Building Nutritious Food Baskets

Provitamin A Maize

Participant's Guide

Training of Trainers (ToT) Provitamin A Maize: A Biofortified Solution for Vitamin A Deficiency

ISBN: 978-92-9060-500-3

DOI: 10.4160/9789290605003

International Potato Center

P.O. Box 1558, Lima 12, Peru

cip@cgiar.org • www.cipotato.org

Produced by CIP-Sub-Saharan Africa Regional Office (SSA), Nairobi

This module has been produced as part of the Building Nutritious Food Baskets project funded by the Bill & Melinda Gates Foundation.

Building Nutritious Food Baskets project (2018). *Training Module on Provitamin A Maize: A Biofortified Solution for Vitamin A Deficiency*: Building Nutritious Food Baskets Project. International Potato Center (CIP). ISBN 978-92-9060-500-3. 19 p.

Production Coordinator

Joyce Maru

Copyediting and Layout

SONATA Learning

Cover Design

SONATA Learning

Contents

Acknowledgments iv
Foreword v
Acronyms vi
Provitamin A Maize Module Overview 1
Module Objectives 1
Module Outline 1
Unit 1 – Introductions and Housekeeping 2
1.1 Ground Rules 2
Unit 2 - Micronutrients and Biofortification 3
2.1 Objectives 3
2.2 Synopsis 3
2.3 Key Points 3
Unit 3 – Provitamin A Deficiency and PVA Maize 4
3.1 Objectives 4
3.2 Synopsis 4
3.3 Key Points 4
Unit 4 – Breeding PVA Maize 5
4.1 Objectives 5
4.2 Synopsis 5
4.3 Key Points 5
Unit 5 - Fostering Demand for PVA Maize 6
5.1 Objectives 6
5.2 Synopsis 6
5.3 Key Points 6
Unit 6 - Scaling PVA Maize 7
6.1 Objectives 7
6.2 Synopsis 7
6.3 Key Points 7
Unit 7 – Integrating PVA maize into a healthy diet 8
7.1 Objectives 8
7.2 Synopsis 8

7.3 Key Points 8
7.4 Activities 9
7.4.1 Recipes 9
Unit 8 - Conclusion 12
Sources 12

Acknowledgement

In developing the content of this Training Module on Biofortification, SONATA Learning worked with the Building Nutritious Food Baskets (BNFB) project team and various technical specialists from The International Wheat and maize Improvement Center (CIMMYT) and The International Institute of Tropical Agriculture (IITA) to review existing technical content and resources relating to Provitamin A maize, added new knowledge from various scientists, experts and practitioners, and designed the training of trainers module which reflects Adult Learning Theory (ALT) and instructional design principles and practices. The BNFB project deeply appreciates the work and commitment of SONATA Learning in developing these instructional materials.

The expertise of technical module reviewers is greatly acknowledged. These reviewers include James Gethi (CIMMYT), Wende Mengesha (IITA), Stephen Mugo (CIMMYT), Natalia Palacios (CIMMYT) Thokozile NDHLELA, (CIMMYT), Joyce Maru(CIP) and Hilda Munyua (CIP). The photographs and resources used throughout this learning module came from a wide range of sources and institutions and we thank these institutions especially HarvestPlus for making them available for reuse.

Foreword

Biofortification is the process of increasing nutritional value of food crops by increasing the density of vitamins and minerals in a crop through either conventional plant breeding, agronomic practices or biotechnology. It is one of the key nutrition interventions that addresses micronutrient malnutrition among populations / groups who consume most of the staple foods that they produce, especially the poor, rural, and other vulnerable populations. Often, they have limited access to diverse diets, supplements, and commercially fortified foods that provide essential micronutrients necessary for ensuring healthy and productive lives. Adoption of biofortified food crops such as vitamin A rich orange-fleshed sweetpotato (OFSP); provitamin A (PVA) maize, high iron and zinc beans and vitamin A cassava, is an effective way of addressing micronutrients malnutrition because it is sustainable, cost-effective and culturally acceptable.

The Building Nutritious Food Baskets (BNFB) project is a three-year project (November 2015 to October 2018) 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.

To sustainably support the implementation of BNFB's capacity development efforts, the project has developed a training of trainers (ToT) module titled ***Training of Trainers (ToT) Provitamin A Maize: A Biofortified Solution for Vitamin A Deficiency***. The module includes a PowerPoint presentation, an annotated facilitator's guide and a handout for participants. Partner institutions; academic institutions and other users are encouraged to adapt and reproduce these instructional materials and where appropriate, integrate the teaching and learning into existing curriculum.

This module is designed to potentially serve a wide variety of audiences (nutritionists and agronomists, policymakers, extension workers, community development workers, 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; BNFB will apply a cascading approach in the delivery of training; 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 biofortification. They will in turn deliver shorter version courses and step-down the training to various levels of audiences (secondary and tertiary). This trend will continue until the training cascades down to "farmer trainers" who finally train the end users in their communities.

