Quality declared planting material (QDPM) in root and tuber crops

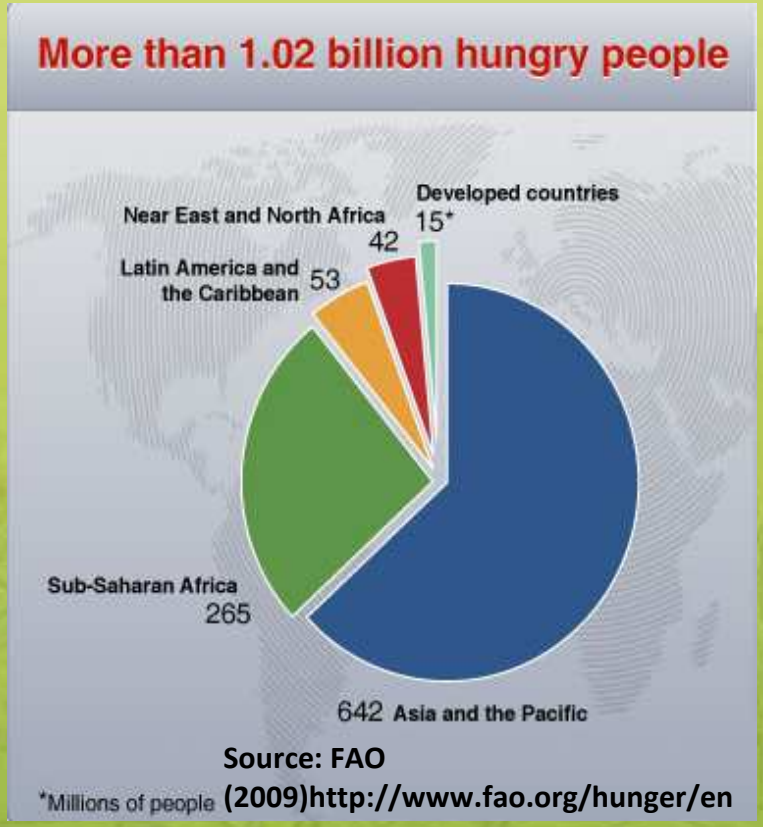
Food and Agriculture Organization
of the United Nations

Outline

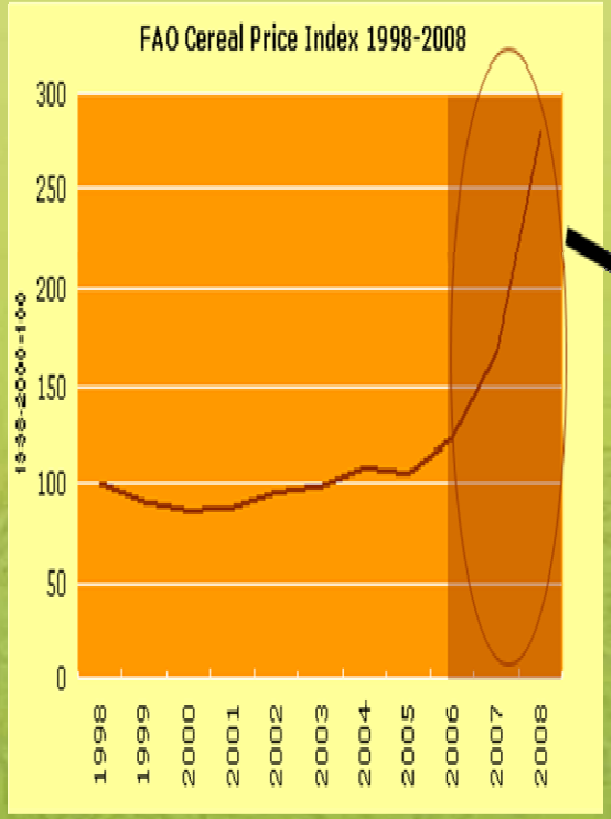
1. Context
2. State of quality assurance for planting material in developing countries
3. Protocols and standards for roots and tubers
4. Capacity building and Future Considerations
5. Concluding comments and Acknowledgments

