield. Therefore, hybrid rice seed production requires specialized techniques, which need to be thoroughly understood before embarking upon this venture. Various factors that affect hybrid seed production include choice of field, isolation, seeding time, planting pattern, weather conditions during flowering, roguing, synchronization in flowering of the parental lines, supplementary pollination and post harvest operations. The present effort aims at providing critical information for successful hybrid rice seed production, which will be of immense use for the agencies/ individuals involved in such a venture.

### **1. Choice of location:**

As it is well known that rice hybrid seed production is a cumbersome practice, a viable seed production requires specific location having fertile field with proper irrigation and drainage system, sufficient sunshine during flowering, and no serious disease and insect problems. Therefore, while choosing location for hybrid seed production above said requirements should be considered.

### **2. Favorable climatic conditions:**

Climatic conditions have profound influence on the seed yield. Detailed information on the weather data of a given locality is necessary for fixing the seeding dates. Seeding of the parental lines should be planned in such a way that the flowering in both parents coincides with the most favorable climatic conditions, which are as follows:

- i. Overall daily mean temperature of 24<sup>o</sup>– 30<sup>o</sup> C
- ii. Relative humidity ranging from 70 – 80 %
- iii. The differences between day and night temperatures should not be more than 8<sup>o</sup>–10<sup>o</sup> C (5<sup>o</sup>-7<sup>o</sup> C is optimum).
- iv. Sufficient sunshine with moderate wind velocity (2-3m/sec).
- v. There should not be rains continuously for three days during the period of flowering.
- vi. Yield will be adversely affected if overall daily mean temperature during flowering is below 20<sup>o</sup> C and above 35<sup>o</sup> C.

### **3. Isolation:**

Rice pollen grains are very tiny and light in weight and thus can travel very far with low speed of wind. In order to ensure the purity of hybrid seed and avoid pollination by unwanted rice varieties, the seed production plots should be strictly isolated. There are several methods available, any of which can be practiced to avoid the unwanted pollination. These are as follows.

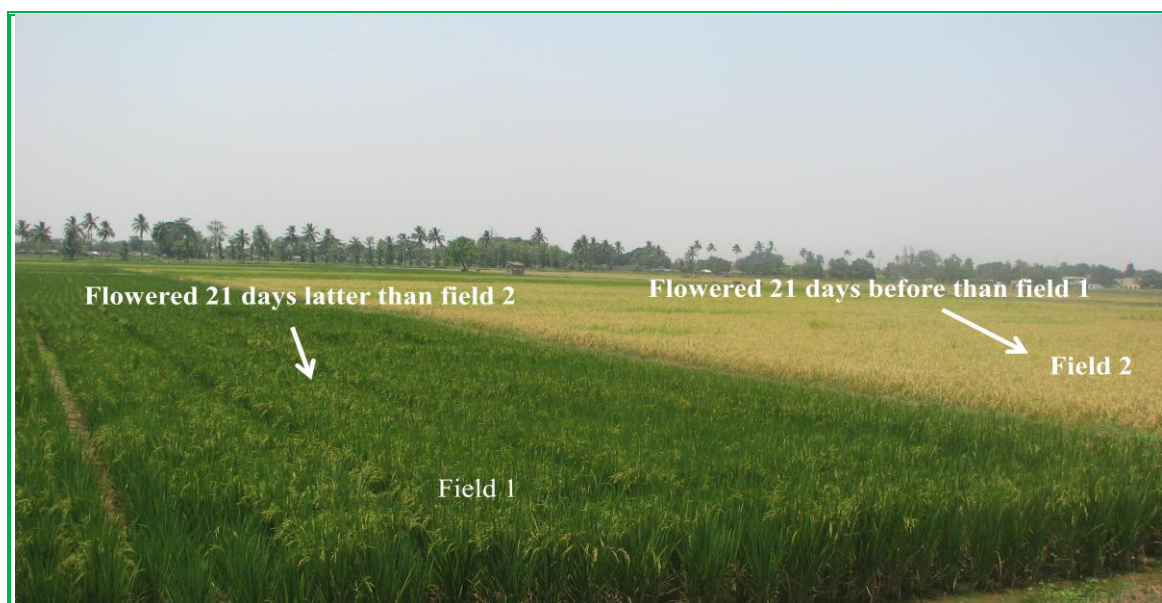


**3.1. Spatial isolation:** Unwanted varietal contamination in hybrid seed production can be prevented by maintaining atleast 100 meter distance between hybrid seed production plots and plots of other varieties, and 500 meter distance for CMS line maintenance.



