Basics of potato production

September 2016, Myanmar

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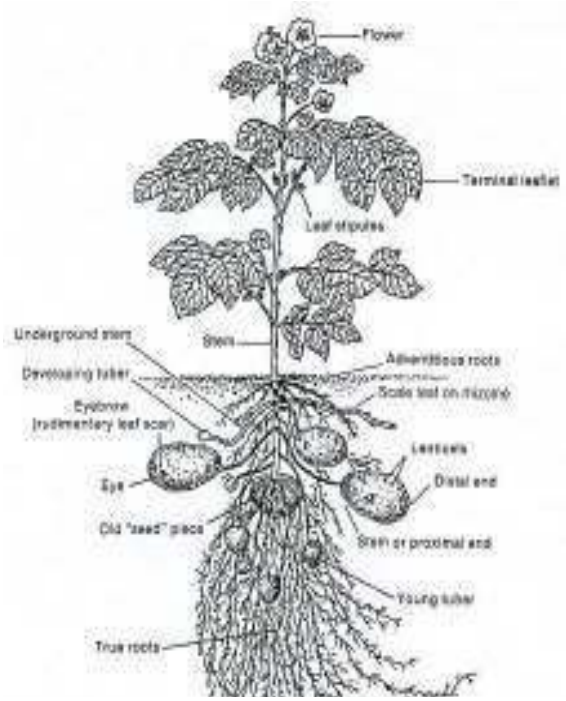
PUM, the Netherlands



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MORPHOLOGY OF THE TUBER

1. Stolon with one side leaflet and five leaflets at the tip.

2. Tip swollen; side leaflet forms first eye and five leaflets at the tip.

3. *Two eyes on the tuber and seven at the tip*

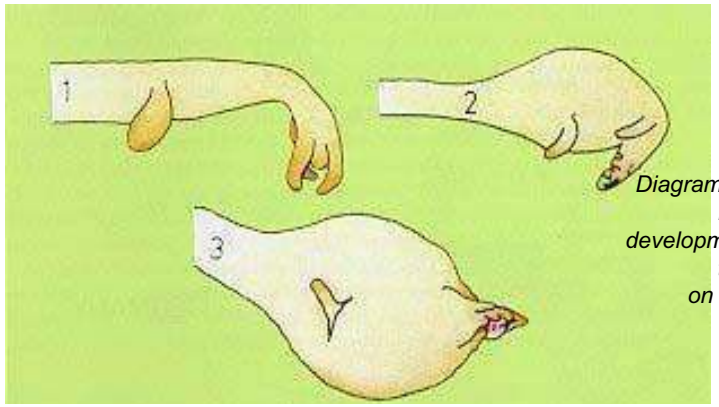

Diagram showing the initial development of a small tuber on a stolon

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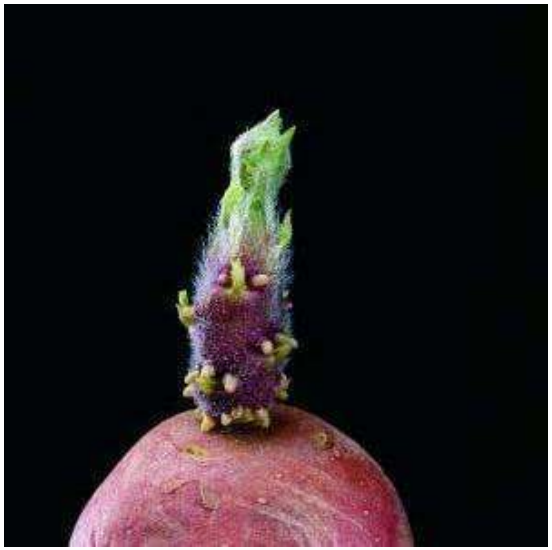

Short compact sprouts formed in light. Small bulges are the beginning of roots.

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Length of the dormancy period depends on:

1. **variety**
2. **degree of maturity at harvest**
3. **temperatures during growing season**
4. **temperature during storage**
5. **the presence of tuber injury caused mechanically (deliberate cutting or accidental damage) or disease (e.g. blight).**

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Tubers at different stages of physiological development. From left to right, dormant, apical dominance, normal sprouting, later weak thin sprouts

1. Changing very rapidly from cool storage to conditions ideal for, sprout growth (approx. 20 °C and high humidity) this is particularly necessary if the tuber is still in the transition phase. In some varieties, cool storage may even prolong this phase
2. 2. Removing the apical sprout(s) and placing the tuber under conditions favouring sprouting

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MAIN YIELD DETERMINING FACTORS

Tuber yield is determined by:

1. cumulative light interception (light = photosynthetically active radiation (PAR) = 400-700 rim)

2. efficiency- of foliage in utilizing the intercepted light for dry matter production

3. distribution of dry matter (harvest index)

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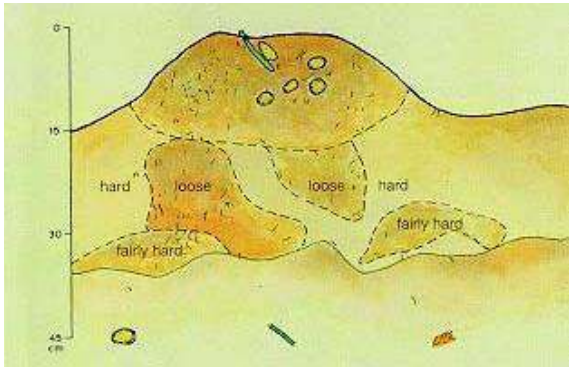

Sketch of the root system of a potato plant on old farmland.

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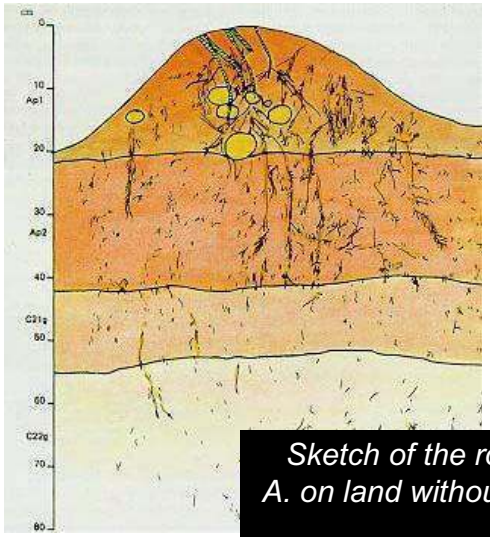

Sketch of the root system of a potato plant. A. on land without obstructive layers in the soil profile

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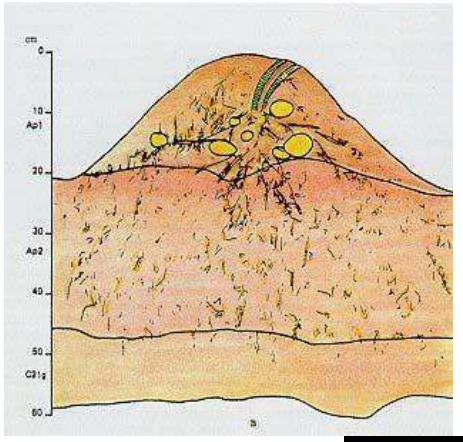

On land with an obstructive layer in the soil profile (root depth about 40 cm).

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The principal means of achieving the desired number of stems are:

1. good pre-sprouting.

2. determination of the most suitable distance between the seed tubers in the row, which, in turn, depends on the number of well-developed sprouts, the number of stems desired per m^2, and the distance between rows.

3. provision of a moist seed bed.

4. avoidance of damage to sprouts during planting.

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Second growth. You can see very well the big tubers are the primary tubers, the little ones are newly formed secondary tubers.

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TUBER dry matter content negatively influenced by

- Water
- Nitrogen
- Potassium
- Early harvests (premature)
- High temperatures
- Sandy soils

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Early crop 40 t/ha	Late crop 60 t/ha
N 100-150 kg per ha.	N 200-300 kg per ha.
P_2O_5 100-150 kg per ha.	P_2O_5 100-200 kg per ha.
K_2O 100-300 kg per ha.	K_2O 200-500 kg per ha.

The lowest doses of nitrogen mainly applied to sandy soils and the lowest doses of potassium to crops which must have a high dry matter content or which are grown in soils rich in potassium.

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Trays for pre-sprouting seed potatoes

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Glass shed for storage and pre-sprouting seed potatoes

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When cutting seed potatoes:

1. The knife must be disinfected each time so that no virus or bacterial diseases are transmitted.

2. The halves of the tubers are suberized, in a humid atmosphere. This can be done by placing the two halves together best done by not cutting the tuber right through.

The two halves are then not separated until they are planted. At low plant densities cutting tubers smaller than 55 mm may have advantages

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Properly pre-sprouted seed potatoes, each with many sprouts.

Steps

1 Land preparation
2 Fertilizer application
3 Planting
4 Ridging
5 Irrigation

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Whereas, in former times, a row spacing of 66 cm was customary, 75 cm is now commonly, used. Wide row spacing has many advantages, for example:

1. More soil (earth) is available to make a good ridge;
2. The sides of the ridges are less likely to be compacted by wide tractor tyres;
3. Less time is needed per hectare for cultivations.

