Virus diseases on sweetpotato, their detection and control

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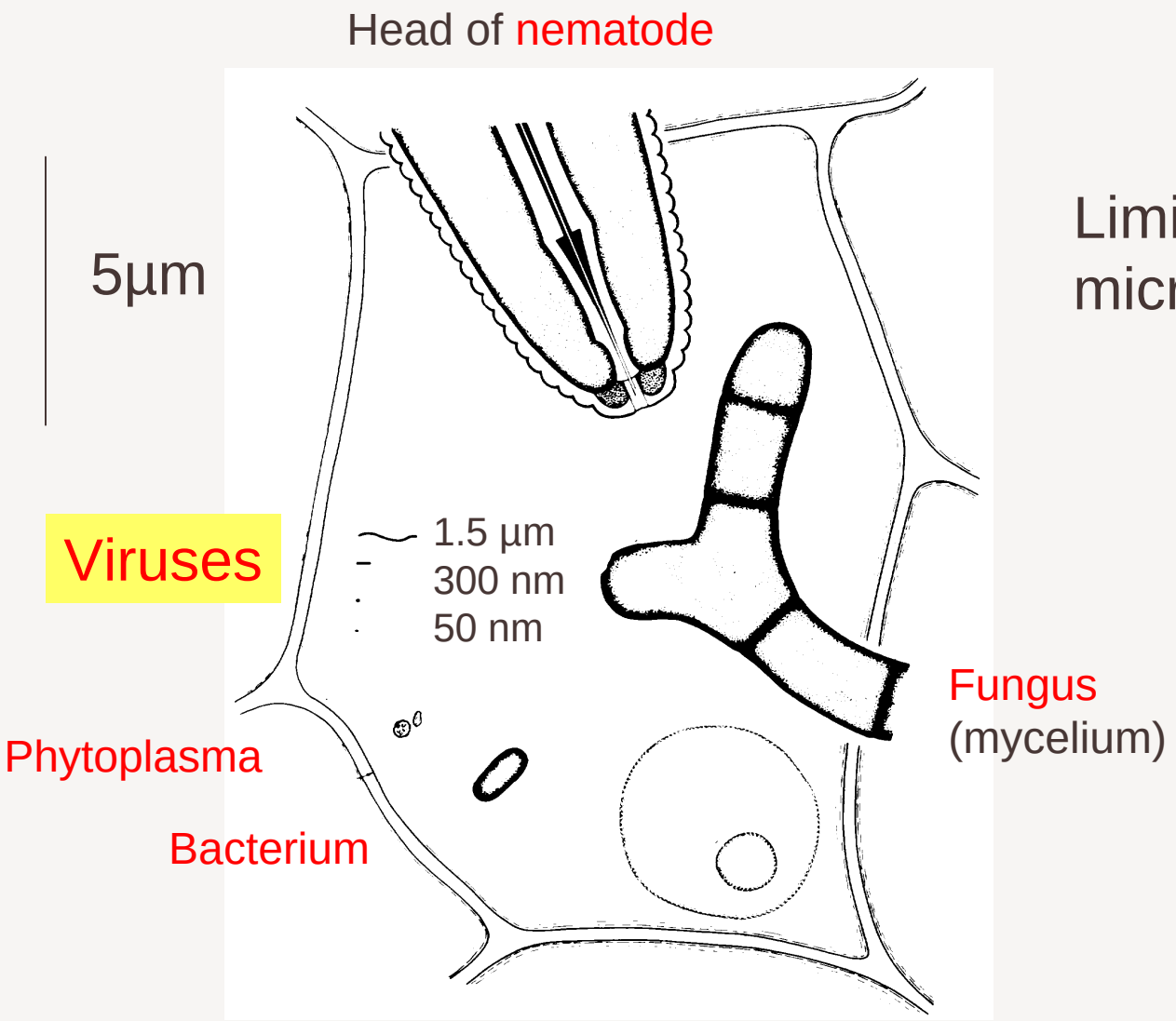
Virus diseases: one of the main production constraints