**Figure 3: Space isolation**

**3.2. Time isolation:** Wherever it is difficult to have space isolation, a time isolation of over 21 days would also be effective. It means that the heading stage of the parental lines in hybrid seed production plot should be 21 days earlier or later than that of other varieties grown in the vicinity.



**Figure 4: Time isolation**

**3.3. Barrier isolation:** In some places, the natural topographic features such as mountains, rivers, forests etc. can serve as the most effective barrier. A crop barrier with maize, sugarcane and *Sesbania* covering a distance of 30 m would also serve the purpose of isolation. Artificial barrier with polythene sheets and seed nets of about 3 m height can also be used in case of small scale seed production. However, the most ideal locations are the areas covered with hillocks and mountains, which act as natural barriers.



**Figure 5: Physical barrier**

#### **4. Nursery management and seed rate**

Around 600-800m<sup>2</sup> nursery area is required for transplanting one hectare land. Before seeding, puddle the seedbed field twice (at an interval of 6-7 days) and keep the water continuously for 4-5 days. After that drain the excess water and puddle (2-3 times) in wet condition to destroy weeds, weed seeds and germinated rice seeds.

- i. Prepare raised seedbeds (5-10 cm height) of 1m width of any convenient length.
- ii. Provide drainage channels (30 cm) in between seedbeds to drain excess water.
- iii. Apply recommended fertilizer and manures (500 : 500 : 500g./100 m<sup>2</sup> N, P, K and 50 kg/100m<sup>2</sup>FYM) to the nursery beds. Double the phosphorus dose where low temperature retards seedling growth and apply zinc sulphate @ 3-4 kg/1000m<sup>2</sup> in zinc deficient area.
- iv. Sow pregerminated seed uniformly on the seedbed (@ of 1-2kg seed/20m<sup>2</sup>)
- v. Use 15 kg of 'A' line seed and 5 kg of 'R' line seed to produce sufficient seedlings to grow in one hectare each.
- vi. Manage the seedbed properly for getting healthy and vigorous seedlings for transplanting.
- vii. To avoid the fungal diseases in nursery, seed treatment with carbendazim 50% WP @ 4g/kg seed should be ensured.
- viii. For proper seedling growth, maintain the optimum moisture in nursery and apply urea @ 600-800g/100m<sup>2</sup> after 15 days of sowing.



- ix. Avoid excess nitrogen application in nursery; it affects the flowering synchronization in parental lines.



**Figure 6: Nursery preparation and sowing of germinated seeds**

### 5. Seeding and transplanting sequence

The seeding sequence of seed parent and pollen parent in the hybrid rice seed production plot depends on the growth duration of seed parent (A line) and pollen parent (R line). Therefore, to attain the complete synchronization in parental lines and long duration availability of pollens, male parent (B/R line) must be sown in three staggered date (at 3-4 days interval) and transplanted as per patterns given in table.

#### 5.1. In case seed parent (A line) has 10 days longer growth duration than pollen parent (R line):

In this situation sowing of A line is to be completed first. Three staggered sowing of R line is to be started on 6<sup>th</sup> day of sowing of CMS line and would be completed with 4 days interval (as given in Table 1). **Transplant 25day old seedlings of the 'A' line 10 days earlier than 'R' line. All R line to be transplanted 10 days later of CMS line planting the age of 2<sup>nd</sup> sown R line would be 25 days older** (Figure 8; scheme 2).

Table – 1: Seeding sequence and seedling age for transplanting

S. No.	Seed/pollen parent	Seeding sequence	Seedling age for transplanting (days)
1	A line	0 day	25
2	First R line	6th day	29
3	Second R line	10th day	25
4	Third R line	14th day	21

**5.2. In case seed parent (A line) has 10 days shorter growth duration than pollen parent (R line):** In such case seeding of R line has to be done in three staggered date with 4 days interval (as given

in Table: 2). Seeding of CMS line needs to be done on 14<sup>th</sup> day of first seeding of R line. The seedlings of the R line are to be transplanted when the age of the 2<sup>nd</sup> date sown R line reaches 25 days. All three staggered sown R lines are to be transplanted simultaneously. Later, 25 days old seedlings of the A line are to be transplanted 10 days later than the second R line seedlings.

