# APPLICATION FOR RELEASE OF THREE DROUGHTTEGO™MAIZE HYBRIDS

BY


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## Introduction

The history of maize germplasm improvement in Uganda is fairly recent having started in the late 1980s but ever since, significant achievements have been registered in the maize industry in the country. Today, maize is no doubt an important crop serving both as staple food crop and a source of income to many households. Most of the country where maize is grown lies in mid-altitude zone (900-1600 masl) with a high potential for production because of generally sufficient rainfall and suitable soils to support seasonal production under small holder conditions. However, the average grain yield of maize is still low, about 1 ton per hectare. The major constraints to increased maize productivity include low soil fertility and intermittent drought incidences whose frequency is increasing. The biotic constraints include turcicum leaf blight, gray leaf spot, maize streak virus, rust, stalk lodging, Striga, ear rot and storage weevil.

**Importance of Previously Released Varieties:** To-date the National Cereals Research Program has released 24 varieties including 4 open pollinated varieties and 19 hybrids. The first OPV, Kawanda Composite A (KWCA) was released in 1971 followed by Longe 1 in 1999 almost three decades after the release of the first variety. More frequent release of varieties commenced as a result of concerted effort of the NARO and regional maize breeding program. This was also enhanced by the advent of private seed companies in Uganda from the year 2000. Two other pollinated varieties (OPVs) were released in 2000 (Longe 4 and Longe 5). Three hybrids Longe 6H, Longe 7H and Longe 8H were released in 2002. In 2008 three hybrids Longe 9H, Longe 10H and Longe 11H were released. Three more varietal hybrids UH5051, UH5052 and UH5053 were released in 2012. Lastly two drought tolerant (WE2114 and WE2115) and one weevil resistant (TAWL118-6) hybrids were released in 2013. In 2014 the Cereals Program again released five more maize hybrids namely; WE2101, WE2103, WE2104, WE2106 from Water efficient Maize for Africa (WEMA) project and TBWL429-40 from National Cereals Program. Three more varieties were released in 2015 and they include NARO maize-03, 56 and 57. While most of the maize hybrids released by the National cereals program are licensed to seed companies on exclusive basis, there were some were turned in to public varieties; Longe 7H, Longe 8H and Longe 11H due to the companies failing to meet the requirements for exclusivity. The hybrids that were released with support from the WEMA project, however, are sub-licensed to seed companies on semi-exclusive basis currently and with time as more varieties are released exclusive sub-licensed will be awarded. Although the earlier focus on the National Cereals Research Program was on development and production of OPVs, of late emphasis shifted to mainly development of hybrids because of preference by the private seed companies for ease of seed production and possibly more profits and better yields for the farmers. The traits that are currently of importance in our breeding program and which, are desired by farmers include; resistance to foliar diseases such as

turcicum leaf blight, gray leaf spot, and maize streak virus and the recently emerged maize lethal necrosis; resistance to insect pests such stem borers and storage weevils; tolerance to abiotic conditions most importance drought and low nitrogen. The candidate varieties presented here were developed for high yield, disease resistance, drought tolerance and desirable grain qualities. We hereby propose release of five candidate varieties.

The DroughtTEGO™ hybrid varieties have shown improved grain yield under optimal and drought stress conditions, with mean yields of 7 - 8 t/ha from 1.8 t/ha under farmer managed trials. For the full potential of these varieties, like with other high performing varieties, it is necessary to follow appropriate agronomic practices like proper land preparation, timely planting, spacing, and weeding; use of fertilizer and certified seed; improved farmers' knowledge in best agricultural practices through training and support.

The DroughtTEGO™ hybrid maize varieties are developed by conventional breeding approaches using materials from the International Maize and Wheat Improvement Center's (CIMMYT) the Monsanto Company, and national research programs in Kenya, Uganda, Tanzania, Mozambique and South Africa.

**Features/Description**

The commercialized DroughtTEGO™ hybrid varieties are early to medium maturing - 120-134 days (4-5 months) - producing good stable yields under moderate drought and especially suited to low to medium altitude areas of 1000 - 1500m. They are white maize with flint to semi-flint grains- a characteristic preferred by many farmers in Africa- and good husk cover on the cob that ensures the grain is protected against bird damage and rotting due to water sipping into the ear.

The varieties have medium crop stature, growing to an average plant height of 200 - 235cm under optimal growing conditions which controls lodging and gives it good crop stand ability.

**Tolerance to Diseases**

The DroughtTEGO™ hybrids have tolerance to major diseases, especially grey leaf spot (GLS); maize streak virus (MSV); and turcicum leaf blight (TLB). The some of the DroughtTEGO™ have shown promise with tolerance to the Maize Lethal Necrosis (MLN) disease, attaining more than 30% higher grain yield than the best commercial checks under MLN inoculation.

**High Yield**

DroughtTEGO™ are stable yielders, providing yields between 7-8 t/ha (80 bags of 90kg/ha on average) under optimal growing conditions. The first commercialized DroughtTEGO™ hybrids have shown improved grain yield under optimal and drought stress conditions, with mean yields of 7.1 t/ha under Optimum condition as compared 2.55 t/ha under farmers' fields.

## How to get the most of the DroughtTEGO™hybrids

### Land Preparation

In most land preparation with small holder farmers are done by hand hoeing. This process takes long to prepare even just an acre of land. Tractor ploughing is mostly common in mid-western Uganda and with medium and large commercial farmers in across the country. Land preparation should start at the end of a season when the rains are reduced and soil is still easy to plough. After first ploughing the field should be allowed to about 3=4 weeks before second ploughing is done. Harrowing should be done when it has rains and soil has drained and drying on the surface. In managing crop residues carry out deep ploughing to burry off crop residues and control disease inoculation from previous crops.

### Planting your DroughtTEGO™hybrid

NARO conducted trials using different plant spacing and population per hectare in different agro-ecologies. NARO with our research partners came up a new recommendation for spacing. Instead of planting at 75cm x 30cm resulting in of 44,444 plant population per hectare, we plant at 75cm x 25cm giving us 53,333. This spacing is suitable for all mid-altitude agro-ecologies where there is loam or clay loamsoils. However, we still recommend a 75 cm × 30 cm spacing in low/dry lands with sandy soils. The seed rate of 10kg/acre or 25kg/ha (1 ha=2.5 acres) is still adequate when 1 seed per hole. For hand planting we recommend spacing of 75cm between rows and 50cm within row with 2 plants per hill.

The hybrids proposed for release are full season varieties. It is highly recommended that they take advantage of the full season. They can be dry planted before the rainy season provided the seed is placed deep enough (about 5 cm) so that it is not seriously affected by the daily fluctuations in temperature. They varieties have been found to withstand the early season moisture stress whereby they grow slowly but are able to take advantage of the main moisture period

### Fertilizer application

Nitrogen and phosphorus are the most limiting nutrient for maize production in the country. The fertilizer amount to be applied will depend on the fertility of the soil, how long the land has been used without fertilizer application and the amount of yield expected. For a 7 tonne/ha crop, it is necessary to apply 150 kg N/ha and 80 kg $P_2O_5$/ha (200kg of DAP per ha). The nitrogen can be applied in the form of urea, calcium Ammonium Nitrate (CAN), Sulfate of Ammonia (S of A) or in the compound fertilizer N-P-K. phosphorus can be applied in the form of Diammonium Phosphate (DAP), Single Supper Phosphate (SSP) or Triple Super Phosphate (TSP). The amount of fertilizer to be applied will depend on the type of fertilizer used since the amount of nutrient varies with the product. The possible combinations and the amounts applied targeting a 7 tonnes/ha crop are as follows;

In cases where CAN is used instead of urea, the amount of CAN to be used is 1.7 times the amount of urea used. The common compound fertilizer, NPK (25-5-5), supplies mainly nitrogen. That requires that it has to be supplemented with more phosphorus. Today there are companies that have come up with fertilizer blends that are specific to maize. One of the companies is called grain pulse. They have a maize fertilizer blend of NPK in the ratio of 20-20-18 respectively. They recommend an application rate of 100 kgs per acre as a single application or 50kg per acre as basal application followed by topdressing with urea at 50Kg per acre at 4-5 weeks after planting.

**Weed management in DroughtTEGO™ hybrid crops**

Keep your crop free of weeds. If hand weeding, first weeding should be done by 3 weeks after planting and the second weeding at 4-5 weeks after planting followed by top dressing of the crop.

If using chemical weed control, there are a number of herbicides in the market which are effective against weeds in maize fields. There are both selective and non-selective herbicides and the choice of each depends on the time of application and planting.