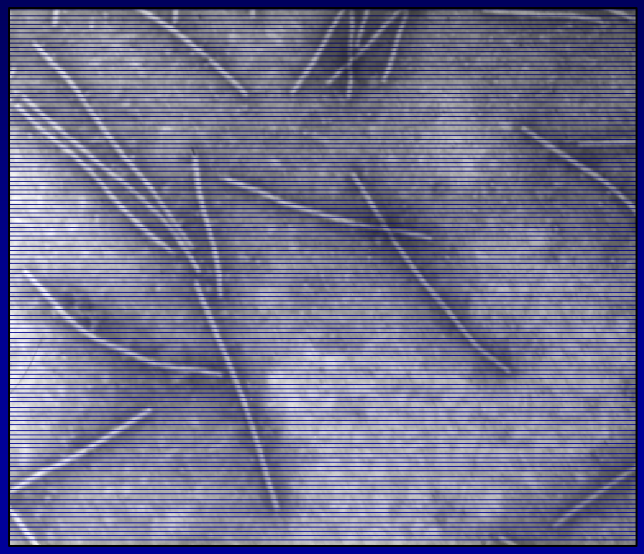
SP plants from a farmer's field in Cañete, Lima-Peru

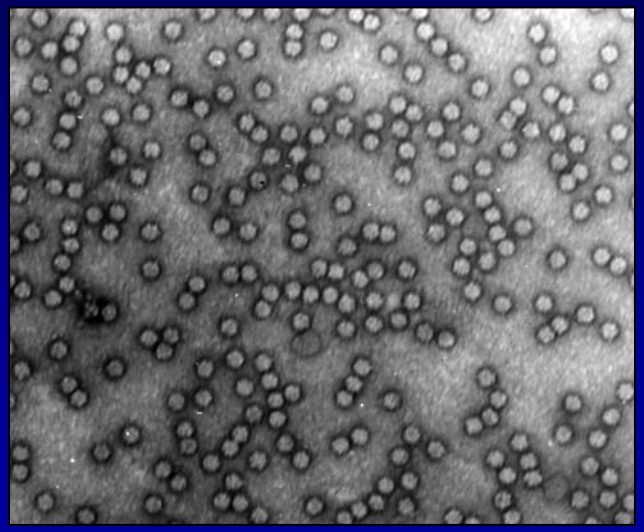
Schematic diagram of the shapes and sizes of certain plant pathogens in relation to a plant cell

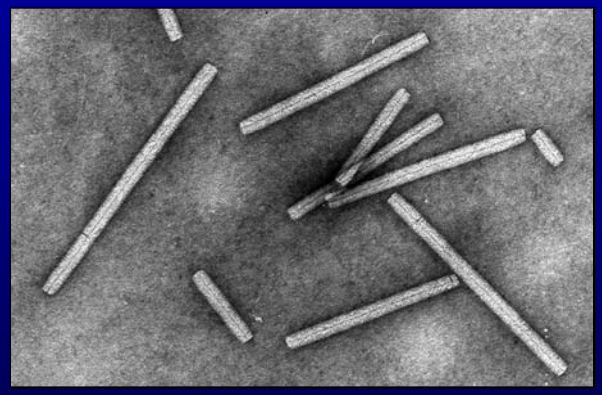


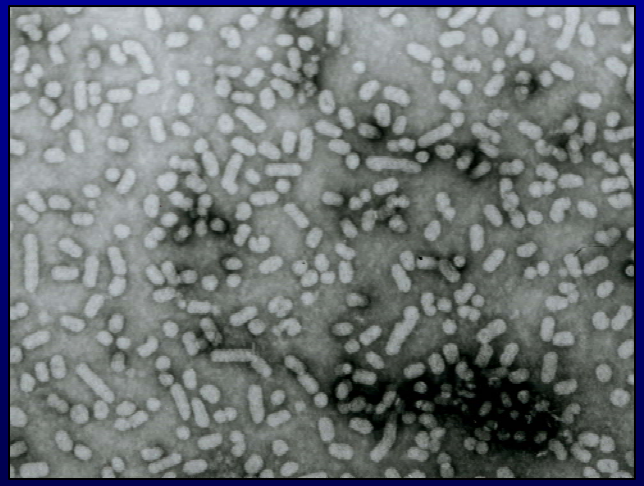
Transmission Electron Microscopy (TEM)

