



# Training Programme-Cum-Exposure Visit on Advancement in Seed Technology and Marketing



**March 12-19, 2019**

Editors

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**Organized by:**

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Varanasi - 221005

**MANUAL**  
**Training Programme-Cum-Exposure Visit**  
**on**  
**Advancement in Seed Technology and Marketing**

**March 12 - 19, 2019**

**For**  
**Students of Diploma in Seed Technology and Marketing**

**Compiled & Edited**

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## Hybrid Seed Production Technique in Maize

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### Introduction

Maize, *Zea mays*, of grass family Poaceae is highest produced annual cereal crop even if it ranks third in land area coverage. In India, maize is cultivated in 9.33 mha having production of 26.88 mt. It is also known as queen of cereals because it has the highest genetic yield potential among the cereals and in addition to staple food for human being and quality feed for animals, maize also serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries *etc.* The demand for maize is ever increasing and estimated to touch around 50mt maize grain by 2025 which can be addressed only through complete adoption of single cross hybrid varieties because of its vigorous & high yielding nature. As hybrid seeds are very costly which is hard to be afforded by the farmers, so hybrid seed production at the local village level can enhance the farmers income as well as it can bring down the cost of the hybrid seed of the maize. Hybrid seed production technique in maize is as easy as normal production technology of maize except some additional important techniques

which need to be followed like male female planting ratio, roguing, detasseling and harvesting hybrid seed only from the female parent. It also requires the careful attention for all the operations to be done at proper time for getting the quality hybrid seed.

### Floral biology of Maize

The maize plant is generally monoecious. The staminate (male) flowers are borne in the tassel at the top of the stalk while the pistillate flowers are located in spikes which terminate lateral branches arising in the axils of the lower leaves. The mature pistillate inflorescence is called cob. The branches of the panicle are spirally arranged around the axis. The spikelets are usually arranged in pairs, one sessile & the other pedicelled. The spikelet is completely enclosed by two firm, more or less pubescent ovate glumes. There are two florets per spikelet. Each floret contains three stamens, two lodicules and a rudimentary pistil. The pistillate inflorescence or ear in a spike with thickened axis. The pistillate spikelets are borne in pairs in several longitudinal rows. The individual spikelet is two flowered, only one floret ordinarily being fertile. The lemma and palea are thinner and shorter than the glumes and produce the chaff. The single ovary in a fertile floret bears a long



style or silk which is forked at the tip. The silk are ordinarily 10-30cm long.

**Pollination:** Maize is normally cross pollinated. The pollination is by wind. Cold wet weather retards the shedding of pollen while hot dry conditions tend to hasten it. The flowers near the middle of the ear develop the silks early and usually are pollinated first.

### **Hybrid**

Hybrids are the first-generation crosses between genetically unrelated or dissimilar parents which may be purelines, inbreds, varieties or population. Pollen from male parent (Pollen parent) will pollinate, fertilize and set seeds in female (seed parent) to produce  $F_1$  hybrid seeds. For production of a hybrid, crossing between two parents is important, the crossing process will result in heterosis. In self-pollinated crops, it is difficult to cross but in cross pollinated crops it is easier.

### **Advantages of Hybrid corn**

- High acceptability among the farmers because of higher yield.
- Highest yield potential among cereals as per day productivity is more.
- Being  $C_4$  plant has better adaptation under climate change.
- Tolerant to biotic and abiotic stresses
- Tolerant to Water stress due to better root system

- Decreases need for irrigation water
- Less yield reduction under nutrient stress condition
- Quick and higher percentage of germination
- Faster growth and most uniform
- Food, income and nutritional security for resource-poor farm families.
- Easy to market because of its uniformity and high productivity.
- Single cross hybrids are homogeneous whereas all other kinds of hybrids are heterogeneous.

### **Prerequisites for hybrid seed production**

- Good compatible, uniform, productive and diverse parents.
- Proper site selection, avoid the sites where preceding crop was maize.
- Fertile and quality land with good quality and assured irrigation.
- Proper isolation distance.
- Knowledge of recommended package of practices.
- Technically experienced manpower
- Stress free climatic condition.





