EVERYTHING YOU EVER WANTED TO KNOW ABOUT SWEETPOTATO

TOPIC 3

Sweetpotato Varietal Selection and Characteristics

Reaching Agents of Change Training of Trainers (ToT) manual

October 2018

Everything You Ever Wanted to Know about Sweetpotato. Topic 3 - Sweetpotato Varietal Selection and Characteristics
Reaching Agents of Change ToT Training Manual

ISBN: 978-92-9060-502-7
DOI: 10.4160/9789290605027T3

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Produced by International Potato Center (CIP)

Correct citation for the entire manual:

Stathers, T., Low, J., Mwanga, R., Carey, T., McEwan, M., David., S., Gibson, R., Namanda, S., McEwan, M., Malinga, J., Ackatia-Armah, R., Benjamin, M., Katcher, H., Blakenship, J., Andrade, M., Agili, S., Njoku, J., Sindi, K., Mulongo, G., Tumwegamire, S., Njoku, A., Abidin, E., Mbabu, A., Mkumbira, J., Ogero, K., Rajendran, S., Okello, J., Bechoff, A., Ndyetabula, D., Grant, F., Maru, J., Munyua, H., Mudege, N., (2018). Everything You Ever Wanted to Know About Sweetpotato: Reaching Agents of Change ToT Manual. International Potato Center, Lima, Perú. https://hdl.handle.net/10568/98335 12 vols., 664 p. (see table on page iii)

Production Coordinator
Joyce Maru

Design and Layout
SONATA Learning
Movin Were, Cartoons
Communications and Knowledge Resources Center, Covers

Printing
Clean Tone (Nairobi, Kenya)

Press run: 500
December 2018

CIP thanks Bill and Melinda Gates Foundation for funding the production of this manual.

CIP also thanks all donors and organizations which globally support its work through their contributions to the CGIAR Trust Fund.

ISBN: 978-92-9060-502-7

TITLE OF TOPIC	DOI	CITATION
Topic 1: Facilitating Training Sessions. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T1	Stathers, T., Low., J., E., Mbabu, A., Maru, J., Munyua, H., 2018. Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 1: Facilitating Training Sessions. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 95 p.
Topic 2: The Origin and Importance of Sweetpotato. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T2	Stathers, T., Low., J., 2018. Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 2: The Origin and Importance of Sweetpotato. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 26 p.
Topic 3: Sweetpotato Varietal Selection and Characteristics. Reaching Agents of Change Training of Trainers (ToT) manual	10.4160/9789290605027T3	Stathers, T., Carey, T., Mwanga, R., Njoku, J., Malinga, J., Tumwegamire, S., Andrade, M., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 3: Sweetpotato Varietal Selection and Characteristics. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 47 p
Topic 4: Nutrition and Orange-fleshed Sweetpotato. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T4	Stathers, T., Ackatia-Armah, R., Grant, F., Benjamin, M., Katcher, H., Blakenship, J., Low., J., Maru, J., Munyua, H., Mudege, N., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 4: Nutrition and Orange-fleshed Sweetpotato. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 107 p
Topic 5: Sweetpotato Seed Systems. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T5	Stathers, T., McEwan, M., Gibson, R., Mwanga, R., Carey, T., Namanda, S., Low., J., Ogero, K., Rajendran, S., Agili, S., Abidin, E., Malinga, J., Andrade, M., Mkumbira, J., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 5: Sweetpotato Seed Systems. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 118 p
Topic 6: Sweetpotato Production and Management. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T6	Stathers, T., Mwanga, R., Carey, T., Njoku, J., Malinga, J., Njoku, A., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 6: Sweetpotato Production and Management. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 33 p
Topic 7: Sweetpotato Pest and Disease Management. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T7	Stathers, T., Gibson, R., Namanda, S., 2018. Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 7: Sweetpotato Pest and Disease Management. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 37 p
Topic 8: Harvesting and Post-Harvest Management. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T8	Stathers, T., Sindi, K., Bechoff., A., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 8: Harvesting and Post-Harvest Management. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 33 p

TITLE OF TOPIC	DOI	CITATION
Topic 9: Processing and Utilisation. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T9	Stathers, T., Stathers, T., Sindi, K., Bechoff., A., (2018). Bechoff., A., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 9: Processing and Utilisation. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 42 p
Topic 10: Marketing and Entrepreneurship. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T10	Stathers, T., Low., J., Sindi, K., Ndyetabula, D., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 10: Marketing and Entrepreneurship. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 41 p
Topic 11: Gender and Diversity Aspects. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T11	Stathers, T., David., S., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 11: Gender and Diversity Aspects. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 31 p
Topic 12: Monitoring, Learning, and Evaluation of Sweetpotato Projects. Reaching Agents of Change Training of Trainers (ToT) manual.	10.4160/9789290605027T12	Stathers, T., Mulongo, G., Low., J., Mbabu, A., Rajendran, S., Okello, J., Maru, J., (2018). Everything You Ever Wanted to Know about Sweetpotato: Reaching Agents of Change ToT Manual. Topic 12: Monitoring, Learning, and Evaluation of Sweetpotato. International Potato Center. Nairobi (Kenya). ISBN 978-92-9060-502-7. 54 p

Contents

Acknowledgments

This manual and the supporting training materials were developed by Tanya Stathers working closely with the following resource people on the different topics: Topic 1: Jan Low, Hilda Munyua, Adiel Mbabu, Joyce Maru Topic 2: Jan Low; Topic 3: Ted Carey, Robert Mwanga, Jude Njoku, Silver Tumwegamire, Joyce Malinga, Maria Andrade; Topic 4: Robert Ackatia-Armah, Fred Grant, Margaret Benjamin, Heather Katcher, Jessica Blakenship, Jan Low, Netsayi Mudege, Joyce Maru, Hilda Munyua; Topic 5: Margaret McEwan, Richard Gibson, Robert Mwanga, Ted Carey, Sam Namanda, Jan Low, Kwame Ogero, Srini Rajendran, Erna Abidin, Joyce Malinga, Sammy Agili, Maria Andrade, Jonathan Mkumbira; Topic 6: Ted Carey, Robert Mwanga, Jude Njoku, Joyce Malinga, Anthony Njoku; Topic 7: Richard Gibson, Sam Namanda; Topic 8: Aurelie Bechoff, Kirimi Sindi; Topic 9: Aurelie Bechoff, Kirimi Sindi; Topic 10: Jan Low, Kirimi Sindi, Daniel Ndyetabula; Topic 11: Sonii David; Topic 12: Godfrey Mulongo, Jan Low, Adiel Mbabu, Srini Rajendran, Julius Okello, Joyce Maru . Luka Wanjohi, Eric Muthuri and Frank Ojwang have provided invaluable support throughout the process.

This team has brought together and shared their many years of experience of working with sweetpotato systems and farmer learning processes across Sub-Saharan Africa to compile this *Everything You Ever Wanted to Know about Sweetpotato* resource. None of this experience would have been gained without the partnership of many sweetpotato farmers and other stakeholders (extensionists, national researchers, traders, transporters, NGO staff, nutritionists, media and donors) across the region. We thank you, and hope that this resource can in return offer you support in your sweetpotato activities.

The photographs used throughout this manual come from a wide range of places and we thank Margaret McEwan, Jan Low, Richard Gibson, A. Frezer, Erna Abidin, Aurelie Bechoff, Keith Tomlins, Sam Namanda, J. O'Sullivan, Gabriela Burgos, Tanya Stathers, Olasanmi Bunmi, Benson Ijeoma, Grant Lee Neurenberg, Sammy Agili, Jentezen Franklin, Kwame Ogero, the late Constance Owori, Ted Carey, Robert Mwanga, Ana Panta, Kirimi Sindi, Frank Ojwang, CIP digital archive, Centre for Behaviour Change and Communication, G. Holmes, B. Edmunds, and Nicole Smit for kindly sharing them. Most of the cartoons used in this manual were drawn by Movin Were.

This manual was originally produced as part of the Reaching Agents of Change project in 2013 and updated by the Building Nutritious Food Baskets project in 2017/2018 – both projects funded by the Bill & Melinda Gates Foundation.

Acronyms and Abbreviations

AIs	Adequate Intakes
AVRDC	The World Vegetable Centre
BNFB	Building Nutritious Food Baskets
CBO	Community Based Organisation
CIP	International Potato
DAP	Days After Planting
DFE	Dietary Folate Equivalents
DONATA	Dissemination of New Agricultural Technologies in Africa
DVM	Decentralised Vine Multipliers
dwb	Dry Weight Basis
FAO	Food and Agriculture Organisation of the United Nations
FW	Fresh Weight
HH	Household
HKI	Helen Keller International
IBPGR	Bioversity International
IPM	Integrated Pest Management
IPPM	Integrated Pest & Production Management
K	Potassium
LGA	Local Government Areas
M&E	Monitoring and Evaluation
MAP	Months After Planting
m.a.s.l.	Metres Above Sea Level
Mm	Mass Multiplication
MSC	Most Significant Change
N	Nitrogen
NARO	National Agricultural Research Organisation
NGO	Non-Government Organisations
NHV	Negative Horizontal Ventilation
NRI	Natural Resources Institute
OFSP	Orange-fleshed Sweetpotato
P	Phosphorous
PMCA	Participatory Market Chain Approach
PMS	Primary Multiplication Site
PPP	Public Private Partnership
PVC	Polyvinyl Chloride
QDPM	Quality Declared Planting Material

QDS	Quality Declared Seed
RAC	Reaching Agents of Change
RAE	Retinol Activity Equivalents
RCT	Randomised Control Trial
RDA	Recommended Daily Allowances
RE	Retinol Equivalents
REU	Reaching End Users
RH	Relative Humidity
SASHA	Sweetpotato Action for Security and Health in Africa
SMS	Secondary Multiplication Site
SP	Sweetpotato
SPCSV	Sweetpotato Chlorotic Stunt Virus
SPFMV	Sweetpotato Feathery Mottle Virus
SPKP	Sweetpotato Knowledge Portal
SPVD	Sweetpotato Virus Disease
SSA	Sub-Saharan Africa
ToT	Training of Trainers
TMS	Tertiary Multiplication Site
Tshs.	Tanzanian Shillings
TSNI	Towards Sustainable Nutrition Improvement
UNICEF	United Nations Children's Fund
USD	United States Dollar
Ushs.	Ugandan Shillings
VAD	Vitamin A Deficiency
WAP	Weeks After Planting
WHO	World Health Organisation
WTP	Willingness to Pay

Foreword

During the past decade, interest in sweetpotato in Sub-Saharan Africa (SSA) has expanded, the number of projects utilizing sweetpotato has increased, and the demand for quality training resources, training development practitioners and farmers has subsequently risen. Sweetpotato scientists at the International Potato Center and national research centres often received these requests and frequently held 1-3 day training sessions, drawing on whatever training materials they had or could quickly pull together.

The Reaching Agents of Change (RAC) project in 2011 changed that situation. Jointly implemented by the International Potato Center (CIP) and Helen Keller International (HKI), RAC sought to empower advocates for orange-fleshed sweetpotato (OFSP) to successfully raise awareness about OFSP and mobilize resources for OFSP projects. RAC also sought to build the capacity of public sector extension and non-governmental organizational personnel to effectively implement those projects to promote the dissemination and appropriate use of vitamin A rich, orange-fleshed sweetpotato. The Building Nutritious Food Basket (BNFB) is a three-year project (November 2015 to October 2018) that followed on from the RAC project. The project is implemented in Nigeria and Tanzania and funded by the Bill & Melinda Gates Foundation. The goal of the project is to accelerate and support scaling up of biofortified crops for food and nutrition security and to help reduce hidden hunger by catalyzing sustainable investment for the utilization of biofortified crops (OFSP, PVA maize, high iron beans and vitamin A cassava) at scale. BNFB develops institutional, community and individual capacities to produce and consume biofortified crops. The objectives of the project are to strengthen the enabling environment for increased investments in biofortified crops and to develop institutional and individual capacities to produce and consume biofortified crops.