Table –2: Seeding sequence and seedling age for transplanting

S. No.	Seed/pollen parent	Seeding sequence	Seedling age for transplanting (days)
1	First R line	0 day	29
2	Second R line	4th day	25
3	Third R line	8th day	21
4	A line	14th day	25

**5.3. In case seed parent (A line) has same growth duration as pollen parent (R line):** In such case, first seeding of R line is to be done 4 days before seeding of CMS line. CMS line and second staggered seeding of R line need to be done simultaneously on 4<sup>th</sup> day of first seeding of R line. Last seeding of R line to be done on 8<sup>th</sup> day of first sowing. Transplanting of both A and R lines to be done simultaneously. First A line planting is to be completed with 25 day old seedlings followed by R line with the seedling age of 29 days (1<sup>st</sup> sown R line), 25 days (2<sup>nd</sup> sown R line) and 21days (3<sup>rd</sup> sown R line) old (Figure 8; scheme 3).

Table –3: Seeding sequence and seedling age for transplanting

S. No.	Seed/pollen parent	Seeding sequence	Seedling age for transplanting (days)
1	First R line	0 day	29
2	Second R line and A line	4th day	25
3	Third R line	8th day	21

#### 5.4. Corrective measures for flowering synchronization in production plot

Flowering synchronization between parental lines of a hybrid is a major seed productivity determinant. Even after all the required management practices are followed, synchronization of flowering between parental lines remains incomplete. Generally, it occurs due to either microclimatic changes in the field or in the environment, which cause advancement or delay (4-6 days in either direction) in flowering. For instance, excess application of nitrogen and less water availability cause delay, whereas extra dose of phosphorus and flooding causes advancement in flowering. This type of mismatch can be overcome through some cultural as well as chemical management practices.



Advancement in flowering can be achieved by spraying 1% solution of Phosphoric acid before 3<sup>rd</sup> stage of panical development (up to 7-9<sup>th</sup> days of panicle initiation) or application of single super phosphate @ 50-60 kg/ha in male row and 100 kg/ha in female row. This causes 4-5 days advancement in flowering. Delaying in the flowering can also be achieved by spraying 2% solution of urea or 50-60 kg/ha nitrogen in male and 75-100 kg/ha in female rows before 3<sup>rd</sup> stage of panicle development. This causes 4-5 days delay in flowering. Some other corrective measures as given in Table-4, can also be successfully applied in flowering adujstment of parental lines in seed production plots. Dual corrective measures of opposite effect on male and female parents will be more effective in getting good response.

**Table 4: Corrective measures for adjustment in flowering**

<b>Methods for delaying flowering</b>					
S. No.	Name	Chemical Quantity		Stage of Application	Adjustment possible (Days)
		Male	Female		
1	Urea broadcasting	50-60Kg/ha	75-100Kg/ha	Before III Stage	4-5
	Urea spray	1-2%	1-2%	Before III Stage	2-3
2	Paclobutrazol spray	1.0Kg/ha	1.5 Kg/ha	Before III Stage	6-8
3	Draining out water	Effective	Not effective	I-V stage	2-3
4	Leaf clipping	Effective	Effectove	VII-VIII Stage	2-3
5	Removing panicles	1-3 times	1-3 times	At heading	5-6
6	Delayed GA3 application	Effective	Effective	At 40-50% flowering	1-2
7	Walking on root zone	Effective	Effective	After PI	2-3
<b>Methods for advancing flowering</b>					
1	SSP broadcasting	50-60Kg/ha	100Kg/ha	Before III Stage	4-5
2	MOP broadcasting	10-20Kg/ha	30-40 Kg/ha	Before III Stage	4-5
3	Flooding	Effective	Not effective	Before III Stage	2-3
4	GA3 application	10-15 g/ha	10-15 g/ha	At heading	2-3
5	Boric Acid	100 g/ha	150 g/ha	Before III Stage	2-3

## **6. Transplanting:**

To ensure good plant growth, complete flowering synchronization between parental lines and higher seed producibility, it is necessary to transplant the parental lines at proper seedling age. Seedlings of both, A and R lines are to be transplanted when they attain the age of 21-25 days. Transplanting of older seedling (one day old seedling may cause half day delay in floweing and vice-versa) delays flowering and transplanting of younger seedling advances flowering. If the transplanting of seedlings of 'A' line is delayed, then delay transplanting of the 'R' line by the same number of days is necessary. One or two seedlings per hill of the 'A' line and 3-4 seedlings per hill of B/R (male lines) are to be transplanted. For uniform distribution of pollen parent in the seed production plot, staggered sown seedlings of R line