This module greatly contributes to BNFB's efforts in strengthening institutional and community capabilities to produce and consume biofortified crops (entire value chains) and to reach a critical mass.

Dr Hilda Munyua
Project Manager - Building Nutritious Food Baskets Project
International Potato Center - March 2018

Acronyms and Abbreviations

ALT	Adult Learning Theory
BNFB	Building Nutritious Food Basket
CGIAR	Global Research Partnership for a Food Secure
CIAT	International Center for Tropical Agriculture
CIMMYT	International Wheat and Maize Improvement Center
CIP	International Potato Center
FARA	Forum for Agricultural Research in Africa
GMO	Genetically Modified Organism
IITA	International Institute of Tropical Agriculture
NEPAD	New Partnership for Africa's Development
OFSP	Orange-Fleshed Sweet potatoes
PVA	Pro-Vitamin A
SSA	Sub-Saharan Africa
TOT	Training of Trainers

Provitamin A Maize Module Overview

Module Objectives

Upon completing this module, participants should be able to:

- Explain how biofortified provitamin A maize can address vitamin A deficiency among poor populations
- Describe the process use in developing new PVA Maize varieties
- Outline a strategy for promoting PVA maize to farmers, consumers and partner organizations
- Describe how PVA maize can be integrated into a healthy diet
- Summarize key studies demonstrating the effectiveness of PVA maize for addressing vitamin A deficiency
- Review best practices for maize cultivation

Module Outline

The 'Provitamin A Maize' module is divided into units and sub-units, as follows:

1) Introductions and housekeeping
2) Micronutrients and biofortification: An introduction
    a) The problem of "hidden hunger"
    b) Biofortification: An intervention for "hidden hunger"
3) Vitamin A Deficiency and PVA Maize
4) Breeding PVA Maize
    a) Breeding PVA Maize varieties
    b) The breeding process
5) Fostering demand for PVA Maize
    a) Variety release
    b) Seed systems
    c) Promoting farmer adoption
    d) Promoting consumer demand and utilization
6) Scaling PVA Maize
7) Integrating PVA Maize into a healthy diet
8) Conclusion

Unit 1 – Introductions and Housekeeping

1.1 Ground Rules

- Mobile phones off
- In addition to lecturing, there will be opportunities for discussions and asking questions.
  - To keep things moving, we might have to cut some conversations short and move on to the next topic
  - Not everyone will get to answer every question, but everyone will get multiple chances to speak and be heard throughout the session
  - If one or two people are answering every question, we will politely ask them to give someone else a chance to speak.
- As participants in this learning experience, we need to:
  - Share our ideas without fear of criticism, and listen to the ideas of others without criticizing
  - Engage in discussions without arguing
  - Help other participants and accept help from others
  - Create a safe, supportive environment for everyone to learn
  - Have fun

Unit 2 - Micronutrients and Biofortification

2.1 Objectives

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

- List and describe the three types of malnutrition
- Define 'hidden hunger' and explain the importance of micronutrients for good health
- Identify natural sources of micronutrients
- List and describe common interventions for micronutrient deficiency
- Define 'biofortification'
- Compare biofortification to other interventions and summarize its major advantages and challenges
- Differentiate between biofortified crops produced through selective breeding and GMOs

2.2 Synopsis

This unit introduces the basic concepts of micronutrient malnutrition and biofortification.

2.3 Key Points

- Micronutrient malnutrition is a serious public health issue
- While everyone is affected, children and women of reproductive age are most vulnerable
- Biofortification is a promising new intervention for micronutrient malnutrition that can be quite effective for vulnerable populations, especially in combination with other interventions
- Biofortification involves the development and distribution of new staple crop varieties with higher micronutrient levels than traditional varieties
- The crops discussed in this program are all the product of *selective breeding* (i.e., conventional natural reproduction) and are **not** GMOs

Unit 3 – Provitamin A Deficiency and PVA Maize

3.1 Objectives

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

- Describe the effects of Vitamin A deficiency on human health
- Identify populations particularly vulnerable to Vitamin A deficiency
- Describe the nutritional characteristics of PVA Maize
- Describe the agronomic qualities of maize that make it a good crop for biofortification
- Define "Biofortification Priority Index"
- Explain key benefits of PVA Maize
- Summarise key challenges with PVA Maize adoption

3.2 Synopsis

This unit reviews the effects of provitamin A deficiency on human health and introduces PVA maize as a potential intervention for provitamin A deficiency.