RAC/BNFB goal of developing and revising the Training of Trainers (ToT) manual on *Everything You Ever Wanted to Know about Sweetpotato* was to see *sustained* capacity for training senior extension personnel about the latest developments in sweetpotato production and utilization in each of the major sub-regions of SSA: Eastern and Central Africa, Southern Africa, and West Africa. Hence, CIP identified local institutions to work with in Mozambique, Tanzania, and Nigeria to host an annual course entitled: *Everything You Ever Wanted to Know about Sweetpotato.* The course has progressed from initially having CIP scientists working closely with national scientists to implement it, to national scientists and partners independently organising and conducting the course. In subsequent years, institutions in Burkina Faso, Ethiopia, Ghana, Malawi and others have been capacitated in conducting the course.

In developing the course content, a long-time collaborator of CIP, Tanya Stathers of the Natural Resources Institute (NRI), University of Greenwich, worked with CIP Scientists to review the existing training material, added in new knowledge from sweetpotato scientists and practitioners, and designed the course with a heavy emphasis on learning-by-doing. The CIP personnel who contributed to the development of the initial manual include, (Robert Mwanga, Ted Carey, Jan Low, Maria Andrade, Margaret McEwan, Jude Njoku, Sam Namanda, Sammy Agili, Jonathan Mkumbira, Joyce Malinga, Godfrey Mulongo), Adiel Mbabu and HKI nutritionists (Margaret Benjamin, Heather Katcher, Jessica Blankenship) and an HKI gender specialist (Sonii David) as well as NRI colleagues (Richard Gibson, Aurelie Bechoff, Keith Tomlins). Some of the materials were adapted from the DONATA project training materials, the Reaching End Users project and many others. After practitioners had used the course and the manual, a review was held in 2012 and the manual and course were subsequently updated, and a standard set of accompanying Power Point presentations created. In 2017-2018, the Building Nutritious Food Baskets project led a further review of the manual working closely with Tanya Stathers, the above mentioned CIP teams again plus Robert Ackatia-Armah, Kwame Ogera, Srini Rajendra, Julius Okello, Fred Grant, Joyce Maru, Hilda Munyua and Netsayi Mudege to update the content of topics 3, 4, 5, 12 and 13 which cover: sweetpotato varietal selection; nutrition; seed systems; monitoring, learning and evaluation; and using the 10 and 5 day ToT course.

This manual is designed to potentially serve a wide variety of audiences (nutritionists and agronomists, policymakers, extension workers, community development workers, leaders of farmer organizations, farmers etc.). Not all the materials will be relevant to all audiences, but facilitators can adapt the content to their audience and facilitation best practices. To ensure sustainability and wide reach; a cascading approach in the delivery of training is recommended; where key experts (agriculturalists, nutritionists, health workers, marketing and gender experts) will attend more detailed ToT workshops. The experts trained will then become primary facilitators and drive the agenda for OFSP. This group will in turn deliver shorter version courses and step-down the training to various levels of audiences (secondary and tertiary) – based on needs identified. This trend will continue until the training cascades down to "farmer trainers" who finally train the end users in their communities.

The original version of the manual has also been translated into Swahili, French, Portuguese, and Amharic are available online at https://www.sweetpotatoknowledge.org/learn-everything-you-ever-wanted-to-know-about-sweetpotato/ with the intension of translating the revised chapters as soon as resources permit. We envision the course to continue to be improved as new knowledge comes in. In this way, we expect the vibrant and knowledgeable sweetpotato community of practice to continue to grow in the coming years. The *Everything You Ever Wanted to Know about Sweetpotato* course will help us to achieve the major objectives of the Sweetpotato Profit and Health Initiative (SPHI). Launched in October 2009, the SPHI seeks to improve the lives of 10 million sub-Saharan African families in 16 countries by 2020 through the diversified use of improved sweetpotato varieties.

Jan W. Low, Leader of the Sweetpotato for Profit and Health Initiative, International Potato Center
October 2018, 2nd edition.

How to Use This Guide

This guide was designed to be used in two ways:

- As self-study material, or
- As a facilitator's guide for classroom training sessions

For each topic we have provided:

- A handbook (this volume)
- A PowerPoint presentation, and
- A handout for classroom training participants

If you plan to deliver this as classroom training, then we would encourage you to read the **Facilitator's Guide** (separate volume) prior to planning your lessons.

Introduction: Sweetpotato Varietal Selection and Characteristics

Topic Objectives

By working through this topic, participants will be able to:

- Explain that sweetpotato varieties differ in many ways, and provide examples
- List at least 5 characteristics of sweetpotato varieties which farmers view as important
- Summarise why men and women may view the importance of various sweetpotato characteristics differently
- Describe the 7 key stages in an on-farm participatory variety testing trial, and explain why each stage is important

If you have additionally participated in the Training of Trainers (ToT) course, you will also be able to:

- Describe the attributes sweetpotato farmers' view as important
- Identify sweetpotato varieties using standard descriptors
- Conduct gender-sensitive consumer taste tests
- Describe key characteristics of at least 3 sweetpotato varieties suitable for your area
- Converse intelligently (listen) with farmers about key characteristics they look for in a sweetpotato variety
- Develop OFSP promotional materials referring to key characteristics of importance to farmers and consumers

Synopsis

Topic 3 highlights the wide diversity of sweetpotato varieties, and discusses key characteristics that sweetpotato farmers, traders, processors and consumers use when they select particular varieties. Step-by-step instructions for conducting an on-farm participatory variety testing trial are presented.

Unit 1 - Natural Diversity of Sweetpotato

Objectives

By the end of this unit, participants should be able to:

- List identifying characteristics of varieties of sweetpotato
- Describe typical flesh colours of sweetpotato varieties

Key Points

- **There are thousands of sweetpotato varieties**
- **They differ by leaf and root shapes, growth habit, skin and flesh colour, texture, dry matter content etc.**
- **Flesh colours range from white > yellow > orange > purple**
- **These are natural flesh colours, as no genetically engineered sweetpotato varieties are being commercially produced yet**
- **In any one area, just a few dominant varieties are typically grown**

Natural Diversity of Sweetpotato

Sweetpotato is believed to have originated in Central America over 5,000 years ago, and then spread across continents, with varieties developing and being selected for different agro-ecological conditions and uses. There are now thousands of sweetpotato varieties available in the world. Over 6,000 looking into the genetic engineering of traits such as virus resistance, insect resistance, starch modification, baking properties, drought, heat and salt tolerance, protein quality, and herbicide resistance in sweetpotato, no genetically engineered sweetpotato varieties are being commercially produced yet.

Sweetpotato flesh in addition to its wide range of colours also has a wide range of tastes from sweet to bland, dry matter content from below 20 % to above 40 %, and textures from moist landraces, breeding lines and advanced cultivars are conserved in the CIP gene bank.

Sweetpotato varieties differ from each other in many ways, including leaf shape and colour, growth habit, root shape, root skin colour, flesh colour, taste, texture, dry matter content, resistance to pests and diseases and yield.

The range of flesh colours from white, through yellow, to deep orange and even dark purple is astounding. This wide and striking range of flesh colours has led to some people erroneously suggesting the different colours are the result of genetic engineering. However, they are not, they are simply natural flesh colours. Whilst there is some research work to try.

These different characteristics influence the decision-making of farmers, traders and processors regarding which varieties to use, and development projects also need to be aware of consumer and market preferences. For example, the adult African palate prefers a dry and floury sweetpotato, and all would prefer varieties that have good shelf-life and do not rot quickly.

Despite the existence of such diversity, in any specific geographical area there tend to be just a few dominant varieties grown. There are usually fewer varieties in areas with a strong market orientation than where the crop is grown predominantly for local consumption. The main varieties are typically selected based on market-demand and the planned use of the sweetpotato.

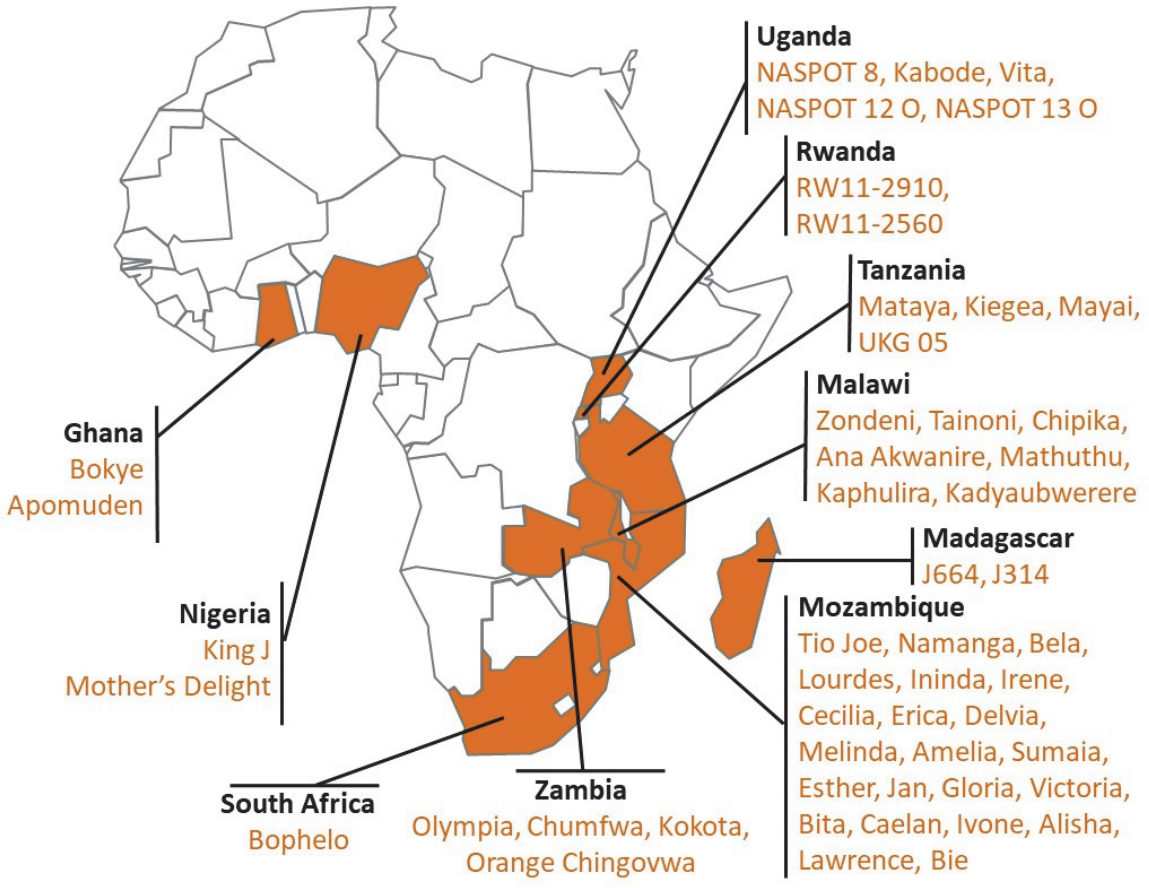
In eastern Africa, an early maturing variety (matures about 4 months after planting), with high dry matter content (30-33%), cream skin and yellow flesh emerged as a market favourite. It is known as SPN/O, Simama, Tanzania, Kenya or Chingova depending on the country. However, researchers and farmers are constantly developing and evaluating new varieties, and the predominant varieties do change over time often getting replaced by superior performing market-preferred varieties.