### Characteristic of good seed parent

Female parent	Male parent
<ul style="list-style-type: none"><li>• Productive</li><li>• Strong</li><li>• Long cobs with complete exertion</li><li>• Low cob placement</li><li>• Shorter anthesis silking interval</li><li>• Nutrient responsive</li><li>• Stay green traits</li><li>• Erect leaves</li><li>• Resistant/tolerant to biotic and abiotic stress</li><li>• Strong root system</li></ul>	<ul style="list-style-type: none"><li>• Lax tassel, long main branch with few secondary branches</li><li>• Long duration of pollen shedding</li><li>• Taller than female parent</li><li>• Attractive grain color</li><li>• Strong resistant to lodging with better root system</li><li>• High yield potential</li><li>• Resistant/tolerant to biotic and abiotic stresses</li></ul>

### Hybrid seed production technique

#### Soils

Maize hybrid seed production can be done in soils ranging from loamy sand to clay loam. However, soils having good organic matter content and high water holding capacity with neutral pH are considered good for higher productivity. Being a sensitive crop to moisture stress especially excess soil moisture and salinity stresses; it is desirable to avoid low lying fields having poor drainage and also the field having higher salinity. Preferably the field where preceding crop was not maize to maintain the genetic purity

#### Time of sowing

Maize can be grown in all seasons viz; *Kharif* (monsoon), post monsoon, *Rabi* (winter) and spring. The optimum time of sowing in kharif

is Last week of June to first fortnight of July, in rabi last week of October for inter cropping and up to 15th of November for sole crop while in spring, it is first week of February. Generally, the raised bed planting is considered as best planting method for maize during monsoon and winter seasons both under excess moisture as well as limited water availability/rainfed conditions. For most part of India, First week of July is preferred in kharif to avoid flowering during heavy rains (washing off the pollens) and first week of November during Rabi to avoid low temperature during flowering (killing anthers)

#### Seed Rate

Optimum plant stand is the key factor to achieve higher productivity. The seed rate varies depending on plant type, season, sowing methods *etc.* The following crop geometry and seed rate should be adopted.



Generally for Grain (normal and QPM), optimum seed rate is 15kg for female and 10 kg for male. The spacing should be 60/75cm row to row & 20cm plant to plant. The minimum recommended germination percent is 80%.

### Seed treatment

Seed treatment is advisable/ recommended with fungicides and insecticides before sowing to protect the maize crop from seed and major soil borne diseases and insect-pests, as per the below given details.

S. No.	Crop Stage	Nitrogen rate (%)
1.	Basal (at sowing)	20
2.	V4 (four leaf stage)	25
3.	V8 (eight leaf stage)	30
4.	VT (tasseling stage)	20
5.	GF (grain filling stage)	5

Disease/insect-pest	Fungicide/Pesticide	Rate of application (g kg <sup>-1</sup> seed)
Turicum Leaf Blight, Banded Leaf and Sheath Blight, Maydis Leaf Blight	Bavistin + Captan in 1:1 ratio	2.0
BSMD	Apran 35 SD	4.0
Pythium Stalk Rot	Captan	2.5
Termite and shoot fly	Imidacloprid	4.0

### Nutrient management

The rate of nutrient application depends mainly on soil nutrient status/balance and cropping system. For obtaining desirable yields, the doses of applied nutrients should be matched with the soil supplying capacity and plant demand (Site-specific nutrient management approach) by keeping in view of the preceding crop (cropping system).

Response of maize to applied organic manures is notable and hence integrated nutrient management (INM) is very important nutrient management strategy in maize based production systems. Therefore, for higher economic yield of maize, application of 10 ton FYM/ha, 10-15 days prior to sowing supplemented with 150-180 kg N, 70-80 kg P<sub>2</sub>O<sub>5</sub>, 70-80 kg K<sub>2</sub>O and 25 kg ZnSO<sub>4</sub> ha<sup>-1</sup> is recommended. Full doses of P, K and Zn should be applied as basal dose during field preparation. Nitrogen should be applied in 5-



splits as detailed below for higher productivity and use efficiency. N application at grain filling results in better grain filling. Therefore, nitrogen should be applied in five splits as per below mentioned for higher N use efficiency.