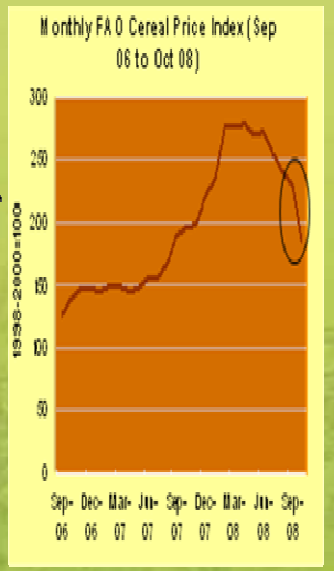
1. Context

Role in food security and livelihoods



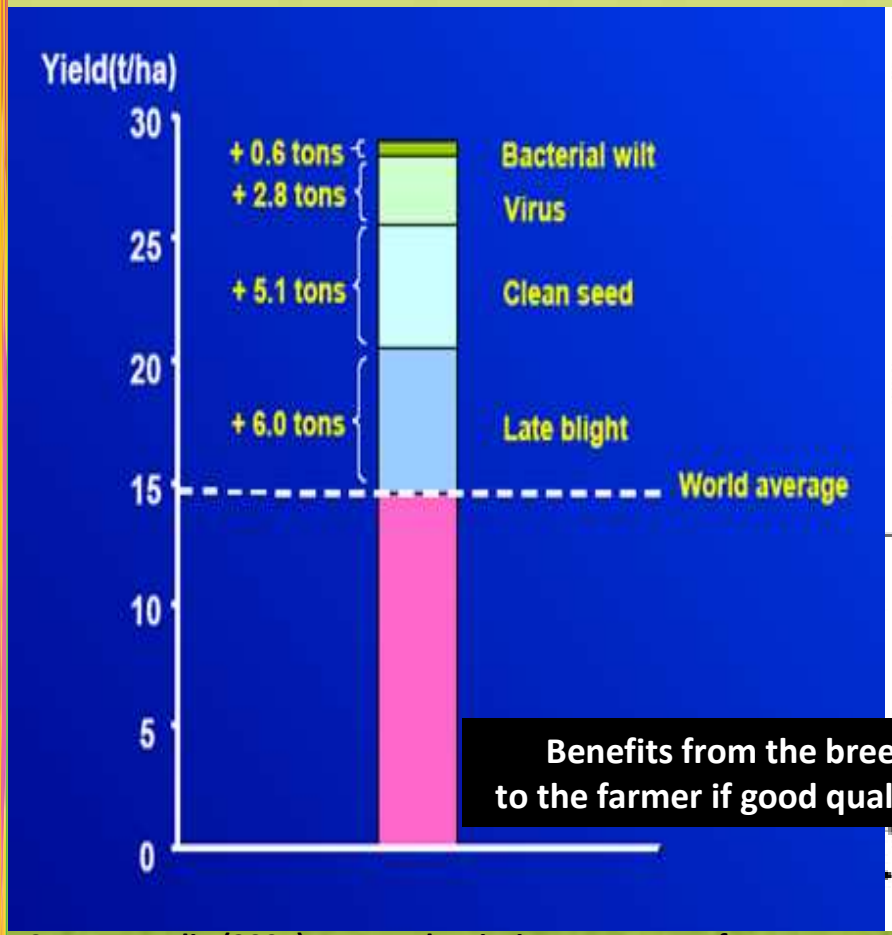
Source: FAO (2009)http://www.fao.org/hunger/en





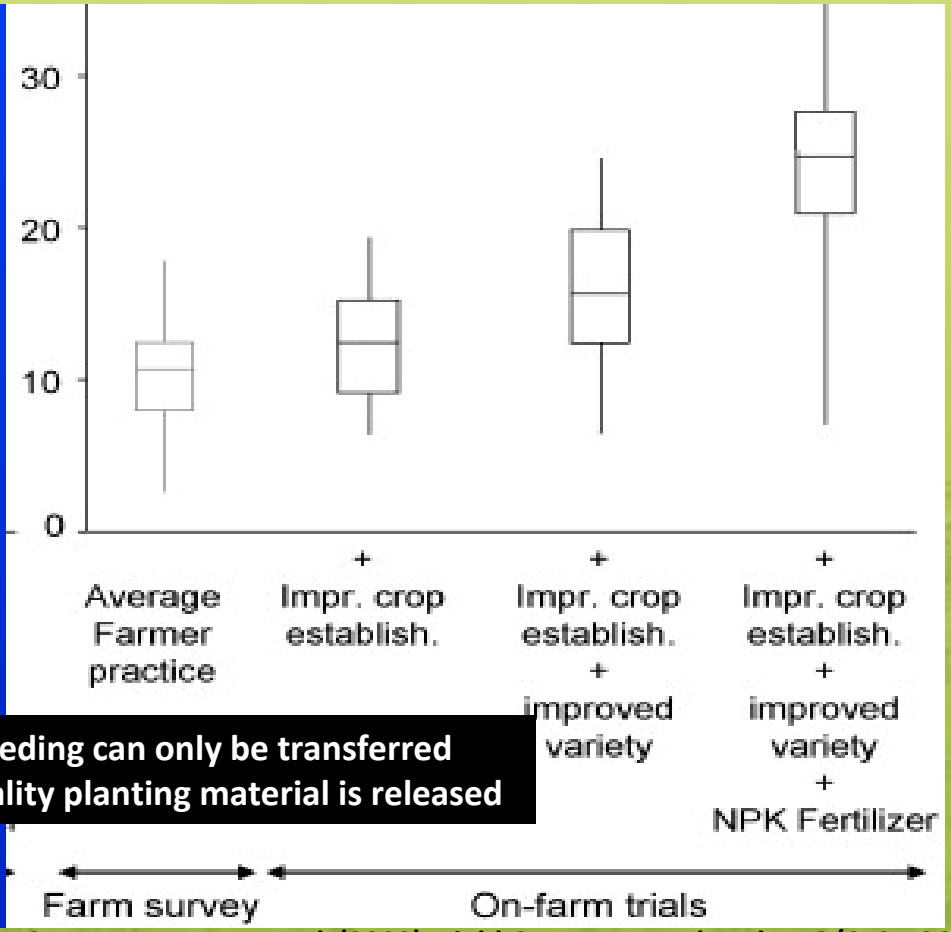
Factors effecting yields

Potato yield gap analysis



Source: Fuglie (2007). Research priority assessment for the CIP 2002-2015 Strategic Plan: Project impacts on poverty, employment, health and environment

Closing the cassava yield gap



Source: Fermomt *et al.* (2009). Field Crops Research Vol. 112/6. 24-36

Benefits from the breeding can only be transferred to the farmer if good quality planting material is released

What is quality planting material?