In Uganda, two orange-fleshed sweetpotato (OFSP) varieties were released in 2004 (Ejumula, and SPK004 which is also known as Kakamega). Both varieties have high dry matter content (>30%) and a dry texture when cooked. Within the communities they were promoted in, they went from constituting 3.2% of the total sweetpotato production in 2004, to 22.4% by 2006. The proportion of farmers producing OFSP increased from 21.7% to 64.3% during the same two-year period, highlighting the fast acceptance of these new varieties.

The OFSP sweetpotato for Africa catalogue includes information about OFSP varieties available across Africa and can be downloaded at: http://cipotato.org/wp-content/uploads/2014/08/006163.pdf

Recently released OFSP varieties include those shown on the map below.

Names of Some Recently Released OFSP Varieties in Different African Countries (2017)



Review Questions

1. What are some of the ways sweetpotato varieties differ from each other?
2. Are genetically engineered sweetpotato varieties being commercially produced?

Unit 2 – What Characteristics Are You Looking for In Your Sweetpotato Plants?

Objectives

By the end of this unit, participants should be able to:

- List characteristics that farmers are looking for in sweetpotatoes
- Distinguish between important features of different varieties
- Explain the impact of beta-carotene on sweetpotato flesh colour
- Summarise how sweetpotatoes are selected for drought tolerance

Key Points

- **Farmers prefer varieties with higher yield potential, resistance to pests and diseases, a higher market price and other characteristics**
- **Sweetpotato varieties differ by leaf, root, colour (beta-carotene content) and other characteristics**
- **Breeding for drought tolerance is often done by evaluating performance under both adequate soil moisture and dry conditions**

What Characteristics Are You Looking for In Your Sweetpotato Plants?

Farmers are always on the lookout for new varieties with better characteristics such as:

- Higher yield potential
- Good root characteristics (e.g. determined by shape, size, skin colour, flesh colour, dry matter content, and nutritional value)
- Appreciable resistance to major diseases and pests
- Drought and cold tolerance
- A dry texture (this differs e.g. very dry for east Africa, medium-dry for southern Africa)
- A higher market price
- The ability to produce enough planting material
- Long in-ground storability, and
- A shorter period to harvest (early maturity, about 3 to 4 months after planting)

However, it should be remembered that each variety performs differently under different situations, depending on location-specific and seasonal conditions. This highlights the importance of varietal testing by and with farmers under different agro-ecological zones and farmer management, so that farmers can select those most likely to perform well in their specific locations; for example, drought prone areas. We describe how you can do this in the following unit, *How to Access and Test Different Sweetpotato Varieties*.

Male and female farmers often identify the same preferred characteristics (root yields and size) but there can be differences along gender lines, reflecting the gender roles in production and processing. Women farmers tend to be more interested in cooking qualities such as cooking time, low oil absorption during frying and the tendency of cooked roots to crumble compared with men. In situations where men are responsible for root sales, they are more likely than women to be interested in market-related characteristics.

A farmer field school group in Uganda, identified the most desirable attributes as high yields (for increased income returns), sweet taste (for home and market acceptance), vitamin A content (to

improve health problems in the community), early maturity (for food security), pest and disease resistance (to minimize losses) and drought tolerance (to help supply of planting materials at the start of the rains). The same group identified the most undesirable attributes as: low yields (low income returns, food insecurity, waste of farmers' energy and time), high fibre content and poor taste (low consumer acceptability and therefore difficult to sell), susceptibility to pests and diseases (low yields and wastage of resources), small root size (difficult to sell and to peel).

Just as we distinguish people by their features, sweetpotatoes have distinguishing features that help to tell them apart. The features that are most useful for sweetpotato variety identification are plant growth habit, vine colour, petiole colour, leaf shape, leaf colour, root shape, root skin colour, and root flesh colour.

Examples of some features are shown below.

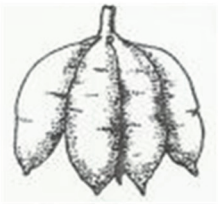
Distinguishing Features of Sweetpotato Varieties (See Appendix 3.1. For Full Version)

Hastate shaped leaf

Deep, five lobed leaf

Reniform shaped, no lateral lobed leaf

Moderate, five lobed leaf, with semi-eliptic shaped central lobe



Closed cluster of roots

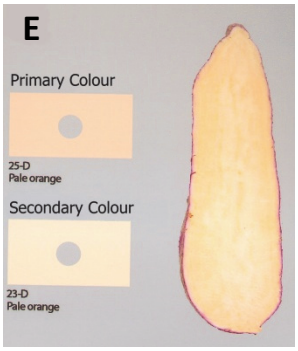
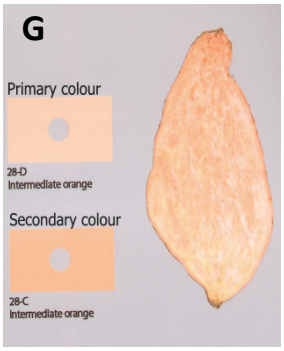
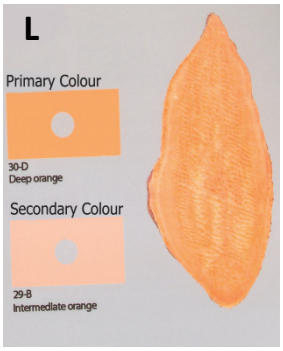
Disperse cluster of roots

Elliptic root shape

Obovate root shape

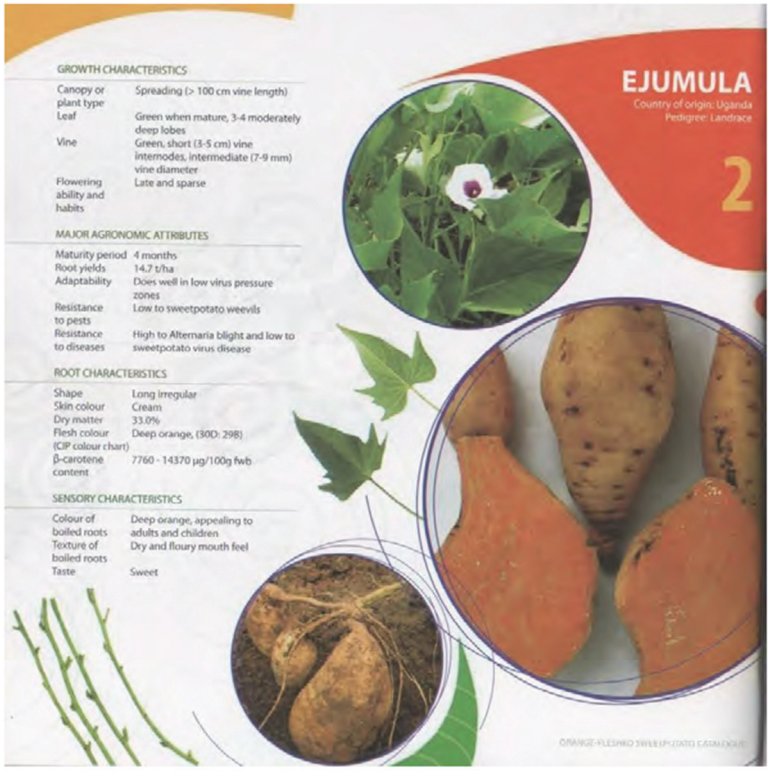
Beta-carotene content of OFSP roots can be estimated from their colour, see table below.

Flesh Colour as A Proxy for Beta-Carotene Content (See Appendix 3.2 For Full Version)

		
β-carotene: 1.65mg/100g, FW Vit A: 137.5 µg RE/100g, FW	β-carotene: 4.92 mg/100g, FW Vit A: 410.0 µg RE/100g, FW	β-carotene: 14.37mg/100g, FW Vit A: 1197.5 µg RE/100g, FW

A form for recording key morphological descriptors is presented in Appendix 3.3.

Promising OFSP varieties for Sub-Saharan Africa are illustrated in a Sweetpotato Catalogue available on the Sweetpotato Knowledge Portal http://www.sweetpotatoknowledge.org or from any CIP office. The catalogue shows details of the characteristics of the different varieties.



It is important to realise that the same varieties may have different names in different locations, and sometimes different varieties are called by the same name. Plus, different "strains" or "types" of the same variety can exist, which may be very difficult to distinguish from each other, so seed multipliers need to be really familiar with the varieties they are multiplying.

Attributes of some recently released OFSP varieties can be found in Appendix 3.4.

Attributes of Some Orange-Fleshed Sweetpotato Varieties

	Name	Bela (IIAM-CIPBD004)	Namanga (IIAM-CIPBD002)	Zondeni	Chipika	Kabode	Vita	CRI-Apomuden
Variety Info	CIP No:	In process	In process			CIP100200.4	CIP100200.3	CIP440254
	Country of origin	Mozambique	Mozambique	Malawi	Malawi	Uganda	Uganda	Bangladesh
	Pedigree	UW 119 x OP	UW 119 x OP	Local	OPV Kenya (SP/NO)	SPK004 x OP	SPK004 x OP	Unknown
Growth characteristics	Canopy or plant type	Spreading	Semi-erect	Spreading	Spreading	Semi-erect	Semi-erect	Spreading
	Leaf	Green mature and young leaves, 5 moderate lobes	Green old leaves, green young leaves with purple margins, 5 slight lobes, green leaf stalk	Green	Green	Green, immature leaf, light purple	Green, immature leaf, light purple	Green, immature leaf, purple
	Vine	Light/ pale green; short (2-3 cm) internode lengths	Green vine, short (2-3cm) internodes, 4-5 vine diameter	Green	Green	Green, purple tip	Green, purple tip	Green
	Flowering	Sparse	Early and profuse	Rare	Sparse	Sparse	Sparse	Moderate
Major agronomic attributes	Maturity period (months)	5	5	6	5	4	4	4
	Root yields (t/ha)	25.9	19.3	8-16	25-30	5-35	8-28	20
	Adaptability	Wide	Wide	High rainfall		Moderate to high rainfall	Moderate to high rainfall	Wide
	Resistance to pests	Resistant to weevils	Resistant to sweetpotato weevil	Tolerant	Tolerant	Susceptible to weevils	Susceptible to weevils	Susceptible to weevils
	Resistance to diseases	Resistant to SPVD	Resistant (1.5 mean score)	Tolerant	Susceptible to Alternaria	Resistant to SPVD	Resistant to SPVD	Moderately resistant to SPVD
Root characteristics	Root shape	Long elliptic	Long elliptic	Long	Long	Long irregular or curved	Obovate	Long irregular
	Root skin colour	Cream	Cream	Pale orange	Pale orange	Purple-red	Purple-red	Red-orange
	DM (%)	27.5	27.0	30	30	30.5	30	21
	Flesh colour	Orange, (18 colour chart)	Intermediate Orange (20 colour chart)	Orange	Orange	Dark orange	Intermediate orange	Orange with yellow stripes
	B-carotene (fwb)	31.4 mg/100g	33.2 mg/ 100g	8.9mg/100g	3.9mg/100g	11.0 mg/100g	11.0 mg/ 100g	32.8-46 mg/100g
Sensory characteristics	Colour of boiled roots	Deep orange (27 colour chart)	Intermediate orange (25 in colour chart)	Orange	Pale orange	Dark orange	Orange	Orange
	Texture of boiled roots	Moist to intermediate	Intermediate	Dry	Moderate dry	Moderately dry	Moderately dry	Moist, soft mouth feel
	Taste	Good (mean score 3.6; score 1-5)	Fairly good (mean score 3.4; score 1-5)	Very good	Good	Good	Good	Moderately sweet
Importance	Released in which countries	Mozambique	Mozambique	Malawi	Malawi	Uganda, Kenya	Uganda, Kenya	Ghana
	Parent in crossing block	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Commercial variety	Yes	Yes	Yes/no	Yes/no	Yes	Yes	Yes
	Home food/ food security	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Selecting for Drought Tolerance

In drought prone regions, root and vine yield, vine survival and sprouting potential of small roots all determine the acceptance of a variety, as varieties that fail in these attributes will have no planting materials available when the rain comes. Drought tolerant varieties need to be able to yield relatively well under both dry and normal rainfall conditions.