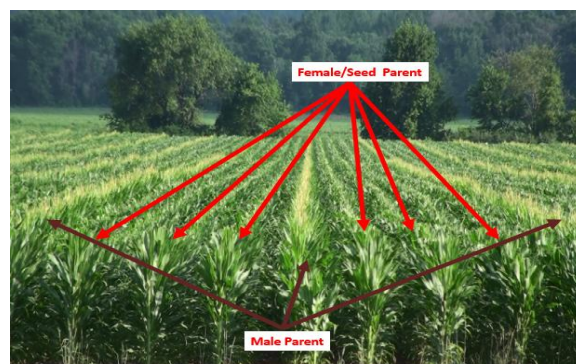
### Proper isolation distance

It is very important to maintain the proper isolation distance to avoid the pollen contamination from unknown sources. It manages the pollen drift effectively. Isolation distance is accomplished in three ways including, distance, time and good synchronization. It also includes planting a barrier of foundation or certified seed of the same variety or the other crop like bazra or Napier grass on all sides about 50 m from the production block. It also depends upon wind velocity/ season.

### Male female ratio:

During hybrid seed production of maize, 3-4 female line is planted between one male line on each side. Male female ratio must be maintained to get optimum pollen and achieve good seed set. It depends on the pollen shedding potential of male parent and male female synchrony in flowering. Different ratios

are  
**1male:2female:1male:2female:1male** or  
**1male:3female:1male:3female:1male** or  
**1male:4female:1male:4female:1male.**



### Roguing

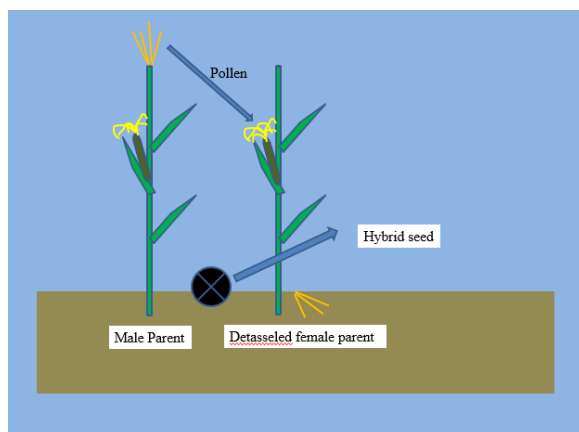
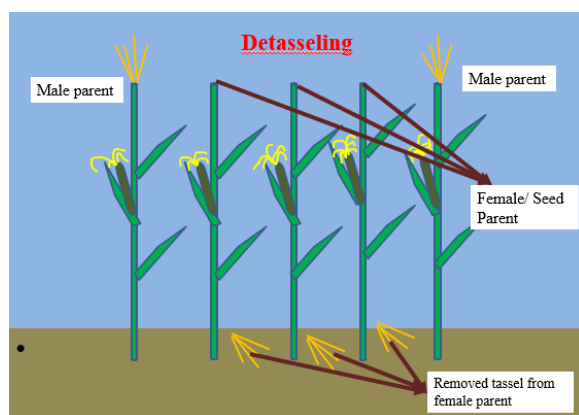
It is the method of removing unwanted and off type plants which should be done periodically based on height of plant, position of cob, colour of silk, arrangements of seeds in cob, leaves *etc.* It Should be conducted before genetic or physical contamination. Shedding tassels are to be removed in roguing. It refers to the tassels in female parent rows, shedding pollen or that has shed pollen in hybrid maize plots. During field inspection, a tassel whose main spike or any side branch or both have shed pollen or shedding pollen in more than 5 cm of branch length is counted as a shedding tassel. During inspection, the shedding tassels are taken into count for acceptance or rejection of production plot. Roguing on male plants must be complete before pollen shedding begins and female plants should be rogued completely soon after silk-emergence.

