‘Alisha’, ‘Anamaria’, ‘Bie’, ‘Bita’, ‘Caelan’, ‘Ivone’, ‘Lawrence’, ‘Margarete’, and ‘Victoria’ Sweetpotato

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It takes on average 7 to 8 years to breed a suitable sweetpotato cultivar in Africa adapted to local farmer and consumer needs. For southern Africa, the major sweetpotato breeding objectives are high storage root and vine yield, high β-carotene levels, and drought adaptation. Orange-fleshed sweetpotato (OFSP) cultivars alleviate vitamin A deficiency in African rural households (Hotz et al., 2012; Low et al., 2007). Furthermore, sweetpotato needs in southern Africa are critical and vine yield to plant the next growing season and for feed, particularly where land availability is scarce. However, food and fodder dual-purpose cultivars were not available in African sweetpotato germplasm (Niyireba et al., 2013) until the recent release of RW cultivars by the Rwanda Agriculture Board and the International Potato Center (CIP) (Shumbusha et al., 2014). Purple-fleshed sweetpotatoes (PFSP) are the sources of antioxidants (Teow et al., 2007), and anthocyanins derived from PFSP affect the growth of human retinal pigment damage-protective activities on epithelial cells (Kubow et al., 2016; Sun et al., 2015). Moreover, PFSP can be used for natural food coloring, which is a relatively new market for sweetpotato and cultivars high in anthocyanin, are increasingly becoming popular in Asia used fresh or in a variety of processed snacks (Gilbert, 2005; Timberlake and Henry, 1988). This is a report on nine new cultivars bred together by CIP and the Instituto de Investigação Agrária de Moçambique (IIAM).

Origin

The nine new cultivars are known as (breeding code used during evaluation in brackets): ‘Alisha’ (Uejumula-U07-13), ‘Anamaria’ (MUSG0646-126), and ‘Ivone’ (MUSG11022-11) OFSP; ‘Bie’ (MUSG11049-7), ‘Caelan’ (MUSG11016-6), and ‘Margarete’ (MUSG11016-1) PFSP; and ‘Bita’ (MUSG11016-12), ‘Lawrence’ (MUSG11016-16), and ‘Victoria’ (MCKSG0820-6) dual-purpose sweetpotato (Fig. 1). This sweetpotato germplasm was derived from either an open-pollinated polycross breeding nursery or a biparental crossing block setup in CIP in Mozambique. The parents were African landraces, CIP breeding clones, and cultivar introductions. ‘Alisha’, ‘Anamaria’, and ‘Victoria’ are selections from an open-pollinated progeny polycross nursery and their female parents are ‘Ejumula’, ‘105421’, and ‘98-21-1’, respectively, while their male parents are unknown. ‘Bie’ and ‘Ivone’ are selections from the biparental crosses ‘Tacna’ × ‘Resisto’ and ‘Manhissane’ × ‘Resisto’, respectively, while ‘Bita’, ‘Lawrence’, ‘Margarete’, and ‘Caelan’ are selections from ‘Huambachero’ × ‘Resisto’.

Description and Production

The nine sweetpotato cultivars (Table 1; Fig. 1) were characterized using descriptors developed by CIP, Asian Vegetable Research and Development Center (AVRDC), and International Board for Plant Genetic Resources (IBPGR) (1991). These cultivars are either semierect or spreading plant type with short and thin internodes. Most cultivars have green vine pigmentation except the PFSP ‘Margarete’ and ‘Bie’, whose predominant vine pigmentation is purple. ‘Bie’, ‘Bita’, ‘Caelan’, and ‘Margarete’ have a purple secondary pigmentation. The mature leaf shape descriptors are diverse among these nine clones, while their foliage is mostly green except for ‘Victoria’ and ‘Ivone’ that have purple foliage or green foliage with a purple edge, respectively. Most cultivars have purple petiole pigmentation except ‘Alisha’, ‘Anamaria’, and ‘Ivone’. Their storage root shape is either elliptic (most of...
Table 1. Morphological descriptors of nine sweetpotato newly bred cultivars evaluated in Mozambique, 2011 to 2014.*