Distance within the row depends on seed tuber size and desired size of the tubers at harvest (0.3 m x 0.75 cm =4.4 plants per m^2).

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Planting with a semi-automatic planter

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Planting pre-sprouted seed with fully automatic planter.

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A row-crop cultivator used to loosen the earth between the rows and then to build up the ridge.

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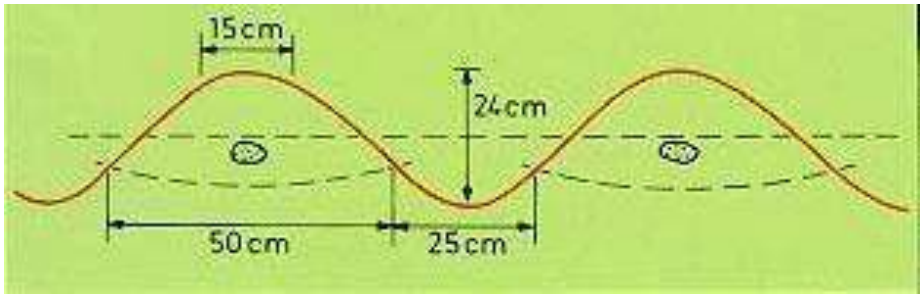

Diagram of a well-shaped potato ridge.

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Water Management

- The water use efficiency in potato under conventional furrow method is quite low i.e. 50 %. Knowledge of critical stages of water stress is essential for efficient use of irrigation water.
- Experiments have established that stolonization and early tuberization stages are the most critical for water supply.
- An inadequate supply of water during these stages affects the yield more than the water at other stages. Therefore, plants should be irrigated at 0.3 bar tension or at 15-20 mm CPE during critical stages of growth.

End

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Spraying a field of potatoes to control late blight.

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LATE BLIGHT CONTROL

1.Diseased plants developing from diseased tubers on refuse dumps or in the field provide highly dangerous foci of infection and are to be destroyed as soon as possible.

2. Where susceptible varieties are involved, chemical control is required as soon as plants meet in the rows.

3. A regular programme of spraying is maintained. Most growers spray every ten days and, when the weather favours the disease, every seven days.

4. The right fungicides must be used.

5. Should the foliage be at all seriously affected by the disease, the leaves are immediately killed off by spraying in order to prevent infection of the tuber.

6. Where tubers have nevertheless become infected, it is essential for the crop to be dried quickly and then stored in a well-ventilated store.

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Harvesting and storing

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Flailing: mechanical cutting of haulms.

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A self-propelled 2-row harvester.

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Potatoes are often unloaded into a hopper from which they are transferred to a pre-cleaner which removes still more earth and small tubers.

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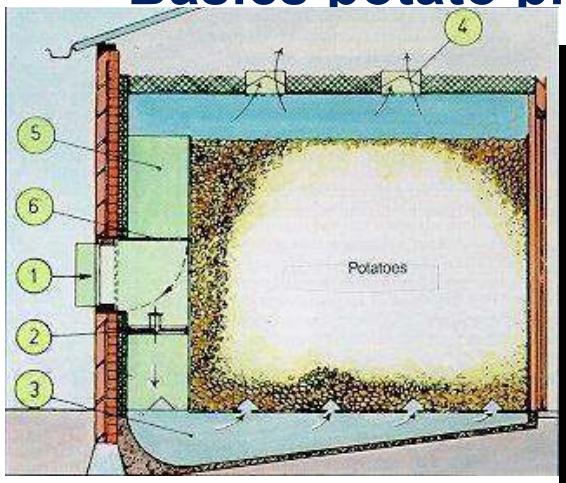

Diagram of a potato store

1. Closed fresh air intake
2. Fan for forced ventilation
3. Underground air duct facilitating air distribution
4. Air outlets in ceiling
5. Internal air circulation when intake damper is closed
6. Damper is in the horizontal position, when ventilating with air from outside

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Grading machine

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Transport of potatoes from the farm to a grading plant or from a grading plant to a processing factory.