Different types of virus particles





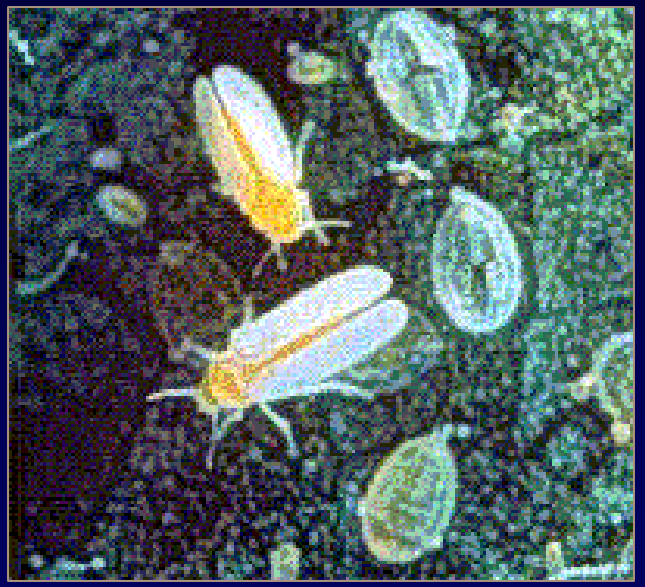




3,333 virus particles (300 nm) = 1 mm

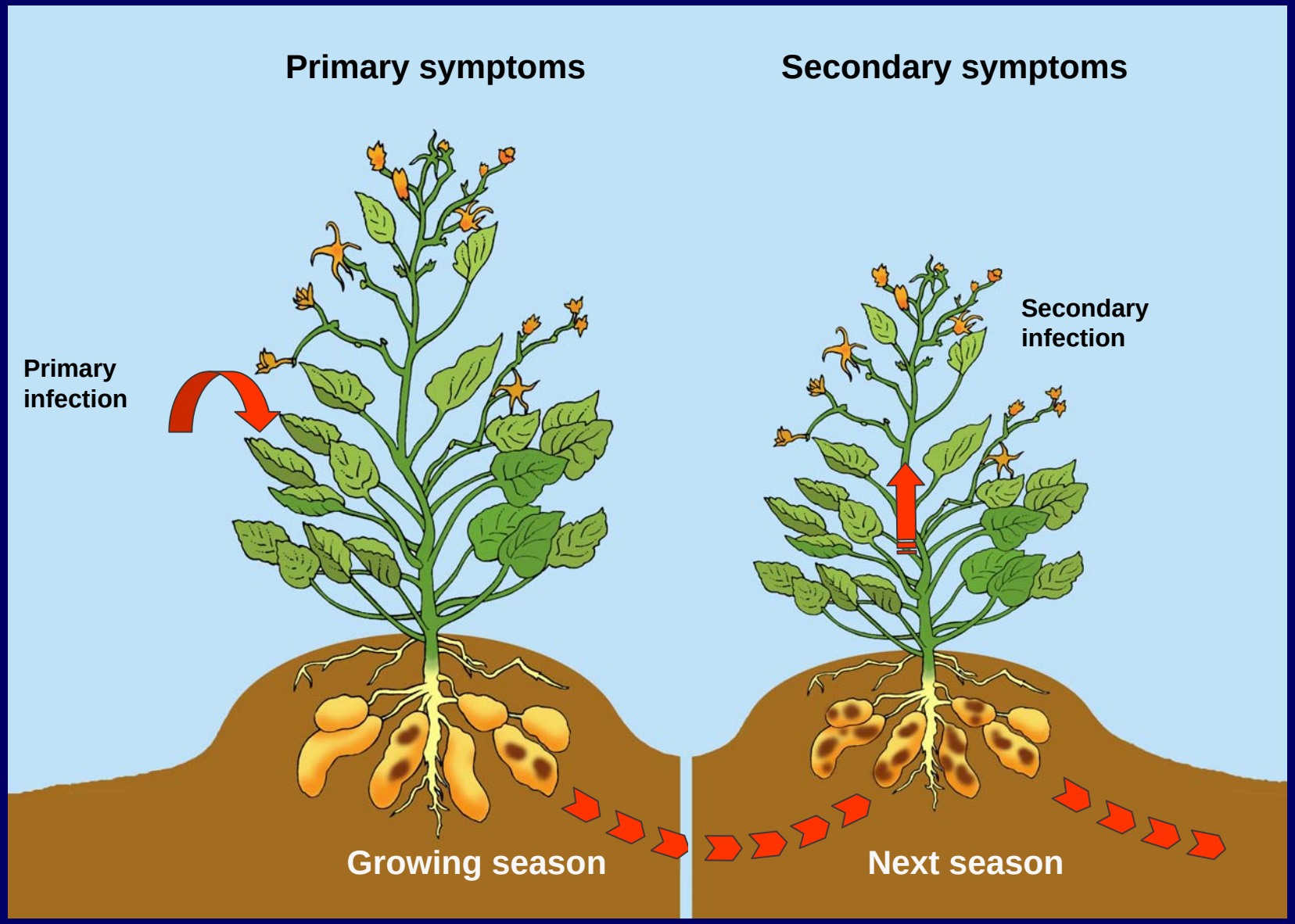
Virus vectors

Aphids



Whiteflies

Type of symptoms / infections



Incidence of viral diseases in Barbados

SYMPTOMS CAUSED BY VIRUS INFECTION

Vein clearing

Vein clearing

Chlorotic spots

Leaf curling

Mosaic

Stunting and mosaic

Stunting, leaf reduction and deformation, chlorosis (SPVD)

Stunting, leaf reduction and deformation, chlorosis (SPVD)

SPVD in cv. Beauregard (North Carolina – USA)

Recognized viruses that infect sweetpotato

Genus	Virus	Transmission	Distribution
Potyvirus	SPFMV	Aphid	Worldwide
	SPLV	Aphid	Taiwan, China, Japan, Indonesia, Philippines, India, Egypt
	SPMSV	Aphid	Argentina, Peru, Indonesia, Philippines, China, Egypt, South Africa, Nigeria, New Zealand
	SPVG	Aphid	China, Japan, USA, Egypt, Ethiopia, Nigeria, Barbados, Peru, Spain, South Africa
	SPV2	Aphid	USA, Taiwan, China, South Africa, Portugal, Australia, Barbados
	SPCSV?	Unknown	Caribbean Region, Zimbabwe, Uganda, Kenya