To identify such varieties, breeding for drought tolerance is often done by evaluating performance under both adequate soil moisture and dry conditions. The harvest index is also used as an indicator of a variety's ability to survive drought, it is expressed as a percentage and is the ratio between the storage root yield and total biomass yield multiplied by 100. A higher harvest index typically indicates the variety has a good translocation capacity and is more likely to survive drought conditions.

Review Questions

1. What are some of the characteristics that farmers prefer?
2. Does a darker sweetpotato flesh colour indicate a higher or lower concentration of Beta-Carotene?

Unit 3 – How to Access and Test Different Sweetpotato Varieties

Objectives

By the end of this unit, participants should be able to:

- List different ways for farmers to access new sweetpotato varieties
- Explain the purpose of conducting on-farm participatory testing of different sweetpotato varieties
- Summarise seven steps of conducting on-farm participatory testing

Key Points

- Farmers can access new varieties through neighbours, agricultural extensions or NGO offices, local or long-distance traders, research stations or specialised seed producers
- **The seven steps of conducting on-farm participatory testing are:**
  1. **Situation analysis**
  2. **Identification of local partner(s) and areas for on-farm trials**
  3. **Identification of farmers or farmers' groups**
  4. **Planning the trials with the farmers**
  5. **Planting the trial**
  6. **Monitoring of the trial**
  7. **Evaluation of the trial**

How to Access and Test Different Sweetpotato Varieties

There are many ways that farmers can access new varieties to test in their own fields:

- **Neighbours:** They might know of a neighbouring farmer who shared some delicious sweetpotato with them which they would like to try, and so could ask for, swap or purchase some of the planting materials of that variety to then test in their own field.
- **Agricultural extension or NGO office:** The local agricultural extension office or an agricultural NGO office are places where farmers can ask for new sweetpotato varieties to test.
- **Traders:** Local and long-distance traders can also be asked and might even help bring planting materials of varieties with good marketing characteristics that they would like farmers to grow.
- **Research station:** If there is a research station nearby, this will likely be a source of new varieties for testing.
- **Specialised seed producers:** In many communities there are a few farmers who maintain and produce planting materials, for example: decentralized vine multipliers (DVMs) (see the topic, *Sweetpotato Seed Systems*).

Sweetpotato breeding programs work closely with farmers and consumers to develop and select new varieties in many countries in Sub-Saharan Africa. They use seed from crossing blocks, from varieties and advanced breeding clones introduced from other countries, or from farmers' varieties collected within their countries.

An overview of the main steps of the sweetpotato breeding scheme is shown below.

Breeders in CIP work closely with the national programs through breeding Support Platforms in East, West and Southern Africa to strengthen regional sweetpotato breeding efforts and to ensure smooth international movement of sweetpotato germplasm, in line with quarantine regulations. NGOs, CBOs, extension workers and individuals interested in accessing released varieties and promising materials for testing should contact the appropriate agricultural research station.

The next section presents the protocol for conducting on-farm participatory testing of sweetpotato varieties and is currently used by CIP and partners in Sub-Saharan Africa.

Protocol for On-Farm Participatory Testing of Different Sweetpotato Varieties

Purpose

On-farm participatory sweetpotato variety testing aims to:

- Introduce the breeder's varieties to farmers, and thus it can be an initial step in variety dissemination
- Test the performance of promising varieties under farmer growing conditions and researcher-farmer management
- Test farmers' acceptance and ranked preference of the varieties for yield and quality attributes (including taste tests)
- Help breeders obtain feedback (in terms of what farmers like in a variety)
- Build farmers' capacity in assessing varieties and experimenting

Background

While sweetpotato breeding and seed dissemination efforts are expanding in Sub-Saharan Africa, it is probably true that most production is still based on local farmers' varieties. This may be because improved varieties have not yet reached farmers, but it may also be because of problems with the released varieties which lead to their rejection or abandonment by farmers. For example, if there is no market demand for OFSP, or if farmers and consumers are not sensitized to the special uses and characteristics of OFSP, then farmers may not continue to grow them. Also, if plants are not vigorous enough to survive over a long dry season, new varieties may be lost, while farmers' varieties persist.

It is important for any variety selection and dissemination to have a clear understanding of the needs of farmers and consumers. One way of ensuring this, is to use a participatory approach. This

can be done from the very beginning stages of the breeding process, which is called participatory plant breeding because farmers are involved from the beginning of the selection process.

A successful variety, Tomulabula (NASPOT 11), was developed and released in 2010 in Uganda using this approach with very experienced sweetpotato farmers. A more common approach is to evaluate promising materials and released varieties with farmers in on-farm trials at the final stage of the selection process. This is called participatory varietal selection. A recommended procedure for participatory variety testing is presented below.

Methodology

On-farm participatory sweetpotato variety testing needs to start with an analysis of the current situation to ensure the trials will help farmers in identifying sweetpotato varieties with the characteristics that are most relevant to them (e.g. virus resistance, cooking properties, market-traits). On-farm participatory variety testing consists of **seven main steps**.

Step 1: Situation Analysis

Before starting on-farm sweetpotato varietal testing researchers should carry out a general situation analysis to learn about sweetpotato in the focal farming and livelihood systems. All too often this step is missed because researchers feel they can depend on the knowledge of extension agents or local partners to understand the context. However, in many cases extension agents lack an accurate understanding of many issues particularly related to the socio-cultural context. The situation analysis should investigate gender and diversity issues, including the roles and responsibilities of men and women in sweetpotato production. A tool for carrying out a gender situation analysis is shown in Appendix 11.1 in the Topic Gender and Diversity.

Step 2: Identification of Local Partner(s) and Areas for On-Farm Trials

Local partners can facilitate the implementation of the on-farm trials, and may be NGOs, CBOs or local government extension staff working in different target areas. Local partners already involved in agriculture development, human nutrition and health programs may be easier to work with. When selecting the areas for on-farm trials, try and include a range of different agro-ecological (rainfall, soil type, temperature) and socio-economic conditions (better-off farmers, poorer farmers, areas with good road and market links and those without, different cultural groups, different genders). Make sure you clarify the aims of the on-farm trials, work plans and roles with the local partner(s).

Step 3: Identification of Farmers or Farmers' Groups

The local partner can identify which farmers or farmer groups would be good to work with, this may include groups they already work with or new farmers. Ensure they include a range of agro-ecological and socio-economic conditions.

Important criteria for selecting the on-farm participatory variety trial farmers include:

- Good coverage of agro-ecological and socio-economic diversity among the selected farmers
- Someone willing to manage and host the trial and have visitors come to her/his farm on the evaluation days
- Assess whether there is sufficient labour (own or hired) and land to undertake the trial using the agreed management approach
- Located in an accessible area (not too far from a major road)
- Experienced sweetpotato grower in good health
- Soil for plot to be used in the trial should be homogeneous
- Being aware if the farmer has had problems in the past with animal destruction and theft

- Willingness to invest in sweetpotato production after the trial

Select farmers on the basis of gender and diversity with regards to the roles they play, wealth status, ethnicity and age. This does not mean just involving one woman or man. The proportions or gender representation should be representative of those growing sweetpotato in the community. This also applies to ensuring the farmers selected are representative of the local wealth structure e.g. 30% poor households, 60% medium wealth households, and 10% wealthy. Where women are the major producers of sweetpotato, but men contribute some labour, it is important to work directly with women rather than just with men in their role as head of households.

Working with farmer groups *that are well organized* can accelerate varietal dissemination. Otherwise, it is often better to select individual farmers to conduct the trials, with each farmer serving as a replicate. Remember that you are likely to lose some sites during the trials (e.g. due to drought, floods or illness) so strive to have at least 10 farmer sites for a given agro-ecology.

In some countries, it may be useful to have the farmer sign a contract committing to participate *(Appendix 3.4 provides a sample contract)*. The arrangement is normally that the farmers are provided with the planting materials for free and the roots after measurement and removal of a few for tasting belong to them as compensation. Expectations of both farmers and researchers should be discussed and agreed upon at all stages of trial planning and planting and can be included in the contract.

Step 4: Planning the Trials with the Farmers

Using a Participatory Variety Trial helps achieve several important purposes:

- To ensure farmers are involved right from the start of varietal selection
- So, the varieties selected have many of the characteristics that farmers, traders and consumers want
- To test the varieties under farmers growing conditions
- As an initial step in the dissemination of new varieties

A meeting should be scheduled with the entire group of farmers or group leaders who will be involved. It is good to include a local leader as they can help influence adoption of sweetpotato technologies later. The meeting can be done by the local partner alone or together with the researcher.

During the meeting explain or discuss:

a) The aims and underlying activities, including trial design
b) Contributions required from the farmers (e.g. Land, hoes, labour, trial management, and selection of check variety) and from researchers (vines, visits, training, leaflets)
c) Farmers expectations, some of which may not be met
d) Plan of action (what has to be done, by who, how and when) through the planting period, field growth period, harvesting period and post-harvest period.

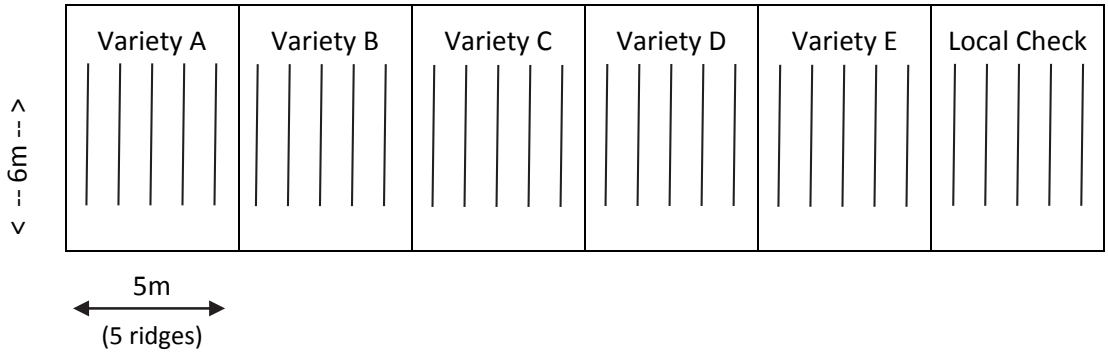
It is important to ensure that the meeting is participatory and should help to generate readiness for trials among the farmers. Land for the trial should be identified and modalities for its preparation agreed on. Where women are the major producers, be open to inviting their husbands to the planning meeting to get their buy-in and alleviate any suspicions about the proposed trials. Arrange to hold the meeting at a time that is convenient to women.

Step 5: Planting the Trial

Remind the farmers about the trial aims and design.

Do not test more than eight varieties at a time. A plot size of about 30 square metres arranged in 5 rows 6 metres long per candidate variety should be used (see example below).

Example of Trial Layout



Leave a spacing of 1 metre between rows. Ridges should be at least 40 cm high. In each row/ridge, vines should be planted approximately 30 cm apart. Thus 100 cuttings are required per plot. Additional cuttings (depending on the supply of material) may be planted at the end of the row to use for gap filling.

