Orange and purple-fleshed dual-purpose sweetpotato varieties bred for Southern Africa

By

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Breeding for increasing storage root and vine yields, dry matter, β-carotene levels, and drought adaptation have been the main sweetpotato breeding goals at CIP support platform in Mozambique and Southern Africa in general.

Foliage is essential in animal feeding and existence of a sustainable seed system especially in drought prone areas.

Food and fodder dual-purpose cultivars are not available in this region.

Purple-fleshed (PFSP) cultivar, anti-oxidants sources, are also not among the sweetpotato germplasm in the region.

Malnutrition and cancer related diseases remain dangerous.
Specific objectives

In the short term the objectives of this work were to develop at least 3 superior cultivars from orange- and purple fleshted sweetpotato classes to serve both producer and consumer needs for food and nutrition security, fresh markets, diversified nutrition value chains, and processed products for expanding urban populations.
Materials and methods

• Genetic variation was created by bi-parental crosses and open pollinated polycross at Gurue and Umbeluzi Research Stations in 2011. About 39000 true seeds were collected and germinated after being scarified with concentrated sulfuric acid.

• Seedlings whose vines were used to establish the breeding trials with two replications from 2011-2014.
Crossing block
Materials and methods

- At advanced yield trials different clones, about 72, arose in three different categories; OFSP, PFSP and dual-purpose.
- These High yielding clones were selected for multi-environment trials (METs) at three experimental stations of the IIAM (Umbeluzi, Chokwe & Gurue) from 2013-2014. On farm trials were concurrently established in sites nearby the stations.
- Trials were laid in an RCBD with four replications. The Accelerated Breeding Scheme (ABS) was followed to hasten the identification of the best cultivars (Figure 2).
The Accelerated Breeding Scheme

Figure 2: The Accelerated breeding scheme
The accelerated breeding scheme (ABS) for clonally propagated crops considers that temporal variation of testing environments equals to spatial variation of testing environments in early stages of a breeding program.

In the ABS all clones derived from true seeds are planted simultaneously in several environments.

The principle of the ABS for clonally propagated crops is to do as much as possible simultaneously, what is done in the general breeding scheme sequentially in various steps over several years.
Seed scarification, germination & trial
Data Analysis

- Data were analyzed within and across sites and storage root yield stability was determined for each clone using the additive main effect multiplicative interaction (AMMI) model in R package.
Summary of results of MTs

- The genotype by environment interaction was highly significant ($P < 0.01$).

- The selected clones had 4-fold significantly ($P \leq 0.05$) greater storage root yield than the cultivar checks.

- The five orange-fleshed clones had higher beta-carotene content than the highest yielding check cultivar. Iron and zinc contents were significantly higher than check cultivars.

- Purple-fleshed clones showed high anthocyanin and suitable sensory quality equal or even better than that of the cultivar checks.
Yield and nutrition results of three orange-fleshed dual cultivars

Storage root (SR) and foliage (FY) yields, dry matter (DM), harvest index, β-carotene (BC), iron (Fe), zinc (Zn) and cooking taste of dual-purpose sweetpotato bred cultivars evaluated at three sites (Chokwé, Gurué and Umbeluzi) in Mozambique, 2011 to 2014

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>SR (t ha⁻¹)</th>
<th>FY (t ha⁻¹)</th>
<th>DM (%)</th>
<th>HI</th>
<th>BC mg 100 g⁻¹ dry weight</th>
<th>Fe</th>
<th>Zn</th>
<th>Cooking taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria</td>
<td>16.6</td>
<td>17.0</td>
<td>24.6</td>
<td>0.49</td>
<td>19.37</td>
<td>2.14</td>
<td>1.45</td>
<td>2.67</td>
</tr>
<tr>
<td>Bita</td>
<td>14.4</td>
<td>28.9</td>
<td>36.6</td>
<td>0.33</td>
<td>26.63</td>
<td>1.61</td>
<td>1.03</td>
<td>2.00</td>
</tr>
<tr>
<td>Lawrence</td>
<td>17.2</td>
<td>12.3</td>
<td>31.0</td>
<td>0.59</td>
<td>20.16</td>
<td>1.81</td>
<td>1.22</td>
<td>2.42</td>
</tr>
<tr>
<td>Resisto</td>
<td>7.5</td>
<td>11.7</td>
<td>27.5</td>
<td>0.30</td>
<td>15.60</td>
<td>1.83</td>
<td>1.19</td>
<td>3.00</td>
</tr>
<tr>
<td>Jonathan</td>
<td>10.0</td>
<td>8.8</td>
<td>23.6</td>
<td>0.34</td>
<td>14.15</td>
<td>1.54</td>
<td>0.93</td>
<td>2.22</td>
</tr>
<tr>
<td>LSD₀.₀₅</td>
<td>9.1</td>
<td>10.1</td>
<td>3.3</td>
<td>0.18</td>
<td>7.51</td>
<td>0.27</td>
<td>0.17</td>
<td>1.51</td>
</tr>
</tbody>
</table>
Yield and nutrition results of three purple-fleshed cultivars