- Variety/genetic purity, required variety
- Physiological stage and conditions
- Uniform size, good plant establishment
- Health Status – disease-free planting material
- Physical aspect.

Rationale for quality assurance system

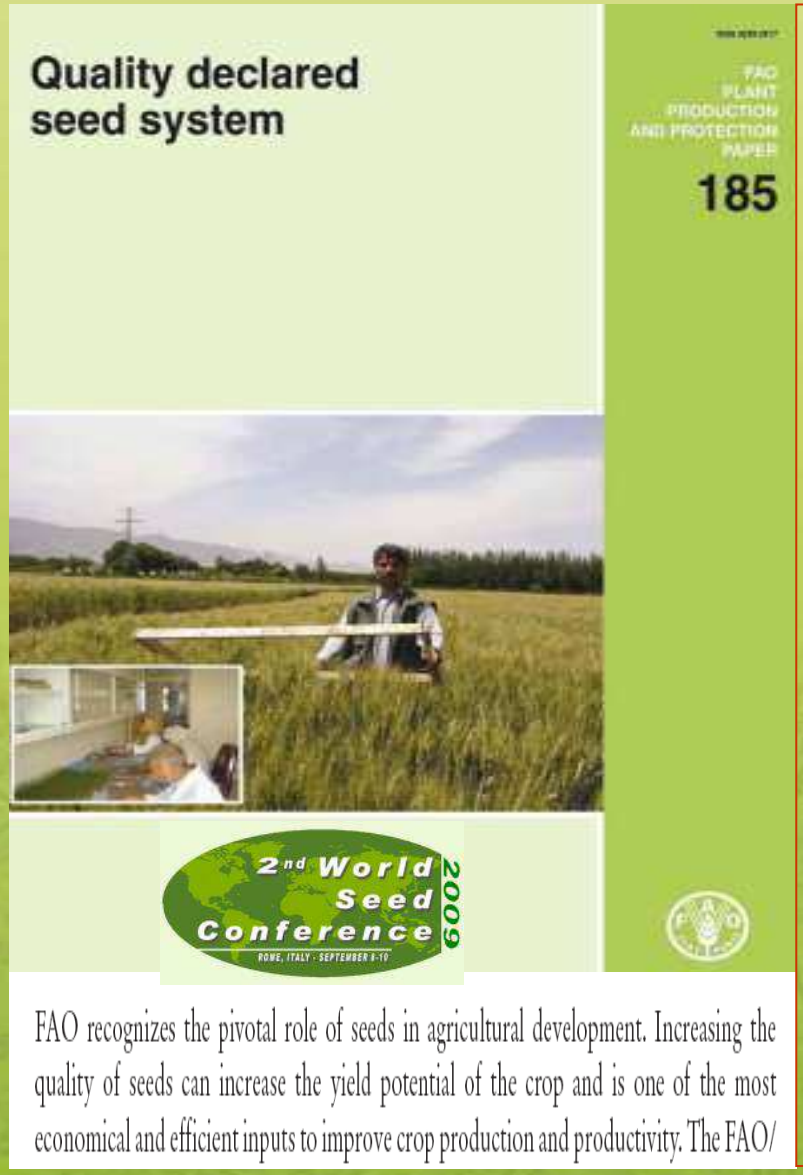
- Ensure that the best quality planting material are produced and made available to farmers
- Prevent the spread of insect pests and diseases
- Meet consumer demands for specified qualities
- Cater for the need of specialized farming
- Comply with intensification of agriculture
- Provide basis for healthy competition among growers/traders of planting material.

2. State of quality assurance for planting material

Issues related to the use of quality planting material

- Absence of formal seed systems (except potato)
- Limited/lack of knowledge of phytosanitary measures and quarantine issues related to safe movement of germplasm, plants and planting material across national borders
- Lack of consistent supplies of good quality planting material
- Variable demand for clean planting material
- Bulkiness and perishability of planting materials
- Use of traditional varietal mixtures, including local varieties.

Quality scheme for small farmers



►**In 1993, the FAO produced guidelines on standards and procedures for quality seeds – known as QDS.**

►**QDS was updated in 2003 for 92 crop species reproduced by means of true seeds and development of quality assurance scheme for vegetatively reproduced crops was recommended.**

►**14th ISTRC symposium in 2006 identified "production of quality planting materials to overcome the degeneration due to diseases and pathogen accumulation" as a key emergent theme.**

►**FAO/CIP collaboration during the IYP and ISFP - Expert consultation in 2007 with international and national experts lead to QDPM.**

Purpose of QDPM

To establish protocols that would improve the quality and availability of planting materials, particularly for the small farmer.