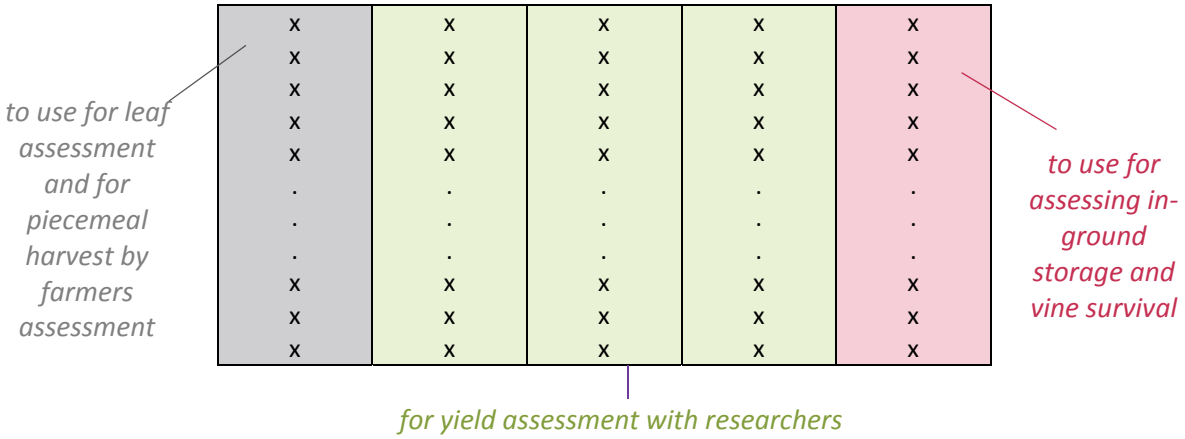
Explain to the Farmers

a) The middle 3 rows cannot be harvested during the growing period, as they need to be assessed with the researcher present to get good measurements of the yields (see figure below). The farmer will keep all of the roots except 10 roots that the researcher will need for lab assessments, and roots that will be cooked for the taste test.

b) The 1st row on the outside can be used by the farmer for piecemeal harvesting. This row will also be used to obtain leaves for evaluating quality when cooked (for countries in which leaves are eaten as a vegetable).

c) The last row must not be piecemeal harvested, because it will be used to assess in-ground storability over a 3-month period.

Example of Individual Plot Layout (5 Rows, Each 6 M Long And 1 M Apart)



Similar plot sizes and layouts can be used in areas where farmers plant sweetpotato on mounds. Usually these are spaced about 1 metre apart. Three vines are usually planted roughly 30 cm apart on the top of the mound. The researcher should guide but let the farmers plant the vines their own way.

Further explanation must be made of what is expected of the farmers and a schedule of when visits will happen should be left with the farmer.

Step 6: Monitoring of the Trial

Monitoring of the trial is done by all the stakeholders (farmers, local partners, researchers).

The purpose is to:

a) Check on the establishment and ensure timely gap filling;
b) Ensure timely weeding of the trials by the farmers; and
c) Ensure general good progress of the trials.

Note that monitoring visits are typically combined with evaluation (or data collection) visits. It is worth reminding the farmer in advance of the date that you will be visiting. Briefly walk through the trial with the farmer and discuss any observation s/he has noted. Record keeping of results from the trials is very important. Standard forms are available to allow researchers to record their observations, and also to allow the collection of farmer assessment of variety performance. These forms are presented in the Appendices 3.5a, b and c, and can also be downloaded from the Sweetpotato Knowledge Portal. Always explain to the farmer what you are measuring, monitoring, and writing and why.

Step 7: Evaluation of the Trials

Virus Assessment and 1st Weeding

The first weeding should be done about **3 weeks after planting** if there are weeds, and farmers should be made aware of this. If funds are sufficient, a visit can be made at 3 weeks. If not, combine a visit to assess virus incidence and weeding at 6 weeks. This assessment will be done by the NGO, extension or research partner helping to supervise the trial. However, the farmers and other local partners should be available, so the researcher can show them virus symptoms if present, and they can discuss other initial farmer impressions of the varieties.

Leaf Taste-Test Evaluation

Three months after planting, leaves or leaves and petioles (depending on local practice) are harvested from each candidate variety and prepared for consumption using the local preparation method.

While the leaves are still on the plant, ask the farmers to evaluate: *Will this be good for cooking? (Yes/No).* Then ask them why.

Then harvest leaves from the border row/ 1st row of each variety so as not to influence the root yield of the other 4 rows. You should note what the local practice is in terms of which leaves are selected (size/location) and whether the petiole is also consumed. Leaves should be cooked in a simple local fashion to generate relevant results.

The prepared leaves are evaluated for:

a) Taste,
b) Appearance, and
c) Texture, using a colour card system as described for roots below (see stage 2 of the final evaluation below).

Then conduct a pair-wise comparison of the cooked leaves from the different varieties being tested in order to stimulate discussion about the difference between the varieties and to rank them in order of preference (use Forms 5C and 5C1 in Appendix 3.5c).

Final Evaluation

Three stages of this evaluation are done at root harvesting time, followed by a fourth stage which sets up the in-ground root storability assessment.

Stage 1. Quantitative Root Assessment

Two weeks prior to harvest, remove the foliage from the central row of each plot in order to evaluate/demonstrate the effectiveness of this practice for pre-harvest curing. Between 3 and 5 months after planting date (*depending on normal practice in a given country and for the given variety - if these are new improved varieties the researcher should provide details on the normal harvest period for each variety in each specific region*), three middle rows/ridges of each of the plots are harvested and quantitative data recorded for standard harvest using standard recording forms (Form 4C, Appendix 3.5b). Researchers will keep 5 roots from the middle row (cured) and 5 roots from the 2nd or 4th row to take back to the station to evaluate shelf-life. The shelf-life evaluation assesses 1) weight, 2) sprouting, and 3) rotting on a bi-weekly basis.

Stage 2. Participatory Field Variety Evaluation

This is done with farmers using cards to indicate their observations on different attributes of each of the test varieties. Farmer assessment of foliage and sweetpotato virus disease (SPVD) susceptibility both need to be done before storage root harvest; indeed, this should be done well before harvest, for example, when the leaf taste test is done. At least 15 male farmers and 15 female farmers should participate for good results, and children six years old and below should be assessed separately especially for OFSP taste tests.

To facilitate the evaluation three types of cards (Green, Yellow and Red) are recommended.

	Green card means very acceptable
	Yellow card means give it another chance or moderately acceptable
	Red card means reject or not acceptable

Farmers are given sufficient cards of each colour to allow assessment of each variety for each attribute *(if you have 8 varieties being evaluated, and you are going to assess 6 attributes of each variety – then each farmer will need 48 green cards and 48 yellow cards and 48 red cards. If you have 40 farmers doing the evaluation you will require a total of 1920 green cards, 1920 yellow cards and 1920 red cards – a lot of cards!)*.

Decide beforehand which attributes you are going to assess and label the three different coloured cards per attribute, ensuring there are enough to evaluate each variety for all the attributes. Each farmer puts into the bag one card that shows the level of performance of the variety per attribute being assessed. When the exercise is completed per individual variety, then bags should be collected and bundled by attributes.

Assessment at field level could be done on all or some of the following attributes depending on what farmers consider important. The question posed to the farmers could be:

"Give Your Opinion by Using the Provided Cards on the Following Attributes"

- The ability to produce enough planting material (foliage production);

- The ability to resist diseases, especially SPVD;
- The ability to resist pest damage (mainly weevils);
- The yielding ability (i.e. number and size of mature roots);
- The attractiveness of the root skin colour. Probe more to understand which colour(s) are most preferred and why?
- The attractiveness of the root flesh colour? Probe more to understand which colour(s) are most preferred and why?
- What is your overall opinion on the acceptability of this variety?

After the farmer evaluators have finished, the cards in each bag should be separated and counted by colours and sex. The information is recorded in the data sheet (Form 5A. Appendix 3.5a).

At the end of the individual assessment, on a group basis, the farmers should be asked to tour and select the best three varieties and worst three varieties respectively and give reasons for their choices. Then for the top five varieties, use pair wise comparison (Form 5A1. Appendix 3.5a), whereby every variety has a chance of being compared with all others. In pair wise comparison, those varieties preferred most frequently are considered most acceptable.

Stage 3. Consumer Acceptability Assessment

Roots from each variety should be labelled; boiled and small pieces are then served on plates for 'blind' assessment using A, B, C etc. or 1, 2, 3 etc. to code each variety. Usually steaming or boiling them in little water for 40 minutes or less is enough to cook them. Choose moderate sized roots of similar size for the test. The use of cards in the consumer acceptability exercise is done in the same way as the field evaluation. The bags for receiving the cards are labelled with a name of the variety and the attribute being assessed. The group should be divided into women and men. Children of six years old and below should be assessed separately so the adults do not bias the choices of the children. Before starting the exercise, review what the attributes are, emphasizing that it is how *they* feel *individually* about the particular variety.

The question posed to the evaluators could be:

"Give Your Opinion by Using the Colour Cards Provided on the Following Root Attributes".

- Attractiveness of the colour of the boiled root (root flesh appearance);
- Taste when chewed (Taste of the root) (some will prefer sweetness, some not);
- Flavour/ aroma in the mouth (Smell/ flavour);
- Flouriness/ starchiness (Dryness);
- Consistency of the root texture (Fibrousness);
- What is your overall opinion on the acceptability of this variety?

For convenience, all the attributes of one variety should be assessed before moving on to the next. In the exercise, several bags labelled with different attributes are passed round one after another for the farmers to put in their cards. When all the varieties have been assessed, the bags are then separated based on the attributes. The information is recorded in the sample sheet (Form 5B. in Appendix 3.5b).

At the end of the individual assessment, on group basis, farmers are asked to select their top five varieties giving reasons. Then for those 5 varieties, a pair-wise comparison should be done by farmers so that again every variety will have an equal chance of being compared with the others (Form 5B2. Appendix 3.5b). Reasons for varieties being ranked best should be captured by the evaluators.

Stage 4: In-Ground Storability Assessment

On the harvest day, hill up the soil on the last row, covering any exposed roots and pack the soil down using your feet.

After a further 3 months, return for the final visit and assess for each variety:

a) Vine survival (define what is meant be vine survival with the farmers),
b) Number of roots,
c) Number of roots with sprouts,
d) Number of roots infested with weevil or rotted,
e) Weight (kg), and
f) Raw taste.

Note: some researchers prefer to cut the vines back at the main harvest time to cure and protect the roots during the in-ground storability period.

Key Visits

The visits to be made by the researcher depend on the above steps. More visits are needed in a new area than in an area where the on-farm trials have been done in the past. If the farmers are very experienced with on-farm trials, it is possible to combine two or all of the first three visits.

	The Purpose of the Visit Is To
Visit 1:	Meet with local partners and identify areas. The researcher visits the local partner(s) to elicit their involvement and support for the on-farm trials in the target area. The objectives and work plan of the trials as well as roles should be explained or discussed during the visit;
Visit 2:	Identify farmers;
Visit 3:	Plan trials with farmers;
Visit 4:	Plant the trial;
Visit 5:	*(6 weeks after planting)* virus assessment and weeding check (farmers must be invited);
Visit 6:	*(3 months after planting)* raw and cooked leaf evaluation;
Visit 7:	*(2 weeks before root harvest)* cut vines on the central row for in-ground curing, but not on other two rows being assessed and set-up invitations for farmer participation in the field and root tasting evaluation;
Visit 8:	Harvest the central three rows of each variety and to conduct the field and root tasting evaluation, and to set up the in-ground storability assessment; and
Visit 9:	*(3 months after main harvest and assessment)* conduct in-ground storability assessment.

Review Questions

1. What are some of the ways that farmers can access new varieties of sweetpotato?

2. What are the advantages of participatory testing?
3. What are the 7 key steps of participatory testing? Summarise what happens at each step.
4. What are the stages of final evaluation?

