OCP Nigeria Maize Validation Trials -Protocol

Introduction

The validation trials (VTs) are intended to validate the two new fertiliser formulations that OCP has developed for the maize target area in Nigeria. The new formulations were developed based on information on nutrient status of the soils in the maize target area that resulted from the analyses of around 2000 soil samples collected from randomly selected locations. In the VTs the new formulations are tested against the commonly used compound fertiliser in Nigeria for maize, which is NPK 15-15-15, using three bags of compound fertilizer for basal application, which is considered common, or recommended, practice. Together with the two bags of urea per ha for top dressing this will results in similar N application for the various treatments, but in different application amounts for the other nutrients, which provides the basis for comparison. This trial is not intended to determine optimum fertilizer application rates, and therefore we do not experiment with different application rates. The VT will include a control treatment where no fertiliser is applied that allows for proper evaluation of fertilizer response.

Site Selection

Locations for the 1500 VTs are randomly selected from the approximate 3000 points from where soil samples have been taken and that have confirmed cropland status. The locations have already been confirmed, and consent from the farmers obtained, for a quite a number of locations. Confirmation and farmers consent for the remaining locations will be obtained in February-March 2017.

Procedures and instruction for the site selection have been provided: In first instance, the randomly selected locations are visited in the field to verify whether these are suited for the VT and to get consent from the farmer. In case the location is not suited for conducting the VT, or consent from the farmer cannot be obtained, another point within the same soil-sampling cluster should be selected. Only in case none of the points in the cluster are suited a location nearest to the location selected at first instance should be selected. This point will then not correspond to an already existing sampling location and additional soil sampling should is done in that field.

Site selection will be done by the same team/facilitator that did the crop survey and soil sampling, the same team/facilitator will also have the responsibility for the establishment of the VTs.

Management of the VT

The farmer will manage the VTs, with oversight and instruction provided by the facilitator for the establishment and management of the trial. The facilitator will be responsible for all data collection in the field.

Experimental design and trial layout

Each trial consists of four treatments: One control treatment in which no fertilizers are applied (T0), a treatment with the commonly used compound

fertiliser in Nigeria (NPK 15-15-15) for basal application and urea for top dressing (T1), a treatment using the compound fertilizer denoted as OCP-F1 and urea for top dressing (T2), and a treatment using the compound fertilizer denoted as OCP-F2 with urea for top dressing (T3). Both OCP-F1 and OCP-F2 formulations have been developed by specifically for this study.
Application rates for three fertilizer treatments are the same: 150 kg/ha (3 bags/ha) of the compound fertiliser for basal application and 100 kg/ha (2 bags/ha) of Urea for top dressing applied in one application.
OCP-F1 contains N, P, K, S, Zn and B -and OCP-F2 contains N, P, S, Zn and B (for exact composition of the new fertilizer formulations see annex 2).

The four plots in the trial have the following dimensions: three plots of 10m by 15m for T1, T2 and T3 treatments and a plot of 5m by 15m for the control treatment. Figure 1 depicts the preferred layout of the plots, if the size and shape of the field allows. If possible 0.5m spacing will be maintained between the plots.

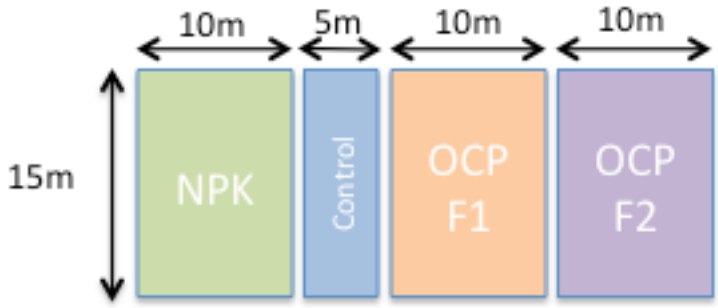

Figure 1 Layout of the plots in the validation trial

Planting will be done in lines/rows with the same orientation as the contour lines; that is perpendicular to the direction of the slope. Consequently the plots will also be aligned in the direction of the contour and perpendicular to the direction of the slope. This will prevent the soil with possible fertiliser being washed from one field onto the other.
In case the shape of the field does not allow for this arrangement, the plots may also be stacked, with maintaining a clear margin between the adjacent plots that are above and below each other.