It is important that weeds are not allowed to compete with the crop especially in the first 45 days of growth. Interviewed farmers have indicated that weeds are a major problem in maize production and can severely affect crop performance. Due to the drudgery of weeding and time factor we recommend the use of herbicides; both pre-emergence and post-emergence. Farmers are also advised to source their herbicide from reputable chemical companies in Uganda. Our experience as the NaCRRI team is that herbicides such as primagrame Gold, Lumax, Auxo are very effective herbicides against weeds in maize since some are selective.

**Insect Pests Control**

***Stem borers control measures***

Monitor your field regularly for stem borers, FAW and their eggs.Apply *Bulldock® (Beta-cyfluthrin) granules or spray as a protective measure against stalk borers at 3-5 leaf stage, 3-4 weeks after planting or when 5-10% plants are affected. Repeat Bulldock® application if signs appear at 10 leaf stage

***Fall army worm control measures***

NARO has focus on educating farmers on the various chemical controls available in the market. There are 13 approved pesticides for controlling the FAW. The choice of each depends on their prices, availability. However, our studies and experience show that Amdocs and Chlobenzo are among the most effective chemical controls.

The dozes and application intervals are some of the information being given to farmers during the training on FAW. The different chemicals in the market are shown in the chart below:

**Rationale for release of three DroughtTEGO™ hybrids**

***More demand for high yielding hybrids***

In collaboration with CIMMYT and other partners in the last decade, NARO-NaCRRI has developed and released over 20 hybrids exhibiting various traits including grain yield, pest and disease resistance, drought and low nitrogen stresses. Release and commercialization of new varieties has contributed to an exponential growth in Uganda's seed sector, which in turn has continued to attract public and private sector investment for the benefit of the farmers. Availability of new superior maize varieties on the market has significantly enhanced adoption of improved cultivars and subsequently tripling maize production and productivity in Uganda.

However, the prevalence of new stresses such as new pests like the fall army worm (FAW) and diseases like maize lethal necrosis (MLN); in addition to the increasing importance of co-existing stresses like drought, low nitrogen and Striga warrant regular development and release of new superior hybrids.

***Demand for exclusivity***

The DroughtTEGO™hybrid maize that are in the market were all given in semi-exclusive terms, which means more than one company are promoting the same variety. There are both positive and negative impact of semi-exclusive promotion of hybrids. If the variety in question is on high demand by farmers especially if it addresses a particularly important production constraint e.g. drought or MLN, then many companies can together produce enough seed to meet the large demand for seed of the hybrid. However, if one of the companies promoting the same variety compromises on quality and farmers reject the variety, the rest of the companies suffer lack of market for their variety as well. This kind of situation is avoidable if each company promoting the variety used a different brand (marketing) name like you see commonly in chemical being sold under different trade names yet their active ingredient is the same.

The TAAT project has put in efforts to promote all climate smart maize varieties currently with seed companies and is working with some companies to sell their seed under different brand names for differentiation.

However, four of the registered seed companies namely; Brac Seeds, Crown Seeds, Pearls and Equator Seeds have requested NARO to release for them DroughtTEGO™ hybrid maize varieties on exclusive term. The four varieties are WE5135 (for Crown Seeds), WE5117 (for Pearl Seeds), WE6103 (for Brac Seeds) and WE6105 (for Equator Seeds). WE6105 is a transitional hybrids with regional results showing good performance in the highland. However, for the release there was no DUS data available for WE5135 and WE6105 hybrids. So we are not representing them for release.

Brac Seeds has additional evaluation and participatory varietal selection with famers in on-farmer trials and demonstration and provided us with additional data for the variety they have chosen. In conclusion, exclusive variety are owned by companies and they invest it its promotion, maintenance and increased access to quality seed by famers thus contributing to increased maize production and productivity Uganda.

**Pedigree of Candidate DroughtTEGO™Hybrids for Release**

The origin of candidates WE5117and, WE6103is from inbred lines with good general and specific combining ability developed from drought tolerant and maize lethal necrosis parental inbred lines from the Water Efficient Maize for Africa (WEMA) Project materials advanced and selected for adaptation and yield performance per se at National Crops Resources Research Institute, Namulonge. The inbred lines have been developed through Double Haploid technology and selected for adaptation to mid-altitude Ugandan maize growing environments. This represented a long- term strategy to hybrid development from locally developed inbred lines.

**Variety description**

Details of important standard morphological descriptors of the three varieties are listed in the appendix I.

**Site description**

Six sites, Namulonge, Ngetta, Bulindi, Serere, Masaka, and Bulegeni, where data for determining genotype-by-environment (GxE) interactions were generated are presented briefly below.

**Namulonge**: 1,150 meters above sea level (masl), rainfall bimodal (1,270 mm/year), mean maximum 28.4 °C, mean minimum 15.9 °C, and annual mean 22.2 °C. Soils are ferralitic (red sand clay loam), soil pH 4.9-5.0, and tall grassland.

**Ngetta**: 1,180 masl, annual temperature, 30.4 °C, mean annual rainfall 1,319 mm, sandy loam, soil pH 5.5, savannah grassland.

**Serere**: 1,140 masl, rainfall is bimodal 800-1150 mm/year, annual temperature 26.0 °C, soils are sandy loam, pH 5.2-6.0, savannah grassland.

**Bulindi**: 1143 masl of rainfall falling in 80 to 100 days, with mean temperatures of 28 – 31°C.

**Masaka**: 1106 masl with mean annual precipitation between 1200 - 1400 mm of rainfall received during two rain seasons.

**Bulegeni**: Elevation is between 1,299 and 4,300 masl with Sub-tropical climate. Temperatures range from high in the plains to low in the mountains and rainfall reaches up to 1,500 mm per annum (two rainy seasons).

**Ikulwe:** Elevation is between 1277masl and located between0° 27' 3N and 33° 28' 16E. Mean annual *rainfall* for the AEZ is 1255 mm (1345 mm for *Ikulwe*) in a bimodal distribution

Specific sites where on-farm trials were conducted in the different districts are mentioned in the text. Detail of agro ecological zone where the on-farm trials were located can be identified in descriptions given by Wortmann and Eledu (1999).

## RESULTS AND DISCUSSIONS

The National Performance Trials (NPT) were conducted in eight testing sites that included Namulonge (Location 1), Serere (Location 2), Masaka (Location 3), Bulindi (Location 4), Bulegeni (Location 5), Ngetta (Location 6), Ikulwe (Location 7) and Abii (Location 8) Zonal agricultural and Development Institutes of NARO. The analysis shows that there were significant differences among genotypes, Locations, interactions of locations by genotypes as shown in the ANOVA below (Table 1) below. This is a significant interaction between environment and genotypes shown in the ANOVA table.

**TABLE 1. SUMMARY OF ANOVA for 2015A**

| Sources of variations | *Df* | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| | | | | | |
| **LOC** | 6 | 2115.9156 | 352.6526 | 130.1566 | 5.5205 |
| **ENTRY** | 55 | 537.5767 | 9.7741 | 3.6074 | 1.1207 |
| **LOC:ENTRY** | 326 | 1178.3329 | 3.6145 | 1.3340 | 0.0065 |
| **LOC:REP:BLK** | 105 | 760.8603 | 7.2463 | 2.6745 | 5.2644 |
| **Residuals** | 280 | 758.6456 | 2.7094 | | |

The Biplot of the Location means shows that there are significant differences among the locations from the ANOVA above (Table 1).

As shown in the Biplot location 1 and 7 very similar and those are Namulonge and Ikulwe that have similar rainfall amount temperatures. Also Locations 2 and 8 are closely similar i.e. Serere and Abii. There are similarities in Temperature and rainfall regimes.

Table 2 shows the results of multi-locational analysis from 8 locations in 2015A. The hybrid for released tested in that season was WE5115 among the top 12 out of 56 hybrids tested including the checks.