	SPVMV	Aphid	Argentina
Ipomovirus	SPMMV	Whitefly?	Africa, Indonesia, China, PNG, India, Egypt, New Zealand
	SPYDV	Whitefly	Taiwan, Far East
Crinivirus	SPCSV	Whitefly	Widespread
Cucumovirus	CMV	Aphid	Israel, Egypt, Kenya, South Africa, Japan, New Zealand
Begomovirus	SPLCV	Whitefly	Far East, USA, China, Taiwan, Japan, Korea, Europe, Africa?, Peru
	SPLCGV	Whitefly	USA, Puerto Rico
	IYVV	Whitefly	Spain, Italy
	ICLCV	Whitefly	Israel
Carlavirus	SPCFV	Unknown	Africa, China, Taiwan, North Korea, Cuba, Panama, South Americaa, N. Zealand
	C-6?	Unknown	USA, Peru, Cuba, Dom. Rep., Indonesia, Philippines, P. Rico, Egypt, Kenya, South Africa, New Zealand
Nepovirus	SPRSV	Unknown	Papua New Guinea, Kenya?
Caulimovirus	SPCaLV	Unknown	South Pacific Region, Madeira, China, Egypt, P. Rico, Nigeria, Kenya?
Ilarvirus	TSV	Unknown	Guatemala
Polerovirus	SPLSV	Aphid	Peru, Cuba
Tobamovirus	TMV	None	USA
Unknown	C-3	Unknown	Brazil. Unknown in others countries
	C-9	Unknown	?

Virus diseases

SP virus disease (SPVD)

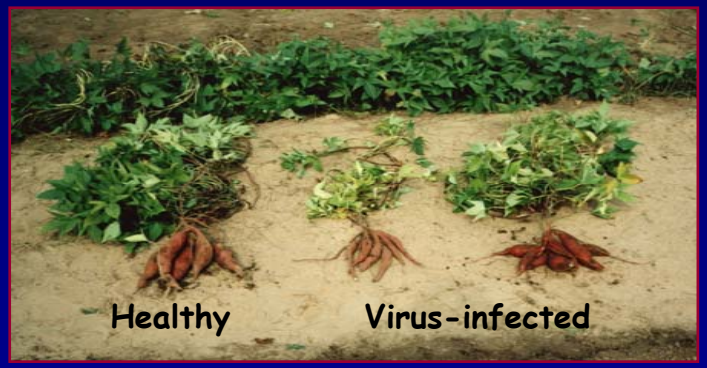
SPFMV + SPCSV

(Worldwide)