The crops described varied greatly in their reproductive means and therefore on the types of processes needed to obtain quality materials.

In general terms, focus was made on quality and sanitary aspects of the production of planting materials.

Objective and principles of QDPM

► guide the production of clean, disease-free planting material

► raise the physiological and phytosanitary quality of reproductive materials available to smallholders, and increase production and productivity

► be implemented primarily by seed/planting material producers at community level or extension and development organizations

► allow easy monitoring and verification of the production and distribution process

► complement and be amenable to formal seed quality control systems, but are cognizant of national/local conditions to ensure they are appropriate/achievable for users

► link breeding activities to planting material multiplication activities of smallholders.

Better planting material enhances food security

QDPM must conform to national and international arrangements on phytosanitary issues;

QDPM sees clear roles for the public and the private sectors:

- maintaining germplasm, introducing and breeding new materials and handling virus indexing;
- mass multiplication and distribution.

Healthy cassava plant

Good quality potato seed tuber

Freshly cut yam tuber pieces

3. Protocols and standards for roots and tubers

- **Andean tubers**
  - **Oca** *Oxalis tuberosa* Molina, *Oxalidaceae*
  - **Ulluco** *Ullucus tuberosus* Loz., *Bassellaceae*
  - **Mashua** *Tropaeolum tuberosum* Ruiz and Pavon, *Tropaeolaceae*
- **Cassava** *Manihot esculenta* Crantz, *Euphorbiaceae*
- **Cocoyam** *Xanthosoma sagittifolium* (L) Schott *Araceae,* subfamily *Aroidea*
- **Hausa potato** *Solenostemon rotundifolius* (Poir) J.K. Morton, *Lamiaceae*
- **Konjac** *Amorphophallus konjac* K. Koch, *Araceae*
- **Potato** *Solanum tuberosum L., Solanaceae*
- **Sweetpotato** *Ipomoea batatas* (L.), *Convolvulaceae*
- **Taro** *Colocasia esculenta* (L.) Schott, *Araceae*
- **Yam** *Dioscorea* spp., *Dioscoreaceae.*

Pattern for protocol and standard development

1. Introduction

- Scientific name, origin, distribution
- Mode or modes of propagation commonly used by small farmers
- Reproduction rate
- Main seed-borne diseases and pests including brief life cycle, identification, detection, natural spread, field symptoms, alternate hosts, control methods and/or any other element useful to characterize the diseases/insect pests.

Pattern *(cont.)*

2. Protocol for the production of planting materials

- Field facilities and equipment
- Source of clean material, including positive selection
- Field requirements
- Field inspection
- Agronomic practices: isolation, rotation, negative selection
- Harvesting and handling
- Post-harvest treatments
- Storage and transport
- Documents accompanying supplied product, if appropriate.