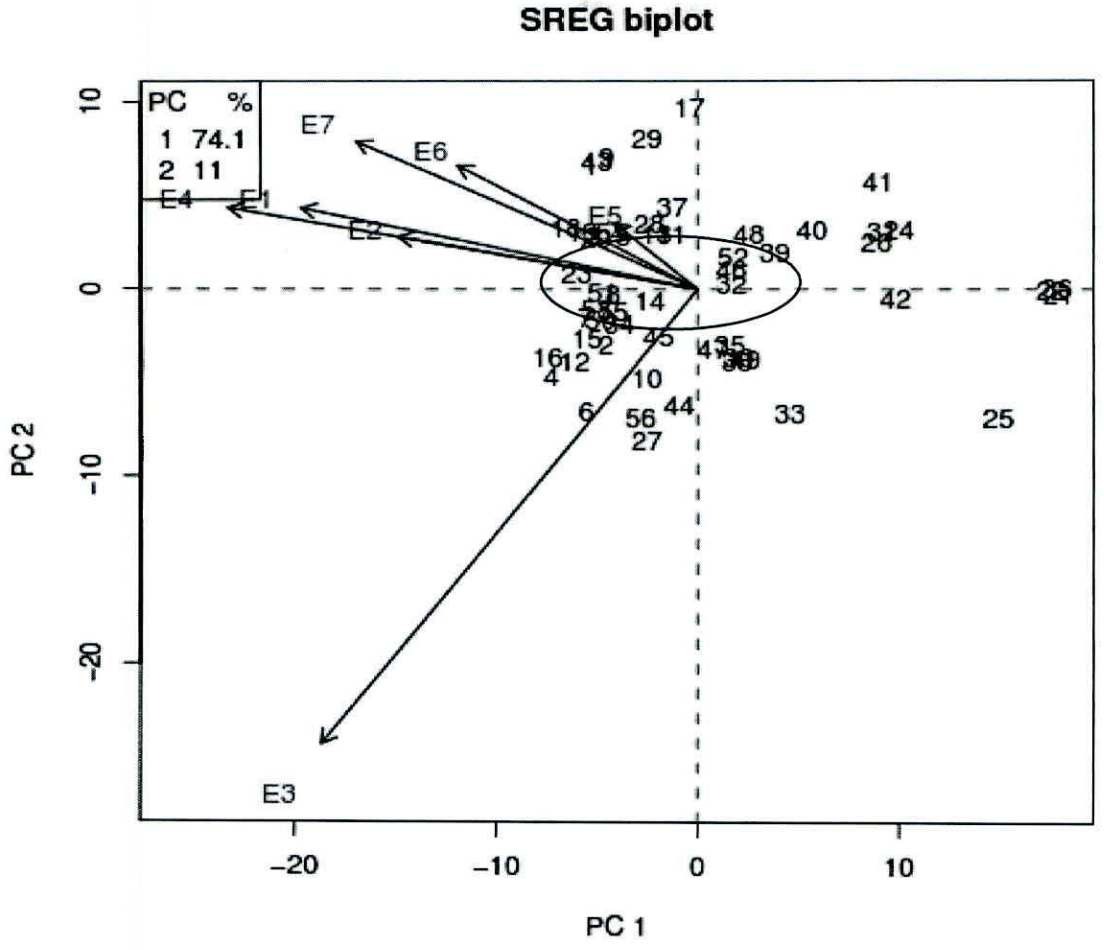
## Table 2: Grain Yield Means in 8 Locations in 2015A

| ENTRY | NAME | Namulonge | Serere | Masaka | Bulindi | Bulegeni | Ngetta | Ikulwe | Abii |
|---|---|---|---|---|---|---|---|---|---|
| | | GY in t/ha | GY in t/ha | GY in t/ha | GY in t/ha | GY in t/ha | GY in t/ha | GY in t/ha | GY in t/ha |
| | | | | | | | | | |
| 1 | WE 5101 | 3.64 | 6.71 | 6.03 | 7.29 | 12.81 | 6.00 | 8.93 | 3.88 |
| 2 | WE 5107 | 6.79 | 7.09 | 3.53 | 4.87 | 13.17 | 4.96 | 6.76 | 5.02 |
| 3 | WE 5109 | 3.57 | 6.96 | 6.47 | 5.81 | 11.90 | 3.85 | 7.94 | 6.95 |
| 5 | WE 5114 | 5.29 | 8.27 | 2.34 | 7.50 | 12.75 | 4.38 | 8.79 | 5.78 |
| 6 | WE 5116 | 5.05 | 7.81 | 2.90 | 7.65 | 11.82 | 4.73 | 9.44 | 5.56 |
| 7 | WE 5117 | 5.15 | 8.04 | 6.11 | 7.10 | 13.54 | 5.10 | 8.64 | 4.24 |
| 8 | WE 5118 | 5.11 | 8.98 | 5.29 | 6.42 | 13.38 | 5.67 | 8.79 | 6.08 |
| 9 | WE 5120 | 6.69 | 8.64 | 3.20 | 6.62 | 11.03 | 5.21 | 8.18 | 7.21 |
| 10 | WE 5122 | 6.33 | 7.52 | 4.54 | 7.34 | 11.30 | 4.65 | 7.39 | 4.58 |
| 11 | WE 5125 | 3.94 | 8.91 | 5.44 | 6.77 | 12.21 | 6.17 | 8.10 | 5.55 |
| 12 | WE 5126 | 4.77 | 5.06 | 3.49 | 4.89 | 11.73 | 5.55 | 7.50 | 5.71 |
| 13 | WE 5128 | 4.91 | 5.41 | 6.14 | 6.62 | 9.91 | 4.94 | 6.69 | 4.71 |
| 14 | WE 5129 | 6.52 | 8.37 | 6.04 | 5.32 | 10.58 | 3.61 | 8.09 | 3.54 |
| 15 | WE 5130 | 6.49 | 7.17 | 5.49 | 6.81 | 12.55 | 3.65 | 8.75 | 6.30 |
| 18 | WE 5133 | 5.59 | 8.68 | 4.09 | 7.31 | 11.03 | 6.09 | 9.11 | 4.79 |
| 19 | WE 5134 | 5.13 | 4.75 | 5.06 | 6.87 | 10.61 | 6.30 | 8.54 | 5.90 |
| 24 | VICTORIA -4 | 5.98 | 6.98 | 3.92 | 6.84 | 10.89 | 4.24 | 6.96 | 6.52 |
| 49 | Longe 6H | 5.74 | 5.65 | 4.69 | 4.86 | 11.28 | 3.53 | 7.08 | 5.70 |
| 50 | Longe7H | 3.70 | 5.08 | 2.53 | 4.22 | 11.09 | 4.69 | 6.24 | 4.38 |
| 51 | Longe 8H | 5.04 | 5.01 | 2.35 | 4.75 | 7.30 | 3.08 | 7.87 | 5.19 |
| 52 | Longe 9H | 4.60 | 6.17 | 2.92 | 4.48 | 9.69 | 7.04 | 6.54 | 4.85 |
| 53 | Longe 10H | 4.75 | 4.58 | 3.42 | 5.99 | 9.91 | 5.55 | 6.00 | 4.92 |
| 54 | UH5354 | 6.53 | 10.11 | 4.51 | 6.39 | 8.90 | 5.52 | 9.25 | 4.82 |
| 55 | WE2114 | 5.69 | 7.68 | 4.68 | 5.91 | 12.36 | 4.33 | 6.30 | 4.81 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 56 | WE2115 | 6.12 | 4.89 | 3.25 | 5.15 | 10.59 | 5.66 | 7.05 | 3.06 |
| | | | | | | | | | |
| **Mean** | | **5.87** | **7.48** | **4.46** | **6.07** | **11.28** | **5.55** | **7.82** | **5.54** |
| **LSD (0.05)** | | **3.34** | **2.83** | **3.57** | **3.63** | **4.88** | **3.56** | **1.98** | **3.27** |
| **MSe** | | **2.70** | **1.99** | **2.85** | **3.24** | **5.55** | **3.03** | **0.98** | **2.54** |
| **CV** | | **28.00** | **18.84** | **37.81** | **29.65** | **20.88** | **31.38** | **12.66** | **28.73** |
| ***p*** | | **0.216** | **0.000** | **0.377** | **0.429** | **0.485** | **0.019** | **0.000** | **0.183** |
| ***p*** | | ns | *** | ns | ns | ns | * | *** | ns |

The varieties responded differently to the different. The varieties performed significantly different at Serere, Ngetta and Ikulwe. At Namulonge, Masaka, Bulindi, Bulegeni and Abii, there was no significant differences in the varieties' performances

**Figure 1: Biplot of Principal components 1 and 2 of genotypes x environment interactions in 2015A**




The biplot above (Figure 1) showed Masaka to be the least productive environment out of the eight environments used for the national performance trials. The is because Masaka has acidic soils and is high disease pressure especially GLS and TLB. Bulegeni, on the other was relatively more stable highly productive environment as shown in the table of means and in the biplot. The hyrbids being released showed stability

The Second NPTs were conducted in 7 locations including Namulonge (Location 1), Masaka (Location 3), Bulindi (Location 4), Bulegeni (Location 5), Ngetta (Location 6) Ikulwe (Location 7) and Abii (Location 8). During this second trials there was no significant difference among locations and entries. As such there was no GxE interaction observed. Tables 5 and 6 show the pooled means across locations and means in the three locations during the season 2015B.