Land preparation

The land is prepared according to how the farmer normally prepares the land. This is generally by animal traction (oxen drawn plough) or if this is not available using hand held hoe. Ploughing is done in the direction perpendicular to the direction of the slope. The way the land is prepared needs to be recorded.

Soil sampling

If the field for the VT is at a different location than where the soil sample was taken, a soil sample will be taken for purpose of soil characterisation. A sample is taken for 0-20cm and for 20-50cm from the centre point of each of the four plots and then bulked (the 0-20cm samples and the 20-50cm samples are bulked separately). Soil sample ID labels will be used to uniquely identify each (bulked) soil sample. These IDs are generated as machine-readable QR codes. Duplicate

SSID labels should go onto every soil sample bag that is collected. The lab analyses will be the same as done for the earlier soil samples, but will include textural analyses as well.

Maize variety

For the VT certified seed will be used, know as Sammaz 15 or IWD-C2-SYN. This is an open pollinated, intermediate maturing, white dent/flint, Striga and MSV resistant and drought tolerant variety.

Planting and gapping

Farmers will do planting supervised by the facilitators. In Taraba, Plateau and Nasarawa states planting is done in the period April-May and for the remaining states of the Northern Guinea Savanna planting is done in June. Maize will be planted in rows spaced at 75cm between rows and at a spacing of 25cm within row. Each plot will have 20 rows. For the T1, T2 and T3 plots there are 40 plants per row, whereas for the control plot there are 20 plants per row.
Two seeds will be planted per planting station and thinned to one plant per stand one week after emergence. Replacement planting (at gaps where plants have not emerged) will be done 5 days after emergence (about 10 days after planting)

Fertilizer applications

Fertilisers will be applied using according to common practice (i.e. using a dibble), latest one week after planting. Per row (40 plants) for each of the plots T1, T2 and T3, 113g of compound fertilizer are applied, that means 2.25 kg per plot.
Urea is applied as top dressing in one application at 4 to 5 after planting (WAP) as is common practice. The top dressing application requires 75g of urea fertiliser per row, which amounts to 1.5kg of urea that is required for each plot (T1, T2 and T3) and 4.5 kg urea per trial (three plots get top dressing of urea).
Preparation for the fertilizer application: Weigh the amount of fertilizer needed for each plot, for the compound and urea fertilizer separately and put in a container/bag and properly label the bags (VTID, name of the fertilizer). In this way we assure that the proper fertilizer is used in the correct amount per plot.

Observations and measurements

Ear leaf sampling

Earleaves will be sampled for analyses for possible nutrient imbalances. Ten (10) earleaves will be sampled in the period between tasseling and silking (male and female flowering respectively) immediately when the position of the ear is identified for each of the plots. An earleave is removed by plucking downwards (at an angle of roughly 30 degrees) with moderate force as this allows the leave to cut at the collar, leaving behind the leaf base that circles the stem. A total of 10 plants per plot will be selected for earleaf sampling as follows (see figure 2b: the locations indicated by the soil blue and solid orange dots):

- Select a plant arbitrarily at the centre of the plot and collect the earleaf, for the second and third earleaf sample select the fifth plant in the same row to the left and the fifth plant in the row to the right. Move up two rows and

repeat the procedure. Then move down two rows from the first selected plant and repeat the procedure for that row as well.

- Take the 10th earleaf from a randomly selected plant.
- The 10 leaves need to be put together in a sample bag (cut them up), which needs to be properly labelled (given a plant tissue sample ID - LSID). These labels will be generated using machine-readable QR codes.