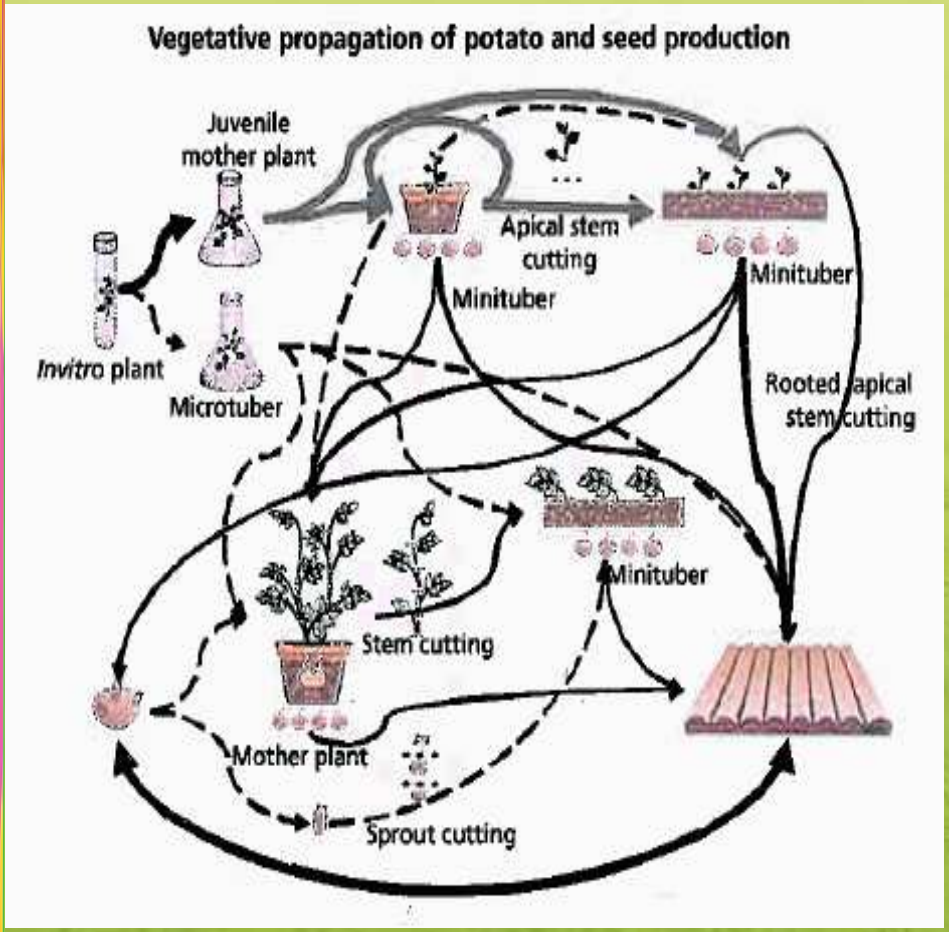
Pattern *(cont.)*

3. Quality requirements

- Table of tolerances (%) for common economically important seed-borne insect pests and diseases, both at field and at storage
- Labelling requirements, where appropriate
- Capacity (%) to sprout and develop a normal plant (when possible)
- Varietal purity (%).