**Table 3:ANOVA for Season 2015B**

| Sources of variations | *Df* | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| | | | | | |
| LOC | 6 | 2196.506 | 366.0844 | 172.1269 | 4.29 |
| ENTRY | 44 | 271.2689 | 6.165202 | 2.898778 | 2.61 |
| LOC:ENTRY | 264 | 603.531 | 2.286102 | 1.074888 | 0.29 |
| REP:LOC:BLK | 119 | 511.0415 | 4.294467 | 2.019189 | 6.58 |
| Residuals | 195 | 414.7314 | 2.126828 | | |

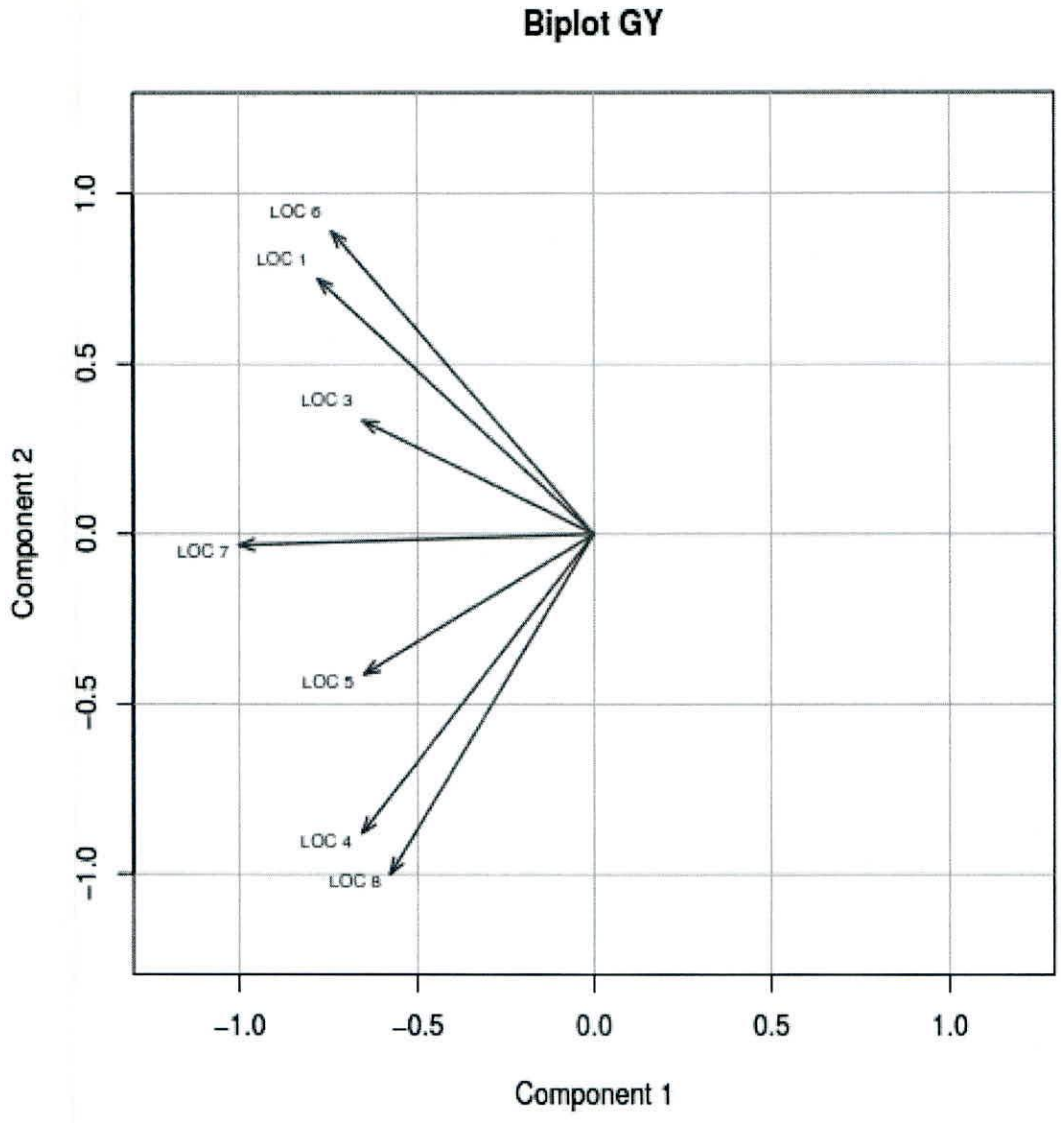
## Table 4: Across location Grain Yield and their relative advantage the means

| Entry | Name | Across | | | Across | Namulonge | Bulindi | Ikulwe |
|---|---|---|---|---|---|---|---|---|
| | | RelGY | Rank | | GrainYield | GrainYield | GrainYield | GrainYield |
| | | % | Avg | StdDev | t/ha | t/ha | t/ha | t/ha |
| 1 | WE 5101 | 96.1 | 26.0 | 13 | 5.44 | 4.59 | 6.49 | 5.25 |
| 2 | WE 5107 | 106.0 | 18.0 | 11 | 5.99 | 5.50 | 6.51 | 5.98 |
| 3 | WE 5109 | 102.8 | 20.3 | 4 | 5.84 | 5.84 | 6.45 | 5.22 |
| 4 | WE 5111 | 101.3 | 22.0 | 18 | 5.71 | 6.74 | 4.57 | 5.83 |
| 5 | WE 5114 | 107.5 | 16.3 | 7 | 6.10 | 5.82 | 6.89 | 5.59 |
| 6 | WE 5117 | 85.9 | 31.3 | 13 | 4.92 | 5.87 | 5.43 | 3.45 |
| 7 | WE 5120 | 77.6 | 39.3 | 4 | 4.43 | 4.67 | 5.06 | 3.55 |
| 8 | WE 5122 | 93.1 | 30.7 | 8 | 5.26 | 5.56 | 4.96 | 5.25 |
| 9 | WE 5126 | 88.2 | 32.7 | 4 | 5.01 | 5.03 | 5.49 | 4.49 |
| 10 | WE 5128 | 83.2 | 37.3 | 4 | 4.71 | 4.77 | 4.72 | 4.63 |
| 11 | WE 5129 | 101.2 | 21.3 | 6 | 5.72 | 5.75 | 5.76 | 5.66 |
| 12 | WE 5130 | 106.5 | 17.0 | 9 | 6.04 | 6.80 | 5.84 | 5.48 |
| 13 | WE 5131 | 110.0 | 13.7 | 7 | 6.22 | 6.13 | 6.35 | 6.18 |
| 14 | WE 5132 | 96.6 | 26.7 | 6 | 5.46 | 5.50 | 5.55 | 5.35 |
| 15 | WE 5133 | 113.3 | 12.3 | 7 | 6.41 | 6.55 | 6.39 | 6.29 |
| 16 | WE 5134 | 89.0 | 33.0 | 9 | 5.07 | 4.74 | 6.06 | 4.39 |
| 20 | VICTORIA -3 | 95.4 | 26.3 | 12 | 5.41 | 6.38 | 5.02 | 4.83 |
| 21 | VICTORIA -4 | 84.2 | 33.0 | 16 | 4.81 | 6.11 | 4.86 | 3.46 |
| 39 | Longe 6H | 86.6 | 34.7 | 4 | 4.92 | 5.05 | 5.32 | 4.39 |
| 40 | Longe 8H | 82.8 | 37.0 | 5 | 4.73 | 5.49 | 5.06 | 3.64 |
| 41 | Longe 9H | 80.0 | 39.0 | 4 | 4.52 | 5.01 | 4.07 | 4.48 |
| 42 | Longe 10H | 81.5 | 38.7 | 8 | 4.60 | 4.25 | 4.70 | 4.83 |
| 43 | UH5354 | 110.5 | 14.0 | 13 | 6.30 | 7.34 | 6.68 | 4.88 |
| 44 | WE2114 | 106.4 | 16.3 | 8 | 6.01 | 6.06 | 5.91 | 6.06 |
| 45 | WE2115 | 82.7 | 33.7 | 15 | 4.68 | 5.98 | 3.75 | 4.32 |
| **Mean** | | **100.0** | **23.0** | **9** | **5.67** | **5.84** | **5.97** | **5.21** |
| **LSD (0.05)** | | **13.0** | **10.1** | **5** | **#REF!** | **1.69** | **1.97** | **1.91** |
| **MSe** | | | | | **0.84** | **0.68** | **0.95** | **0.88** |
| **CV** | | | | | | **14.15** | **16.33** | **18.02** |
| ***p*** | | | | | | **0.000** | **0.004** | **0.018** |
| ***p*** | | | | | | *** | ** | * |