Unit 4 – Gender and Diversity Aspects of Sweetpotato Varietal Selection

Objectives

By the end of this unit, participants should be able to:

- Describe differences in male and female preferences of characteristics
- Summarise the importance of conducting sweetpotato needs assessment

Key Points

- **Men and women may value different characteristics, e.g. women are more likely to prefer cooking qualities, while men favour sweetpotatoes with a higher market value**
- **A sweetpotato needs assessment is done prior to starting sweetpotato work in a new location, in order for the development workers to understand the role sweetpotato plays in the livelihoods of the different groups in the community**

Gender and Diversity Aspects of Sweetpotato Varietal Selection

A thorough discussion of gender and diversity aspects in relation to sweetpotato is presented in the topic Gender and Diversity Aspects. Key gender and diversity issues relevant to sweetpotato varietal selection and characteristics are woven throughout the text of Topic 3 and highlighted below.

Females and males are often interested in different characteristics of sweetpotato due to their roles and responsibilities. For example, women tend to be more interested in cooking qualities of the roots such as low oil absorption during frying and the tendency of cooked roots to crumble compared with men. In situations where men are responsible for root sales, they are more likely than women to be interested in market-related characteristics.

It is important that a sweetpotato needs assessment is done prior to starting sweetpotato work in a new location, in order for the development workers to understand the role sweetpotato plays in the livelihoods of the different groups in the community (e.g. men and women, children, different wealth, age, and religious groups). Extension workers may lack accurate understanding of the relevant socio-cultural issues.

Based on the findings of the needs assessment and the project's goals, on-farm trials can then be developed involving a diverse and representative group of the community throughout the planning and implementation. The farmers involved in the trials should be selected on the basis of gender with regards to the roles they play, wealth status, ethnicity and age. This does not mean involving just one woman or man. The proportion of gender representation should be representative of those growing sweetpotato in the community. This also applies to ensuring the farmers selected are representative of the local wealth structure e.g. 30% poor households, 60% medium wealth, and 10% wealthy. Where women are the major producers of sweetpotato, but men contribute some labour, it is important to work directly with women rather than men in their role as head of households. However, their husbands should be invited to the planning meetings in order to get their buy-in and alleviate any suspicions about the proposed trials.

Meetings and field activities should be arranged at locations and times that are convenient and safe for those involved, including women.

Review Questions

1. What characteristics are more important for women? Men? Both?
2. Why should a sweetpotato needs assessment be done prior to starting development in a new location?

Activities

Activity 3.1 Sweetpotato Taste Test

Objectives

To better recognize the different varieties of sweetpotato and how they taste.

Time

1 hour

Materials

- Different varieties of sweetpotato
- Cooking utensils
- Additional ingredients depending on the recipe chosen

Advanced Preparations

- Collect different varieties of sweetpotato
- Cook the sweetpotato in advance if necessary

Suggested Steps

1. The instructor should bring in uncooked varieties of sweetpotato to view and compare.
2. Pick a recipe that is best for each variety and cook while at the learning centre.
3. If it is not possible to cook together, prepare outside of class and bring in to share.

Activity 3.2 Spot the Difference

Objectives

- Become familiar with attributes of importance to sweetpotato farmers, and with farmers' perceptions of the attributes of their varieties
- Be able to identify sweetpotato varieties using standard descriptors
- Be able to conduct gender-sensitive consumer taste tests

Time

2 hours and 45 mins / half day

Advanced Preparations

Identify a nearby field with several varieties of sweetpotato growing in it, and meet the farmer and see if they are agreeable to their field being visited by the participants, themselves being interviewed by the participants, and some (try and minimize the number) of the plants being dug up to see the root characteristics and to remove some roots for tasting, possibly 1-2 plants per variety. The farmer will need to be compensated for the roots that are used.

Materials

- Nearby field with several varieties of sweetpotato growing in it and which the participants can harvest some roots (note: this activity could also be done in an on-station field but this would then omit the opportunity for participants to learn why farmers grow those varieties)
- Flip chart
- Marker pens
- A4 plain white paper
- Pencils
- Erasers
- Participants notebooks
- Sufficient copies of the handout on sweetpotato descriptors (Appendix 3.1) and on estimating the beta-carotene content through flesh colour of orange fleshed sweetpotato varieties (Appendix 3.2)
- Sufficient copies of the form for participatory storage root taste evaluation (forms 5b and 5b2 Appendix 3.5b)
- Cooking stoves and fuel
- Pans
- Water
- Matches
- Knives

(Note: Taste test could be done in the training room)

Suggested Steps

1. Walk to a nearby field with several varieties of sweetpotato growing in it. Greet the farmer and remind her/him that as per the arrangement the course participants will move around the field and try and identify and then sketch different sweetpotato varieties that are growing there. They would then like to ask her/him about her/his sweetpotato variety choices. In groups of 5 people the participants should move around the field and locate at least 3 different varieties of sweetpotato. Each participant should sketch the leaf and root shapes of the different varieties and note down any colour differences between them. Using the sweetpotato descriptors handout they should then identify the shape of the

sweetpotato roots and leaves that they have drawn.

2. The participants should then ask the farmer about why she/he grows a range of sweetpotato varieties, what the different survival rates, growth durations, growth habits, climatic preferences, root and leaf tastes and marketable traits of the different varieties are. This is best done in small groups if possible. Participants should make a note of the farmer's answers and how they relate to the varieties they have drawn. Encourage the participants to use open-ended probing questions to learn more about the different varieties.
3. In their small groups the participants should discuss and describe the different varieties of sweetpotato in the field.
4. The participants should harvest some roots of each variety to taste together with the farmer/s, and then record the different taste aspects of each variety using the method described in Topic 3.3 of the manual (with the red, yellow and green cards) and use the Forms (5B and 5B2) in Appendix 3.5b and their notebooks to record their findings. *If possible, try and ensure one of the varieties being tested has low dry matter content*.

If Possible

Some roots should be harvested without care (so they become damaged) and some with care. Do not boil all of these roots -- keep several of each variety of them on a table in the training room, to use for the harvesting discussion on day 9 of the ToT. If REALLY organized in advance, you could have some roots that were field cured prior to harvest, and you could also carry these back to the training room so that the effect of curing could be assessed by the participants when they come to study harvesting on Day 9.

Activity 3.3 Selecting Sweetpotato Varieties

Objectives

- Know and describe key characteristics of at least 3 sweetpotato varieties suitable for their area/ region
- Be able to converse intelligently (listen) with farmers about key characteristics they look for in a sweetpotato variety
- Be able to develop OFSP promotional materials referring to key characteristics of importance to farmers and consumers.

Time

70 mins

Materials

- Flip charts (at least 1 page per participant);
- Coloured pencils including plenty of green, brown, orange and yellow ones
- CIP OFSP catalogue.

Suggested Steps

1. Facilitate a group discussion on the key factors differentiating sweetpotato varieties and which are important for which reasons; make notes of key points on a flip chart [10 mins]
2. Then for the main two sweetpotato varieties grown in the participants work locations, ask them each to use half the flip chart page to create an advertising poster showing and describing the different characteristics of each of these varieties. The facilitator should push them to think of different characteristics they could include:
    a) Leaf shape and colour
    b) Time to root maturity
    c) Root size, colour (skin and flesh) and shape
    d) Resistance to diseases
    e) Root yield
    f) Dry matter content
    g) Taste
    h) Texture
    i) Marketing appeal [30 mins]
3. Then ask them to each add into their posters (on the empty half of the page) two new varieties they have learnt about during the ToT, which they feel could be promoted in their work locations (and why, include gender aspects). (Note: These flipchart style posters could act as training materials when this trainer then trains other people). The flipcharts should then be posted up around the training room as a small exhibition and to enable the facilitator to see which characteristics and new varieties have been picked up on by the participants. [20 mins to complete their posters, then 10 mins for the exhibition]

Answers to Review Questions

Unit 1

1. What are some of the ways sweetpotato varieties differ from each other?
    - *Differences include leaf shape and colour, growth habit, root shape, root skin colour, flesh colour, taste, texture, dry matter content, resistance to pests and diseases, and yield.*
2. Are genetically engineered sweetpotato varieties being commercially produced?
    - *While the wide range of flesh colours may seem to indicate otherwise, there is currently no genetic engineering of sweetpotato.*

Unit 2

1. What are some of the characteristics that farmers prefer?
    - *Location, Seasonal conditions; Yield; Root characteristics; Resistance to Drought, Temperature, Disease, Pests; Market price; In-ground storability; Harvest period; Dry texture*
2. Does a darker sweetpotato flesh colour indicate a higher or lower concentration of Beta-Carotene?
    - *Darker colour indicates higher concentration of beta-carotene*

Unit 3

1. What are some of the ways that farmers can access new varieties of sweetpotato?
    - *Through neighbouring farmers, the local agricultural extension or NGO offices, local or long-distance traders, nearby research stations or specialised seed producers.*
2. What are the advantages of participatory testing?
    - *Introduce varieties; Test performance; Farmers acceptance; Feedback; Build farmers knowledge.*
3. What are the 7 key steps of participatory testing? Summarise what happens at each step.
    - *7 steps are: 1) Situation Analysis; 2) Identification of Local Partner(S) and Areas for On-Farm Trials; 3) Identification of Farmers or Farmers' Groups; 4) Planning the Trials with the Farmers; 5) Planting the Trial; 6) Monitoring of the Trial; 7) Evaluation of the Trials.*
4. What are the stages of final evaluation?
    - *Stages of final evaluation are: Stage 1: Quantitative root assessment; Stage 2: Field variety evaluation; Stage 3: Consumer acceptability assessment; Stage 4: In-ground storability assessment.*

Unit 4

1. What characteristics are more important for women? Men? Both?
    - *Women: Cooking characteristics (time, absorption, taste);*
    - *Men: marketing characteristics (sales, income);*
    - *Both – yield, root size.*
2. Why should a sweetpotato needs assessment be done prior to starting development in a new location?
    - *So that development workers can understand the role sweetpotato plays in the livelihoods of the different groups in the community.*

Glossary

Beta-carotene or β-carotene: a carotenoid with 2 beta rings, which is a rich source of dietary vitamin A. Carotene is the yellow or red pigment found in many dark green, leafy and orange or yellow fruits and vegetables. Other types of carotenoids have lower conversion ratios or are not converted to vitamin A in the body.

Characteristic: a typical or notable quality of something, for example: high dry matter content or narrow elongated leaves.

Clone: a vegetative propagated variety or genotype.

Consumer acceptability assessment: a process to gauge whether and what consumers and/or disaggregated groups of consumers (e.g. children, men, women), like about a product. For example: do they like the taste and texture of variety X, and if so do they prefer it to variety Y.

Crossing-block: a nursery where breeders hand-pollinate sweetpotato flowers or let bees pollinate them to create seed, which is used to select new types of sweetpotato.

Cultivar: (short for 'cultivated variety'). The term cultivar, as well as the similar term, variety, are mainly used to refer to officially released products of breeding programs which are being cultivated. These may be the product of crossing and selection, or in some cases, may be selected from germplasm collections of varieties grown by farmers. Cultivars or varieties are distinct from others and are uniform and stable.

Farmer variety: a variety selected and grown by farmers, and which may not have been officially released.

Genotype: refers to the genetic makeup of an organism. A variety or cultivar is thus a genotype, but not all genotypes are varieties, as they may not have been officially released.

Variety: synonymous with cultivar.

