

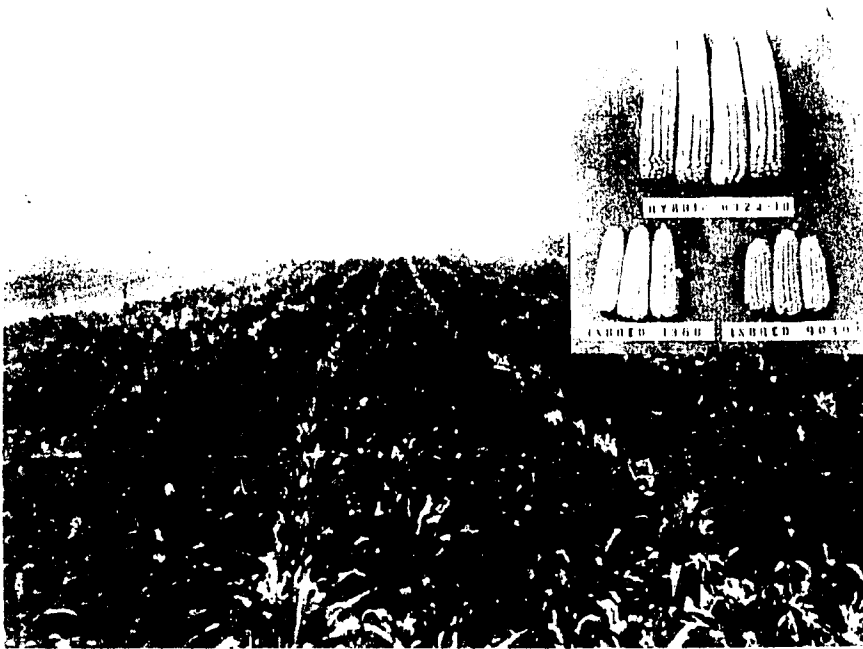
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# Hybrid Maize Seed Production Manual

by

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<u>CONTENT</u>	<u>PAGE</u>
INTRODUCTION	1
1. Specificities on hybrid maize seed production .....	2
2. Major characteristics of inbred lines .....	3
3. Site selection .....	5
4. Field operations .....	6
4.1 Land preparation and fertilization .....	7
4.2 Planting .....	9
4.3 Weed control .....	12
4.4 Disease and pest control .....	13
4.5 Female detasseling and male removal .....	14
- Emergency exercise during flowering .....	16
4.6 Harvesting .....	17
5. Seed processing .....	18
5.1 Shelling and labelling .....	18
5.2 Seed viability test and seed treatment .....	19
6. Field inspection and certification .....	19
7. Inbred line seed increase .....	23

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INTRODUCTION:- Hybrid maize has been chosen to be a major factor in Nigeria's effort to rapidly become self-sufficient in maize production in order to achieve a dramatic increase of maize production in a short period of time. The Government of Nigeria, through the Ministry of Science and Technology, mandated Research Organizations including the IITA and NCRI to embark on hybrid maize program in 1982. The collaboration between Nigerian and International scientists has resulted in successfully developing high yielding and stable first generation "single cross" hybrids for Nigeria in 1983. Without good hybrid seed production, hybrid maize cannot be grown successfully in the farmers' fields. The Federal Ministry of Agriculture requested NSS and IITA to organize

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a collaborative hybrid maize seed production course in February, 1984 (3 weeks). A total of 17 participants from the National Seed Service, State Agricultural Development Projects and leading private farmers attended the course held at IITA. This hybrid seed production manual was written as the course progressed and will be modified continuously as we gain more experience in hybrid maize production. Based on this manual, hybrid seed production will be implemented on farmers' fields for the first time in the history of Nigeria.

1. Specificities on Hybrid Maize Seed Production

Hybrid maize is always produced by cross pollinating two or more parental inbred lines. In general, inbred lines are a kind of end

product for hybrid development since they are developed by five to six generations of inbreeding. Due to this inbreeding, the lines are always lower yielding, less vigorous, shorter and more uniform than normal maize. Hybrid maize produced by cross-pollinating the inbred lines, is high yielding, vigorous and generally uniform. Hybrid seed must be continuously produced by cross pollinating the inbred lines. If farmers save their own seeds from the commercially grown hybrids for the next season, they will fail to obtain high yield due to genetic segregation of the hybrid in the subsequent season.