## Table5: Across locations analysis in 2015B

| Entry | Name | Across RelGY | Across Rank | | Across GrainYield | Anth Date | ASI | GLS | P.sorg | E.turc | Grain Text | MSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | Avg | StdDev | t/ha | d | d | 1-5 | 1-5 | 1-5 | 1-5 | 1-5 |
| 13 | WE 5131 | 110.0 | 13.7 | 7 | 6.22 | 69.1 | 1.4 | 1.2 | 1.6 | 2.0 | 3.0 | 1.2 |
| 12 | WE 5130 | 106.5 | 17.0 | 9 | 6.04 | 68.5 | 0.9 | 1.4 | 1.4 | 2.3 | 2.9 | 2.1 |
| 5 | WE 5114 | 107.5 | 16.3 | 7 | 6.10 | 65.4 | 0.9 | 1.3 | 2.1 | 1.8 | 2.6 | 1.1 |
| 11 | WE 5129 | 101.2 | 21.3 | 6 | 5.72 | 68.8 | 0.4 | 1.4 | 1.6 | 2.0 | 3.1 | 1.4 |
| 15 | WE 5133 | 113.3 | 12.3 | 7 | 6.41 | 68.1 | 1.2 | 1.4 | 1.1 | 1.9 | 3.4 | 1.5 |
| 2 | WE 5107 | 106.0 | 18.0 | 11 | 5.99 | 68.4 | 1.2 | 1.2 | 1.2 | 1.6 | 3.2 | 1.5 |
| 4 | WE 5111 | 101.3 | 22.0 | 18 | 5.71 | 66.4 | 0.9 | 0.9 | 1.5 | 1.6 | 3.0 | 1.5 |
| 44 | WE2114 | 106.4 | 16.3 | 8 | 6.01 | 66.7 | 1.5 | 2.1 | 2.4 | 1.5 | 3.0 | 1.7 |
| 1 | WE 5101 | 96.1 | 26.0 | 13 | 5.44 | 67.3 | 1.3 | 1.7 | 1.8 | 1.9 | 3.5 | 1.6 |
| 3 | WE 5109 | 102.8 | 20.3 | 4 | 5.84 | 66.9 | 0.7 | 1.6 | 1.4 | 1.6 | 3.5 | 1.4 |
| 6 | WE 5117 | 85.9 | 31.3 | 13 | 4.92 | 66.2 | 1.2 | 1.5 | 2.1 | 1.8 | 2.4 | 1.0 |
| 8 | WE 5122 | 93.1 | 30.7 | 8 | 5.26 | 67.9 | 0.5 | 1.2 | 1.0 | 1.5 | 2.6 | 1.6 |
| 14 | WE 5132 | 96.6 | 26.7 | 6 | 5.46 | 68.7 | 0.9 | 1.7 | 1.4 | 2.2 | 3.5 | 2.4 |
| 39 | Longe 6H | 86.6 | 34.7 | 4 | 4.92 | 69.6 | 2.5 | 1.3 | 1.2 | 1.5 | 2.4 | 2.7 |
| 45 | WE2115 | 82.7 | 33.7 | 15 | 4.68 | 64.7 | -1.2 | 1.1 | 1.5 | 2.1 | 2.2 | 1.1 |
| 16 | WE 5134 | 89.0 | 33.0 | 9 | 5.07 | 68.6 | 1.7 | 1.4 | 1.6 | 2.1 | 2.6 | 1.5 |
| 9 | WE 5126 | 88.2 | 32.7 | 4 | 5.01 | 68.7 | 0.9 | 1.3 | 1.8 | 2.5 | 2.9 | 1.6 |
| 7 | WE 5120 | 77.6 | 39.3 | 4 | 4.43 | 66.3 | -0.4 | 1.5 | 2.4 | 1.7 | 2.6 | 1.4 |
| 10 | WE 5128 | 83.2 | 37.3 | 4 | 4.71 | 67.3 | 2.2 | 1.2 | 1.3 | 2.2 | 2.9 | 1.6 |
| 40 | Longe 8H | 82.8 | 37.0 | 5 | 4.73 | 70.1 | 1.9 | 1.3 | 1.3 | 1.6 | 2.6 | 2.1 |
| 42 | Longe 10H | 81.5 | 38.7 | 8 | 4.60 | 67.0 | 2.1 | 1.3 | 1.2 | 1.6 | 2.7 | 1.2 |
| 41 | Longe 9H | 80.0 | 39.0 | 4 | 4.52 | 68.2 | 2.1 | 1.5 | 1.7 | 1.9 | 2.2 | 1.3 |
| | | | | | | | | | | | | |
| **Mean** | | **100.0** | **23.0** | **9** | **5.67** | **66.9** | **1.6** | **1.5** | **1.6** | **1.8** | **2.9** | **1.7** |
| **LSD (0.05)** | | **13.0** | **10.1** | **5** | **1.07** | **1.7** | **1.7** | **0.4** | **0.7** | **0.4** | **0.4** | **0.7** |
| **MSe** | | | | | **0.84** | **3.4** | **2.2** | **0.1** | **0.2** | **0.1** | **0.2** | **0.3** |
| **CV** | | | | | | | | | | | | |
| ***p*** | | | | | | | | | | | | |

**Figure 2: Biplot of PC1 and PC2 for environments in 2015B**




Location 7, that is Ikulwe, was the most stable environment in 2015B as shown in Table 5. The PC1 is most likely to be dry weather experience in 2015B. during that season trials from Serere could be harvested because of relatively severe drought in that region. The PC2 is attributed to insect infestation that are more severe when there is drought. The two factors affected the performances in the location negatively.

## Table 6: Grain Yield Means for NPT1 in 5 locations during 2016A

| Entry | Name | Serere | | Bulindi | | Ngetta | | Bulegeni | | Ikulwe | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FW | Rank | FW | Rank | FW | Rank | FW | Rank | FW | Rank |
| | | t/ha | Rank | t/ha | Rank | t/ha | Rank | t/ha | Rank | t/ha | Rank |
| 11 | WE6101 | 4.38 | 25 | 2.56 | 31 | 2.93 | 24 | 3.39 | 28 | 3.66 | 17 |
| 12 | WE6103 | 7.93 | 3 | 9.05 | 2 | 5.94 | 10 | 11.57 | 1 | 6.82 | 2 |
| 13 | WE6104 | 6.39 | 17 | 4.65 | 26 | 5.17 | 12 | 6.14 | 21 | 2.62 | 25 |
| 14 | WE6112 | 6.45 | 16 | 6.88 | 19 | 4.61 | 14 | 5.42 | 22 | 1.52 | 29 |
| 15 | WE6113 | 4.16 | 27 | 8.91 | 4 | 5.10 | 13 | 7.26 | 17 | 2.52 | 26 |
| 16 | WE6114 | 7.88 | 4 | 6.76 | 21 | 3.54 | 20 | 6.71 | 18 | 3.41 | 19 |
| 17 | WE6106 | 7.45 | 7 | 8.40 | 5 | 6.32 | 7 | 11.03 | 2 | 4.89 | 9 |
| 18 | WE5135 | 3.55 | 29 | 1.46 | 32 | 0.47 | 32 | 1.67 | 30 | | |
| 19 | WE5136 | 6.17 | 19 | 8.07 | 8 | 2.40 | 26 | 8.16 | 12 | 5.81 | 5 |
| 20 | WE5139 | 6.73 | 12 | 8.25 | 6 | 2.65 | 25 | 4.10 | 27 | 0.28 | 31 |
| 21 | WE5141 | 2.70 | 32 | | | | | | | | |
| 22 | WE6108 | 6.35 | 18 | 7.92 | 10 | 1.61 | 30 | 7.80 | 16 | 3.96 | 15 |
| 24 | CKHRM1203 | 8.24 | 2 | 7.81 | 12 | 4.35 | 17 | 7.95 | 13 | 2.32 | 27 |
| 25 | CKHRM122114 | -0.09 | 35 | | | | | | | 0.38 | 30 |
| 26 | CKHRM1212 | 4.61 | 24 | 7.20 | 17 | 6.01 | 9 | 9.11 | 9 | 5.60 | 6 |
| 27 | CKHRM1231 | 6.61 | 14 | 6.89 | 18 | 6.88 | 3 | 6.64 | 19 | 4.39 | 12 |
| 28 | CKHRM1219 | 4.88 | 23 | 7.41 | 16 | 6.22 | 8 | 7.90 | 14 | 3.37 | 20 |
| 29 | CKH143960 | 2.04 | 34 | | | 2.05 | 28 | | | | |
| 30 | CKH143975 | 2.37 | 33 | 2.92 | 30 | -0.64 | 34 | 1.43 | 32 | | |
| 31 | CKH143770 | 4.12 | 28 | 4.96 | 25 | 0.81 | 31 | 1.59 | 31 | 1.69 | 28 |
| 32 | CKHRM1202 | 6.99 | 9 | 6.13 | 23 | 4.42 | 16 | 8.98 | 10 | 3.95 | 16 |
| 34 | Bazooka | 5.09 | 21 | 6.38 | 22 | 3.10 | 23 | 4.11 | 26 | 3.45 | 18 |
| 35 | Longe10H | 5.51 | 18 | | | -0.12 | 33 | 1.43 | 32 | | |
| 36 | WE2115 | 7.23 | 8 | 8.00 | 9 | 6.84 | 4 | 8.52 | 11 | 5.31 | 7 |
| | | 5.55 | 18 | 6.68 | 17 | 4.15 | 18 | 6.69 | 17 | 3.84 | 16 |
| **Mean** | | **5.55** | **18** | **6.68** | **17** | **4.15** | **18** | **6.69** | **17** | **3.84** | **16** |
| **LSD (0.05)** | | **4.52** | **10** | **4.56** | **9** | **4.52** | **10** | **4.26** | **10** | **4.16** | **9** |
| **MSe** | | **4.42** | | **4.26** | | **4.14** | | **3.65** | | **3.39** | |
| **CV** | | **37.84** | | **30.87** | | **49.01** | | **28.58** | | **47.90** | |
| ***p*** | | **0.097** | | **0.092** | | **0.024** | | **0.000** | | **0.243** | |
| ***p*** | | + | | + | | * | | *** | | ns | |