Grain yield and stover yield measurements

Sampling of ears for nutritional analyses, measurement of grain yield and stover yield are all done at full maturity (harvest) stage of the crop. A soil sample is taken for soil analyses to be able to relate the nutritional status of the grain to the soil characteristics.

Procedure for ear and maize stover sampling

From a central location in the field, five maize plants are harvested for sampling five (5) ears/cobs to determine shelling percentage, moisture content of the grain and for nutritional analyses. The maize stover is sampled to determine the conversion factor for determining dry matter weight of the stover yield.

- Select a plant at the central location in the field (not necessarily the same as the central location used for the earleaf sampling) and harvest the cob/ear. Subsequently select the fifth plant to the left in the row and the fifth plant to the right in the row and harvest the ear/cob if not damaged. Then move two rows up and select one the plant in that row and move down two rows and sample the ear/cob (see figure 2b – solid blue points indicate location of plants to be samples relative to the central location selected).
- Sample ears/cobs whole, leaving the husk on the plant. Sample only healthy looking, undamaged cobs. If the cob on the selected plant is damaged take the neighbouring plant in the row. Cobs are harvested such that the husk still remains on the plant. Put the 5 ears/cobs in a sample bag and label correctly using the pre-printed QR codes. Scan the label using the tablet, weight the 5 ears/cobs together and enter the total weight on the ODK harvest form.
- Cut the 5 maize stovers in pieces of approximately 5cm length; put together and mix very well and take a subsample of about 500 g. Put the sample in a sample bag; Label the sample bag with the proper maize stover sample ID (SS-ID) for which the pre-printed QR labels are used. Weigh the subsample and enter the weight on the ODK harvest form.
- From the circular plot a composite soil sample is taken of the top and sub-soil, using the auger or pipe. Samples are taken at three locations, equally distributed within the circular plot, and are then bulked. Take the soil sample from a location in between two plants within the row, and not from in between the rows. The topsoil sample is put in a sample bag and properly labelled and the subsample is placed in a separate sample bag and also properly labelled using the QR codes that have been printed for this purpose. Scan the QR code on both sample bags and enter the codes on the ODK harvest form

The three sub-sample plant parts (grain, cores and stover subsample) will be oven dried (60 ºC for 48 hours) or air-dried if oven is not available and reweighed to determine moisture content. The dry weights of these sub-samples

are recorded. After drying, 100 maize grains from a well-mixed sample will be counted and their weight measured for determination of the 100-grain weight. This grain sample will be taken to the lab for nutrient analyses.

Stover yield measurement and grain yield from the circular sampling plot

Stover yield is measured by harvesting and weighing maize stover (stalk, the leaf, husk, without the cob, remaining after harvest of the cereal grain) from a circular plot located near or at the centre of the plot (see figure 2a and 2b). From the circular plot we also harvest the ears/cobs for grain yield measurement and to take a grain sample from which the moisture content is determined in the field.

- The circular plot is located at the centre of the plot. For the centre the same location/plant is selected as was selected for the ear/cob and maize stover sampling (see above). The circular plot is laid out by walking a marked roped around a fixed location set by a range pole. The rope is marked at 1.784m (the radius of the circular plot), which results in an area of 10m^2. The centre should be located at a particular plant stand, rather then in between the rows or in between plant stands within the row!