Storage root (SR) and foliage (FY) yields, dry matter (DM), harvest index, iron (Fe) and zinc (Zn) content, and taste of purple-fleshed sweetpotato bred cultivars from a breeding population that was evaluated at three sites (Chokwé, Gurué and Umbeluzi) in Mozambique, 2011 to 2014

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>SR (t ha⁻¹)</th>
<th>FY (t ha⁻¹)</th>
<th>DM (%)</th>
<th>HI</th>
<th>Fe (mg 100 g⁻¹ dry weight)</th>
<th>Zn (mg 100 g⁻¹ dry weight)</th>
<th>Cooking taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margarete</td>
<td>29.0</td>
<td>23.5</td>
<td>30.1</td>
<td>0.53</td>
<td>1.51</td>
<td>1.04</td>
<td>3.58</td>
</tr>
<tr>
<td>Caelan</td>
<td>17.8</td>
<td>30.9</td>
<td>36.2</td>
<td>0.32</td>
<td>1.30</td>
<td>0.86</td>
<td>2.92</td>
</tr>
<tr>
<td>Bie</td>
<td>17.5</td>
<td>18.5</td>
<td>27.9</td>
<td>0.46</td>
<td>1.50</td>
<td>0.98</td>
<td>2.92</td>
</tr>
<tr>
<td><strong>Trial mean</strong></td>
<td><strong>10.1</strong></td>
<td><strong>21.2</strong></td>
<td><strong>32.7</strong></td>
<td><strong>0.30</strong></td>
<td><strong>1.61</strong></td>
<td><strong>1.09</strong></td>
<td><strong>2.83</strong></td>
</tr>
<tr>
<td><strong>LSD₀.₀₅</strong></td>
<td>9.1</td>
<td>10.1</td>
<td>3.3</td>
<td>0.18</td>
<td>0.27</td>
<td>0.17</td>
<td>1.51</td>
</tr>
</tbody>
</table>
Quality traits for three orange-fleshed cultivars

Dry matter (DM), harvest index (HI), β-carotene (BC), iron (Fe), zinc (Zn) content and taste of orange-fleshed sweetpotato bred cultivars evaluated across sites (Chokwé, Gurué and Umbeluzi) in Mozambique, 2011 to 2014.

<table>
<thead>
<tr>
<th></th>
<th>DM (%)</th>
<th>HI</th>
<th>BC</th>
<th>Fe</th>
<th>Zn</th>
<th>Cooking taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alisha</td>
<td>29.4</td>
<td>0.45</td>
<td>24.94</td>
<td>1.95</td>
<td>1.29</td>
<td>3.08</td>
</tr>
<tr>
<td>Anamaria</td>
<td>30.0</td>
<td>0.43</td>
<td>4.56</td>
<td>1.69</td>
<td>1.16</td>
<td>3.78</td>
</tr>
<tr>
<td>Ivone</td>
<td>25.6</td>
<td>0.39</td>
<td>27.56</td>
<td>1.63</td>
<td>0.97</td>
<td>3.00</td>
</tr>
<tr>
<td>Chingova (check)</td>
<td>36.1</td>
<td>0.19</td>
<td>2.89</td>
<td>1.08</td>
<td>0.83</td>
<td>1.92</td>
</tr>
</tbody>
</table>

LSD<sub>0.05</sub> 5.7 0.17 11.70 0.44 0.30 1.66
Orange-fleshed dual and purple-fleshed cultivars for release in Mozambique

Figure 1: Orange-fleshed dual and purple-fleshed cultivars for release in Mozambique
Origins of the cultivars

Polycross and bi-parental crosses set by CIP in Mozambique in 2011. These yielded 9 cultivars for release (Figure 1)

• Alisha (Uejumula_U07-13), Anamaria (MUSGP0646-126), Victoria (MCKSG08020-6) were selected from polycross and their female parents are ‘Ejumula’, ‘105421’, and ‘98-21-1’

• Bie (MUSG11049-7) and Ivone (MUSG11022-11) were selected from bi-parental crosses ‘Tacna’ × ‘Resisto’ and ‘Manhissane’ × ‘Resisto’

• Bita (MUSG11016-12), Lawrence (MUSG11016-16), Margarete (MUSG11016-1) and Caelan (MUSG11016-6) are selections from ‘Huambachero’ × ‘Resisto’. 
Conclusion

• The dual-purpose orange – and purple- fleshed cultivars may lead to changes on sweetpotato consumption in Mozambique and the region

• A social-marketing strategy targeting diverse users will facilitate their spread and use in the continent.

• Capacity building through training on postharvest processing, seed multiplication and marketing will contribute further
Thank you
Thank you

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