Application for Release of five cassava varieties in the Lowland Humid to Mid Altitude Sub Humid Agro-ecologies of Tanzania.

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VARIETY INFORMATION

1. (a) Name of the crop: Cassava

   (b) Botanical name: *Manihot esculenta* Crantz

   (c) Family name: Euphorbiaceae

   (d) Chromosome number: 2n = 36 (Diploid)

   (e) Mode of pollination: Cross pollinated

2. (a) Proposed name: **EYOPE**

   (b) Name under which it is tested: **EYOPE**

   (c) Agency responsible for development**: Institute de Investigacio Agraria de Mozambique (IIAM)**

   (d) Cultivar pedigree: **MUCUDO MUEVIA x MZ89186**

3. (a) Proposed area for release: **Lowland to Mid-altitude Sub-humid**

   (b) Proposed elevation: **0-1400 m.a.s.l.**

   (c) Agency responsible for supply of pre-basic seeds: **TARI**, **Root and Tuber Crops Research Program**

   (d) Agency responsible for maintenance: **TARI**, **Root and Tuber Crops Research Program**

4. Points of merits, drought tolerance, disease resistance, lodging resistance, etc.:

   Tolerance to Cassava Brown Streak Disease and Cassava Mosaic Disease, High Dry Matter Content, Tolerance to CBSD Root Necrosis.

5. Yield data /Comparison/Trial

   (a) Yield Compared to Check **30.7 tons/ha**

   (b) Yield in Farmers field…….**16.6 tons/ha**

1 (a) Name of the crop: Cassava

(b) Botanical name: *Manihot esculenta* Crantz

(c) Family name: Euphorbiaceae

(d) Chromosome number: 2n = 36 (Diploid)

(e) Mode of pollination: Cross pollinated

2. (a) Proposed name: **KENYA**

(b) Name under which it is tested: **F10-30-R2**

(c) Agency responsible for development: **Kenya Agricultural and Livestock Research Organisation (KALRO)**

(c) Cultivar pedigree: **KALULU X AMBALI**

3. (a) Proposed area for release: **Lowland to Mid-Altitude Sub-humid**

(b) Proposed elevation: **0 -1400 m.a.s.l.**

(c) Agency responsible for supply of pre-basic seeds: TARI, **Root and Tuber Crops Research Program**

(d) Agency responsible for maintenance: **TARI, Root and Tuber Crops Research Program**

4. Points of merits, drought tolerance, disease resistance, lodging resistance, etc.:

Tolerance to Cassava Brown Streak Disease and Cassava Mosaic Disease, High Dry Matter Content, Tolerance to CBSD Root Necrosis.

5. Yield data /Comparison/Trial

(a). Yield Compared to Check **35.3 tons/ha**

(b). Yield in Farmers field…**25.6 tons/ha**

VARIETY INFORMATION

1 (a) Name of the crop: Cassava

(b) Botanical name: *Manihot esculenta* Crantz

(c) Family name: Euphorbiaceae

(d) Chromosome number: 2n = 36 (Diploid)

(e) Mode of pollination: Cross pollinated

2 (a) Proposed name: **NAROCASS1**

(b) Name under which it is tested: **TZ130**

(c) Agency responsible for development: **National Agricultural Research Organization (NARO) Uganda**

(d) Cultivar pedigree: **KIBAHA HS**

3. (a) Proposed area for release: **Lowland** to **Mid-Altitude Sub-humid**

(b) Proposed elevation: **0 - 1400 m.a.s.l.**

(c) Agency responsible for supply of pre-basic seeds: **TARI, Root and Tuber Crops Research Program**

(e) Agency responsible for maintenance: **TARI, Root and Tuber Crops Research Program**

4. Points of merits, drought tolerance, disease resistance, lodging resistance, etc.:

Tolerance to Cassava Brown Streak Disease and Cassava Mosaic Disease, High Dry Matter Content, Tolerance to CBSD Root Necrosis.

5. Yield data /Comparison/Trial

(f) Yield Compared to Check **39.4 tons/ha**

(g) Yield in Farmers field……**19.3 tons/ha**

VARIETY INFORMATION

(a) Name of the crop: Cassava

(b) Botanical name: *Manihot esculenta* Crantz

(c) Family name: Euphorbiaceae

(d) Chromosome number: 2n = 36 (Diploid)

(e) Mode of pollination: Cross pollinated

(a) Proposed name: **ORERA**

(b) Name under which it is tested: **ORERA**

(c) Agency responsible for development: **Institute de Investigacio Agraria de Mozambique (IIAM)**

(d) Cultivar pedigree: **LIKONDE HS**

3. (a) Proposed area for release: **Mid-altitude Sub-humid**

(b) Proposed elevation: **0 -1400 m.a.s.l.**

(c) Agency responsible for supply of pre-basic seeds: **TARI, Root and Tuber Crops Research Program**

(d) Agency responsible for maintenance: **TARI, Root and Tuber Crops Research Program**

4.Points of merits, drought tolerance, disease resistance, lodging resistance, etc.:

Tolerance to Cassava Brown Streak Disease and Cassava Mosaic Disease, High Dry Matter Content, Tolerance to CBSD Root Necrosis.

5.Yield data /Comparison/Trial

(h) Yield Compared to Check **28.2 tons/ha**

(i) Yield in Farmers field **22.2 tons/ha**

1. (a) Name of the crop: Cassava

   (b) Botanical name: *Manihot esculenta* Crantz

   (c) Family name: Euphorbiaceae

   (d) Chromosome number: 2n = 36 (Diploid)

   (e) Mode of pollination: Cross pollinated

2. (a) Proposed name: **YIZASO**
(b) Name under which it is tested: **YIZASO**
(c) Agency responsible for development: **Department of Agricultural Research, Malawi**
(d) Cultivar pedigree: **NOT AVAILABLE**

3. (a) Proposed area for release: **Lowland to Mid-Altitude Sub-humid**

(b) Proposed elevation: **0 -1400 m.a.s.l.**

(c) Agency responsible for supply of pre-basic seeds: TARI, **Root and Tuber Crops Research Program**

(d) Agency responsible for maintenance: **TARI, Root and Tuber Crops Research Program**

4. Points of merits, drought tolerance, disease resistance, lodging resistance, etc.:

   Tolerance to Cassava Brown Streak Disease and Cassava Mosaic Disease, High Dry Matter Content, Tolerance to CBSD Root Necrosis.