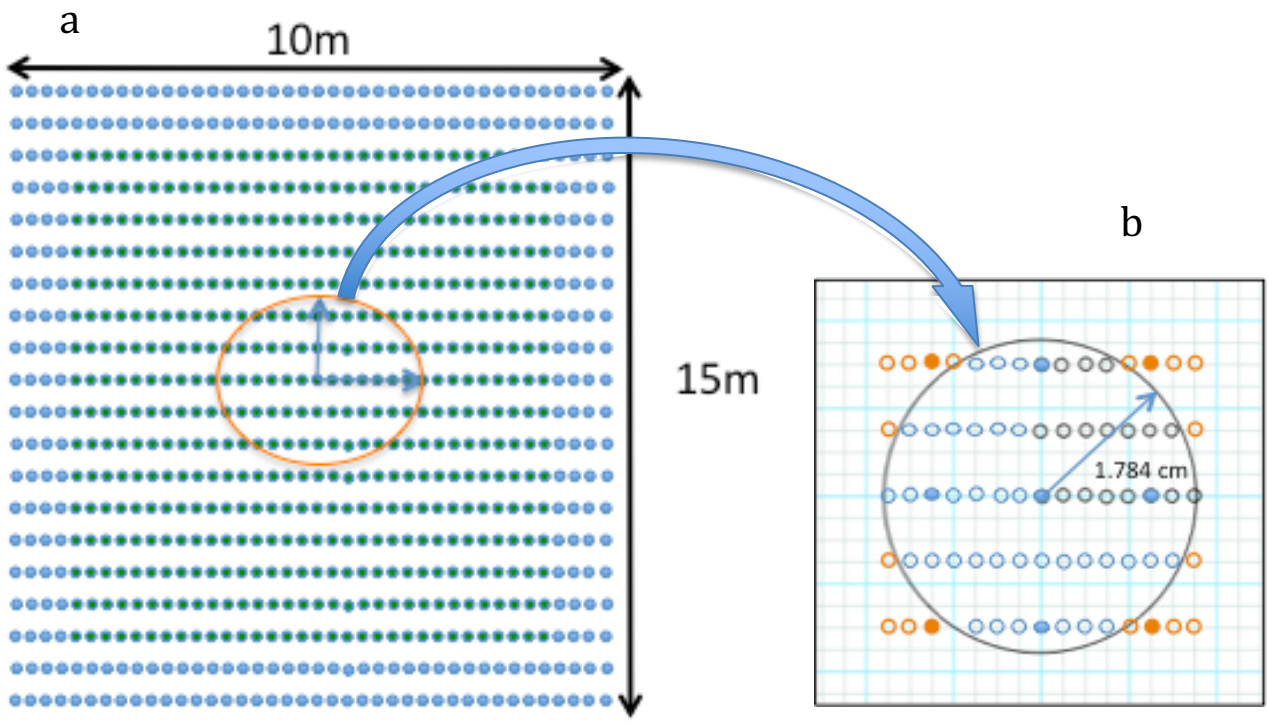

Figure 2 a) Layout of the plot for treatment T1, T2 and T3, with 40 plant per row and 20 rows per plot (not at scale!). Dots in green denote the netplot from where the cobs are harvested for grain yield measurement, b) Layout of the circular plot of 10m2 and radius of 1.784m located at the centre of the plot. Dots in solid blue together with those in solid orange denote the locations for the plants from which the ear leaves are sampled at earlier stage (9 plants plus one plant sampled at random). The dots in solid blue represent locations from which ears/cobs are harvested for nutritional analysis. For stover yield all plant stovers are harvested from the circular plot, which should include all plant locations indicated by the open blue/black circles and the solid blue dots

- Harvest and count all the maize plants that fall within the circular plot, within the radius of 1.784m from the central location. Enter the number of plants on the ODK harvest form
- Harvest the ears/cobs from the plants harvested from the circular plot without removing the husk from the plant; count the number of ears/cobs and enter the number on the ODF harvest form
- Determine the total weight of the ears harvested using the electronic portable scale. Enter the total weight of the ears on the ODF harvest form. (This is part of the grain yield measure, see below)
- Determine the moisture content of the grain, by taking a grain sample from the harvested ears/cobs, using a handheld moisture meter. (Exact procedure to be confirmed – depending on the moisture meter to be used.) Enter the moisture percentage on the ODK harvest form.
- All maize plants/stovers are harvested and bound together using a rope and then weighed using the electronic portable scale. Enter the weight on the electronic ODK harvest form. [*Note: remember to record the weight of the rope*]

Procedure for grain yield measurement

For each of the treatments T0, T1, T2 and T3 the grain yield is determined. This is done by harvesting the ears/cobs from the netplot. The netplot is defined by leaving out the first two and last two rows in the plot, and by leaving out the first and last meter of each row (this corresponds to the first 4 and last 4 planting stations in the row).