Pattern *(cont.)*

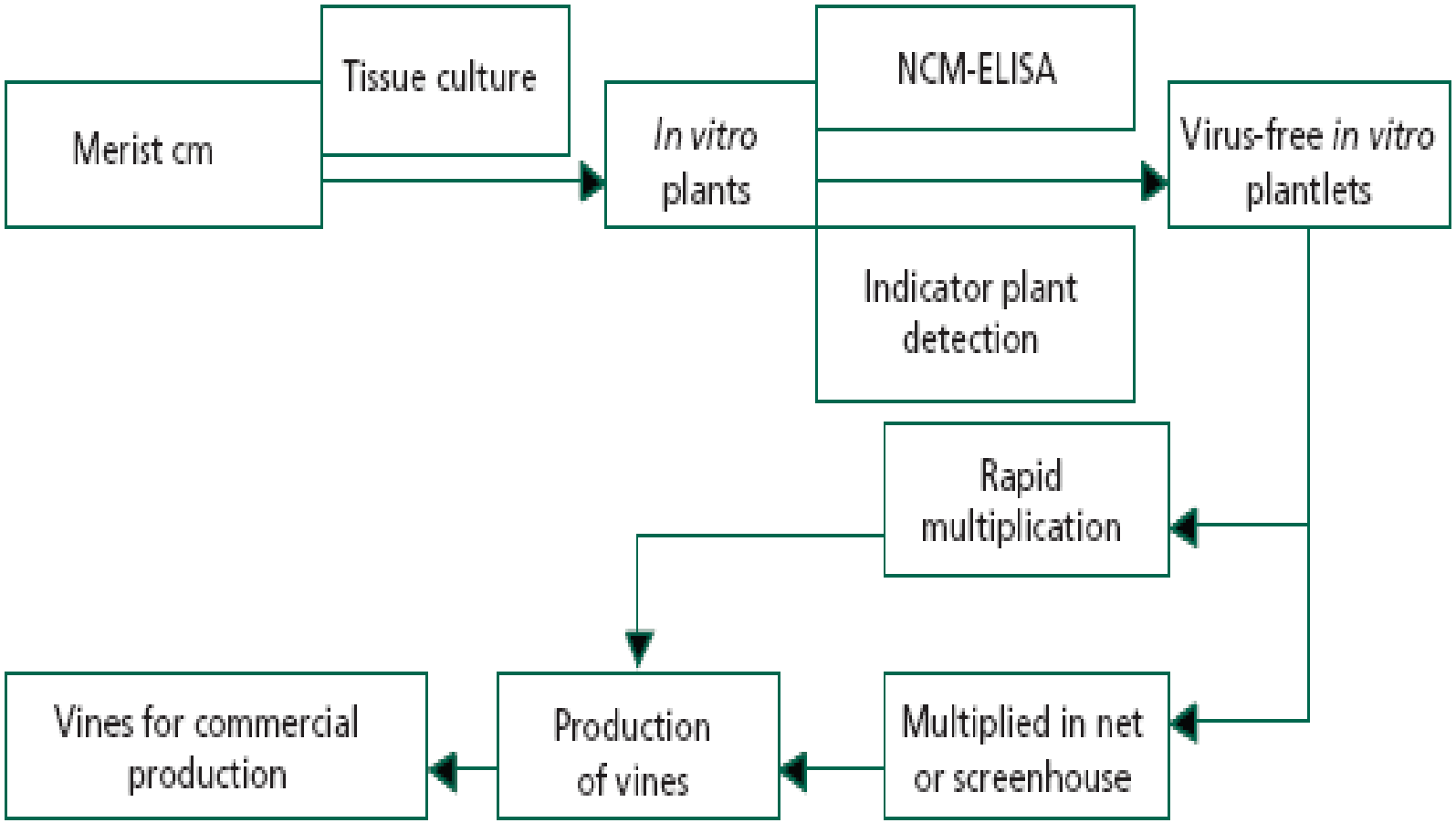
4. Outline of multiplication programme



Rate of multiplication for potato propagation techniques

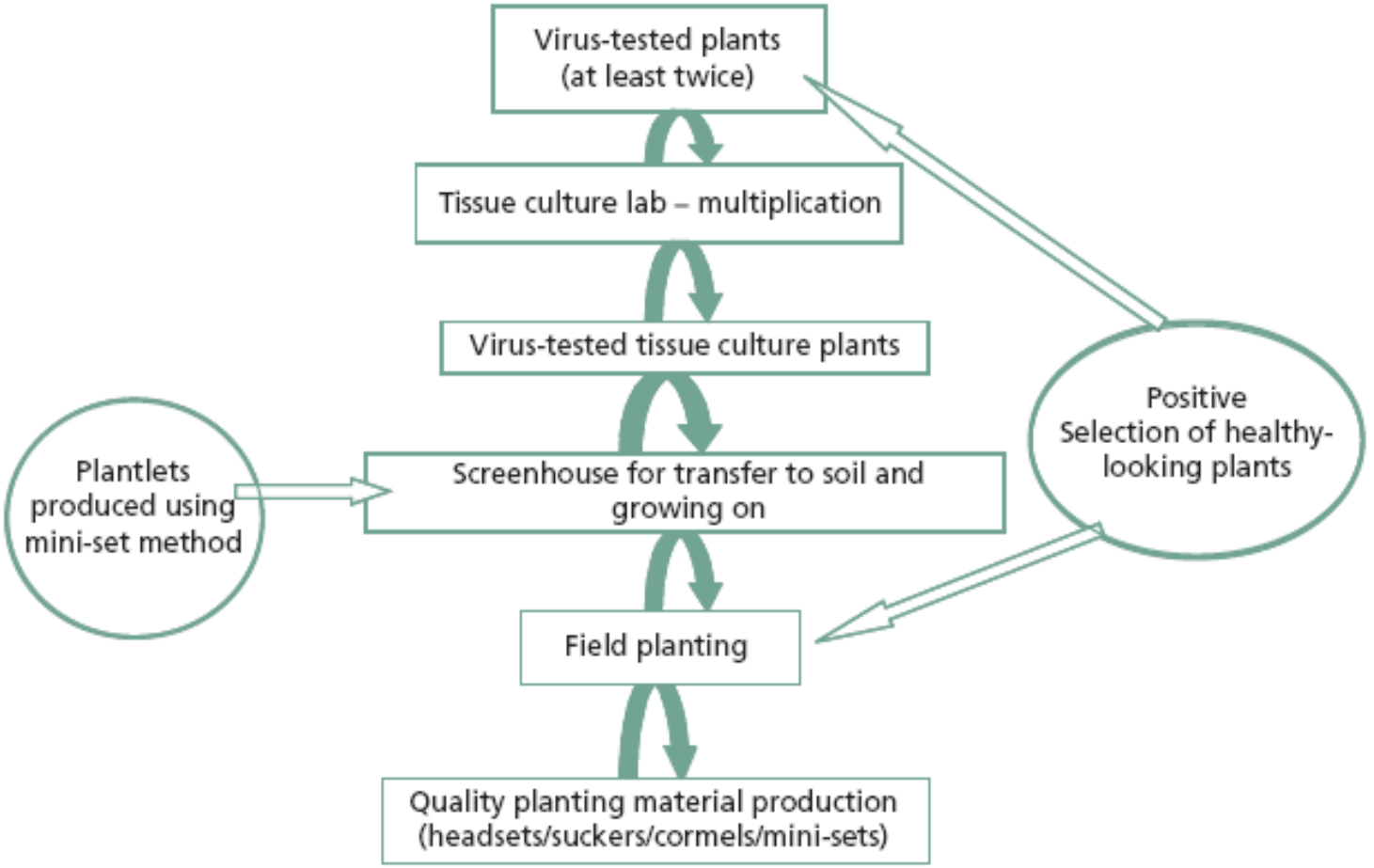
	Source	Product	Harvest time	Estimated mean multiplication rate	Comments
Field	Tuber seed	Tuber	90 days	10:1	
	In vitro plant/ node/ apical stem/sprout cutting	Tuber	90 days	8:1	Management of *in vitro* plant /cuttings to avoid precocious tuberization and low tuber number yield.
Greenhouse	40-day-old plant	Stem node cutting	40 days	15:1	Avoid harvesting old cuttings.
	Mother plant derived from *in vitro* plant or cutting	Apical stem cutting	Every 10 to 15 days	25:1	Maintain mother plants as juvenile. Use foliar fertilizer. Extend photoperiod.
	Tuber	Sprout cutting	14 days	25:1	
	In vitro plant/ node/ apical stem/sprout cutting	Minituber	90 days	10:1	Requires careful management of *in vitro* plant/cuttings to avoid precocious tuberization and low tuber number yield. High density planting (50–100 plants/m²) to produce 350–900 minituber/m².
	In vitro plants for aeroponic culture	Minituber	90 days	30:1 to 80:1	High-density planting (16–67 plants/m²) to produce 1 200–2 000 mini-tubers > 1.5g/m².
Laboratory (*in vitro*)	*In vitro* plant	*In vitro* plant	30 days	5:1 to 10:1	*In vitro* plants can be continuously multiplied.
	In vitro plant	Microtuber	45-60 days	1:1	High density of *in vitro* plants may yield a high number of microtuber/m²