2. Major Characteristics of Inbred Lines

Compared to normal maize varieties or hybrid maize the inbred lines usually have :

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1. Shorter height
2. Less vigor
3. Thinner stem
4. Smaller tassel
5. Smaller ears
6. Lower yield, etc.

There are several different types of hybrids depending on the number of parental inbred lines involved in the hybrid combination :

- Single cross :  $(A \times B)$  = 2 lines
- Three way cross :  $(A \times B) \times C$  = 3 lines
- Double cross :  $(A \times B) \times (C \times D)$  = 4 lines
- Top cross : Variety x line : 1 var., 1 line

Single cross hybrids which involve two parental inbred lines, will be recommended for hybrid seed production in Nigeria for 1984. Each hybrid consists of one seed parent (female) and one pollen parent (male). Depending on the

characteristics of the inbred lines they will be designed either as female or male parents.

General Characteristics of both Parents are as follows:

For Seed Parent (female):

1. Greater number of seeds/ear
2. 2-3 days earlier flowering than male
3. Good silk emergence
4. More vigorous plant

For Pollen Parent (male):

1. More quantity of pollen production
2. 2-3 days later flowering than female, etc.

### 3. Site Selection

The major characteristics of good hybrid seed

production sites are:

- a) Well-drained, fertile soil (land)
- b) Annual rainfall = 1200 mm with good rain distribution
- c) Lots of sunshine during crop growing season
- d) The rain stops at harvest time
- e) Areas less prone to disease and insect pest attack
- f) Good, experienced maize farmers.

In regard to the above site characteristics, the Sudan savanna region, especially Funtua and Zaria areas in Kaduna State, seem to be the most suitable areas for hybrid maize seed production in Nigeria. Ease of hybrid seed field isolation and availability of irrigation facilities will

..../7



also be considered for final site selection in each favorable area.

Isolation distance of hybrid seed production field from neighbouring maize fields is at least 200m. Without adequate isolation, the purity of hybrid seed cannot be guaranteed.

4. Field Operations

4.1 Land Preparation and Fertilization:

Land preparation can be either by minimum tillage or conventional tillage. Herbicide use is necessary for minimum tillage. In the case of conventional tillage, land preparation may start after a good rain. Either ridge or flat land preparation can be used. In water logged soils,

maize should be planted on ridge tops as maize is very susceptible to water logging.

Fertilizer levels are variable depending on the soil fertility of site selected. General dosage of fertilizers are approximately 150 kg Nitrogen(N) 100 kg Phosphate( $P_2O_5$ ) and 70 kg Potassium(K) per hectare. About 60% of N, and all Phosphate and Potassium fertilizer should be broadcast during land preparation. Ten bags of 15-15-15 (NPK) compound fertilizers (500 kg) can be applied at land preparation. Additional 6 bags (300 kg) of Calcium Ammonium Nitrate (CAN) should be applied near the maize plants (at least 5 cm apart) at knee-high stage (side dressing). A total of 30 to 50 kg of ( $MgSO_4$ ) and 5 kg of zinc ( $ZnSO_4$ ) can be

applied in Magnesium and Zinc deficient areas.

NB: Fertilizer Deficiency Symptoms

- Nitrogen : Yellow at the tip and along the middle of leaves.
- Phosphate : Reddish purple leaves particularly on young plants.
- Potash : Appears as a firing or drying along the tip and edges of lowest leaves.
- Magnesium : Whitish stripes along the veins and often a purplish colour in the under side of the lower leaves.

#### 4.2 Planting

Date of female and male planting should be followed according to specific instructions provided by the seed production specialist. Both parents can be either planted at the same date or at different

dates.

° Time : Early planting is desirable for maximum yield.