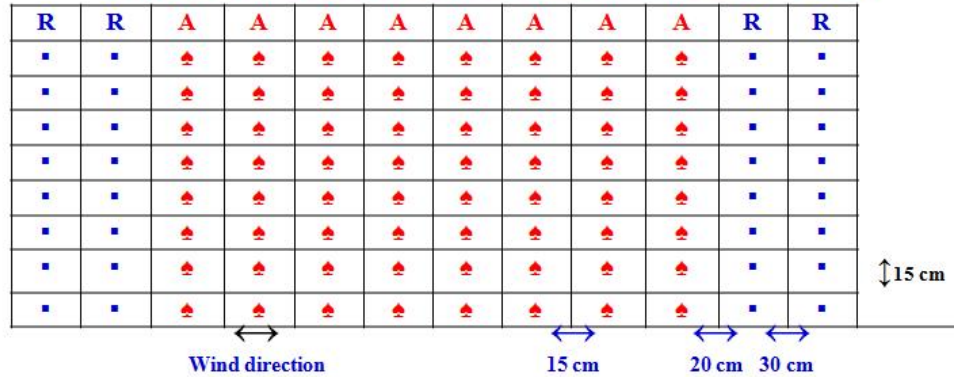
should be properly mixed before transplanting (**Figure: 7**). Every transplanted hill of B/R line should contain seedling of each staggered, so, planting atleast 3 seedlings/ hill has to be ensured.



**Figure 7: Mixing of staggered sown B/R line seedlings**

**6.1. Transplanting in a specific row ratio and row direction:** In hybrid rice seed production, the seed parent and pollen parent are planted in a certain row ratio at certain spacing (Figure 8; scheme1). The row ratio and spacing of pollen parent and seed parent have a distinct effect on the hybrid seed yields. The row ratio or row proportion refers to the number of rows of the male parent (R line) to that of the female parent (A line) in a seed production plot. Suppose if we plant 2 rows of 'R' line followed by 8 rows of 'A', the row ratio can be taken as 2:8. In hybrid rice seed production plot, 2:8 row ratio is reasonable. However, the row ratio may vary from region to region, depending on weather, management and parental lines. R and A lines can be planted in several row ratios of 2:6-14 for hybrid seed production but for maintaining the CMS line, it should not exceed 2:6-8. To encourage 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.

**Scheme 1: Row Ratio, Row Direction and Planting Pattern for Hybrid Rice Seed Production (Male : Female ratio = 2 : 8)**



**6.2. Factors influencing row ratio:** The ratio of pollen parent (R line) to seed parent (A line) is determined by the characteristics of the parental lines.

- Height of the pollinator
- Growth and vigour of the pollinator
- Size of the panicles and amount of residual pollen
- Duration and angle of floret opening in CMS lines
- Stigma exertion of CMS lines

**6.3. Transplanting of the R line**

- Transplant the seedlings of R line in paired rows (Figure:8; scheme 2)
- Leave a space of 115-145 cms inside block between paired rows of 'R' line seedlings for transplanting 6-8 row blocks of 'A' line seedlings.
- Transplant 2-3 seedlings per hill with a row-to-row distance of 30 cms and plant-to-plant spacing of 15 cms.





Figure 8; scheme 2: Planting layout of R line: in case R line has more flowering duration