5. Yield data /Comparison/Trial

   (a). Yield Compared to Check **30.9 tons/ha**,

   (b). Yield in Farmers field **24.2 tons/ha**

1.0 Introduction

Cassava is one of the major food and cash crops in Tanzania. It ranks second to maize in most parts of the country as a source of energy contributing approximately19-21% of the total energy requirement (FAO, 2004). It has been considered as a food security crops over decades (Jarvis et al., 2012) but it is increasingly becoming a commercial crop because the potential for sale of fresh roots and leaves, processed products and planting materials is increasing. In Tanzania, out of the 7 main agro-ecologies, cassava is grown in mainly four, namely: a) lowland warm sub-humid (includes all the coastal areas), b) Mid-altitude semi-arid (includes areas in central Tanzania, Dodoma, Singida, parts of Manyara regions), (c) mid-altitude sub-humid (Mwanza, Kigoma; Mara; Kagera, Kigoma. The crop is increasingly being recognized as a raw material for industrialization in starch, high quality cassava flour, dried chips for starch and Nudo industries, breweries among others.

In Tanzania average cassava production is about 5.5 t/ha lower than the African average production of 8.4 t/ha (FAOSTAT, 2016). This is mainly caused by susceptibility of commonly growing farmer-preferred varieties to major diseases including cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). Tanzania is a country where Cassava Brown Streak Disease (CBSD) was first reported in 1930's (Storey, 1936) and has since expanded territory to affect cassava production in the entire country and beyond (Ntawuruhunga and Legg, 2007). Resistance Breeding strategies are being taken in Tanzania to combine resistance to CMD and CBSD in order to come up with varieties that have due resistance to both viral diseases.

In Tanzania the mandate to generate new cassava varieties that are resistant to important pests and diseases, high dry matter yield per unit area, good root characteristics and acceptability by consumers and processors is vested into Root and Tuber Crops Research Program. In the evaluation and selection of new varieties, breeding lines pass through various evaluation stages namely seedling nursery that is raised from botanical seeds that are generated through genetic crosses of parents with good combining ability. The second stage is Clonal Evaluation trial which is a result of cloning of selected seedlings from seedling nursery; this is followed by replicated Preliminary Yield trial (PYT) conducted in a single on station location. Selected clones from PYT (about 10 to 20 clones) are advanced to Advanced Yield trial (AYT) and planted in 3-4 multi-locational replicated trials. Based on their performance after a year, 5 to 10 clones from AYT are advanced to Uniform yield trial to confirm their performance before they tested on farm.

In 2014 a regional cassava 5CP project funded by The Bill and Melinda Gates Foundation was initiated and the International Institute of Tropical Agriculture as a grantee. This project involved five countries namely Kenya, Malawi, Mozambigue, Tanzania and Uganda. Each of the countries contributed their five best genotypes to make a total of 25 genotypes in additional to two susceptible checks. All these genotypes had gone through an evaluation and selection process as outlined above. These genotypes were evaluated for two seasons under Genotype by environment trials to test their performance for mainly resistance to diseases, root yield and Dry matter content

in diverse agro-ecologies. The performance evaluation of 25-28 cassava varieties was done in 2015/2016 and 2016/2017 consecutively. In Tanzania they were tested in eight locations and out of these genotypes five clones showed good performance against cassava brown streak disease (CBSD) and cassava mosaic disease (CMD) and their performances are presented below for official release consideration

2.0 Material and Methods

Five varieties, namely Eyope, F10-30R, NAROCASS1, Orela and Yizaso (Table 1) from Mozambique, Kenya, Uganda, Mozambique and Malawi respectively were evaluated for their performance in four locations of Tanzania. NAROCASS1 and Yizaso are officially released varieties in Uganda and Malawi respectively while Eyope and Orela are released in Mozabique. Albert and Kibandameno (not released) were included as standard susceptible checks for CBSD and CMD respectively across all sites. Mkombozi and Mkuranga1 were used as a improved checks due to their best yield performance in the mid altitude sub-humid and lowland humid environments respectively. All the study materials were virus indexed, acclimatized and multiplied under minimal disease pressure at Makutupora and Maruku (Tumwegamire et al. 2018) to ensure similar health status at the onset of the trials.

A total of ten sites representing the diverse agro-ecologies for cassava in Tanzania were used over the two seasons (Table 2). Nine sites were used in the first season that run between late 2015 and early 2017. Ten sites were used in the second season that run between late 2016 and early 2017. Seven sites were used for both seasons while two and three sites were used only in first season and second season respectively. For this report data from six locations are presented

The trials were established at the onset of rainfall in different agro ecological zones. For example, in Lake Zone the trials were established between November and December; in the Southern Zone the trials were planted between December and February and in the Eastern Zone, the trials were planted between March and April. All the trials were under rain-fed conditions throughout the growing season. The experimental design used was Randomized complete block design (RCBD) in three replications. The plot size used was 7 rows of planted with 6 stem cuttings (42 $m^{2)}$ spaced at 1m within the rows.

Data was collected for CBSD and CMD leaf symptoms severity using scale of 1-5 where 1=Asymptomatic, 2=Mild severity and 5 most severe symptoms. First season: CBSD and CMD shoot symptoms in all experimental sites was done at 3MAP, 6MAP, 9MAP and 12MAP. Second season, CBSD and CMD foliar symptoms were recorded at 3, 6, 9 and 12 MAP. The average disease score for each plot was used to represent the disease severity while the number of symptomatic diseased plants to the total net plot assessed was used to calculate disease incidence on respective plot.

Harvesting was done at 12MAP by uprooting all plants in the (maximum 20) in the inner net plot. All roots were collected together counted and weighed using a balance and recorded in kilograms.

The root yield in tons per hectare was calculated based on total root weight and area harvested in relation to a hactre. The shoots were also weighed (in Kgs) and recorded. The total biomass was calculated as a sum of root and shoot weights. Harvesting index (percentage) was obtained through root weight to the total biomass multiplied by one hundred. Fresh root dry matter content was determined using the specific gravity method as described by Teye *et al*. (2011) using a sample freshly harvested roots from net plot. The percentage marketable roots were calculated by taking number of marketable roots over total number of roots harvested times one hundred.

The CBSD root necrosis symptoms were evaluated using scores 1 to 5 where 1= was clean without necrotic lesions, 2= mild necrotic symptoms and 5= highly severe with necrotic rot (Hillocks and Thresh, 2000). The average of the scores from each net plot was used to get root necrosis severity while the sum of roots with necrosis to the total roots harvested in a plot was used to get the CBSD root necrosis incidence.

The data were analyzed using Statistical Analysis Software Genstat version 14.2 based on Randomised Complete Block Design and means were separated using the Fischers' Protected LSD Test.

3.0 Results

For purposes of this report, focus has been made on a few performance variables namely: foliar severities and incidences of CBSD and CMD, CBSD root necrosis damage, fresh root yield, harvest index, and dry matter content. These traits are currently key traits of a selection index for cassava in Tanzania.

Table 3 presents data in the season 2015/2016 for Bunda, when foliar CMD severities and incidences were lowest (1 and 0%). Except for susceptible check genotypes foliar CBSD severities and incidences for test genotypes did not exceed 10%, the check genotypes with CBSD severities above 10 % were Mkombozi (42.2) and Sauti (47.2%). Most of test genotypes NAROCASS1 (15.93) and Orera (12.7) showed significantly higher yield than check Mkombozi (4.66).

