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Standard Operating Procedure (SOP) for Trial Management

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1. Introduction

Trial management is the set of agricultural practices performed to improve the growth, development, and yield of crops. It also draws on information on soils, site selection, seed, land preparation, fertilizer application, control of weeds, pests, and diseases. The operation includes sowing of seeds, crop maintenance and management of irrigation for good crop establishment and growth. The maximization of the production of agricultural crops is crucial to the sustenance of the global society as it ensures food security. In developing countries where the livelihood of the population hinges solidly on agricultural production, there is always the need to always implement best management practices of agricultural crops. This is key to developing the economic status of such communities. Perpetual supply of food depends largely on effective and sustainable management of agricultural crops. This is essential in averting losses in agricultural crops in the general food supply chain.

2. Purpose

The purpose of this SOP is to ensure the adoption of best trial management practices which improve crop productivity and can contribute to greater yields with improved quality. It involves making and implementing of the decisions involved in the evaluation of a trial in an experimental site for optimum production

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3. *Scope*

This SOP contains the trial management procedure required for maize breeding activities at IITA. It covers the different management practices specific to the types of trials conducted in the Maize Improvement Program at IITA.

- i. Normal Yield Trial
- ii. Abiotic Stress trial
 - a. Drought trial, Heat trial
 - b. Combined Drought & heat trial
 - c. Low Soil Nitrogen trial
- iii) Biotic Stress Trial
 - a. Striga trial
 - b. Stem borer trial
 - c. Fall armyworm trial
 - d. Aflatoxin trial

4. *Definition of terms*

Trial Management: any method or practice that is technically and environmentally sound and which when utilized in agricultural crop production prevents or reduces the common problems related to general agricultural production.

Site selection: Maize can be grown on a wide range of soils, but performs best on well-drained well-aerated, deep soils containing adequate organic matter and supplied with nutrients (soil organic matter). Sandy and shallow soils hamper growth of maize and hence depressed yield because of increased drought effects and lower soil nutrients (nutrient deficiencies). To get high yields, maize should be planted after legumes but not cereals, especially sorghum (heavy feeder) or after consecutive maize cropping. It is important to know the history of land for growing maize.

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Soil testing: Maize can be grown successfully on soils with a moderately acid environment having a pH value of 5.5 to 7.0. Any pH level outside this range will increase mineral toxicity and make the soil nutrient deficient.

Land preparations: A wide range of land preparation methods is used in different agro-ecological regions of Africa. It is advisable to apply organic manures (preferably chicken manure because it works faster) before plowing to improve soil structure and supply nutrients. Field is either sprayed with round-up to smolder grass or mowed/slashed to facilitate ploughing. The field is plowed using a standard tractor to optimize soil temperature and moisture conditions for seed germination and emergence, encourage root development and seedling establishment as well as reduce weed competition. The field is then ridged at least two weeks after plowing to improve drainage. Bed-forming and marking can be done depending on the availability of resource and implement.

Fertilizer application: Because of its fast growth nature, maize has relatively high demand for fertilizers (N, P, and K) to obtain high yields. A compound fertilizer (NPK) is applied half at the time of sowing at the rates of 60 kg N, 60 kg P, and 60 kg K ha⁻¹ and the additional 60 kg N ha⁻¹ applied as top dressing four weeks later.

Weed Control: Weeds can be defined as plants growing out of place. Weeds compete with crop plants for environmental factors and usually out-compete the crop plants, depriving them of the much-needed growth-promoting factors. The herbicide, Lagon can be used at rate of 0.5L/ha on soil low in organic matter (e.g. Northern region of Nigeria) or a rate of 0.75 L/ha on soil rich in organic matter (e.g. Southern region of Nigeria) applied as pre-emergence herbicides one to two days after panting. Subsequent weeding is done either by applying LifeLine (Glufosinate ammonium), at the rate of 1.6 L/ha or hand-weeding (manually) to keep the trials weed free. These herbicides can used

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separately or in combination and dissolved in 200L of water to spray one hectare (200 H₂O/ L).

Pest and disease control: The major pests of maize in the tropics are stem borer and the recent invasive fall armyworm (FAW). Stem borers attacks on maize trials are not common in most parts of the West African Savannas, probably due to the use of seed dresser (Apro star, Cube plus) that protects the seedling. In some cases, especially in the humid forest transitional zones, the borer attack is high and is controlled by spraying with Pyrinex, Termex or Karate in the whorls of the seedlings. For the FAW, the control measures start during the application of pre-emergency herbicide where a mixture of Best and Sharpshooter is applied same day with the herbicide. The subsequent application of any commercially available chemicals (Ampligo, Catapillar-Force, Sharp-shooter, Emacot, etc.) starts two weeks after planting. For Ampligo, at least one spray weekly and Emacot lasts longer (spray only three to four times during the crop cycle), starting two weeks after planting. For Caterpillar-Force and Sharp-shooter, the frequency of spray is at four days interval, starting two weeks after planting till physiological maturity. The time of application (early morning or late evening) of these chemicals is crucial.