Protocol for virus free sweet potato planting material production



Outline of a multiplication programme

Taro



Pattern *(cont.)*

5. Quality standards for planting material

Summary table of standards **for KONJAC**	
Weight of propagules	200–300 g
Varietal purity	98 %
Germination	99 %
Maximum tolerances for pests and diseases	
Mosaic disease (in field)	1 %
Collar rot (in field)	5 %
Other pests and diseases (in storage)	5 %

Summary table of standards for Yam	
Weight of set (seed yam)	25–50 g
Varietal purity	98 %
Viability	100 %
Tolerances for all pests and diseases	10 %

- Set weight of seed tubers: 200 g but not more than 250 g.
- Package tubers in batches of 25 kg each.
- Produce seed yams from the same variety and use very uniform setts of 25–50 g.
- Store only healthy seed yams tubers.
- Inspect field for disease and variety purity.
- Inspect harvested tubers for health and seed yam size.
- Set 98 percent purity of the specified variety on the label as the standard.
- Set physiological and physical status at 100 percent viability at date of label.
- Give statement of the results of field inspections as percentage observed among plants of the sample counted and assessed.
- Add other criteria for standards as deemed fit by the local authority, based on the prevalent pests and diseases.
- Allow tolerances of 10 percent for most variables. But less is preferable.
- Ensure tolerances are less than those that can be observed in "common seeds", i.e. regular commercial planting material not derived from a monitored, controlled QDS programme.

Summary table of standards for Taro

Standard	Headsett/sucker	Cormel
Size	5 cm diameter, at the base of the petiole	30–50 g
Varietal purity (minimum)		98 %
Germination (minimum)	99 %	95 %
Tolerances for pests and diseases: taro beetle, TLB, CBDV, alomae, pythium	0 %	

Summary table of standards for Sweetpotato

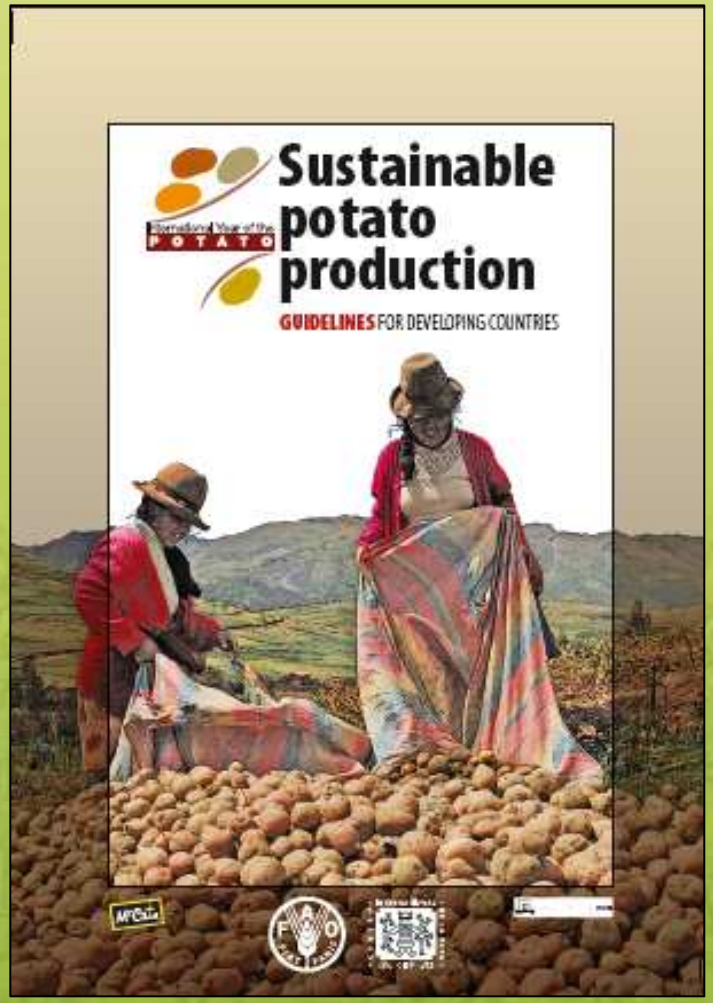
Vine length	25 cm
Tolerance for other varieties	2 %
Tolerances for pests and diseases	
Black rot	0.5 %
Root knot nematodes (RKNs)	1 %
Scurf	0 %
Wireworms	10 %
Wilt	0.5 %
SSR-Pox1	10 %
Mosaic and stunting virus	1 %
Leaf curl (SPLCV)	5 %
Other virus (e.g. purpling of old leaves, chlorotic spots, vein clearing)	5 %
Storage rot	None
Sweet potato weevil	None