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Appendix 3

Appendix 3.1. Descriptors For Sweetpotato

Source: CIP, AVDRC, IBPGR, 1991

Plant Type

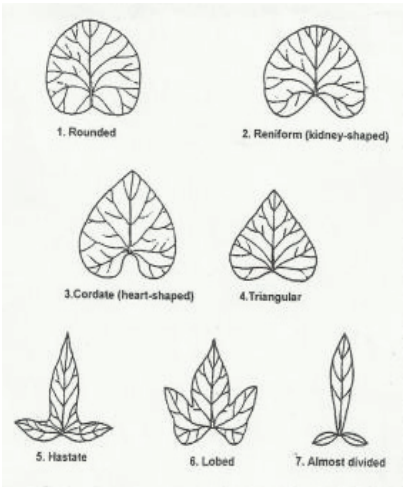
1. Erect = less than 75 cm high,
2. Semi-erect = 75-150 cm,
3. Spreading = 151-250 cm in length,
4. Extremely spreading = more than 250 cm

Predominant Vine Colour

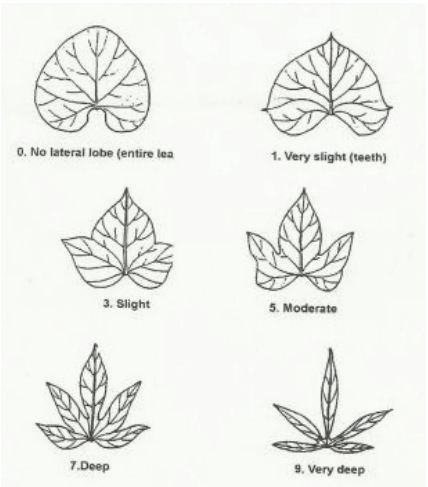
1. Green
2. Green with a few purple spots
3. Green with many purple spots
4. Green with many dark purple spots
5. Mostly purple
6. Mostly dark purple
7. Totally purple
8. Totally dark purple

Secondary Vine Colour

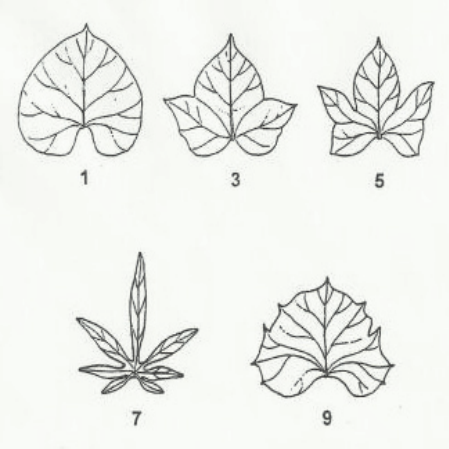
0. Absent
1. Green base
2. Green tip
3. Green nodes
4. Purple base
5. Purple tip
6. Purple nodes



General Outline of the Leaf



Leaf Lobe Type



Leaf Lobe Number

Shape of Central Leaf Lobe

Abaxial Leaf Vein Pigmentation

1. Yellow
2. Green
3. Purple spot on base of mid-rib
4. Purple spots on several veins
5. Main rib partially purple
6. Main rib mostly or totally purple
7. All veins partially purple
8. All veins mostly or totally purple
9. Lower surface and veins totally purple

Mature Leaf Colour

1. Yellow-green
2. Green
3. Green with purple edge
4. Greyish-green (due to heavy pubescence)
5. Green with purple veins on upper surface
6. Slight purple
7. Mostly purple
8. Green upper, purple lower
9. Upper and lower surfaces purple

Immature Leaf Colour

1. Yellow-green
2. Green
3. Green with purple edge
4. Greyish-green (due to heavy pubescence)
5. Green with purple veins on upper surface
6. Slight purple
7. Mostly purple
8. Green upper, purple lower
9. Upper and lower surfaces purple

Skin Colour

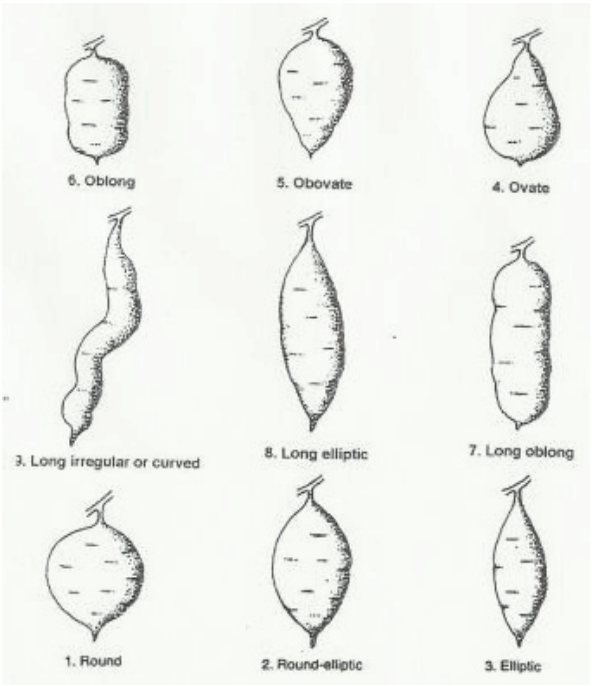
1. White
2. Cream
3. Yellow
4. Orange
5. Brownish-orange
6. Pink
7. Red
8. Purple-red
9. Dark-purple

Intensity of Skin Colour

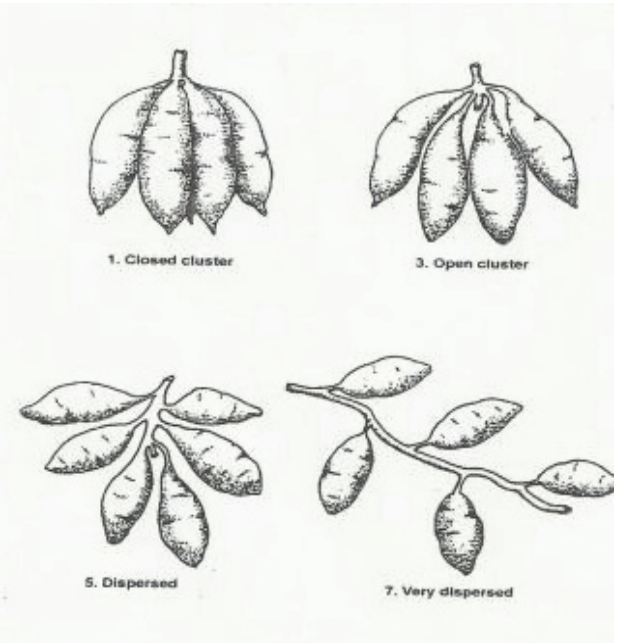
1. Pale
2. Intermediate
3. Dark

Flesh Colour

1. White
2. Cream
3. Dark-cream
4. Pale-yellow
5. Dark-yellow
6. Pale-orange
7. Intermediate-orange
8. Dark-orange
9. Strongly pigmented with anthocyanin



Storage Root Shape



Storage Root Formation

Appendix 3.2. The B-Carotene Sweetpotato Colour Chart

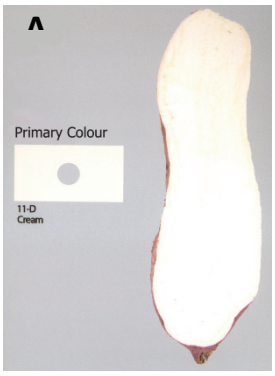
Source: Adapted from Burgos et al., (2001) "A colour chart to screen for high beta-carotene content in OFSP breeding"

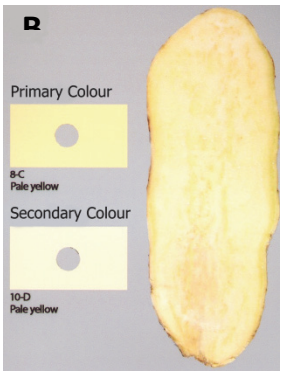
For estimating the β-carotene content of slices of freshly harvested sweetpotato

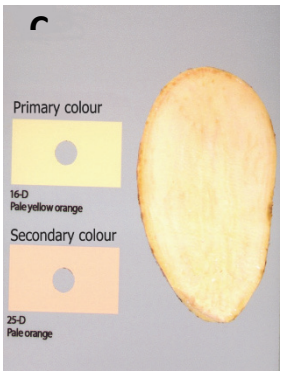
Instructions

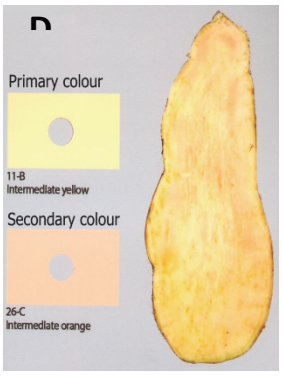
1. Cut a longitudinal slice off your freshly harvested sweetpotato root
2. Hold the root up to the colour chart and see which picture its colour is closest to
3. Read off the approximate B-carotene and Vitamin A concentrations.

N.B. This tool is for use with orange-fleshed sweetpotato, as in yellow fleshed varieties the β-carotene content can be very variable.

<table>
<tr>
<td> 

β-carotene: 0.03 mg/100g, FW
Vit A: 2.5 µg RE/100g, FW</td>
<td> 

β-carotene: 0 mg/100g, FW
Vit A: 0.0 µg RE/100g, FW</td>
<td> 

β-carotene: 0.15 mg/100g, FW
Vit A: 12.5 µg RE/100g, FW</td>
<td> 

β-carotene: 1.32 mg/100g, FW
Vit A: 110.0 µg RE/100g, FW</td>
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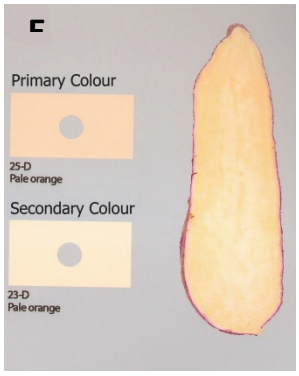
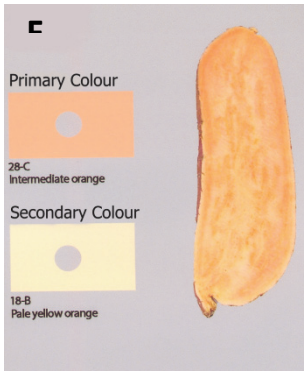
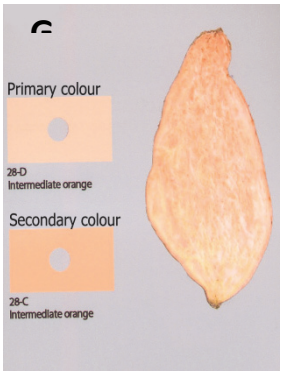
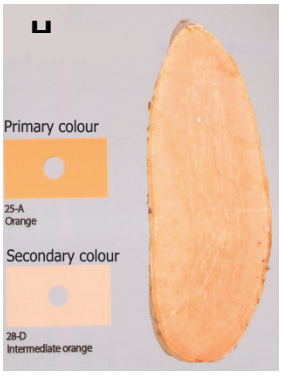
<tr>
<td> 