| Descriptor                      | Alisha          | Ivone           | Anamaria         | Victoria        | Lawrence        | Bita            | Caelan          | Margarete       | Bie             |
|--------------------------------|-----------------|-----------------|------------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| Breeding codes                 | Uejumula-U07-13| MUSG11022-11    | MUSG0646-126     | MCKSG0820-6     | MUSG11016-16   | MUSG11016-12   | MUSG11016-6    | MUSG11016-1    | MUSG11049-7     |
| Type                           | Spreading       | Semierect       | Spreading        | Spreading       | Extremely spreading | Spreading     | Spreading      | Spreading       | Spreading       |
| Length                         | Short           | Very short      | Very short       | Short           | Short          | Short          | Short          | Short           | Very short      |
| Diameter                       | Very thin       | Very thin       | Very thin        | Very thin       | Very thin      | Thin           | Thin           | Thin            | Thin            |
| Predominant Vine internode     | Purple          | Green           | Green            | Purple          | Purple         | Purple         | Purple         | Purple          | Dark purple     |
| Secondary Vine pigmentation    | Absent          | Absent          | Absent           | Absent          | Absent         | Absent         | Absent         | Absent          | Absent          |
| Predominant Mature leaf shape  | Triangular      | Triangular      | Lobed            | Lobed           | Almost divided | Triangular     | Triangular     | Almost divided | Almost divided |
| Lobe type                      | Very slight     | Very slight     | Moderate         | Very deep       | Very slight    | Very slight    | Very slight    | Very deep       | Very deep       |
| Lobe number                    | 1               | 1               | 5                | 5              | 7              | 1              | 1              | 5               | 5               |
| Central lobe shape             | Triangular      | Triangular      | Triangular       | Triangular      | Triangular     | Triangular     | Triangular     | Triangular      | Triangular      |
| Mature leaf shape              | Green           | Green           | Green            | Mostly purple   | Mostly purple  | Mostly purple  | Mostly purple  | Mostly purple   | Slightly purple |
| Abaxial leaf vein              | Green           | Green           | Green            | Green           | Purple         | Purple spot at the base of main rib | Green         | Purple          | Green           |
| Immature leaf                  | Green with purple edge | Green with purple edge | Green with purple edge | Mostly purple | Mostly purple | Mostly purple | Mostly purple | Slightly purple | Slightly purple |
| Petiole pigmentation           | Green           | Green           | Green            | Green           | Green          | Purple         | Purple         | Purple          | Purple          |
| Flowering                      | Absent          | Absent          | Absent           | Absent          | Absent         | Profuse        | Sparse         | Sparse          |                  |
| Storage root                   | Absent          | Absent          | Absent           | Absent          | Absent         |                 |                |                 |                  |
| Skin color                     | Cream           | Red             | Brownish orange  | Orange          | Purple-reddish | Red            | Dark purple    | Dark purple     |                  |
| Predominant Flesh color        | Intermediate   | Intermediate   | Dark             | Intermediate   | Intermediate   | Intermediate   | Intermediate   | Intermediate   | Intermediate   |
| Secondary                      | Absent          | Absent          | Absent           | Absent          | Absent         | Absent         | Absent         | Absent          | Absent          |
| Predominant Secondar           | Intermediate   | Intermediate   | Dark orange      | Intermediate   | White with anthocyanins | Light orange with anthocyanins | Strongly pigmented with anthocyanins | Pigmented with anthocyanins |                  |
| Flesh group                    | Absent          | Absent          | Absent           | Absent          | Absent         | Purple         | Absent         | Absent          |                  |
| Secondary                      | Orange-fleshed sweet potato | Orange-fleshed sweet potato | Orange-fleshed sweet potato | Yellow         | Purple         | Absent         | Purple-fleshed sweet potato | Absent          |                  |

*Following CIP, AVRDC, and IBPGR (1991).
them) or ovate (‘Bita’ and ‘Caelan’) and none has surface defects. The skin color varies from cream to dark purple (only in PFSP), while their flesh is either orange (most of them) or purple (‘Bic’, ‘Bita’, ‘Caelan’, and ‘Margarete’).

**Performance Across Mozambique as a Proxy for Southern Africa**

True seeds were scarified with concentrated sulfuric acid, and thereafter germinated to get seedlings whose vine cuttings were used to establish the breeding trials with two replications. There were 30,836 clones included in breeding trials from 2011 to 2014, of which 72 (27 OFSP, 25 PFSP, and 20 dual purpose) had high yield and were therefore selected for multienvironment trials (METs) at experimental stations of the IIAM in Chokwe (Gaza Province; 24°32’S, 33°01’E, 33 masl; silt clay loam, brown to dark grey soils, deep soils; PFSP, ‘Caelan’, had a significantly higher Fe and Zn content than the control cultivars (Table 4), while the Fe content in the storage roots of ‘Alisha’ was also high. The taste of the OFSP was equal or better than that of the cultivar checks (Tables 3 and 4), while that of the PFSP was above the average of the evaluated genotypes (Table 5). PFSP cultivars show high anthocyanin in their roots (Xu et al., 2015), and their derived products such as fermented juice may contain essential antioxidants and show suitable sensory quality (Ray et al., 2011). These dual-purpose, OFSP and PFSP

### Table 2. Storage root and forage yields of new orange-fleshed sweetpotato bred cultivars evaluated in sites in Mozambique, 2011 to 2014.

| Cultivar       | Storage root yield (t ha⁻¹) | Forage yield (t ha⁻¹) | DM (%) | HI | BC 100 g⁻¹ (dry wt) | Fe mg 100 g⁻¹ (dry wt) | Zn mg 100 g⁻¹ (dry wt) | Taste
|----------------|-----------------------------|-----------------------|--------|----|---------------------|------------------------|------------------------|------
| Alisha         | 25.3                        | 19.3                  | 8.5    | 17.7| 26.1                | 17.4                   | 18.0                   | 20.5 |
| Ana Maria      | 25.1                        | 22.4                  | 7.9    | 18.5| 26.3                | 19.4                   | 23.7                   | 23.3 |
| Ivone          | 26.8                        | 19.9                  | 7.4    | 18.0| 24.0                | 29.3                   | 20.7                   | 24.7 |
| Chingova (control) | 5.4                  | 6.6                   | 1.9    | 4.7 | 20.7                | 17.7                   | 18.8                   | 19.1 |

LSD = least significant difference.