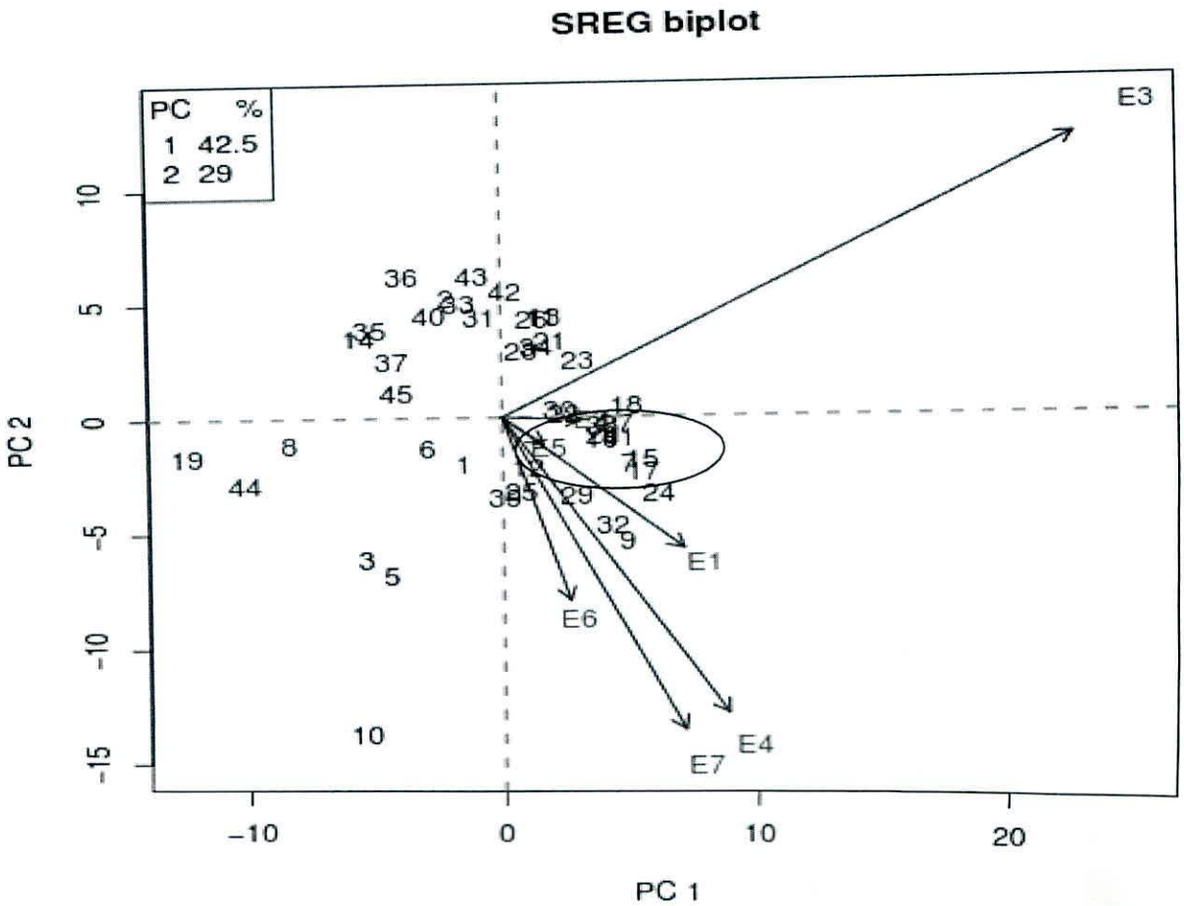
## Table 7: Pooled means across location and relative performance over the mean in season 2016A

| Entry | Name | Across | | | Across | | Anth | ASI | GLS | P.sorg | E.turc | Grain | MSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RelGY | Rank | | GrainYield | Rank | Date | | | | | Text | |
| | | % | Avg | StdDev | t/ha | Rank | d | d | 1-5 | 1-5 | 1-5 | 1-5 | 1-5 |
| 17 | WE6106 | 159 | 5 | 4 | 8.67 | 5 | 60.3 | 1.0 | 1.5 | 1.3 | 1.5 | 3.2 | 2.6 |
| 12 | WE6103 | 158 | 6 | 6 | 8.76 | 6 | 63.6 | 1.0 | 1.4 | 1.3 | 1.5 | 2.0 | 1.9 |
| 36 | WE2115 | 146 | 8 | 5 | 7.68 | 8 | 62.7 | 2.7 | 1.2 | 1.4 | 1.5 | 2.2 | 2.0 |
| 15 | WE6113 | 116 | 15 | 3 | 6.18 | 15 | 63.7 | -0.3 | 1.3 | 1.4 | 1.5 | 2.7 | 2.1 |
| 13 | WE6104 | 108 | 17 | 6 | 5.65 | 17 | 64.5 | 0.7 | 1.3 | 1.4 | 1.5 | 2.6 | 1.1 |
| 14 | WE6112 | 96 | 18 | 6 | 5.01 | 18 | 64.5 | 0.2 | 1.9 | 1.7 | 1.3 | 2.7 | 1.1 |
| 16 | WE6114 | 93 | 19 | 1 | 5.12 | 19 | 65.2 | 0.4 | 1.7 | 2.8 | 1.5 | 2.5 | 1.6 |
| 22 | WE6108 | 78 | 23 | 10 | 4.71 | 23 | 62.7 | 1.8 | 1.2 | 1.8 | 1.3 | 2.1 | 2.2 |
| 34 | com. Check | 68 | 25 | 2 | 3.60 | 25 | 63.4 | 1.9 | 1.4 | 1.9 | 1.5 | 2.1 | 1.2 |
| 11 | WE6101 | 61 | 26 | 3 | 3.16 | 26 | 62.8 | 0.4 | 1.9 | 1.7 | 1.0 | 3.1 | 2.8 |
| 35 | Longe10H | 9 | 33 | 1 | 0.65 | 33 | 66.0 | 1.4 | 1.2 | . | 1.4 | 3.1 | . |
| **Mean** | | **99** | **17** | **5** | **5.35** | **17** | **63.6** | **1.3** | **1.4** | **1.6** | **1.5** | **2.6** | **1.8** |
| **LSD_0.05** | | **47** | **9** | **4** | **2.85** | **9** | **2.6** | **1.1** | **0.4** | **0.6** | **0.4** | **0.4** | **1.0** |
| **MSe** | | | | | **3.90** | **0** | **6.5** | **0.5** | **0.1** | **0.1** | **0.0** | **0.2** | **0.2** |