## **Figure 8;scheme 3: Planting layout of R line: in case R and CMS line has same flowering duration**

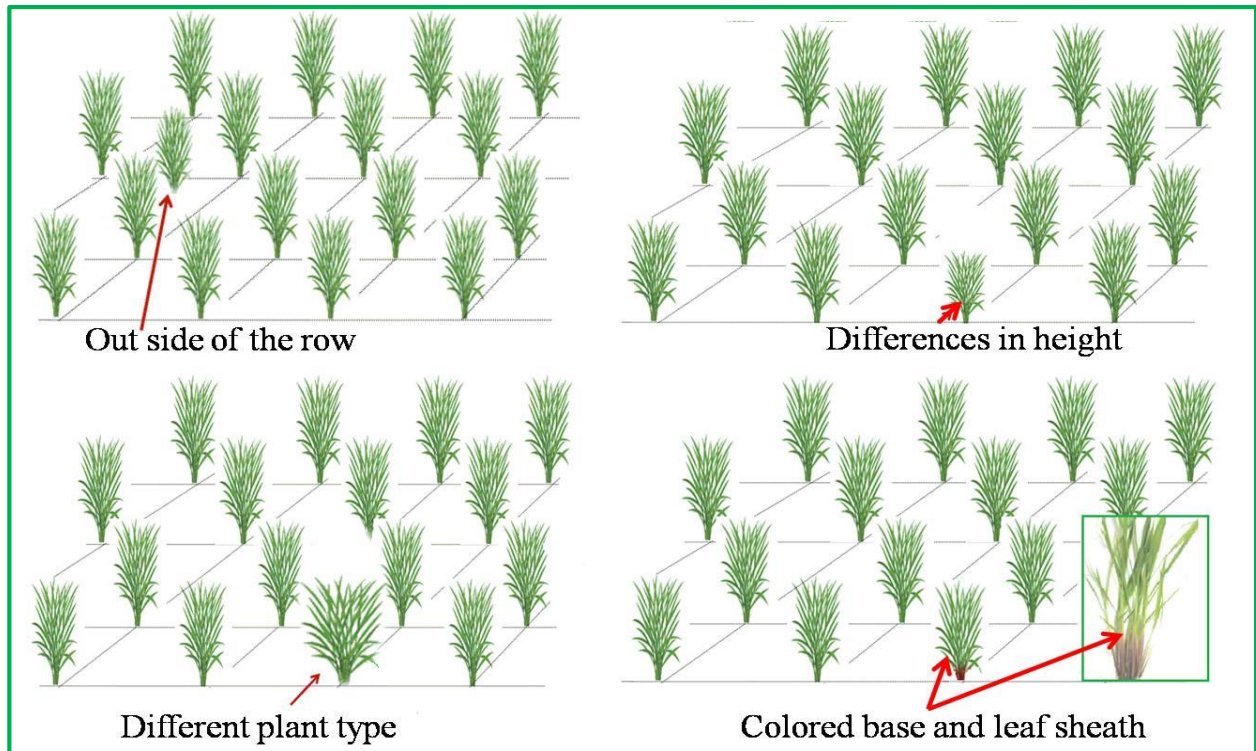
### **6.4. Transplanting of CMS line (A line)**

- Transplant 'A' line seedlings in blocks of 8 rows in between the paired rows of 'R' lines (Scheme-1, Figure: 8b)
- Transplant with 1-2 seedlings per hill at a spacing of 15 x 15 cms
- Always keep 20 cm wide space between A line rows and nearest R line row.

### **7. Roguing**

The purity of hybrid rice seeds used in commercial production must be more than 98%. To meet this requirement, the purity of the restorer and CMS lines must be more than 99%. Therefore, in addition to ensuring strict isolation, it is necessary to remove all rogues from the seed production plots. Roguing is the removal of undesirable rice plants from the hybrid seed production plots. Undesirable rice plants are those plants either in A or R line rows that differ from plants that are true to type. Roguing helps to prevent the off-types from cross-pollinating the true to type A line plants and thus enhancing the purity of hybrid seed. The undesirable plants come from many sources. They may be voluntary plants from the previous crop. Contamination due to improper isolation also results in the occurrence of off-types. Admixing during the process of harvesting, threshing, packing and handling is also possible for which the off-types occur. Therefore, due care is to be taken to remove the off-types during the cropping season. Roguing can be done at any time during the crop stage. Off-type rogues can be removed whenever they are identified – earlier the better. The important stages for roguing are maximum tillering, flowering and just before harvesting.

**7.1. Roguing at maximum tillering:** We can identify the off-types by their morphological differences from the true to type plants. Therefore, it is essential to know the characteristic features of parental lines, which help in easy identification of rogues and efficient roguing. As a basic step, any plant found out side the rows (figure 9) has to be removed as they may be volunteer plants. Remove all those plants which are either too tall or too short than the seed or pollen parent. We can also identify the off-type plants by difference in their leaf blade size, shape and leaf sheath colour.



**Figure 9: Roguing at tillering stage**

**7.2. Roguing at flowering:** Roguing at flowering is extremely important as it is the stage when we can identify many off-types which look similar to the parental lines during the early stages of growth. All the off-type plants that flower very early or very late are to be removed. The plants which differ from parental line plants in respect of leaf size, shape, angle, panicle shape, size and pigmentation are to be carefully removed. Remove all the plants from A line that have plumpy yellow anthers. Plants in the A line should not have fertile pollen. The off-types in A lines can also be distinguished from their fully exerted panicles (imperfect panicle exertion occurs in CMS). Care should be taken to remove the plants, which are highly infested with pests and diseases.