Funtua/Zaria area : Early to mid-June

Ilorin area : Mid-May

Ikenne area : Mid-April

After two good rains in the rainy season, planting can start.

° Spacing : 75 x 20 cm (flat) or 90 x 17 cm (ridge); marked rope lines can be used for manual planting. One seed/hill will be dropped (5-7cm depth), and seed should be covered well with soil and pressed.

Soil should not be pressed when

moisture is high.

The seed parent (female) and the pollen parent (male) should be planted in a regular alternating pattern with 2 rows female and 1 row male.

NB :: Additional male rows could be planted along the end of the field to protect the female from foreign pollen and also to provide more pollen to the female seed parent. It is also advisable to plant additional male seeds (about 2% of total male seeds) in about 5-7 days after first male planting.

\*Bird protection may be necessary in the bird-prone areas during seedling emergence.

#### 4.3 Weed Control

- a. Hand weeding method could be adopted if conventional tillage is practised. First weeding takes place 2-3 weeks after planting. Second weeding is accomplished 6 weeks after planting.
- b. Herbicide application - adequate level of soil moisture is prerequisite for herbicide spraying. Gramoxone plus primextra are used as pre-emergence herbicides at the rate of 5 litres each per hectare. Pre-emergence herbicides cannot be sprayed later than two days after planting. Post-emergence herbicides such as Gramoxone may also be sprayed, between the maize rows around 6 weeks after planting (4 lit./ha). Never spray Gramoxone onto the maize plants.

N.B. Too much weed can affect maize seed yield significantly. The seed production field should be clean from weeds up to flowering time.

4:4 : DISEASE AND PEST CONTROL

DISEASES AND PESTS	SYMPTOMS	CONTROL
Maize Streak Virus (MSV)	Continuous whitish stripes on the leaves	1) Use resistant varieties 2) Seed treatment with Furadan 3) Apply 5-10 grains of Furadan per maize whorl at 2-3 weeks
Blight	Boatlike necrosis and/or roundish or rectangular spots on the leaves	Use resistant varieties
Rust	Powdery and brownish pustules on the leaves	Use resistant varieties

Stalk or Ear Rot	Dark brown water-soaked spots resulting in premature death of plant or drooping of the ears	Use resistant varieties; apply more Potasium, avoid moisture-ladden field.
Stem Borer	Destruction of pith of the stalk often shows "dead heart"	Use Furadan as seed treatment and as post-planting application or spray Vetox 85 or Sevin/weekly
Termite	Induces lodging	Apply Dieldrin or Aldrex 10
Birds	Destruction of seedlings, pollen and ears	Use bird scarers

NB: Precaution should be taken for chemical application.

#### 4.5 Female Detasseling/Male Removal

Detasseling is the most important exercise in hybrid maize seed production. This is the removal of the



tassel from the female rows before pollen shed. Start detasseling when 5% tassel appears and continue until 100% detasseling is achieved. Never allow the female rows to produce pollen. This operation could last 10 - 14 days. Off-type plants in male rows should also be removed before pollen production to produce pure hybrids. Detasseling must be done at least once each day in the early morning before pollen shed. Any mismanagement of detasseling will spoil hybrid seed quality. Only perfect detasseling can guarantee the purity of hybrid seed. Only pollen from male plants (pollen parent) should be available for female plants in each hybrid seed production field. Any foreign pollen will create different hybrids.

Male (pollen parent) rows will be completely cut out after pollen shed is finished. Removal time of male plants usually comes two weeks after pollen shed has started. Delayed removal of male rows may reduce hybrid seed yield.

NB: Emergency Exercise During Flowering

Plant female and male inbred lines at the instructed date to synchronise silking and pollen shedding.

Factors for emergency exercise in hybrid maize production are :

- (a) Late silking
- (b) Nicking problem (synchronization of female and male plants)
- (c) Insufficient pollen production
- (d) Poor germination and low plant stand

Under these situations the following exercises should be carried out :

- (a) Cutting of tip of ear to accelerate early silk emergence.
- (b) May collect pollen from male plants for hand pollination (pollen movement).
- (c) Shake male lines to enhance pollen movement in case there is no wind.