Table 4 presents data for Mean root yield and viral severities and incidences for cassava genotypes evaluated at Naliendele for season 2015/16. Generally foliar CBSD root incidences and severities were low or absent in all genotypes. Root CBSD severities and incidences were low in test genotype but higher in checks Kibandameno (2.44 and 7.15%), Albert (3.43 and 24.16%) and Tajirika (2.26 and 21.56%). Fresh root yield was significantly highest on NAROCASS1 (30.26), Yizaso (23.56) and lowest in check Kibandameno (10.55). Genotype with highest dry matter content was Albert (30.63) while the lowest was Mkombozi (22.3).

Foliar CBSD and CMD severities and incidences were low or absent with exception of Kibandameno (1.66 and 3.4%) and (3.16 and 100%) respectively. Harvest index ranged from 0.59 (NAROCASS1) to 0.32 for local check (Kibandameno). Root CBSD severities and incidences were significantly low in all test genotypes. Significant high fresh root yield was shown by

Mkuranga1 (23.23) and NAROCASS1 (21.40) while the lowest fresh root yield was shown by local check Kibandameno (6.8)

Table 6 show that foliar CBSD severities and incidences at Ukiriguru were absent except for a susceptible genotype Kibandameno (1 and 10.06%) and CMD severities and incidences were absent at this site. The root CBSD severities and incidences were the highest in check Kibandameno (2.9 and 31.93) other genotypes had mild symptoms. The highest root yield was registered by NAROCASS1 (20.4). Dry matter content was significantly high in all genotypes except local check Mkombozi (20.86).

In 2016/2017 season, unlike previous season foliar CBSD severities and incidences were significantly low for the test genotypes with root CBSD severities and incidences less than 2.5 %. Foliar CMD severities and incidences were absent except for check variety Kibandameno (3.66 and 4.33%). During harvesting root CBSD severities and incidences was relatively low (1 and 5%) except check Kibandameno (2.6 and 26.2), Mkombozi (2.36 and 13.80) and Albert (3.06 and 24.40%) (Table 6).

In terms of root CBSD incidences, overall means were comparably lower for Mkuranga 1, Orera, NAROCASS1, Mkuranga1 and Eyope both seasons. Mkombozi overall mean root CBSD necrosis incidences were comparable to the standard checks Kibandameno and Albert during the two seasons. In season one Albert, Kibandameno and Tajirika had relatively high incidences of root CBSD necrosis at all Lake Zone representative sites. However, in season two Kibandameno, Albert and Tajirika had higher root CBSD necrosis incidences. Other test genotypes had lower incidences while at Naliendele there was no CBSD root necrosis incidence (Table 4).

Further genotype performances at each location in the two different seasons have been presented for root yield and root CBSD incidences (Tables 3, 4, 5, 6, 7 and 8). In terms of fresh root yield, all the test genotypes had higher or close root yields compared to the local check Mkombozi in the two representative sites for the lake zone sites (Bunda and Ukiriguru). For example, in season one Mkombozi was out yielded by all test genotypes at Bunda. A nearly similar result was obtained at Ukiriguru during season two where all the test genotypes yielded higher or nearly similar to Mkombozi. In season one Yizaso, NAROCASS1, Eyope, F10_30R2, Mkuranga1 and Orera had higher root yields than Mkombozi at Bunda, while NAROCASS1 had higher root yields than Mkombozi at Bunda, Ukiriguru, Naliendele and Chambezi. In season two only Yizaso yielded higher than Mkombozi at Naliendele (Table 7).

Evaluations were repeated for two seasons (or two years) and Table 10 shows mean performance of the different yield and viral disease variables through seasons. The result show that root CBSD severity and incidences (2.4 versus 2.06) and (19.5 versus 8.98) respectively were significantly higher in season 1 than season 2 and fresh root yield was also higher in season 1 than season 2 (14.77t/ha versus 14.34) while dry matter content was higher in season 2 than season 1(29.9% versus 32.41%). Incidences for foliar CBSD, foliar CMD and root CBSD necrosis were not

significantly different between the two seasons. However, in season 2 there were higher CMD severities and incidences than season 1 across test sites. All the traits measured for performance assessment varied significantly between genotypes (varieties) and sites.

Mean performance across sites for fresh root yield for season 1 and season 2 is shown in Table 11 and Table 12 and fresh root yields were highest at Naliendele (21.66 t/ha), Chambezi (17.92t/ha) and Ukiriguru (13.84 t/ha) and lowest fresh root yield was registered at Bunda (8.83) in season 1. Unlike season 1, Ukiriguru yielded highest (27.4t/ha), followed by Naliendele (15.5t/ha) and the lowest was Bunda (14.2t/ha).

Table 13 and 14 presents data for seasons 2015/16 and 2016/ 2017, on diseases severities. Albert had the highest root severities (2.66), Kibandameno (2.51), Tajirika (2.38). However, all candidate genotypes had mild severities less than 2. In 2016/2017 season, mild severities at relatively high incidences of root CBSD necrosis were observed for check varieties Tajirika (2.6), Albert (2.4) and Kibandameno (2.4) while candidate genotypes maintained comparatively low severities to local check Mkombozi.

However, no foliar CBSD symptoms were observed on F10_30R2, Mkuranga1 and Orera. Foliar CBSD severities and incidences were significantly high at Bunda and low or absent in other sites. However, CBSD root necrosis was recorded for all the sites, being significantly higher at Bunda and Ukiriguru. Other sites had lower severities and incidences. Foliar CMD severity and incidences absent at all sites in season 1. Highest harvest index was significantly high at Chambezi (50.9), Ukiriguru (50.1) and Naliendele (49.3) and was the lowest at Bunda (44.4).

Mean root yields were significantly different between genotypes, ranging between 11.77 t/ha and 21.96t/ha in season one, and between 13.4 t/ha and 25.2 t/ha in season two (Table 2). In season one NAROCASS1 (21.96 t/ha) had the highest root yields in season one while Orera had the lowest (11.77 t/ha) (Table 11) . Other high yielding varieties included Albert (18.49 t/ha), Yizaso (16.84), Sauti (15.42t/ha) and Mkuranga1 (14.15 t/ha). In season two, Sauti had the highest root yields (25.2t/ha), Yizaso (23.7t/ha), NAROCASS1 (21t/ha) while F10_30R2 (13.4 t/ha) had the lowest (Table 12). The other high yielding varieties are Kibandameno (18.1 t/ha), Mkombozi (17.5 t/ha) and Mkuranga1 (17 t/ha) and Eyope (16t/ha) (Table 12).