β-carotene: 1.65 mg/100g, FW
Vit A: 137.5 µg RE/100g, FW</td>
<td> 

β-carotene: 3.96 mg/100g, FW
Vit A: 330.0 µg RE/100g, FW</td>
<td> 

β-carotene: 4.92 mg/100g, FW
Vit A: 410.0 µg RE/100g, FW</td>
<td> 

β-carotene: 6.12 mg/100g, FW
Vit A: 510.0 µg RE/100g, FW</td>
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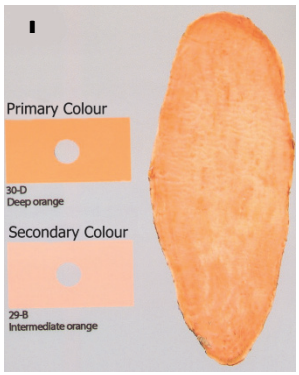
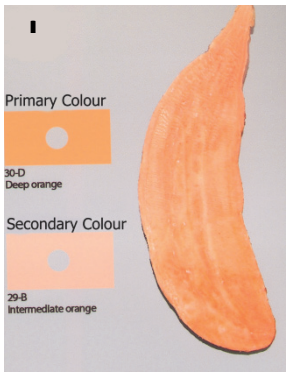
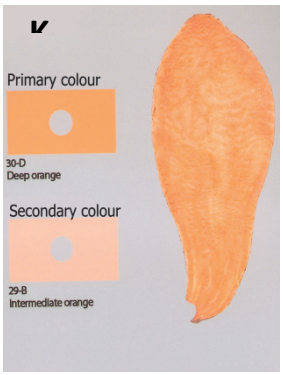
</table>

			
β-carotene: 7.76 mg/100g, FW Vit A: 646.7 µg RE/100g, FW	β-carotene: 10.5 mg/100g, FW Vit A: 875.0 µg RE/100g, FW	β-carotene: 12.39mg/100g, FW Vit A: 1032.5 µg RE/100g, FW	β-carotene: 14.37mg/100g, FW Vit A: 1197.5 µg RE/100g, FW

Key: FW = Fresh Weight; Vit A = Vitamin A; RE = Retinal Equivalent

Appendix 3.3. Sheet For Collecting Key Morphological Descriptors For Identifying Sweetpotato Varieties

(see Appendix sheets 3.1 and 3.2 for details)

Variety name	Plant type	Predominant vine colour	Secondary vine colour	General outline of leaf	Leaf lobe type	Leaf lobe number	Shape of central leaf lobe	Leaf vein pigmentation	Mature leaf colour	Immature leaf colour	Skin colour and intensity	Flesh colour	Estimated β-carotene content	Storage root shape	Storage root formation

Appendix 3.4. Sample Farmer Contract for On-Farm Trial

Contract between the farmer named _____ and the researcher named _____ and the representative from the local partner organization _____.

We, the undersigned:

1. Understand that the 3 middle rows of each plot will be reserved for harvesting together with the researchers/local partners, and that they will not be harvested before the agreed-on main harvest time. One row will be reserved for in-ground storage. One row will be for farmer's use to harvest as desired.

2. The farmer agrees to the following management practices:

a. To take good care of the trial plots, weeding and performing other management following the instructions agreed upon with the researcher including:

Preparing the field with 30 cm between plants on ridges, ridges should be 40 cms high.

1st weeding after 3 weeks.

2nd weeding as needed, hilling up as demonstrated by the researcher.

b. To protect the field from animal attack through careful site selection or fencing (with bushes or other materials).

c. To be available to attend field training on sweetpotato management

3. Understand that other farmers and members of the community will be invited for field days or at other times to observe the fields

4. Researchers will make several visits to take measurements during the growing season

5. The plot owner will own all of the roots from the harvest, except those needed for the cooking trials and the storage trials (approximately 20 roots).

6. Any other agreed upon point.

Signed and dated:

_____ _____

Farmer(s) Date

_____ _____

Researcher(s) Date

_____ _____

Local partner(s) Date

Appendix 3.5a. Forms for Pre-Harvest and Harvest Evaluation of On-Farm Trials by Research, Extension or NGO Workers

FORM 4B. SWEETPOTATO PRE-HARVEST COUNTRY (C): ____

SITE (L) ____ Trial Type (T) ____ Year:(Y) ____ Season(S) ____ Page: ____

PLOT NO.	REPLICATION NO.	GENOTYPE NAME (USE NUMBER IF NO NAME EXISTS)	SIMPLE CODE	1-Check clone 2- New Clone	3-4 WEEKS AP # VINES PLANTED	# PLANTS ESTABLISHED	VIRUS SYMPTOMS 6-8 WKS AFTER PLANTING 1- No symptoms to 9- Very Severe	VIRUS SYMPTOMS 1 MONTH BEFORE HARVEST 1- No symptoms to 9- Very Severe	ALTERNARIA 6-8 WKS AFTER PLANTING 1- No symptoms to 9- Very Severe	ALTERNARIA 1 MONTH BEFORE HARVEST 1- No symptoms to 9- Very Severe	VIGOR 1 MONTH BEFORE HARVEST 1- None to 9- Strong
PN	R	G	SC	CL	NOPS	NOPE	VIR1	VIR2	ALT1	ALT2	V V

AP= AFTER PLANTING.

CODING SCHEMES:

VIRUS SYMPTOMS

1- No virus symptoms
2- Unclear virus symptoms
3- Clear virus symptoms < 5% of plants per plot
4- Clear virus symptoms at 6-15% of plants per plot
5- Clear virus symptoms at 16-33% of plants per plot
6- Clear virus symptoms at 33-66% of plants per plot
7- Clear virus symptoms at 67-99% of plants per plot
8 = Clear virus symptoms at all plants per plot (not stunted)
9 = Severe virus symptoms in all plants per plot (stunted)

ALTERNARIA SYMPTOMS

1- No symptoms
2- Unclear symptoms
3- Clear virus symptoms at one plant per plot
4- Clear symptoms at 6-15% of plants per plot
5- Clear symptoms at 16-33% of plants per plot
6- Clear symptoms at 33-66% of plants per plot
7- Clear symptoms at 67-99% of plants per plot
8 = Clear symptoms at all plants per plot (not fully
9 = Severe virus symptoms in all plants per plot (fu

VINE VIGOR

1- Nearly no vines exist
2- Weak vines, thin stems, very long internode distances
3- Weak to medium strong vines, medium thick stems & long internode distances
4- Medium strong vines, medium thick stems, and medium internode distances
5- Medium strong vines, thick vines, & long internode distances
6- Medium strong vines, thick stems, and medium internode distances
7- Strong vines, thick stems, short internode distances, and medium long vines
8- Strong vines, thick stems, short internode distances, and long vines
9- Very strong vine strength, thick stems, short internode distances and very long vines

FORM 4C. SWEETPOTATO HARVEST COUNTRY (C): SITE (L) Trial Type (T) Year:(Y) Season(S) Page:

Code: 1- Preliminary (PT) 2- Advanced or Uniform (AT) 3- On-farm (OFT)

PLOT NO.	REPLICATION NO.	GENOTYPE NAME *(USE NUMBER IF NO NAME EXISTS)*	SIMPLE CODE	# PLANTS HARVESTED	# PLANTS WITH ROOTS	# ROOTS >100 gms undamaged MARKETABLE	# ROOTS <= 100 gms or damaged NON-MARKETABLE	WEIGHT OF ROOTS (KGS) MARKETABLE	WEIGHT OF ROOTS (KGS) NON-MARKETABLE	VINE WEIGHT AT HARVEST KGS	SKIN COLOR *see codes*	FLESH COLOR *4 roots, 1 rep Page # from color chart*	SIZE 1- Excellent 3- Good 5- Average 7- Fair 9- Terrible	FORM	WEEVIL 1- No damage 3- Minor 5- Mod (10-30%) 7- Heavy (30-60%) 9- Severe (>60%)	ROOT DEFECT C- Cracks V- Veins G-Grooves or constrictions P-Pencil roots
PN	R	G	SC	NOPH	NOPR	NOCR	NONC	CRW	NCRW	VW	SCOL	FCOL	RS	RF	WED1	DAMR

SKIN COLOR: 1- White 2- Cream 3- Yelllow 4- Orange 5- Brownish Orange 6- Pink 7- Red 8- Purple Red 9- Dark Purple

FLESH COLOR ***IF COLOR CHARTS ARE UNAVAILABL*** 1- White 2- Cream 3- Dark cream 4- Pale yellow 5- Dark yellow 6- Pale orange 7- Intermediate orange 8- Dark orange 9- Stongly pigmented with anthocyanins (purple)

FORM 5A. SWEETPOTATO FARMER PARTICIPATORY FIELD EVALUATION

SITE: ______ Year: ______ Season: ______ PAGE ______

TOTAL NUMBER OF FARMERS ______ TOTAL NUMBER OF FEMALE FARMERS ______ TOTAL NUMBER OFMALE FARMERS ______

GENOTYPE CODE	GENDER	PRODUCTION OF PLANTING MATERIAL			ASSESSMENT OF SPVD RESISTANCE			ASSESSMENT OF WEEVIL RESISTANCE			ASSESSMENT OF YIELDING ABILITY			ASSESSMENT OF ROOT SKIN COLOUR			ASSESSMENT OF ROOT FLESH COLOUR			OVERALL ACCEPTABILITY		
		# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					
	1 - MALE																					
	2 - FEMALE																					

Colour code: red – (red = not acceptable; yellow = moderately acceptable; and green = very acceptable)

Group Ranking of Varieties for the Overall Field Performance Using Pair Wise Comparison

Form 5A1

	Variety					
Variety	A	B	C	D	E	F
A	X					
B		X				
C			X			
D				X		
E					X	
F						X
Total frequency per variety						
Rank						

Reasons for the high ranked varieties:

_____

_____

_____

_____

Reasons for the least ranked varieties:

_____

_____

_____

_____

Appendix 3.5b. Forms for Farmer Participatory Storage Root Taste Evaluation

FORM 5B. SWEETPOTATO FARMER PARTICIPATORY TASTE TEST EVALUATION

SITE: ______ Year: ______ Season: ______ PAGE ______

TOTAL NUMBER OF FARMERS ______ TOTAL NUMBER OF FEMALE FARMERS ______ TOTAL NUMBER OFMALE FARMERS: ______

GENOTYPE CODE	GENDER	ASSESSMENT OF APPEARANCE # RED	# YELLOW	# GREEN	ASSESSMENT OF TASTE # RED	# YELLOW	# GREEN	ASSESSMENT OF STARCHINESS # RED	# YELLOW	# GREEN	ASSESSMENT OF FIBROUSNESS # RED	# YELLOW	# GREEN	OVERALL ACCEPTABILITY # RED	# YELLOW	# GREEN
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															

Group Ranking of Varieties for the Overall Consumer Acceptability of Storage Root Taste Using Pair Wise Comparison

Form 5B2

	Variety				
Variety	A	B	C	D	E
A	X				
B		X			
C			X		
D				X	
E					X
Total frequency per variety					
Rank					

Reasons for high ranked varieties:

_____

_____

_____

_____

Reasons for least ranked varieties:

_____

_____

_____

_____

Appendix 3.5c. Forms for Farmer Participatory Evaluation of Leaf Culinary Quality

FORM 5C. SWEETPOTATO FARMER PARTICIPATORY LEAF EVALUATION

SITE: ______ Year: ______ Season: ______ PAGE ______

TOTAL NUMBER OF FARMERS ______ TOTAL NUMBER OF FEMALE FARMERS ______ TOTAL NUMBER OFMALE FARMERS: ______

		PREHARVEST ASSESSMENT OF APPEARANCE			ASSESSMENT OF COOKED APPEARANCE			ASSESSMENT OF COOKED TASTE			ASSESSMENT OF COOKED TENDERNESS			OVERALL ACCEPTABILITY		
GENOTYPE CODE	GENDER	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN	# RED	# YELLOW	# GREEN
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															
	1 - MALE															
	2 - FEMALE															

Group Ranking of Varieties for the Overall Culinary Quality/Acceptability of Sweetpotato Greens Using Pair Wise Comparison

Form 5C1

	Variety				
Variety	A	B	C	D	E
A	X				
B		X			
C			X		
D				X	
E					X
Total frequency per variety					
Rank					

Reasons for high ranked varieties:

_____

_____

_____

_____

Reasons for least ranked varieties:

_____

_____

_____

_____

The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.
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