**Figure 10: Roguing at flowering stage**

**7.3. Roguing just before harvest:** This is the last opportunity to keep away the off-types in order to maintain high purity. Before harvesting, the plants in A line rows are to be thoroughly checked and those plants which show normal seed set (more than 70% seed set) are to be removed. It is necessary to remove all the off-types that have different grain characters as compared to that of A line plants. The grain size, shape, colour and pigmentation of A line plants have to be critically examined for effective roguing.

## **8. Out-crossing encouragement:**

Most of the male sterile lines based on WA cytoplasm have imperfect exertion of panicle. As a result, as much as 15-20% spikelets remain enclosed in the flag leaf and are not exposed for out crossing. By adopting following methods, the exertion of the panicles can be promoted to a great extent.

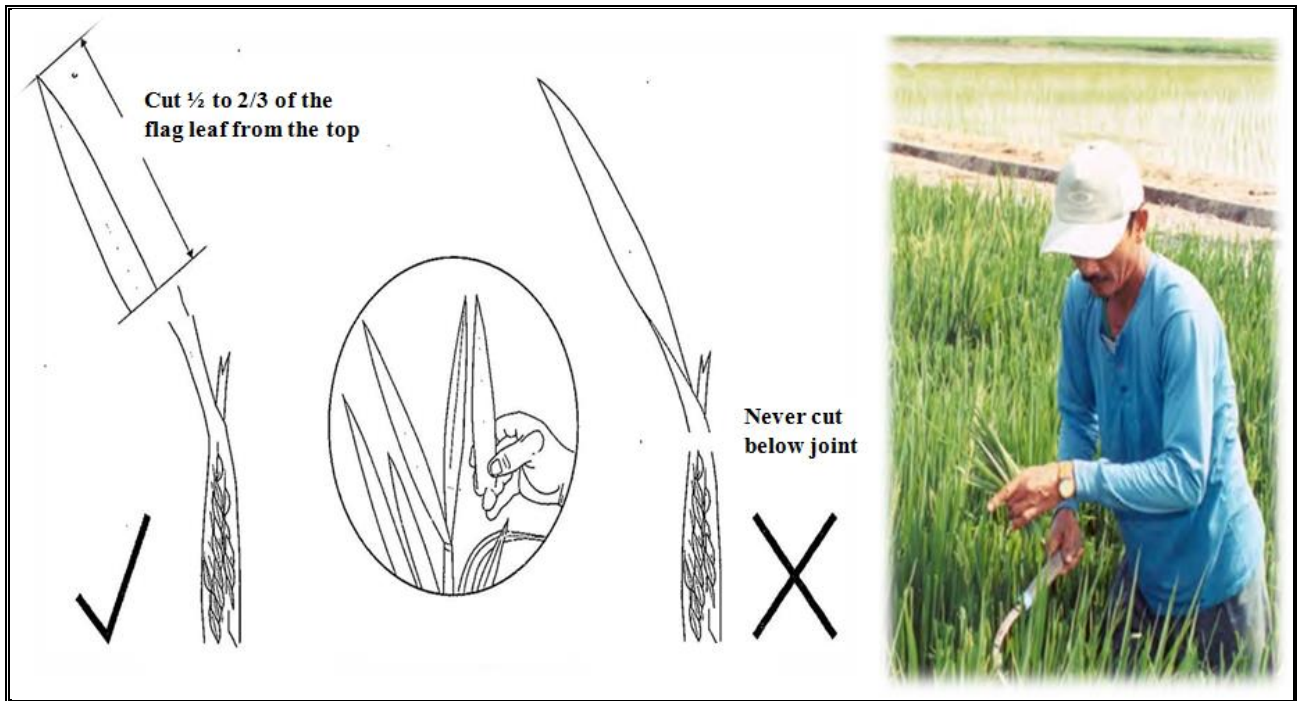
**8.1. Application of gibberellic acid (GA3):** It is an efficient and effective plant growth regulator, which stimulates the cell elongation, thus can be used to enhance panicle exertion in CMS line.

Besides, GA3 has the following favorable effects:

- Increases the duration of floret opening
- Increases stigma exertion and receptivity
- Promotes plant height
- Influences flowering and hence flowering in parental lines can be adjusted
- Widens the flag leaf angle
- Promotes exertion and growth rate of secondary and tertiary tillers.

In hybrid seed production plots of rice, 8-10% panicle emergence stage is most appropriate for first spraying (40%) and the remaining 60% of GA3 should be sprayed on the following day. The ideal time for spraying is from 8 to 10 AM and from 4 to 6 PM. Spraying should be avoided during cloudy weather and when the wind velocity is high. A dose of 45-60 g/ha of GA3 is optimum. The hormone does not dissolve in water and it should be dissolved in 70% alcohol (1 g of GA3 in 25-40 ml of alcohol).