4.0 Discussions

The turbulence in performance of different yield and disease variables due to seasonal effects (Table 10) are not surprising and are possibly associated with climate change effects where patterns of different weather conditions seem to vary with each season. There seem to have been better plant establishment in season one than season two as implied by the number of plants harvested (data not presentd). This finding might have caused a negative implication on root yield estimates in season two (14.34t/ha) which were observed to be lower than for season one (14.77 t/ha). The higher root CBSD severities (2.4) in season one suggests higher CBSD pressure in that season compared to season two. However, this is confirmed by root CBSD severity and root CBSD

incidences which were significantly different between the two seasons. Unlike CBSD, there seem to have been low CMD pressure in both seasons (fCMDsev =1) than season one (fCMDsev = 0.0). This is not confirmed by the incidences which were not significantly different. Dry matter was higher in season two than one for unclear reasons. Dry matter content in cassava is a highly physiological trait that varies a lot with the moisture content at harvest. The dry matter content is usually lower if harvesting is done in rainy season compared to dry season.

The strongly significant variation in performance across sites (Anova table not presented) confirms that the study sites were distinct. Tanzania is large with diverse agro-ecological conditions which probably are evidenced by the current study sites. The relatively high foliar CBSD severities and incidences at Bunda and Ukiriguru (two seasons) suggest high CBSD pressure at these sites. This finding is confirmed by relatively higher root CBSD necrosis severities and incidences at the same sites. Chambezi has been reported (Rudolph Shirima and James Legg personal communication) as a high CBSD/CMD high pressure site but only in *Vuri* (short rains season, October to December/January) season. In season one Naliendele (21.7 t/ha) and Chambezi (18.0 t/ha) had outstanding root yield performance while Bunda (8.7 t/ha) and Ukiriguru (13.8 t/ha) had lowest root yields. In season two, it was instead Ukiriguru (27.4 t/ha) that had outstanding roots yield followed by Naliendele (15.5 t/ha). Overall, yield is highly affected by changes in the environment and therefore difficult to stabilize unless estimated under controlled environments. Like root yields the findings show inconsistent dry matter performance in different sites over the two seasons. As earlier reported, root dry matter estimates in cassava can change with the prevailing weather conditions at harvest giving low and high estimates if it is rainy and dry weather conditions respectively.

The genotypes were also significantly different (Anova table not presented) for all the performance parameters measured in this assessment. Under seemingly high CBSD pressure experienced in season one, it was Kibandameno that showed highest root CBSD incidence (14.1%) followed by Albert (8.9%). The rest of the varieties had mild severities and incidences including the standard checks Mkombozi. The low foliar CBSD severity and incidence for Albert during season one is surprising given its known susceptibility status. However, mild root CBSD necrosis severities with relatively high incidences were observed in both seasons for Albert as it was for Kibandameno. .

In season one NAROCASS1 (21.96 t/ha), Yizaso (16.84 t/ha), Albert (18.49t/ha) and Sauti (15.42) yielded higher than the local check Mkombozi (14.84 t/ha) while in season two the varieties namely Sauti (25.2t/ha), Tajirika (24.5t/ha), Yizaso (23.7t/ha) and Albert (18.4t/ha) yielded higher than the Mkombozi (17.5t/ha) (Tables 2 and 3). The genotype by environment interactions for yield performance is known and explains its instability across seasons and locations. This result highlights the potential of the varieties if proper times of planting and agronomic practices are adopted. A similar close understanding of the root CBSD necrosis incidence across the sites reveal that all the varieties except Tajirika and Kibandameno have advantage of CBSD/CMD dual resistance to the local check Mkombozi.

5. On farm Evaluation and Farmers Assessment

Performance of varieties on farm

Performance of cassava genotypes evaluated on farm at different sites for 2018/2019 season is presented below. The sites that were used include Bunda, Magu and Muheza and up to 7 genotypes including one local check per site were evaluated for 2018/2019 season to determine their performance in terms of selected root yield tons/ha, harvest index, CBSD root severity and incidence. (Table 17 and 18).

There were significant differences between genotypes in root yield on farm trials at Bunda, Magu and Muheza and significant differences observed between genotypes (P>0.05). At Bunda and Magu root yield in on farm trials ranged from 17.95t/ha (TZ-130) to 6.8t/ha (F10-30-R2) and 15.16t/ha (TZ-130) to 6.11t/ha (Mkombozi) respectively (Table 15and 16. With exception of genotype F10-30-R2, the rest of the candidate genotypes had higher root yield than local check At Magu, root yield in mother trial ranged from 49.5 (TZ-130) to 14.27(Segeledi). In addition, there was significant differences between genotypes in harvest index for on farm trials at Bunda and Magu and there was significant differences observed between genotypes (P>0.05). Almost at all sites, the best genotypes with higher harvest index across sites were TZ-130, Mkombozi and EYOPE. At Bunda, except for genotype ORELA, the rest candidate genotypes had the highest harvest index (Table 1-2). At Magu, harvest index in mother and baby trials ranged from 0.72 (ORELA) to 0.47 (ORELA) and 0.84(TZ-130) to 0.5 (SEGELEDI) respectively. To get feedback from farmers' new varieties were participatory evaluated by farmers with agreed criteria. The criteria used to test varieties by farmers include availability of plating material, variety tolerance to pests and disease, drought tolerance, early maturity, yield, appearance, pulp color, fresh color, taste, DMC and general acceptability. Farmers' assessment results and pair-wise ranking for 7 genotypes at Bunda are summarized in Table17 and 18. Overall ranking indicated that NAROCASS1 to be the most preferred genotype, followed by Eyope and Yizaso in that Order. The genotype Mkombozi was the least preferred genotype among improved genotypes followed by F10-30-R2 because both were less tolerant to diseases. On other hand NAROCASS1 and Eyope were preferred by farmers due to the fact that these genotypes were high yielding with medium sized roots and exhibited good tolerance to CMD and CBSD.

Farmers Assessment

Farmers' assessment results and pair-wise ranking for 7 genotypes at Magu are presented in Table 19 and 20. Overall ranking indicated that NAROCASS1 to be the most preferred genotype, followed by Orela and Eyope in that order. The genotype Mkombozi was the least preferred genotype among improved genotypes followed by F10-30-R2 because both were less tolerant to diseases. On other hand NAROCASS1 and Orela were preferred by farmers due to the fact that these genotypes were high yielding, good taste and showed good tolerance to CBSD.