3.3 Key Points

- Vitamin A deficiency is one of the most comment micronutrient deficiencies in the world, and it particularly affects preschool aged children
- The effects of vitamin A deficiency can be severe and devastating, including permanent blindness, reproductive issues, low blood cell count, susceptibility to disease infection and, stunting among others
- Maize is a #1 crop in the world, consumed in large quantities in many areas where vitamin A deficiency is a serious risk
- Maize has agronomic qualities that make it attractive to farmers, such as high yield and adaptability to adverse climate conditions
- PVA maize has been bred to contain high levels of vitamin A, to help alleviate vitamin A deficiency

Unit 4 – Breeding PVA Maize

4.1 Objectives

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

- List the factors nutritionists consider while setting micronutrient targets for biofortified crops
- Identify causes of micronutrient loss
- List the characteristics that farmers and consumers find desirable in maize varieties
- Explain the significance of maize being a "hybrid" crop
- Outline the key steps of the breeding process and summarize what happens at each step

4.2 Synopsis

This unit reviews the process for breeding PVA maize, from setting nutritional targets through breeding and testing new varieties.

4.3 Key Points

- Nutritional targets are set based on the dietary needs of preschool aged children and non-pregnant women – the most vulnerable groups – and must account for micronutrients lost during storage, processing and/or preparation
- PVA maize is a hybrid crop, and its seeds cannot simply be replanted. Farmers must purchase new seeds from certified suppliers every season, to ensure quality.
- Breeders must account for agronomic qualities and consumer preferences
- Selectively breeding varieties with the desired traits involves years of work, crossing different varieties of maize with desirable traits to create new lines with all the best qualities of the parent lines
- New varieties are tested for nutrient content in the lab and tested for their agronomic performance in the field
- Breeders might "fast track" release of promising varieties that do not fully meet the targets, in order to help vulnerable populations benefit from biofortified crops sooner

Unit 5 - Fostering Demand for PVA Maize

5.1 Objectives

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

- Outline the steps for "scaling" and "anchoring" PVA maize in local food systems
- List key activities for introducing a new crop
- Differentiate between different seed systems
- Explain the role of private sector partners for promoting hybrid crops
- Summarise advantages of PVA maize for the farmers
- Summarise advantages of PVA maize for the consumers

5.2 Synopsis

This unit focuses on strategies for supporting the introduction of PVA maize within a country and influencing farmers, consumers and partner organizations to support PVA maize adoption.

5.3 Key Points

- Biofortification cannot succeed unless farmers can be persuaded to grow biofortified crops and consumers can be persuaded to purchase and eat them
- Ensuring a secure seed system is critical (if farmers cannot acquire seeds, they cannot grow biofortified crops)
- The fact that farmers cannot replant seed year over year makes PVA maize more appealing to commercial seed companies
- Emphasizing the agronomic qualities of PVA maize is often an effective way of promoting adoption among farmers
- Consumers generally prefer the sensory qualities of biofortified varieties, and providing them with nutrition information can further increase demand
- There are many possible channels and media for distributing promotional messages, though studies have shown that broadcast media such as radio is often more cost-effective than delivering messaging face-to-face
- Potential partners for promoting biofortified crops include local governments, seed companies, NGOs, multilateral organizations and various participants in the agricultural value chain (e.g., food processors)

Unit 6 - Scaling PVA Maize

6.1 Objectives

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

- Outline the strategic goals of biofortification interventions
- Identify potential partner organizations for supporting PVA maize over the long term
- Recognize the potential impact of policies, regulations and trade on biofortification initiatives
- Explain the importance of integrating biofortification into international standards

6.2 Synopsis

In this unit we explore long-term strategies for "scaling" and "anchoring" PVA maize within national food systems, including the impact of policy, regulations, trade and international standards on the promotion, adoption and sustainability of biofortified crops generally, and PVA maize in particular.

6.3 Key Points

- The introductory phase of intensive promotion and support for biofortified crops is not intended to last forever
- Goal is to achieve sustainability and transfer ownership to local stakeholders
- Creating incentives and supports through policy, regulations, trade and international standards can help to ensure that biofortified crops become permanently anchored within local food systems

Unit 7 – Integrating PVA maize into a healthy diet

7.1 Objectives

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

- Review the nutritional benefits of eating PVA maize
- Compare different methods of preparing PVA maize in terms of nutrition
- Name some of the other nutrients contained in PVA maize

7.2 Synopsis

In this unit we discuss different methods for preparing PVA maize and the impact of consuming PVA maize on human health.