### Table 3. 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 (Chokwe, Gurué, and Umbeluzi) in Mozambique, 2011 to 2014.

| Cultivar       | DM (%) | HI | BC 100 g⁻¹ (dry wt) | Fe mg 100 g⁻¹ (dry wt) | Zn mg 100 g⁻¹ (dry wt) | Taste |
|----------------|--------|----|---------------------|------------------------|------------------------|-------|
| Alisha         | 29.4   | 0.45| 24.94               | 1.95                   | 1.29                   | 3.08  |
| Ana Maria      | 30.0   | 0.43| 4.56                | 1.69                   | 1.16                   | 3.78  |
| Ivone          | 25.6   | 0.39| 27.56               | 1.63                   | 0.97                   | 3.00  |
| Chingova (control) | 36.1     | 0.19| 2.89                | 1.08                   | 0.83                   | 1.92  |

LSD = least significant difference.

### Table 4. Storage root (SRY) and foliage (FY) yields, dry matter (DM), harvest index, β-carotene, iron (Fe), zinc (Zn) and taste of dual-purpose sweetpotato bred cultivars evaluated at three sites (Chokwe, Gurué, and Umbeluzi) in Mozambique, 2011 to 2014.

| Cultivar       | SRY (t ha⁻¹) | FY (t ha⁻¹) | DM (%) | HI | BC 100 g⁻¹ (dry wt) | Fe mg 100 g⁻¹ (dry wt) | Zn mg 100 g⁻¹ (dry wt) | Taste |
|----------------|--------------|------------|--------|----|---------------------|------------------------|------------------------|-------|
| Victoria       | 16.6         | 17.0       | 24.6   | 0.49| 19.37               | 2.14                   | 1.45                   | 2.67  |
| Bita           | 14.4         | 28.9       | 36.6   | 0.33| 26.63               | 1.61                   | 1.03                   | 2.00  |
| Lawrence       | 17.2         | 12.3       | 31.0   | 0.59| 20.16               | 1.81                   | 1.22                   | 2.42  |
| Resist (control)| 7.5      | 11.7       | 27.5   | 0.30| 15.60               | 2.15                   | 1.19                   | 3.00  |
| Jonathan       | 10.0         | 8.8        | 23.6   | 0.34| 14.15               | 1.54                   | 0.93                   | 2.22  |

LSD = least significant difference.

### Table 5. Storage root (SRY) 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 (Chokwe, Gurué, and Umbeluzi) in Mozambique, 2011 to 2014.

| Cultivar       | SRY (t ha⁻¹) | FY (t ha⁻¹) | DM (%) | HI | BC 100 g⁻¹ (dry wt) | Fe mg 100 g⁻¹ (dry wt) | Zn mg 100 g⁻¹ (dry wt) | Taste |
|----------------|--------------|------------|--------|----|---------------------|------------------------|------------------------|-------|
| Margarete      | 29.9         | 23.5       | 36.2   | 0.33| 1.51                | 0.04                   | 3.58                   |       |
| Caelan         | 17.5         | 30.9       | 36.2   | 0.32| 1.30                | 0.86                   | 2.92                   |       |
| Bic            | 17.5         | 18.5       | 27.9   | 0.46| 1.50                | 0.98                   | 2.92                   |       |
| Trial mean     | 10.1         | 21.2       | 32.7   | 0.30| 1.61                | 1.09                   | 2.83                   |       |

LSD = least significant difference.

### Quality

The β-carotene content in the flesh of the storage roots of the OFSP ‘Alisha’ and ‘Ivone’ was higher than those of the highest yielding control cultivar Chingova (Table 3). The dual-purpose sweetpotato, ‘Victoria’, had significantly higher Fe and Zn content than the control cultivars (Table 4), while the Fe content in the storage roots of ‘Alisha’ was also high. The taste of the OFSP was equal or better than that of the cultivar checks (Tables 3 and 4), while that of the PFSP was above the average of the evaluated genotypes (Table 5). PFSP cultivars show high anthocyanin in their roots (Xu et al., 2015), and their derived products such as fermented juice may contain essential antioxidants and show suitable sensory quality (Ray et al., 2011). These dual-purpose, OFSP and PFSP
cultivars may lead to changes in sweetpotato consumption in Mozambique and neighboring countries in southern Africa. A social marketing strategy targeting diverse users could facilitate their spread and use on the continent. Capacity building through training on postharvest processing, seed multiplication, and marketing may contribute further to this endeavor.

Availability

The nine sweetpotato bred germplasm proposed for cultivar release are kept in the CIP breeding nursery in Mozambique. They are available for further use from CIP, which distributes its germplasm using a material transfer agreement. Requests for the dual-purpose, OFSP and PFSP should be sent to Dr. Maria Andrade, International Potato Center, IIAM, Av. FPLM 2698, P.O. Box 2100, Maputo, Mozambique or to M.Andrade@cgiar.org.

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