Using eleven attributes that were used to assess the accessions, farmers at Muhaga and Mkuzi villages indicated that NAROCASS1and Eyope were highly accepted at Mkuzi village than the rest of the varieties. Whereas, NAROCASS1and F10-30R indicated to be highly accepted at Muhaga village. NAROCASS1 was highly accepted due to its high yielding ability by having a

mean score of 5 (Table 8). Similar score was obtained across the villages. For the other field attributes, NAROCASS1 scored between 3 and 5, indicating to have

Conclusions

Our assessment reveals that varieties **Eyope, F10-30R2, NAROCASS1, Orera and Yizaso** can perform very well in the Lowland humid to Mid Altitude Sub Humid agro-ecology of Tanzania. The yield estimates are comparable with Mkuranga1 and Mkombozi, the current best performing varieties in Tanzania. Performance on farm and farmers' assessment show good acceptability by the farmers in these areas. There is a higher potential for root yield performance of the varieties in the targeted areas if farmers practice early time planting and observe good agronomic practices. Importantly, our findings reveal that the varieties present dual tolerance to CBSD and CMD, a factor that is critical for increased cassava productivity in the Tanzania. To date the effects of CBSD in lowering cassava productivity in Tanzania is increasing and need for resistant/tolerant cassava varieties is eminent. We therefore recommend for their release in the Lowland humid to Mid Altitude Sub Humid agro-ecologies

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Table 1. Cassava genotypes evaluated in different agro ecological environments of Tanzania

Genotype	Country of origin	CBSD resistance	CMD resistance	Release status
Eyope	Mozambique	Moderate	Moderate	Released
F10-30-R2	Kenya	Moderate	Moderate	Evaluation
Mkombozi	Tanzania	Weak	Strong	Released
Mkuranga1	Tanzania	Moderate	Moderate	Released
Orera	Mozambique	Moderate	Moderate	Released
TZ130	Uganda	Moderate	Strong	Released
Yizaso	Malawi	Moderate	Moderate	Released
Albert	Tanzania	Susceptible	Strong	Local landrace
Kibandameno	Kenya/Tanzania	Susceptible	Susceptible	Local landrace

Table 2. Sites used for evaluation of selected cassava varieties in Tanzania for two seasons between 2015-2017

Sites	CBSD pressure	Zone	Altitude
Bunda	High	Lake	1277 m
Ukiruguru	Moderate	Lake	1229 m
Chato	High	Lake	1168 m
Maruku	Low	Lake	1352 m
Naliendele	Moderate	Southern	111 m
Suluti	Moderate	Southern	1020 m
Chambezi	High	Eastern	48 m
Ilonga	Low	Eastern	494 m
Ifakara (Katrin)	Low	Eastern	427 m
Nachingwea	Unknown	Southern	380 m

Table 3: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Bunda in Tanzania for 2015/2016 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY (t/ha)	DMC
Albert	1.60	10.00	1.00	1.00	0.58	3.26	42.60	11.10	32.06
Eyope	2.00	4.20	1.00	1.00	0.48	2.50	5.20	8.16	30.63
F10-30-R2	1.00	0.10	1.00	1.00	0.36	2.20	10.46	7.40	30.33
Kibandameno	1.00	0.10	1.00	1.00	0.45	3.06	55.90	9.50	33.63
Mkombozi	3.50	42.20	1.00	1.00	0.50	1.70	39.10	4.66	23.16
Mkuranga1	1.00	1.00	1.00	1.00	0.35	2.00	3.50	6.10	31.20
NAROCASS1	1.90	10.06	1.00	1.00	0.67	2.23	11.10	15.93	28.60
Orera	1.00	1.00	1.00	1.00	0.39	2.40	11.70	12.70	32.16
Sauti	4.70	47.20	1.00	1.00	0.37	3.30	67.80	3.73	25.83
Tajirika	3.50	12.50	1.00	1.00	0.41	2.8	16.40	6.45	28.66
Yizaso	3.00	10.05	1.00	1.00	0.39	2.50	12.70	8.20	29.75
Mean	**2.05**	**12.50**	**1.00**	**1.00**	**0.45**	**2.50**	**26.47**	**8.76**	**29.73**
CV	**62.82**	**140.70**	**7.80**	**5.59**	**13.16**	**23.20**	**56.96**	**37.00**	**10.11**
LSD	**0.65**	**14.3**	**0.87**	**0.00**	**3.6**	**1.2**	**15.4**	**7.8**	**2.2**

CBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 4: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Naliendele in Tanzania for 2015/2016 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY(t/ha)	DMC%
Albert	1.00	0.00	1.00	0.00	0.34	3.43	24.16	19.7	30.63
Eyope	1.00	0.00	1.00	0.00	0.47	1.66	0.4	19.8	26.76
F10_30R2	1.00	0.00	1.00	0.00	0.43	1.66	2.43	18.23	29.76
Kibandameno	1.30	0.00	1.00	0.00	0.45	2.44	7.15	10.555	27.65
Mkombozi	1.00	0.00	1.00	0.00	0.53	1.7	2.3	20.55	22.3
Mkuranga1	1.00	0.00	1.00	0.00	0.51	1.33	0.66	17.01	27
NAROCASS1	1.00	0.00	1.00	0.00	0.65	1.66	0.33	30.26	26.46
Orera	1.00	0.00	1.00	0.00	0.46	2.26	2.06	14	26.86
Sauti	1.00	0.00	1.00	0.00	0.51	1.00	0.11	23.8	24.83
Tajirika	1.00	0.00	1.00	0.00	0.51	2.26	21.56	18	n/a
Yizaso	1.00	0.00	1.00	0.00	0.50	2.53	2.46	23.56	27.8
Mean	**1.01**	**0.00**	**1.00**	**0.00**	**0.49**	**1.97**	**5.83**	**19.82**	**27**
CV	**17.68**	**0.00**	**0.00**	**0.00**	**15.09**	**33.11**	**57.64**	**30.05**	**6.4**
LSD	**0.3**	**0.00**	**1.1**	**0.00**	**1 2.7**	**4.9**	**6.9**	**7.8**	**4.2**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 5: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Chambezi in Tanzania for 2015/2016 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY(t/ha)	DMC
Albert	1.00	0.00	1.00	0.00	0.55	1.00	2.80	19.33	32.00
Eyope	1.00	0.00	1.00	0.00	0.48	1.00	0.10	14.66	28.43
F10-30-R2	1.00	0.00	1.00	0.00	0.48	1.33	0.50	14.23	33.26
Kibandameno	1.66	3.40	3.16	100	0.32	1.55	3.03	6.8	30.80
Mkombozi	1.00	0.00	1.00	0.00	0.59	1.66	2.96	20.5	24.00
Mkuranga1	1.00	0.00	1.00	0.00	0.59	1.33	0.40	23.23	30.60
NAROCASS1	1.00	0.00	1.00	0.00	0.59	1.33	0.36	21.40	28.50
Orera	1.00	0.00	1.00	0.00	0.38	1.33	1.06	10.73	29.40
Sauti	1.00	0.00	1.00	0.00	0.52	1.00	0.10	18.33	30.60
Tajirika	1.00	0.00	1.00	0.00	0.52	1.66	0.33	16.46	29.60
Yizaso	1.00	0.00	1.00	0.00	0.54	1.66	1.83	23.6	29.43
Mean	**1.06**	**0.30**	**1.20**	**9.09**	**0.51**	**1.35**	**1.23**	**17.2**	**29.70**
CV	**32.82**	**45.8**	**19.23**	**0.45**	**11.55**	**45.50**	**150.70**	**30.21**	**9.53**
LSD	**0.6**	**0.52**	**1.1**	**0.3**	**9.7**	**1.75**	**0.72**	**6.46**	**12.36**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 6: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Ukiriguru in Tanzania for 2015/2016 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY(t/ha)	DMC
Albert	1.00	0.00	1.00	0.00	0.43	2.5	0.1	14.4	28.2
Eyope	1.00	0.00	1.00	0.00	0.48	2.366	1.26	11.56	30.3
F10_30R2	1.00	0.00	1.00	0.00	0.56	1.87	12.7	14.46	27.96
Kibandameno	1.2	10.06	1.00	0.00	0.44	2.9	31.93	17.83	27.36
Mkombozi	1.00	0.00	1.00	0.00	0.46	2.8	22.7	14.83	20.86
Mkuranga1	1.00	0.00	1.00	0.00	0.52	2.0	2.4	11.4	27
NAROCASS1	1.00	0.00	1.00	0.00	0.59	2.0	7.9	20.4	26.3
Orera	1.00	0.00	1.00	0.00	0.32	1.0	0.1	10.22	26.73
Sauti	1.00	0.00	1.00	0.00	0.46	2.53	19.86	12.93	31.5
Tajirika	2.00	3.4	1.00	0.00	0.56	2.2	20.1	13.83	27.76
Yizaso	2.33	0.00	1.00	0.00	0.53	2.26	17.44	15	30
Mean	**1.22**	**1.38**	**1.00**	**0.00**	**0.49**	**2.25**	**14.9**	**14.25**	**27.66**
CV	**74.47**	**98.7**	**0.12**	**0.00**	**13.06**	**34.8**	**70.5**	**27.21**	**9.59**
LSD	**1.45**	**1.82**	**0.68**	**0.00**	**2.6**	**9.11**	**3.1**	**5.2**	**4.1**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 7: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Bunda in Tanzania for 2016/2017 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY(t/ha)	DMC%
Albert	2.66	4.70	1.00	0.00	0.62	3.06	24.40	16.13	27.63
Eyope	1.00	0.00	1.00	0.00	0.55	2.36	2.23	12.86	24.00
F10_30R2	1.00	0.00	1.00	0.00	0.42	2.10	2.46	11.23	31.30
Kibandameno	1.60	0.40	3.66	4.33	0.60	2.60	26.20	16.66	30.00
Mkombozi	2.00	2.36	1.00	0.00	0.62	2.36	13.80	14.36	24.70
Mkuranga1	1.00	0.00	1.00	0.00	0.48	1.00	1.00	7.43	23.30
NAROCASS1	1.00	0.00	1.00	0.00	0.60	1.00	1.00	12.56	21.13
Orera	1.00	0.00	1.00	0.00	0.49	2.60	4.26	10.86	24.50
Sauti	2.33	1.40	1.00	0.00	0.61	2.86	5.93	13.33	22.36
Tajirika	2.5	1.5	1.00	0.00	0.57	2.4	1.73	12.33	23.70
Yizaso	2.33	0.73	1.00	0.00	0.62	1.00	0.00	13.66	27.60
Mean	**1.75**	**1.16**	**1.24**	**0.48**	**0.56**	**2.16**	**8.63**	**14.19**	**25.49**
CV	**76.07**	**28.23**	**14.01**	**143.61**	**13.39**	**27.25**	**119.58**	**40.18**	**20.45**
LSD	**0.41**	**0.1**	**0.21**	**0.15**	**11.6**	**1.38**	**4.3**	**2.88**	**5.9**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 8: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Naliendele in Tanzania for 2016/2017 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY(t/ha)	DMC
Albert	1.66	3.76	1.00	0.00	0.43	2.00	24.16	14.30	31.66
Eyope	1.00	1.00	1.00	0.00	0.54	1.00	0.40	14.83	28.03
F10_30R2	1.00	1.00	1.00	0.00	0.30	1.00	2.43	6.90	31.40
ibandameno	3.66	6.70	3.20	66.6	0.33	2.33	7.15	9.23	31.56
Mkombozi	1.30	1.00	1.66	6.70	0.57	2.33	4.00	20.46	29.30
Mkuranga1	1.00	1.00	1.00	0.00	0.51	1.33	0.40	13.00	28.70
NAROCASS1	1.00	3.40	1.30	3.70	0.64	1.66	0.33	19.70	29.66
Orera	1.00	3.40	1.00	0.00	0.47	1.00	2.06	10.86	29.30
Sauti	2.33	9.73	1.00	0.00	0.50	1.33	0.11	18.90	28.76
Tajirika	1.00	1.00	1.00	0.00	0.44	2.66	21.56	15.16	28.06
Yizaso	1.00	1.00	1.00	0.00	0.54	1.30	2.46	26.70	27.63
Mean	**1.51**	**2.99**	**1.30**	**7.73**	**0.48**	**1.63**	**5.84**	**15.46**	**29.46**
CV	**64.99**	**89.60**	**19.86**	**72.20**	**13.85**	**38.15**	**57.64**	**32.61**	**9.32**
LSD	**0.11**	**3.5**	**0.56**	**0.27**	**7.8**	**0.12**	**5.5**	**10.7**	**0.95**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield; DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table 9: Mean root yield and viral disease severities and incidences for cassava genotypes evaluated at Ukiriguru in Tanzania for 2016/2017 season

Genotype	fCBSDSev	fCBSDInc	fCMDSev	fCMDInc	HI	rCBSDSev	rCBSDInc	FRY (t/ha)	DMC
Albert	1.00	0.00	1.00	0.00	0.60	2.0	2.36	22.3	35.53
Eyope	1.00	0.00	1.00	0.00	0.58	2.0	1.4	30.7	31.93
F10_30R2	1.00	0.00	1.00	0.00	0.53	2.4	2.1	35.3	37.26
Kibandameno	1.00	0.00	2.3	1.3	0.66	2.4	15.96	24.8	32.13
Mkombozi	1.00	0.00	1.00	0.00	0.68	2.66	7.13	17.83	29
Mkuranga1	1.00	0.00	1.00	0.00	0.71	1.33	0.5	30.5	31.56
NAROCASS1	1.00	0.00	1.00	0.00	0.74	1.66	2.33	39.43	31.6
Orera	1.00	0.00	1.00	0.00	0.50	2.0	9.1	28.2	34.06
Sauti	1.00	0.00	1.00	0.00	0.49	2.33	0.5	21.92	35.93
Tajirika	1.33	1.4	1.00	0.00	0.71	2.43	5.26	20.2	34.23
Yizaso	1.00	0.00	1.00	0.00	0.61	1.76	2.5	30.9	32.16
Mean	**1.03**	**0.0**	**1.12**	**0.2**	**0.62**	**2.05**	**4.4**	**27.45**	**33.22**
CV	**16.89**	**31.16**	**31.05**	**33.5**	**8.76**	**22.73**	**88.01**	**17.72**	**6.03**
LSD	**0.1**	**0.1**	**0.2**	**0.1**	**13.7**	**0.34**	**1.57**	**2.5**	**2.8**

fCBSDSev=foliar CBDS severity; fCBSDInc= foliar CBSD incidence; FRY= Fresh root yield (t/ha); DMC=Dry matter content expressed in percentage; fCMDSev=foliar CMD severity; foliar CMD incidence; HI=harvest index; rCBSDSev= root CBSD necrosis severity; rCBSDInc= root CBSD severity incidence; disease scored on a scale of class 1 to 5(1 means no symptoms and 5 severe symptoms).