**8.2. Flag leaf clipping:** Normally the flag leaves are erect and longer than the panicles and they come on the way of easy pollen dispersal thus affecting the out-crossing rate. The clipping of flag leaf helps in free movement and wide dispersal of pollen grains to give higher seed production. The flag leaves should be clipped when the main culms are in booting stage. Only half or two-third portion of flag leaf should be removed (see in figure 11). However, flag leaf cutting is not advisable in the plots infested with diseases as this operation may spread the disease further.



**Figure 11: Flag leaf cutting**

**8.3. Supplementary pollination:** Rice is basically a self-pollinated crop and hence in order to enhance the extent of out-crossing there is a need to go for supplementary pollination. Supplementary pollination is a technique of shaking the pollen parent so that the pollen is shed and effectively dispersed over the A line plants. Supplementary pollination can be done either by rope pulling or by shaking the pollen parent with the help of two bamboo sticks (see in Figure 12. Scheme 1 & 2). Timing and frequency of supplementary pollination is very important. The first supplementary pollination should be done at peak anthesis time i.e. 8.30 a.m. to 10.30 a.m. when 30-40 % of the spikelets are opened. This process is repeated 3–4 times during the day at an interval of 30 minutes. Supplementary pollination has to be done for 7-10 days during the flowering period.





Scheme 1: Supplementary pollination through stick shaking



Scheme 2: Supplementary pollination through rope pulling

**Figure 12: Supplementary pollination through stick shaking and rope pulling**

### **9. Fertilizer management**

Fertilizer management is very crucial activity in hybrid seed production. Imbalanced dose and improper timing of application may affect the flowering synchronization in parental lines. Therefore, it should always be done on the basis of soil fertility test report. In India, recommended dose of N: P: K for kharif season is 100:50:50 kg/ha whereas for Rabi it is slightly more i.e. 120:60:60. Like hybrid rice cultivation, nitrogen in seed production plot should also be applied in four equal split doses (25% of total at each time). First dose should be applied just before the transplanting as basal, second dose at

maximum tillering, third at panicle initiation (20-25 days before flowering) and fourth at milking stage (5 days after flowering). Whole phosphatic fertilizer should be applied as basal but potash in two split i.e.  $\frac{3}{4}$  of total as basal and  $\frac{1}{4}$  at PI growth stage along with third dose of nitrogen. Extra nitrogen application causes delayed flowering, hence it should be restricted.

#### 10. Irrigation and other intercultural practices

Three centimeter water layer up to 12-15 days of transplanting and 5-6 centimeter up to dough stage should be maintained, which ensure proper growth and development in rice. Within ten days after transplanting gap filling should be done.

Weed management should be done either by two time manual weeding (first after 21 days and second after 42 days of transplanting) or chemically by applying Butachlor @ 1.5 l/acre within 48 hrs after transplanting; Benthocarb (50 EC) @ 3l/ha or Anilofos (30 EC) @ 3 l/ha within 3-4 days after planting; Erazo-strong or Segment granules @ 4 kg/acre with sand after 8 day of transplanting.

#### 11. Plant protection

Rice is prone to many insect pests, diseases and other nutritional disorders, which cause great loss in production and seed quality. Therefore, preventive measures before severe damage in field should be taken to stop/eradicate such problems. Some chemical methods which are given in Table 5 may be utilized in successful management of major rice problems.

**Table 5: Important plant protection measures**

Name of insect	Management practice
Gundhy bug	Spray chloropyrifos 20%+ cypermethrin 2% EC @ 1 L in 200L water. Apply Malathion 5 % dust @ 6-8 kg/acre at morning time.
Stem borer	Apply cartap hydrochloride 50 SG/ Fipronil 5 SG @ 1kg/ha in 200 litres water at 15 days intervals.
Plant hopper	Spray the Imidaclorpid 17.8% EC @ 1.2 L/ha
Rice hispa	Spray the chloropyrifos+super methrin solution or quinalphos 25 EG @ 1.25 L in 200L water.
Name of diseases	Management practice
Bacterial leaf blight	Spray Streptocyclin/Agrimycin 60 or 80g+500g blitox or phytolon or fupravit in 500 litres of water 2-3 times at 10-15 days interval.
Blast and sheath blight	Early sowing and less nitrogen application may allow the crop to escape from blast and sheath blight. Spray fungicides like tricyclozol, hexaconozol or propiconozol @ 200ml/acre in 200 litres of water
False smut	Seed treatment with thiram+carbendazim (2:1 ratio) @ 3 g/kg seeds Spray Tricyclozol 75% WP @ 1.5 g/litre water
Khaira disease	Apply Zinc sulphate @ 20-30 kg/ ha.
Brown spot	Sparry one of these: carbendazim (0.1%), diathane M 45(0.25%), Tilt (0.1%), or hinosan (0.1%) 2-3 times at 10-12 days interval



**12.0 Harvesting, threshing and processing** From the point of view of maintaining high purity, extreme care is needed while harvesting, threshing and processing of the hybrid rice plots.