7.3 Key Points

- PVA maize can provide an excellent source of provitamin A, though some methods of preparation are more nutritious than others
- Studies indicated PVA maize is as effective as supplementation and resulted in improved serum concentration

7.4 Activities

Cooking with PVA maize (Breakout Groups)

7.4.1 Recipes

PVA Maize Ugali/Sima

Ingredients:
¾ cup PVA orange maize meal
2 cups water

Method:

- Put clean water in a pot and bring to boil.
- Gradually add small quantities of maize meal, stirring continuously (making sure there are no lumps) to make thick porridge.
- Let the porridge cook for approximately 5-8 minutes.
- Gradually add maize meal until the mixture thickens.
- Reduce heat and let the sima/ugali cook over low heat for 5 minutes.
- Serve

Orange Maize Bread

Ingredients:

1 ½ cups orange maize flour

½ cup wheat flour

2 teaspoons baking powder

2 teaspoons sugar

1 teaspoon salt

2 eggs

1 cup milk

¾ cup oil or melted margarine

100g raisins (optional)

Method:

- Sieve together orange maize flour, baking powder, salt and sugar.
- Add milk, eggs, and margarine and mix well.
- Spread the dough across a greased baking pan.

- Bake for 45 minutes in a hot oven at 180°C.

Orange Maize Biscuits

Ingredients:

¾ cup orange maize meal

¼ cup wheat flour

1 egg

1 teaspoon baking powder

1 teaspoon butter

Salt to taste

Method:

- Sieve the flours and baking powder into a bowl.
- Add salt and sugar.
- Rub oil into the mixture to form a bread crumb texture.
- Break the egg into a cup, beat, add to the flour mixture and knead into dough.
- Roll out the mixture and make shapes as desired.
- Place the shaped batter on a baking sheet.
- Bake in a hot oven at 160°C for 10 to 15 minutes.
- Serve as a snack.

Orange Maize Scones

Ingredients:

50g butter

50g sugar

2 large eggs, lightly beaten

2 cups orange maize meal

½ cup wheat flour

1 tablespoon baking powder

Pinch of salt

½ teaspoon grated coconut

1½ cup milk

250g raisins (optional)

Method:

- In a large bowl, beat the butter and sugar together until light and creamy.
- Add the eggs, a little at a time, beating well between additions.
- Sift the flour, baking powder, salt and coconut together.
- Slowly add to the butter-egg mixture along with the milk.
- Gently fold the ingredients together.
- Spoon the mixture into a greased muffin/scone pan, filling each hole to about two thirds full.
- Bake in a preheated oven at 180^{o}C for 15 to 20 minutes or until the scones are lightly brown and firm to touch.
- Serve as a snack.

Unit 8 - Conclusion

Sources

- Jéan du Plessis. (2003). *South Africa Ministry of Agriculture Maize Production Guide.* Available: http://www.arc.agric.za/arc-gci/Fact%20Sheets%20Library/Maize%20Production.pdf. Last accessed 23rd March 2018.

- E.D. Nafziger . (2007). *Growth and Production of Maize: Mechanized Cultivation.* Available: http://www.eolss.net/Sample-Chapters/C10/E1-05A-13-00.pdf. Last accessed 23rd March 2018.

- John F. MacRobert, Peter Setimela, James Gethi and Mosisa Worku Regasa May 2014. (2014). *CIMMYT Maize Hybrid Seed Production Manual.* Available: http://spotidoc.com/doc/298228/maize-hybrid-seed-production-manual-may-2014. Last accessed 23rd March 2018.

- IIAT. (1982). *Maize Production.* Available: http://biblio.iita.org/documents/U82ManIitaProductionNothomNodev.pdf-9fce0a6ccf8448043986682d83036bc0.pdf. Last accessed 23rd March 2018

- Thai Agricultural Standard. (2010). *Good Agricultural Practices for Maize.* Available: http://www.acfs.go.th/standard/download/eng/GAP_maize.pdf. Last accessed 23rd March 2018.

- Iowa State UP. (1986). *How a Corn Plant Develops.* Available: http://publications.iowa.gov/18027/. Last accessed 23rd March 2018.

- Semaana, Hillary Rugema. (2000). *SASAKAWA Global Maize Production Manual.* Available: http://teca.fao.org/sites/default/files/resources/Maize%20Production%20in%20Uganda_SASAKAWA_%20GLOBAL%202000.pdf. Last accessed 23rd March 2018.

- Kansas State University .(2007). *c560 corn production.* Available: http://teca.fao.org/sites/default/files/resources/Maize%20Production%20in%20Uganda_SASAKAWA_%20GLOBAL%202000.pdfhttps://www.bookstore.ksre.ksu.edu/pubs/C560.pdf. Last accessed 23rd March 2018.

- IIAT, USAID. (2006). *Growing Maize in Nigeria.* Available: http://teca.fao.org/sites/default/files/resources/Maize%20Production%20in%20Uganda_SASAKAWA_%20GLOBAL%202000.pdfhttps://www.bookstore.ksre.ksu.edu/pubs/C560.pdf. Last accessed 23rd March 2018.

- Denis Owusu Boateng. (2011). *Manual for Maize Production.* Available: https://www.slideshare.net/DENNIS90/manual-for-maize-production-9558330. Last accessed 23rd March 2018.