4. Capacity Building and Future Considerations

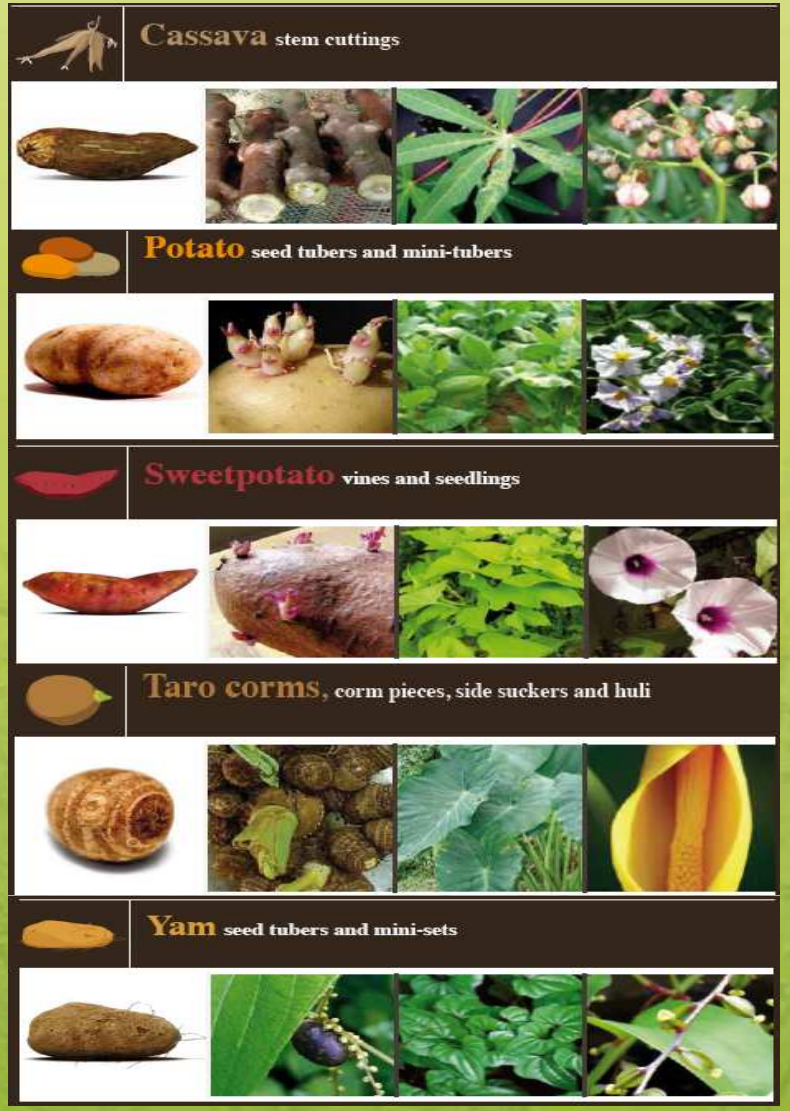
Expert consultation recommended:

- capacity building for the implementation of QDPM in the field and promotion of its use in community-based seed multiplication activities;
- developing a monitoring system to observe the operation of QDPM in the field and integrate results and lessons learned;
- promoting governmental responsibility in the implementation of QDPM and in promoting the use of clean planting materials.

Capacity building support tools



Capacity building *(cont.)*



Capacity building *(cont.)*

What need to be taken into account for development of quality scheme:

- **Development of physical structures, equipment and facilities**
- **Human resource development and deployment**
- **Formulation and/or review of policy, legislation, guidelines, standards, etc.**

Capacity-building activities :

- Emergency panting material relief and rehabilitation
- Planting material programme development
- Harmonization of quality assurance system
- Development of potential “certification” scheme for vegetatively propagated crops
- Training of growers of planting materials in community-based multiplications.

Constraints of capacity building:

- Lack of resources especially for the provision of necessary infrastructure/facilities.
- Lack of interest by many countries to providing necessary financial support for planting material-related training and studies.
- Little or no interest of many donors to fund projects aimed at capacity building related to quality planting material.

Future Considerations

- Need for long term sustainability and country ownership of outputs from projects on multiplication and distribution of planting material
- Regional networking and coordination in laboratory testing, virus indexing and clean-up services
- Policy and legislation in relation to quality assurance
- Variety development programme including participatory breeding and variety release system
- Cost effective methodologies for quality assurance of planting material in the public sector.

5. Concluding comments and Acknowledgements

Concluding comments

1. The role of new/improved varieties and high quality planting material of roots and tubers is critical in responding to the challenges of a changing world, especially in developing countries in tropical and subtropical areas.

2. Quality planting material determination, as established by QDPM, on reproductive material to be supplied to farmers is an important measure of achieving successful agricultural production and productivity.

3. Capacity building through training in QDPM implementation and use in community based multiplication activities and through establishment or maintenance of appropriate scientific/technical infrastructure and monitoring system related to QDPM is highly recommended in developing countries.

4. Participation in harmonized quality scheme is an important means for developing countries to increase the availability of high quality planting material for the benefit of farmers.

5. A reliable and user friendly QDPM is crucial to ensure that farmers have access to high quality planting material at a faire cost and timely.

6. Supportive government measures and increased public and private investment in planting material sector is required, for the long term, to meet the challenge of food security in the context of climate change and population growth.

Acknowledgements

EXPERT CONSULTATION. Lima, Peru, 27-29 Nov. 2007

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