**12.1. Harvesting:** All R line rows are to be harvested first (see figure 13). The R line harvest is to be removed and kept in a safe place separately. The left over R line panicles in the field should also be removed. After R line harvesting, a final roguing in seed parent has to be done carefully, removing the plants showing more than 70% seed setting. Then the seed parent plants are to be harvested.



**Figure 13. Harvesting: first B/R lines are harvested. Then final roguing in A line rows followed by harvesting**

**12.2 Threshing:** During threshing, the 'A' line parent and 'R' line parent harvests must be kept separate from each other. The A and R lines should be threshed separately. Before starting threshing, all the threshing equipment, threshing floor and tarpaulin to be thoroughly cleaned.

New gunny bags are to be used for storing the seeds. Two labels for each bag need to be prepared– one to place inside the bag and one to attach to the bag outside. Each label should contain the following information.

- Name and Address
- Name of the parent
- Name of the location
- Season and year
- Date of harvest

**12.3. Yield:** By following the appropriate hybrid seed production procedure, farmers can get 1.5-2.5 tonne/ha hybrid seed yield (with an average of 2.0 tonnes/ha).

**12.4. Seed drying and storage:** Hybrid seed must be dried up to 12-13% moisture content and stored in cool place. Less moisture helps the seed to maintain their longevity, vigour and health for a longer period.

### 13. Economic advantage of hybrid seed production:

Inspite of being more cumbersome and high input intense practice, hybrid rice seed production is a profitable venture. It creates additional job opportunity (requires 100-105 more man days) and provides more net income (around Rs. 75000/ha net income, 70% more than the unit production cost) as compared to seed production of HYV (Rs. 13000/ha, only 18% more than production cost) (see Table: 4). The market price of hybrid seed is Rs. 250-270/ kg. The farmers producing the hybrid seed get only Rs. 80-90/kg. In case of low production (<5 quintal/ acre) farmers get minimum Rs. 45000 as compensation from seed production agencies.

**Table 4: Production function analysis of hybrid rice seed**

Item		Quantity/Number (per hectare)	Cost/income (in Rs.)	
			Hybrid seed	HYV
Seed cost	Male	5 kg @ Rs. 50/kg	250	2000
	Female	15 kg @ Rs.200/kg	3000	Nil
Labour cost		250/145 @ Rs. 200/labour/day	50000	29000
FYM and fertilizer cost		N:P:K (100:50:50) (based on market price)	5400	5400
Irrigation		18-20 Irrigation (weekly) @Rs.1500/ha /irrigation)	30000	30000
Gibberellic acid			2000	Nil
Others			15000	10000
Total cost			1,05,650	76,400
Average production			2.0 t/ha	4.5
Gross income		*Price @ Rs. 90/kg and Rs. 20/kg	1,80,000	90,000
Net income			74,350	13600



\* Price of seed is the price given to the farmer.

Note: Always use fresh hybrid seeds, avoid hybrid rice product of own field for next year sowing.

### **References**

- **Mao CX, Virmani SS and Kumar I, 1998.** In: Technology innovation to lower the cost of hybrid seed production. Advances in hybrid rice technology. Proceeding of third international symposium on hybrid rice. 14-16 November, 1996, Hyderabad, India. IRRI, Manila, Philippines. pp. 111-128.
- **Virmani SS, Chaudhary RC and Khush GS, 1981.** Current outlook on hybrid rice. *Oryza*. **18**:67-84.
- **Xie F and Hardy B, 2010.** Book 'Accelerating hybrid rice development, International Rice Research Institute, Manila, Philippines, pp. 698.
- **IRRI, 1997.** Hybrid rice manual, International Rice Research Institute, Manila, Philippines, pp. 194.
- **National Food Security Mission, 2010.** Guidelines for seed production of hybrid rice, Gov. of India, Ministry of Agriculture, Department of Agriculture and Cooperation, pp. 44.