Potatoes in a Bagan vegetable market

Potatoes in Bagan

Potatoes in Bagan

1. Green tubers
2. Insect damage
3. Black scurf
4. Secondary growth
5. Loose skins
6. Internal brown spot
7. Hollow heart

Causes of defects

Fungal:

- Black scurf

Insect:

- Yet to be established

Physiological:

- Hollow heart
- Secondary growth
- Green skin
- Loose skin
- Internal brown spot

Control and management

Black scurf:

- Seed treatment with Moncerene
- Crop rotation: 1 in 6 seasons

Control and management

Insect damage

- Various insects
  - Cut worms
  - Tuber moth

Control and management

Physiological

- Hollow heart
  - More frequent irrigation with less water per irrigation
- Secondary growth
  - New / regrowth from existing tuber after a hot spell

Control and management

Physiological

- Green skins
  - Tubers have been exposed to sunlight
  - Tubers need to be covered by soil at all times
- Loose skin
  - Tubers have been harvested immature
  - Only mature tubers are to be harvested:
  - Two weeks after haulm killing

Control and management

Physiological

- Internal brown spot
  - Usually a calcium defiency
  - Sufficient levels of Calcium are required, a soil testing laboratory can assist

Any questions ?

Thank you for your attention

SWOT analysis potato Myanmar

20 October 2014; Heho, Taunggyi, Myanmar

Participants potato training course, Agricultural Research Station, Heho

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Yield gap analysis

Which improvements are required to bridge the gap between potential yield and farmers' yield

1. Seed potato quality
2. Water supply
3. Control of diseases and pests
4. NPK: nutrient management
5. Control of weeds
6. Farm management
7. Soil conditions

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Strengths

1. Skills, knowledge available
2. Favourable climate
3. Fertile fields
4. Low labour costs
5. Sufficient labour availability
6. Year round production due to three growing seasons
7. Sufficient and easy water supply for irrigation; lesser and less easy water supply in upland fields
8. Seed potato production knowledge available
9. Presence of processing companies (Diamond Star & Pepsico)

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Weaknesses

1. Poor seed potato quality
2. Seed potato production absent
3. Private and public investment lacking
4. Credit supply for potato lacking
5. Young and old seed is mixed to achieve higher selling prices
6. Seed potato technology (facilities and qualified personnel) lacking at farm level
7. Ware potato technology (facilities and qualified personnel) lacking at farm level
8. Insufficient training capacity for growers
9. Fluctuating prices in markets; prices based on supply (free market situation)
10. Insufficient availability of agrochemicals for late blight control: limited number of compounds (chlorothalonil, cymoxanil, mancozeb, metalaxyl)

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Weakness (continued)

- Low quality and unreliability of agrochemicals including label description
- Lack of suitable varieties for processing

Opportunities

1. Import of modern varieties; increased testing modern varieties: table and processing
2. Large domestic market for table and processed products
3. Better seed → higher yields → increased farmers income → increased value in potato chain
4. Market opportunity for better seed potato quality
5. Investment from abroad; joint venture(s)
6. Store construction to even out high price levels: stabilization of prices
7. Contract farming for processing industries
8. Increased knowledge availability from international sources
9. Increased investments from within Asia: i.e. China, Korea, Thailand

Threats

1. Non-guaranteed market prices (selling prices)
2. Farmers lack knowledge, structural training required
3. Insufficient knowledge and expertise in potato sector
4. Increased investment in potatoes will increase competitivety with other vegetables
5. Storage capacity lacking
6. Standards and certification lacking
7. Climate change causing drought and severe rainfall
8. High prices agrochemicals and mineral fertilizers due to imported products

Potato creates employment and value addition

Thank your for your contributions !

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For quality of life

Seed potato production: Concepts and Strategies
Myanmar, September 2016
Romke Wustman,
PUM, the Netherlands

Seed potato quality and yield

Northeast Netherlands 2001 – cv. Seresta

- 50 samples of 50 growers
- Variation yield: 40-80 ton per hectare
- Causes:
  - Physiology: age of seed
  - Tuber-borne diseases

Seed potato quality and yield

Lüneburger Heide (Germany) 2003 – cv Kuras

- 24 samples of 24 growers
- Variation yield: 29-61 ton per hectare
- Causes:
  - Physiology: age of seed
  - Tuber-borne diseases

Varieties

Variety development: 10-12 years to select 1-2 varieties starting with 100.000 genotypes

High investment

Source of varieties

- Public (national) breeding programmes
- Private breeding companies:
  - Varieties for different climates
  - Market oriented
  - Cost effective
  - Healthy starting material assured (Companies have variety maintenance system)

Example private breeding programmes

Netherlands

- Over 10 companies active in variety development for climates worldwide
- over 400 varieties registered
- 1 million tons of seed potatoes produced
- 70 % exported
- seed exports to over 80 countries

CONCLUSION: many varieties from the northern hemisphere are adapted to tropical conditions

Quality factors of seed potatoes

All factors that affect yielding capacity of seed tubers:

Seed health

Seed size (number of stems)

Physiological age of seed (sprouting capacity, number of stems, plant vigour)

Variety

Seed multiplication: concepts

Multiplication: Increasing quantity of seed but gradually lower seed health

- Degeneration of seed health (virus, bacterial diseases)
- Multiplication rate (weight or number)
- Seed programme: mult. rate of 6-8

The number of possible field multiplications depends on degeneration rate in the local environment

Number of field multiplications can range from 1 (North Africa) to 8 (Netherlands)

Concepts (continued)

Degeneration rate depends on:

- Aphid population: transmit virus diseases
- Soils: bacterial wilt (Ralstonia)
- Variety: resistance to pests and diseases
- Agronomic management
  - rogueing
  - Insecticides (PLRV)
- Neighbouring fields (source of virus infection)

Seed multiplication: techniques in seed production

Starting material: In-vitro plants and minitubers

Field multiplication:

- High plant density
- Aphid control
- Early haulm killing

Negative selection: removal of diseased plants in mainly healthy crop OR:

Positive selection: marking of healthy plants to be used as seed for the next season

QUESTION: when to apply pos. and when neg. selection

Phases in seed multiplication

Phase	Location	Degeneration of seed health	Type of seed production	Common number of generations
1. Pre-basic seed	Lab/ greenhouse	(Almost) none	Formal	1-2
2. Basic and Certified seed	Special Seed fields	Low	Formal	2-4
3. Farm-saved seed	Farmer's field	High	Informal	2-5 or more

Phase 1. Pre-basic seed or starting material

Popular methods applied worldwide

- Import of basic seed
- Clonal selection
- Microtubers (tubers produced in-vitro)
- Minitubers produced from in-vitro plants in potting soil
- Minitubers produced from in-vitro plants in hydroponics/aeroponics
- True Potato Seed (TPS)

Comparison of methods to produce starting material (pre-basic seed)

Method	Advantage	Disadvantage
Import of seed	Flexible: Rapid up/down-scaling	Transport Costs
Clonal selection	On-farm method	Many generations needed
Microtubers	High mult. rate Controlled conditions	Tubers too small Low plant vigour
Minitubers produced in potting soil	High mult. rate High plant vigour	Soil replacement or disinfection needed
Minitubers produced in hydroponics, aeroponics, etc	Very high mult. rate Controlled conditions No soil disinfection Repeated harvesting	Transfer of diseases Cost and labour intensive Batch effect
True Potato Seed (TPS)	Low cost Easy to transport	Low plant vigour Low uniformity

Phase 2. Seed multiplication: field practices for formal seed production

Crop rotation 1:3 or 1:4
Separate plots for seed and table potatoes
High plant density
Optimum crop management
Low nitrogen
Rogueing (negative selection)
Control of aphids
Early haulm killing
Harvest with mature skin

Phase 3. Informal seed multiplication: farm-saved seed

Positive selection:

- Farmers select healthy plants, harvest and store separately as seed for next year

Seed plot technique

- Farmers have separate plot to grow seed (year 1)
- Most vigorous plants are marked, harvested separately and planted as seed plot in year 2
- The rest of the seed plot is used to plant the table crop in year 2
- Procedures are repeated in seed plot of year 2

Seed certification: Why?

To prevent spread of diseases
To maintain absence of diseases in nuclear stock
To maintain low levels of diseases in seed multiplication in first generations
To increase buyers confidence (vigour, disease free, size)

CONCLUSION: seed certification is essential for quality assurance and seed sector development

Seed certification: How?

Steps in a seed certification system:
Application (origin of seed, soil free of nematodes)
Field inspection (visual)
Early Haulm killing (aphid flights)
Post-harvest laboratory test for virus and bacterial diseases (Elisa, PCR)
Lot inspection just before marketing

Seed certification: Issues

Standards (too strict: no seed; too low: poor seed)

Costs (who pays the fees)

Sample size for post-harvest tests

Reliability of lab tests

Communication to stakeholders

CONCLUSION: seed certification systems and standards should not be copied from other countries but adapted to local conditions

Key factors for a successful seed supply system (1)

Special varieties for different purposes (table, processing, starch, etc)

Reliable source of healthy starting material

Suitable areas for seed production

Special management for seed crops

Not too many field multiplications (degeneration)

Introduction of positive selection and seed plot technique for farm-saved seed

Key factors for a successful seed supply system (2)

Adequate price for certified seed (2-3 times ware price) to compensate for high production costs of seed

Price difference between different size grades in relation to seed rate

Adequate storage systems

MARKET-ORIENTED seed supply systems

Thank you for your attention