### Detasseling

Detasseling is the removal of tassel from female parent line. Detasseling is done when the tassel emerge out of the boot leaf, but before anthesis *i.e.* anthers have shed pollen. Anthers take 2-4 days to dehiscence after complete



emergence. Only in few cases, the anthers start dehisce before its complete emergence. In such case, detasseling should be done earlier. Detasseling is done every day from the emergence of tassel up to 14 days. Detasseling is done by holding the stem below the boot leaf in left hand and the base of the basal in right hand and pulling it out in a single pull. Care should be taken to remove the complete pollen part and not to break or remove leaves as removal will reduce yields and will result in lower quality of seed.



## Water management

The irrigation water management depends on season. However, in areas having assured irrigation facilities, depending upon the rains and moisture holding capacity of the soil, irrigation should be applied as and when required by the crop and first irrigation should be applied very carefully wherein water should not overflow on the ridges/beds. In general, the irrigation should be applied in furrows up to 2/3rd height of the ridges/beds. Young seedlings, knee high stage, flowering and grain filling (GF) are the most sensitive stages for water stress and hence irrigation should be ensured at these stages. In raised bed planting system and limited irrigation water availability conditions, the irrigation water can also be applied in alternate furrow to save more irrigation water. In rainfed areas, tied-ridges are helpful in conserving the rainwater for its availability in the root zone for longer period. For winter maize, it is advisable to keep soil wet (frequent & mild irrigation) during 15 December to 15 February to protect the crop from frost injury.

## Weed Management

Weeds are the serious problem in maize, particularly during *kharif* /monsoon season they competes with maize for nutrient and causes yield loss up to 35%. Therefore, timely weed management is needed for achieving higher yield. **Atrazine** being a selective and broad-spectrum herbicide in maize checks the emergence of wide spectrum of weeds. Pre-





emergence application of Atrazine (Atratraf 50 wp, Gesaprim 500 fw @ of 1.0-1.5 kg a.i ha<sup>-1</sup> in 600 litre water, Alachlor (Lasso) @ 2-2.5 kg a.i ha<sup>-1</sup>, Metolachlor (Dual) @ 1.5-2.0 kg a.i ha<sup>-1</sup>, Pendamethalin (Stomp) @ 1-1.5 kg a.i. ha<sup>-1</sup> are effective way for control of many annual and broad-leaved weeds. While spraying, following precautions should be taken care by the person during spray, he should move backward so that the Atrazine film on the soil surface may not be disturbed. One to two hoeing are recommended for aeration and uprooting of the remaining weeds, if any. While doing hoeing, the person should move backward to avoid compaction and better aeration. Under heavy weed infestation, post-emergence application of Paraquat & Loudis can also be done as protected spray.

Integrated pest and disease management should also be done carefully on incidence of specific pest and disease in consultation with agricultural expert.

### Harvesting

Male lines are harvested first then female lines are harvested to avoid mixture. Harvest from the female line is taken as hybrid seed while from male line is taken as grain. Optimum moisture for grain harvesting should be 20%. Harvested crops should be spread evenly instead of pooling.

### Post-harvest management

Drying and sorting of seed parent cobs is needed after harvest in which Sun drying is the best. Cobs can be Spreaded on Tarpoline sheets to avoid seed injury. Final moisture of 13-14% should be retained. After drying, shelling should be done either manually or power operated maize sheller. Shelling should be avoided during high moisture to avoid embryonic damage.

After shelling, seed processing should be undertaken when seeds get dried completely. Seed processing is necessary to maintain the quality of the hybrid seed. It is done by removing all under sized, broken, damaged and malformed seeds. Seed drying should be done to bring moisture up to 8 % and should be kept in aerated jute bag for seed storage and marketing. Seed should be stored in dry and cool place to avoid germination and vigor loss during storage.

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