Table10: Overall seasonal mean performances for various yield and viral disease severities and incidences across different sites in Tanzania

Season	rCBSDSev	rCBSDInc	FRY (t/ha)	DMC%
Season 1	2.402	19.5	14.77	29.99
Season 2	2.068	8.98	14.34	32.41
Overall means	2.235	14.24	14.55	31.2
LSD 0.05	0.404	7.641	3.803	2.218
CV%	27.6	81.9	39.9	10.8

rCBSDSev= root CBDS severity; rCBSDInc= root CBSD incidence; FRY= Fresh root yield; MC=Dry matter content expressed in percentage; disease scored on a scale of class 1 to 5 (1 means no symptoms and 5 severe symptoms)

Table 11: Mean root yield of different cassava genotypes across different test sites in Tanzania during 2015/16 season

Genotype	Mean fresh root yield (t ha^{-1}) across trial sites overall mean				
	Bunda	Ukiriguru	Naliendele	Chambezi	Mean
1. Albert	11.09	13.47	22.99	19.34	18.49
3. Eyope	8.2	11.6	19.8	14.6	12.65
4. F10_30R2	7.4	14.5	16.6	14.2	11.85
5. Kibandameno	10.5	20.1	10.6	6.8	13.06
8. Mkombozi	4.7	14.9	20.5	20.5	14.84
10. Mkuranga1	6.1	11.4	17	23.3	14.15
11.NAROCASS1	15.94	20.38	30.24	21.37	21.96
14. Orera	12.7	10.3	13.6	10.7	11.77
15. Sauti	3.7	12.9	23.8	18.4	15.42
17. Tajirika	7.24	13.9	18.1	16.5	13.64
28. Yizaso	8.2	15	23.5	23.6	16.84
Site mean	8.83	13.84	21.66	17.92	
CV	**43.2**				
LSD (site)0.05	**2.517**				
LSD(Variety)0.0	**4.035**				
LSD(Site*Variety)0.05	**10.677**				

FRYtha^{-1} = average fresh root yield in tons per hectare;

Table 12: Mean root yield of different cassava genotypes across different test sites in Tanzania during 2016/17 season

Genotype	Mean Fresh root yield(tha^{-1}) across trial sites overall mean			
	Bunda	**Ukiriguru**	**Naliendele**	**Mean**
1. Albert	16.1	24.8	14.3	18.4
3. Eyope	12.9	20.2	14.8	16
4. F10_30R2	11.2	22	6.9	13.4
5. Kibandameno	16.6	28.3	9.2	18.1
6. Mkombozi	14.4	17.8	20.5	17.5
7. Mkuranga1	7.4	30.5	13.1	17
8.NAROCASS1	12.5	30.7	19.7	21
9. Orera	10.8	21.9	10.9	14.5
10. Sauti	21.3	35.3	18.9	25.2
11. Tajirika	19	39.4	15.2	24.5
12. Yizaso	13.7	30.9	26.7	23.7
Site mean	14.2	27.4	15.5	
CV	**27.5**			
LSD (site)0.05	**2.57**			
LSD(Variety)0.0	**4.93**			
LSD(Site*Variety)0.05	**8.53**			

Table 13: Means for root yield, yield components and viral disease incidences and severities across four sites for the season 2015/16 in Tanzania

Site	fCMDInc	fCMDSev	fCBSDInc	fCBSDsev	HI	rCBSDSev	rCBSDinc	FRY(t/ha)	DMC_%
1. Chambezi	0.00	1.00	0.9	2.7	0.51	2.3	0.7	18.0	29.6
2. Bunda	0.00	1.00	17.2	4.0	0.44	2.7	28.2	8.7	29.5
3. Naliendele	0.00	1.00	1.3	2.8	.049	2.5	7.5	21.7	27.0
4. Ukiriguru	0.00	1.00	2.2	3.5	0.50	2.7	14.2	13.8	27.2
Overall Means	0.00	1.00	**4.7**	**3.2**	**0.50**	**2.4**	**12.0**	**14.4**	**29.6**
$LSD_{0.05}$	0.00	1.00	**4.6**	**0.3**	**3.1**	**0.2**	**5.2**	**2.4**	**1.4**
CV%	0.00	0.00	**337.7**	**27.8**	**18.7**	**22.1**	**135.8**	**48.7**	**14.4**

FRY = average fresh root yield; DMC = dry matter content; HI=Harvesting index; rCBSDInc = CBSD Root Necrosis Incidence; rCBSDSev = CBSD root necrosis severity; fCMDInc = average foliar CMD incidence; fCMDSev = average foliar CMD severity; fCBSDInc = average foliar CBSD incidence; fCBSDSev = average foliar CBSD severity.

Table 14: Means for root yield, yield components and viral disease incidences and severities across three sites for the season 2016/17 in Tanzania[a]

Site	fCMDInc	fCMDSev	fCBSDInc	fCBSDsev	HI	rCBSDSev	rCBSDinc	FRY(t/ha)	DMC %
1. Bunda	0.5	1.2	1.2	1.8	0.56	2.2	8.7	14.2	25.5
2.Naliendele	7.1	1.3	2.5	1.5	0.48	1.6	0.1	15.5	29.5
3. Ukiriguru	0.3	1.1	0.2	1	0.62	2.1	4.5	27.4	33.2
Overall Means	2.6	1.2	**1.3**	**1.4**	**0.55**	**2.1**	**4.4**	**19**	**29.4**
$LSD_{0.05}$	2.29	1.57	**1.49**	**0.48**	**3.22**	**0.28**	**1.59**	**2.57**	**0.76**
CV%	77.1	22.1	**133.9**	**67.8**	**11.8**	**28.7**	**46.6**	**27.5**	**10.5**

[a] Chambezi site was affected by floods and not data was obtained

Table 15: Mean performance of genotypes evaluated at on farm at Kangetutya village, Bunda for 2018/2019 season