5. ***Roles and Responsibilities***

All staff involved in implementing breeding activities in the maize breeding unit at IITA must use the breeding trial management SOP. No alteration should be made to the procedures unless approved exceptionally by the program leaders. The list of individuals responsible for each section of the trial management SOP in the breeding data cycle are listed below.

Crop Lead (CL) Responsible for the overall management of the trials and for delegating

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team responsibilities. The CL is the lead breeder and coordinator of Maize Improvement Program at IITA.

Breeder (B): Coordinate the field layout of experiments, planting and checks on the implementation of defined protocols on the different experimental sites. Ensures all trials are established in the on-station and out-stations respectively. This includes trial management and data collection.

Trial Manager (TM): Oversees trial preparations and management protocols, land acquisitions, oversees planting in the outstations. Also supervises planning of inputs and other planting logistics for the various stations.

Research Supervisor (RS): Coordinates the activities of the Research Technician to ensure that assigned tasks are carried out correctly. The RS involves in planting, field management and post-trial management practices as well as coordinates fertilizer application in on station and outstation experimental fields. S/he involves in the Nursery and seed increase protocols as delegated by the CL and B respectively.

Research Technician (RT): The Research Technician performs field tasks as defined in the trial protocols such as field data collection or field management practices. RT's responsibility is to perform assigned tasks including the use of digital tools defined in the protocol for capturing, storing, transmitting, and ensuring quality of data within defined time periods.

6. Procedure

Steps in Basic Management Practices

1. **Seed dressing:**– maize seed is treated with a fungicide (Apro star, Cube plus) to protect emerging seedlings from soilborne fungal diseases and insect pests..

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2. **Planting time:** Days to maturity may vary in different environments. Sow the trial/s in moist soil when drought during the seedling stage is unlikely. Adjust the planting date, so that the plants will mature during a dry period. For example, for the trials in lowland Savannas of West Africa, plant about 90-120 days before the expected end of the rainy season, usually between mid-June to mid-July. If for any reason you fail to plant in the suggested planting date, use the next possible planting date.
3. **Method of planting:** Planting is done by Jack-planter. Two to three seeds are dropped in a hole made with a Jack-planter and covered with soil. Planting depth between 2 to 4 cm is adequate for moist soil, while deep sowing for dry soils is between 5 to 8 cm.
4. **Planting:** Maize yield is strongly influenced by time of planting, depth of planting, and method of planting. For Extra-Early and Early maturing maize varieties, inter-row spacing is kept at 75 cm and intra-row space at 40 cm, planting three seeds per hole and thinned to two plants per hill (double density) or spacing at 20 cm and planting two seeds/hole thinning to one seedling/hill. Whereas for Intermediate/ Late maturing varieties, inter-row spacing is kept at 75 cm and intra-row spacing at 50 cm for double density or use 25 cm spacing, plant two seeds/hole and thinned to one seed/hill.
5. **Border effect:** Two border rows should be planted on both sides of the trial and two to three meters at both ends of the trial in order to avoid border effects on test entries and any physical damage to the trial.
6. **Thinning:** It is common to over-plant maize variety trials to ensure a near-perfect plant stand, and then to thin the emerged plants to the desired plant density at the 2–4 leaf stage (three weeks after sowing). Therefore, it is essential to ensure that the plant stand is as near-perfect as possible.

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7. **Data collection:** During the growing season, data must be captured directly into the tablet using the KSU Fieldbook app.
8. **Weed, insect and disease control:** Control weeds, insects, and other pests with appropriate recommended chemicals as soon as they are noticed and assessed to be at or beyond thresh-levels in the maize filed.
9. **Fertilizer application**—Fertilizers promote the vigorous growth and high productivity of maize. N, P, K, and some micro-elements are required by maize plants and must be supplied by the soil. Therefore, where soil tests indicate inadequate levels in the soil, fertilizers must be applied externally.
10. **Management of irrigation:** After planting the trial(s), irrigation intervals are designed so that the crop receives adequate water for good crop establishment and growth every week. The method of irrigation may be furrow/flood (in Kadawa) or sprinkler irrigation (in Ikenne) or the combination to ensure uniform moisture is maintained across the field.
11. **Field visits:** Frequent field visits, especially during flowering to record flowering data.
12. **Timely harvesting:** —Harvest the maize crop as soon as possible after the plants seem to be sufficiently dry. Regularly check the trials for maturity and start harvesting at the right moisture content ($\leq 20\%$).

7. Appendix

7.1 Contacts for support

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For Issues relating to trial management, you can contact breeders: Drs. Abebe Menkir (A.menkir@cgiar.org), Baffour Badu-Apraku, (B. Badu-Apraku@cgiar.org), Silvestro Meseka (S.Meseka@cgiar.org) and Wende Mengesha (W.Mengesha@cgiar.org).

8. *References*

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