## Table 8. Grain Yield Means across 4 locations in 2016B

| Entry | Name | Serere | | Ngetta | | Bulegeni | | Ikulwe | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FW | Rank | FW | Rank | FW | Rank | FW | Rank | FW | Rank |
| | | t/ha | Rank | t/ha | Rank | t/ha | Rank | t/ha | Rank | t/ha | Rank |
| 1 | WE4101 | 9.47 | 8 | 6.72 | 10 | 10.51 | 5 | 7.85 | 1 | 1.85 | 28 |
| 2 | WE4102 | 10.11 | 3 | 7.60 | 3 | 9.97 | 7 | 4.83 | 22 | 3.71 | 7 |
| 3 | WE4103 | 7.31 | 25 | 5.73 | 19 | 11.71 | 3 | 6.53 | 6 | 3.21 | 9 |
| 4 | WE4104 | 9.53 | 7 | 7.40 | 5 | 8.66 | 14 | 6.45 | 7 | 3.76 | 6 |
| 5 | WE4106 | 9.71 | 6 | 6.25 | 14 | 9.59 | 9 | 6.02 | 13 | 3.85 | 4 |
| 6 | WE4111 | 8.75 | 16 | 5.25 | 23 | 10.42 | 6 | 6.25 | 10 | 1.69 | 31 |
| 7 | WE4126 | 7.40 | 24 | 6.45 | 11 | 9.35 | 10 | 6.53 | 5 | 2.76 | 13 |
| 8 | WE 5101 | 8.85 | 14 | 6.34 | 13 | 7.51 | 20 | 6.54 | 4 | 2.29 | 19 |
| 9 | WE 5114 | 8.28 | 21 | 5.28 | 22 | 9.12 | 11 | 6.32 | 8 | 4.33 | 2 |
| 10 | WE 5117 | 8.98 | 11 | 6.45 | 12 | 8.06 | 16 | 3.95 | 29 | 2.10 | 22 |
| 11 | WE 5120 | 8.94 | 12 | 6.03 | 16 | 7.13 | 22 | 5.64 | 16 | 2.51 | 14 |
| 12 | WE 5130 | 8.31 | 20 | 8.48 | 1 | 7.75 | 18 | 6.29 | 9 | 4.06 | 3 |
| 13 | WE 5132 | 9.13 | 10 | 5.46 | 20 | 10.93 | 4 | 4.40 | 28 | 3.30 | 8 |
| 14 | WE 5133 | 10.37 | 2 | 6.09 | 15 | 11.76 | 2 | 5.78 | 15 | 2.77 | 12 |
| 15 | WE 5134 | 6.30 | 31 | 4.69 | 30 | 3.23 | 37 | 5.88 | 14 | 1.98 | 25 |
| 19 | VICTORIA -3 | 8.09 | 22 | 4.83 | 27 | 9.01 | 12 | 4.94 | 21 | 1.86 | 27 |
| 34 | Longe 6H | 5.77 | 34 | 3.65 | 34 | 5.61 | 31 | 1.35 | 36 | 1.84 | 29 |
| 35 | Longe 10H | 6.10 | 33 | 4.91 | 25 | 3.63 | 36 | 3.58 | 33 | 2.01 | 24 |
| 36 | Bazooka | 6.72 | 29 | 6.84 | 8 | 5.27 | 32 | | | 2.03 | 23 |
| 37 | WE2114 | 8.56 | 17 | 7.53 | 4 | 8.46 | 15 | 5.20 | 19 | 3.20 | 10 |
| 40 | UH5355 | 8.48 | 18 | 4.51 | 31 | 6.68 | 26 | 4.41 | 27 | 1.44 | 34 |
| | | 7.78 | 21 | 5.44 | 20 | 7.33 | 21 | 4.78 | 20 | 2.34 | 21 |
| **Mean** | | **7.78** | **21** | **5.44** | **20** | **7.33** | **21** | **4.78** | **20** | **2.34** | **21** |
| **LSD (0.05)** | | **2.55** | **12** | **2.86** | **11** | **4.47** | **12** | **2.62** | **12** | **2.23** | **12** |
| **MSe** | | **1.53** | | **1.78** | | **4.54** | | **1.59** | | **1.11** | |
| **CV** | | **15.89** | | **24.48** | | **29.09** | | **26.39** | | **45.12** | |
| ***p*** | | **0.000** | | **0.001** | | **0.000** | | **0.000** | | **0.031** | |
| ***p*** | | *** | | ** | | *** | | *** | | * | |

**Figure 3: Biplot of PC1 and PC2 for gentypes x environemnt interaction for season 2016B**




The Biplot above (Figure 3) showed Serere as the stable and medium productive environment. Bulegeni was also stable with average productive environment in 2016B. It should be noted that Bulegeni area maize is produced in first rainfall season of the year (March – August season) only. However, for trials we use both seasons. Masaka still stood out as a very different environment from the rest of the other six locations. In this season there was no disease pressure and the soil was limed so the productivity was high and positive. The hybrids being released are consistent in the response to environments, hence stable.

**Addition information from testing done by seed companies**

NaCRRI provided Brac Seeds Limited with a few hybrids for own testing through demonstrations. Brac Seeds established demos in 5 districts for two seasons. The company conducted farmers' field days in each of the demos and farmers were able to selected varieties according to their own preferences basing the attributes that they

consider important for them the results are shown in Table 9 and Table 10. Consistently hybrid WE6103 and WE5117 performed well and WE6103 was most preferred by farmers.

**Figure 9. Mean Yield of hybrids evaluated on-farm demos in 2018 B**

| Entry | Nakaseke Farm | Lira | Iganga | Masaka | Masindi |
|---|---|---|---|---|---|
| WEMA6103 | 9,298 | 8,109 | 7,646 | 9,870 | 10,901 |
| WEMA5117 | 8,175 | 8,426 | 7,683 | 7,837 | 8,526 |
| WEMA 7119 | 7,836 | 5,608 | 5,981.8 | 6,676 | 7,295 |
| WEMA 3106 | 6,302 | 6,084 | 8,729 | 7,488 | 9,512 |
| CKH130001 | 9,316 | 9,214 | 8,191 | 8,908 | 9,693 |
| CKH 143770 | 6,010 | 8782 | 8,219 | 6,864 | 5,443 |
| Commercial Check 1 | 6,859 | 5,627 | 6,925 | 7,720 | 8,657 |
| Commercial Check 2 | 5,511 | 6,241 | 7,176 | 5,416 | 7,251 |

**Figure 10.Mean Yield of hybrids evaluated on-farm demos in 2019A**

| Entry | Nakaseke Farm | Lira | Iganga | Masaka | Masindi |
|---|---|---|---|---|---|
| WEMA6103 | 9,698 | 9,409 | 9,646 | 9,870 | 10,901 |
| WEMA5117 | 8,175 | 8,426 | 7,683 | 7,837 | 8,526 |
| WEMA 7119 | 7,836 | 5,608 | 5,981.8 | 6,676 | 7,295 |
| WEMA 3106 | 6,302 | 6,084 | 7,729 | 7,488 | 7,512 |
| CKH130001 | 8,316 | 8,214 | 8,191 | 8,908 | 9,193 |
| CKH 143770 | 6,010 | 8782 | 5,219 | 6,864 | 8,443 |
| Commercial Check 1 | 6,859 | 5,627 | 6,925 | 7,720 | 8,657 |
| Commercial Check 2 | **5,511** | **6,241** | **7,176** | **5,416** | **7,251** |

**APPENDIX I: DUS FOR: WE5117, ITS PARENTAL LINES AND SINGLE CROSS FEMALE**

| Characteristics | WE5117 | CML566/CML395 | CML566 | CML395 | CML539 |
|---|---|---|---|---|---|
| First leaf: anthocyanin colouration of sheath | . | . | very weak to weak | very weak to weak | v.weak to strong |
| First leaf: Shape of the tip of first leaf | . | . | pointed to round | round to spatulate | round |
| Leaf: undulation of the margin of the blade | Medium | medium - strong | strong | slight | slight |
| Leaf: angle between blade and stem (on leaf just above upper ear) | Small | very small - small | v. small | large | medium |
| Leaf: curvature attitude of blade (on leaf just above upper ear) | Recurved | strongly recurved | strongly recurved | slightly recurved | strongly recurved |
| Leaf: anthocyanin colouration of sheath (in middle of plant) | absent | Absent | absent | absent | absent to very weak |
| Leaf: width of blade (leaf of upper ear) (cm) | 10.49cm | wide (9.8 cm) | 9.2 | 9.05 | 8.6 |
| Stem: degree of zig-zag | absent | straight/Absent | absent/v. slight | absent/very slight | absent/v.slight |
| Stem: anthocyanin colouration of brace roots | . | Absent/very weak | absent to very weak | weak | medium to strong |
| Stem: anthocyanin colouration of internodes | Absent/very weak | Absent | absent to very weak | weak | weak |
| Tassel: time of anthesis (on middle third of main axis, 50 % of plants) (Days at Kiboko) | 60 | 61 | 66 | 66 | 65 |
| Tassel: anthocyanin colouration at base of glume (in middle third of main axis) | Absent/weak | Absent/very weak | absent | weak | Absent to v. weak |
| Tassel: anthocyanin colouration of glumes excluding base (in middle third of main axis) | very weak - weak | very weak - weak | weak | weak - medium | weak to medium |
| Tassel: anthocyanin colouration of anthers (in middle third of main axis on fresh anthers) | medium - strong | very weak - weak | absent | absent/very weak | weak |
| Tassel: density of spikelets (in middle third of main axis) | lax | medium | dense | lax - medium | dense |