Genotype	FRY (ton/ha)	HI (%)	rCBSDsev	rCBSDi%
EYOPE	12.70	57	1.00	0.0
F10-30-R2	9.10	50	1.00	0.0
KALINGISI	10.70	49	1.29	11
MKOMBOZI	12.50	64	1.23	13
ORELA	11.20	54	1.02	0.0
NAROCASS1	19.30	76	1.00	0.0
YIZASO	12.50	62	1.00	0.0
C.V	**27.30**	**7.90**	**14.81**	**158.80**
P(5%)	**0.0465***	**0.0003*****	**0.144**	**0.07**
Grand mean	**12.6**	**58**	**1.09**	**0.04**

FRY=Average fresh root yield; HI=Harvesting Index in percentage ;rCBSDsev= cassava brown streak root severity; rCBSDi=cassava brown streak root incidence;

Table 16: Mean performance of genotypes evaluated at on farm at Kisesa village, Magu for 2018/2019 season

Genotype	FRY (t/ha)	HI (%)	rCBSDsev	rCBSDi
EYOPE	26.44	70	1.06	5
F10-30-R2	25.62	69	1.18	15
SEGELEDI	14.27	51	3.01	74
MKOMBOZI	18.25	66	3.37	78
ORELA	22.24	54	1.36	2.4
NAROCASS1	49.50	85	1.10	7
YIZASO	24.90	62	0.99	3.8
C.V	**40.78**	**11.84**	**13.29**	**28.28**
P(5%)	**0.0217***	**0.00214****	**0.00074*****	**0.000745*****
Grand mean	**26.00**	**65**	**1.85**	**33**

FRY=Average fresh root yield; HI=Harvesting Index in percentage ;rCBSDsev= cassava brown streak root severity; rCBSDi=cassava brown streak root incidence;

Table 17 Mean performance of genotypes evaluated on farm at Muhaga village

in Kisarawe district, season 2018/19

Accession	Fresh root yield (t/ha)	HI	CBSD	CMD
TZ 130	43.2	0.59	1.0	1.0
Eyope	16.6	0.55	2.8	1.0
Kiroba	23.9	0.56	2.2	1.0
F10-30-R2	12.3	0.40	1.1	3.3
Mkuranga 1	29.1	0.57	1.2	1.0
Mean	24.0	0.53	1.7	1.278
LSD	23.26	0.08	1.17	0.43
CV%	51.5	7.6	0.94	18.4
P (0.05)	0.059	0.002**	0.001**	0.001***

Table 18 Mean performance of genotypes evaluated on farm at Mkuzi village in Muheza district in Eastern, season 2018/19

Accession	Fresh root yield (t/ha)	HI	CMDSev	CBSDSev
Mkuranga 1	26.9	0.50	1.00	1.00
F10-30-R2	21.4	0.52	1.00	1.67
Kiroba	24.5	0.50	1.67	2.33
Orera	20.9	0.47	1.00	2.00
Eyope	38.5	0.53	1.67	1.00
TZ130	58.4	0.68	1.67	2.00
Mean	31.7	0.53	1.33	1.67
LSD	30.99	0.17	0.996	1.908
CV%	53.70	17.60	41.1	62.9
P (0.05)	0.137	0.171	0.326	0.546

Table 19: Participatory variety assessment at Bunda, 2019

s/n	Genotype	Planting Material	Tolerance to disease	Tolerance to pests	Drought tolerance	Early Maturity	Vigor	Appearance	Pulp color	Flesh color	Taste	DM content	General acceptability
1	A	3.1	1.5	4	4	3	4.6	4.1	4.5	4.3	2	2.6	3.6
2	B	3.3	3.8	4.5	3.8	4.1	4.6	4.8	3.5	4.3	3	4	4.1
3	C	3.3	3.8	4.1	4.5	4.1	4	4.3	3.5	4.6	2	3	4.1
4	D	3.1	3.6	4	4.5	4.3	4.1	4	4	4.6	3.1	4.3	4
5	E	4.1	3.6	3.1	4.5	4.1	3.8	4.5	4.3	4.5	4.3	4.1	4
6	F	3	3.8	4	4	4	4.3	4.3	4.1	5	4	4.3	4.6
7	G	3.2	3.7	3.6	3.8	4	3.5	4.42	3.7	4.5	4	4.2	4.5
	Total Marks	23.1	23.8	27.3	29.1	27.6	28.9	30.42	27.6	31.8	22.4	26.5	28.9

Table 20: Pair-wise ranking of cassava genotypes at Bunda, 2019

Genotype	A	B	C	D	E	F	G	Total	Score
A								0	7
B	B							1	6
C	C	C						3	4
D	D	D	D					5	2
E	E	E	C	D				2	5
F	F	F	F	F	F			6	1
G	G	G	g	G	G			4	3

Key: A-Kalingisi; B-Mkombozi; C-Orela; D-Eyope; E-F10-30-R2; F-NAROCASS1, G-Yizaso

Table 21: Participatory variety assessment at Magu, 2019

S/N	Genotype	Planting Material	Tolerance to disease	Tolerance to pests	Drought tolerance	Early Maturity	Vigour	Yield	Appearance	Pulp color	Flesh color	Taste	DM content	General acceptability
1	A	2.8	2.3	4	4.1	4.5	4.3	5	4.1	5	4.6	3.8	4.6	4.1
2	B	2.1	1.8	2.8	3.5	4	4	3.8	3.3	2.8	3.3	3.6	3.5	2.8
3	C	2.8	2.5	3.3	4	4.3	3.8	4	3.6	3.8	4.3	3.8	3.3	4.5
4	D	3.5	3.8	4.8	4.6	4.8	4.8	5	5	4.6	4	4.1	3.5	5
5	E	3.3	4	4.5	4.1	5	4.5	5	5	4.6	4.6	4	4.3	5
6	F	3.5	3.5	4.8	4.5	5	4.5	4.8	4.5	4.5	4.6	2.8	4.5	5
7	G	3.3	2.9	4.4	4.7	4.2	4	4.5	4.5	4.3	4.2	2.8	3.9	4.5
	Total marks	18	17.9	24.2	24.8	27.6	25.9	27.6	25.5	25.3	25.4	22.1	23.7	26.4
Key: A-Mkombozi; B-Segeledi; C-F10-30-R2; D-NAROCASS1; E-Eyope; F-Orela, G-YIZASO														

Table 20: Pair-wise ranking of cassava genotypes at Magu, 2019

GENOTYPE	A	B	C	D	E	F	Total	Score
A							1	6
B	A						0	7
C	C	C					2	5
D	D	D	D				6	1
E	E	E	E	D			4	3
F	F	F	F	D	F		5	2
G	G	G	G	E	G		3	4

Key: A-Mkombozi; B-Segeledi; C-F10-30-R2; D-NAROCASS1; E-Eyope; F-Orela, G-Yizaso