What remains is the area indicated by the green dots in Figure 2 for T1, T2 and T3 and in Figure 3 for the control treatment T0. This will results in the effective area of the netplots as follows:

Control plot (plot with the control T0 treatment):
Effective area: 3m x 12m=36m^2
Corresponding to: rows 3 to 18 (16 rows) and plant 5 to 16 (12 plants or planting stations)
T1, T2 and T3 plots:
Effective area: 8m x 12m=96m^2
Corresponding to: rows 3 to 18 (16 rows): plant 5 to 36 (32 plants or planting stations)

Figure 3 The layout for the control plot T0, with dots indicating the planting stations. In green the planting stations that denote the netplot

- Ears/cobs are harvested from the netlpot such that the husk still remains on the plant and the plant remains standing. Harvesting is done row by row. The ears/cobs are collected in 50 litre bags (like the

50kg fertilizer bags) until these are more or less full and then weighed using the electronic portable scale (maximum load is 40kg). The weight is recorded on ODK harvest forms.

- Harvesting may need to be done in batches as all the ears/cobs may not be harvested and measured in one go. So repeat the above procedure until the whole net plot is harvested and the weight of the separate batches is recorded on the ODK harvest form accordingly. You are not likely to exceed two batches for harvesting the netplot.

  Note: The circular plot has been harvested prior to harvesting the netplot and the results from the circular plot will be later added to get the totals for the netplot,

Rainfall measurements

Data on daily rainfall will be obtained from the whether station that is within the sentinel site or the nearest station from the sentinel site. It needs to be found out where these whether stations are located and the exact coordinated of the weather station needs to be recorded.

Data collection and management

All the data from the validation trials are recorded using pre-designed field forms and these will we implemented on ODK forms, such that the tablets can be used to record the data. Barcodes will be generated for each of the validation trials that can then be used for the soil, earleaf, stover and grain samples as well as for the unique identifier of the VT for entering data collected in the field.

Annex 1. Equipment and materials

Per team or facilitator the following equipment is needed

- ✓ An Android phone or tablet.
- ✓ A separate GPS device (optional, but highly recommended for field navigation).
- ✓ Portable Electronic Scale (MoboFree), 10g precision, 40 kg maximum load
- ✓ Tripod (for hanging the mobile scale for weighing
- ✓ Mobile/handheld whole grain moisture meter (brand to be confirmed)
- ✓ Soil auger or pipe for soil sampling
- ✓ A marked 2.5 meter long range pole
- ✓ 2, 20-liter plastic buckets per team.
- ✓ A rope clearly marked with coloured tape placed at 1.784 meter and with a ring on one side to stick the range pole through.
- ✓ A rope for tying the maize stalks for weighing
- ✓ Sturdy, ~3-5 litre brown paper bags or plastic containers/bags for the exactly measured fertilizer (compound and urea) needed for each plot (six bags per trial)
- ✓ Sturdy, ~3-5 litre brown paper bags, 2 bags for each plant sample (earleaf).
- ✓ Sturdy, ~3-5 litre brown paper bags, 2 bags for each stover sample
- ✓ Sturdy, ~3-5 litre brown paper bags, 2 bags for each grain sample (ears/cobs)
- ✓ Bags for the soil samples (same as used for soil samples during the soil characterisation phase
- ✓ 50-100 litre bags for collecting and weighing ears/cobs harvested
- ✓ Preprinted QR code sticky labels,
    - 2 for each maize plant/ earleaf sample.
    - 2 for each grain sample
    - 2 for each stover sample
    - 2 for each soil sample

Annex 2. Fertilizer formulation

Fertilizer formulation %	N	P2O5	K2O	S	Zn	B2O3
OCP F1	11	21	22	5	1	0.8
OCP F2	14	31	0	9	0.9	1