| | | | | | |
|---|---|---|---|---|---|
| Tassel: angle between main axis and lateral branches (in lower third of tassel) | small - medium | very small - small | very small | very small | medium to large |
| Tassel: attitude of lateral branches (in lower third of tassel) | divergent | straight, bunchy & upright | straight | straight | straight |
| Tassel: number of primary lateral branches (counts) | 13 | 9-17 | 12 | 13.6 | 7 |
| Tassel : length of main axis above lowest side branch (cm) | 40.9 | 42 cm | 9 very long 35.3cm | 9 very long 38.8cm | 29.5 |
| Tassel: length of main axis above upper side branch (cm) | 27.6 | 25.9 cm | 9 very long 25.1cm | 7 long 25cm | 22.1 |
| Tassel:- length of side branches (cm) | 16.3 | 19.4 cm | 17.4 | 18.5cm | 15.8 |
| Tassel: curvature of lateral branches | Slightly recurved | Straight & upright | straight | straight | straight |
| Plant : Ear height (up to flag leaf) (cm) | 113 | 130.5 | 62.2 | 89.5 | 56.8 |
| Plant : height of plant including the tassel cm) | 269 | 278.5 | 153 | 220 | 150.2 |
| Plant: ratio between height of insertion of upper ear to plant height | 0.42 | 0.468581688 | 0.41 | 0.406818182 | 0.38 |
| Ear: time of silk emergence (50% plants) (days) | 60 | 61 | 68 | 68 | 67 |
| Ear: anthocyanin colouration of silks | Present | Present | present | present | present |
| Ear: intensity of anthocyanin colouration of the silks | very weak - medium | medium - strong | weak to medium | weak | very strong |
| Ear: length of peduncle (cm) | 8.36 | 7.01 | short(3) 5.4cm | long(7) 10.8cm | medium (5) 8.7cm |
| Ear: length without husk (cm) | 19.93 | 14.8 | very short(1) 9.1cm | medium(5) 15.0cm | short(3) 13.8cm |
| Ear: diameter without husk (in middle) (cm) | 4.45 | 4.51 | very short(1) 3.8cm | short(3) 4.5cm | very short(1) 3.8cm |
| Ear: length of husk above tip of the ear | 1.95 | 6.3 | long(7) 5.4cm | long(7) 6.5cm | long(7) 5.7cm |

| | | | | | |
|---|---|---|---|---|---|
| Ear: shape | Conico - cylindrical | conico - cylindrical | conico-cylindrical | conico-cylindrical | conico-cylindrical |
| Ear: number of rows of grains | 12 - 16 | Medium(5) 12-16 | medium(5) 14-16 | medium(5) 12-15 | medium(5) 12-16 |
| Ear: type of grain (in middle third of ear) | flintlike | Dentlike | 2 flintlike | 1 flint - intermedi | flint |
| Ear: colour of top of grain | white | white | white | white | white |
| Ear: colour of dorsal side of grain | white | white | white | white | white |
| Ear: anthocyanin colouration of glumes of cob | Absent | Absent | absent | absent | absent |
| Kernel: row arrangement | regular | Regular/straight | irregular-straight | regular at top of ear and irregular bottom | straight |

**DUS FOR: WE6103, ITS PARENTAL LINES AND SINGLE CROSS FEMALE**

| **Characteristics** | **WE6103** | **CKDHL0089/CML395** | **CKDHL0089** | **CML395** | **CKLTI0036** |
|---|---|---|---|---|---|
| First leaf: anthocyanin colouration of sheath | . | . | very weak to weak | very weak to weak | . |
| First leaf: Shape of the tip of first leaf | . | . | pointed to round | round to spatulate | . |
| Leaf: undulation of the margin of the blade | strong | medium - strong | strong | slight | medium |
| Leaf: angle between blade and stem (on leaf just above upper ear) | small | very small - small | v. small | large | small |
| Leaf: curvature attitude of blade (on leaf just above upper ear) | recurved | strongly recurved | strongly recurved | slightly recurved | Recurved |
| Leaf: anthocyanin colouration of sheath (in middle of plant) | absent | Absent | absent | absent | very weak |
| Leaf: width of blade (leaf of upper ear) (cm) | medium | wide (9.8 cm) | 9.2 | 9.05 | Narrow |
| Stem: degree of zig-zag | straight | straight/Absent | absent/v.slight | absent/very slight | straight |
| Stem: anthocyanin colouration of brace roots | . | Absent/very weak | absent to very weak | weak | . |
| Stem: anthocyanin colouration of internodes | very weak - weak | Absent | absent to very weak | weak | weak |
| Tassel: time of anthesis (on middle third of | | 61 | 66 | 66 | |

| | | | | | |
|---|---|---|---|---|---|
| main axis, 50 % of plants) (Days at Kiboko) | | | | | |
| Tassel: anthocyanin colouration at base of glume (in middle third of main axis) | very weak - weak | Absent/very weak | absent | weak | strong |
| Tassel: anthocyanin colouration of glumes excluding base (in middle third of main axis) | weak - medium | very weak - weak | weak | weak - medium | weak |
| Tassel: anthocyanin colouration of anthers (in middle third of main axis on fresh anthers) | weak - medium | very weak - weak | absent | absent/very weak | medium - strong |
| Tassel: density of spikelets (in middle third of main axis) | medium | medium | dense | lax - medium | dense |
| Tassel: angle between main axis and lateral branches (in lower third of tassel) | small | very small - small | very small | very small | small |
| Tassel: attitude of lateral branches (in lower third of tassel) | straight, slight opening | straight, bunchy & upright | straight | straight | very slight recurved |
| Tassel: number of primary lateral branches (counts) | 15.8 (13~18) | 9-17 | 12 | 13.6 | 12.6 |
| Tassel : length of main axis above lowest side branch (cm) | 45.88 | 42 cm | 9 very long 35.3cm | 9 very long 38.8cm | 32.12 |
| Tassel: length of main axis above upper side branch (cm) | 30.25 | 25.9 cm | 9 very long 25.1cm | 7 long 25cm | 23.32 |
| Tassel:- length of side branches (cm) | 23.1 | 19.4 cm | 17.4 | 18.5cm | 17.43 |
| Tassel: curvature of lateral branches | straight upright | Straight & upright | straight | straight | upright |
| Plant : Ear height (up to flag leaf) (cm) | 120.5 | 130.5 | 62.2 | 89.5 | 76.5 |
| Plant : height of plant including the tassel (cm) | 276 | 278.5 | 153 | 220 | 194.5 |
| Plant: ratio between height of insertion of upper ear to plant height | 0.436594203 | 0.468581688 | 0.41 | 0.406818182 | 0.393316195 |
| Ear: time of silk emergence (50% plants) (days) | | 61 | 68 | 68 | |
| Ear: anthocyanin colouration of silks | present | Present | present | present | present |

| | | | | | |
|---|---|---|---|---|---|
| Ear: intensity of anthocyanin colouration of the silks | medium | medium - strong | weak to medium | weak | medium |
| Ear: length of peduncle (cm) | 9.8 | 7.01 | short(3) 5.4cm | long(7) 10.8cm | 5.2 |
| Ear: length without husk (cm) | 16.18 | 14.8 | very short(1) 9.1cm | medium(5) 15.0cm | 9.1 |
| Ear: diameter without husk (in middle) (cm) | 5.27 | 4.51 | very short(1) .8cm | short(3) 4.5cm | 3.15 |
| Ear: length of husk above tip of the ear | 4.86 | 6.3 | long(7) 5.4cm | long(7) 6.5cm | 8.45 |
| Ear: shape | conico-cylindrical | conico - cylindrical | conico-cylindrical | conico-cylindrical | cylindrical |
| Ear: number of rows of grains | 14~18 | Medium(5) 12-16 | medium(5) 14-16 | medium(5) 12-15 | 12 - 14 |
| Ear: type of grain (in middle third of ear) | | Dentlike | 2 flintlike | 1 flint - intermediate | flint |
| Ear: colour of top of grain | white | white | white | white | white |
| Ear: colour of dorsal side of grain | white | white | white | white | white |
| Ear: anthocyanin colouration of glumes of cob | absent | Absent | absent | absent | Absent |
| Kernel: row arrangement | regular | Regular/straight | irregular-straight | regular at top of ear and irregular bottom | Regular |