4.6 Harvesting:

- (a) Harvest at physiological maturity of grains (black layer formation at the base of the kernels).
- (b) Grain moisture content is 20-25%

Harvesting could be done manually or mechanically (not by normal combine).

- Ear Selection:
- a. Remove off-type ears
  - b. Big ears should be removed

May need to scare birds before harvest.

5. Seed Processing

5.1 Shelling/labelling

- a. Dry ears to a minimum grain moisture content of 12% (sun dry or use a dryer)
- b. Remove diseased and damaged kernels before shelling and spray all ears with insecticide
- c. Shell manually or mechanically with care, kernel should not be damaged.
- d. Labelling.

- i Name of farmer
- ii Name of hybrid
- iii Date of harvest

e. Packaging:

- i Pack seeds in clean bags
- ii Insert 3 labels inside each bag
- iii Seal the bag
- iv Fasten 2 labels outside each bag.

5.2 Seed Viability Test / Seed Treatment

- a.
  - i. Viability test
  - ii. Farmer seed stock record to be kept
  - iii. Payment is based on viability of seed

b. Seed Treatment

Use any of the following chemicals for storage:

- i. Phostoxin pellets - 1 pellet per 100 kg bag
- ii. Furadan
- iii. Aldrex-T
- iv. Fernasan-D

6. Field Inspection and Certification

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Items	After the development of hybrid, the production of high quality seed is needed before farmers can benefit from the improved seeds.
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Field Inspection and Certificate (contd.)

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- a. Isolation      To minimise the risk of contamination of seed parent from foreign pollen, a maize seed field should be isolated by a specified distance from other maize fields.
- For parental inbred seed increase: 400m.
  - For hybrid seed production: 200m
  - Where buffer crops are planted on the edges, isolation distance could be reduced.
- b. Field Inspection.
- 1st Inspection - before planting. Check for isolation and the cropping history of the field.
- 2nd Inspection - Insure proper fertilizers and field preparation. Planting time. Check the field layout; proper female to male ratio (2:1) is maintained and straight rows.
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Field Inspection and Certificate (contd.)

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- 3rd Inspection - 5 weeks after planting.
- Check if female and male lines are characterized morphologically.
  - Off-types removed from both male and female plants.
  - Diseased and infested plants removed.
  - Other managements such as weeding, side dressing at right time.
- 4th Inspection - During flowering time.
- Check that detasseling is well done.
  - Entire female plants must be detasseled before pollen is produced.
  - Check the characteristics of female and male plants (plant type; leaf size, direction (angle), tassel of pollen parent).

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Field Inspection and Certification (contd.)

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- 5th Inspection - 4 weeks after flowering.
- Removal of male plants
  - Male rows completely cleared in preparation for good hybrid seed development and harvesting
- 6th Inspection - Harvesting time.
- Check that no male plant present during harvesting.
  - Check the moisture content (%)
  - Check that harvested cobs are properly labelled.
- 7th Inspection - Before shelling
- Examine the ears and see that they are all true to type.
- Off-type ears must be removed.
  - Ensure absolute cleanliness is maintained in the processing plant before shelling and other operations.



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Field Inspection and Certification (contd.)

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- C. Certification : This is a legally sanctioned system for quality control in seed multiplication and production supported by seed testing and legislation. It protects the farmers against the risk of buying and planting seeds of doubted quality.
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7. Inbred Line Seed Increase

Parental inbred lines of hybrid should be maintained in a separate fields to ensure purity of foundation seeds. Isolation distance for inbred seed increase is 400m from other maize fields. There will be no female and male rows. Only one single line will be planted in one isolated field. Rouging of off-type, and good management etc. are the same as the hybrid seed production. There are no detasseling of female

rows, nor removal of male row. Still, it should be remembered that inbred lines are sensitive to environmental conditions and poor management. Only good management can guarantee maximum seed increase.

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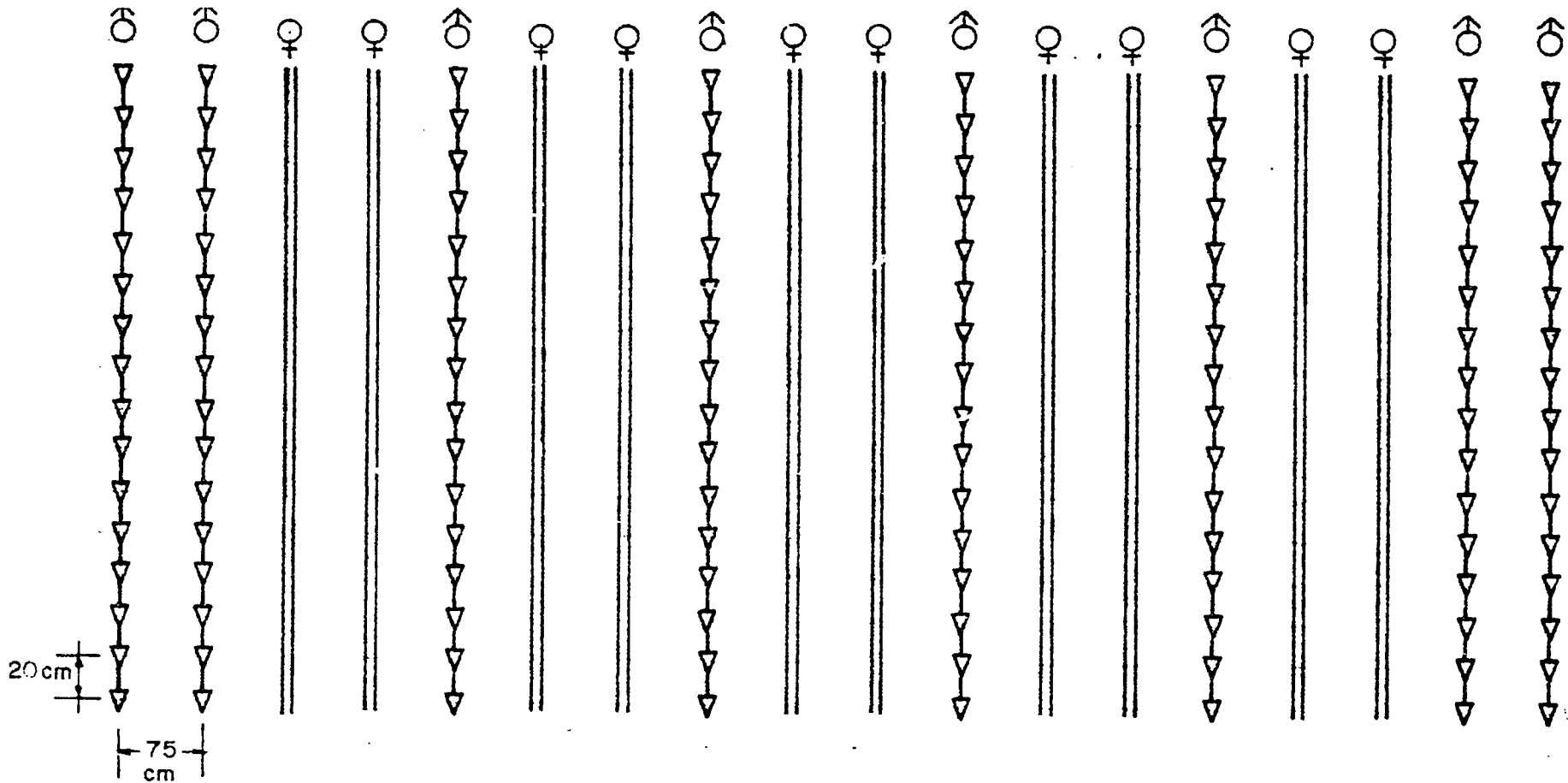


Fig. 1. A diagram of hybrid ( single cross ) maize seed production

♀ Female (seed ) parent      ♂ Male (pollen) parent

Plant spacing : 75 cm x 20cm, One seed will drop in covering 20 cm hill spacing