“Chlorotic dwarf (CD)”

SPFMV + SPCSV + SPMSV

(Argentina)



“Camote Kulot”

Simultaneous infection by several viruses

(Philippines)

Aphids

← **SPFMV** + **SPCSV** →

Potyvirus Crinivirus

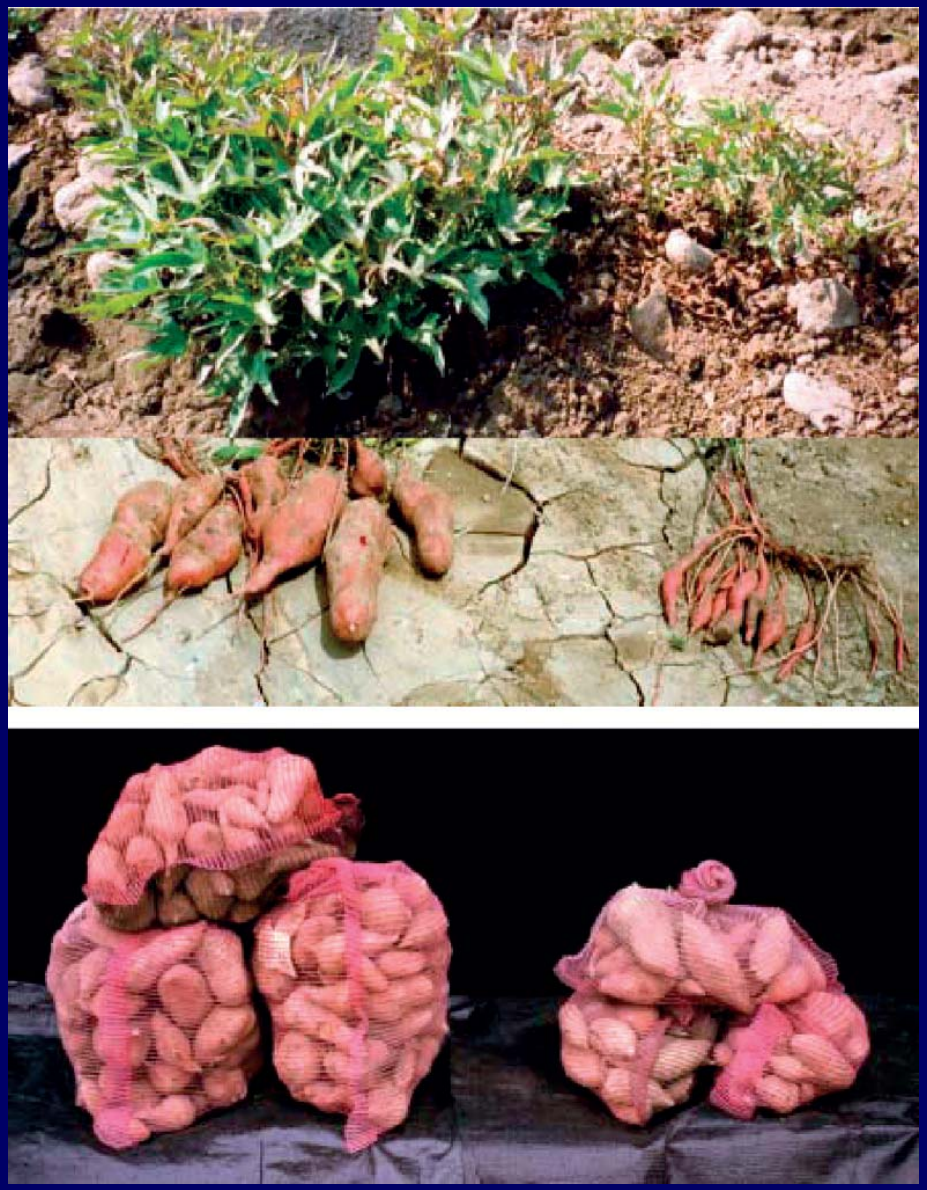
Whiteflies

Sweetpotato virus disease (SPVD)

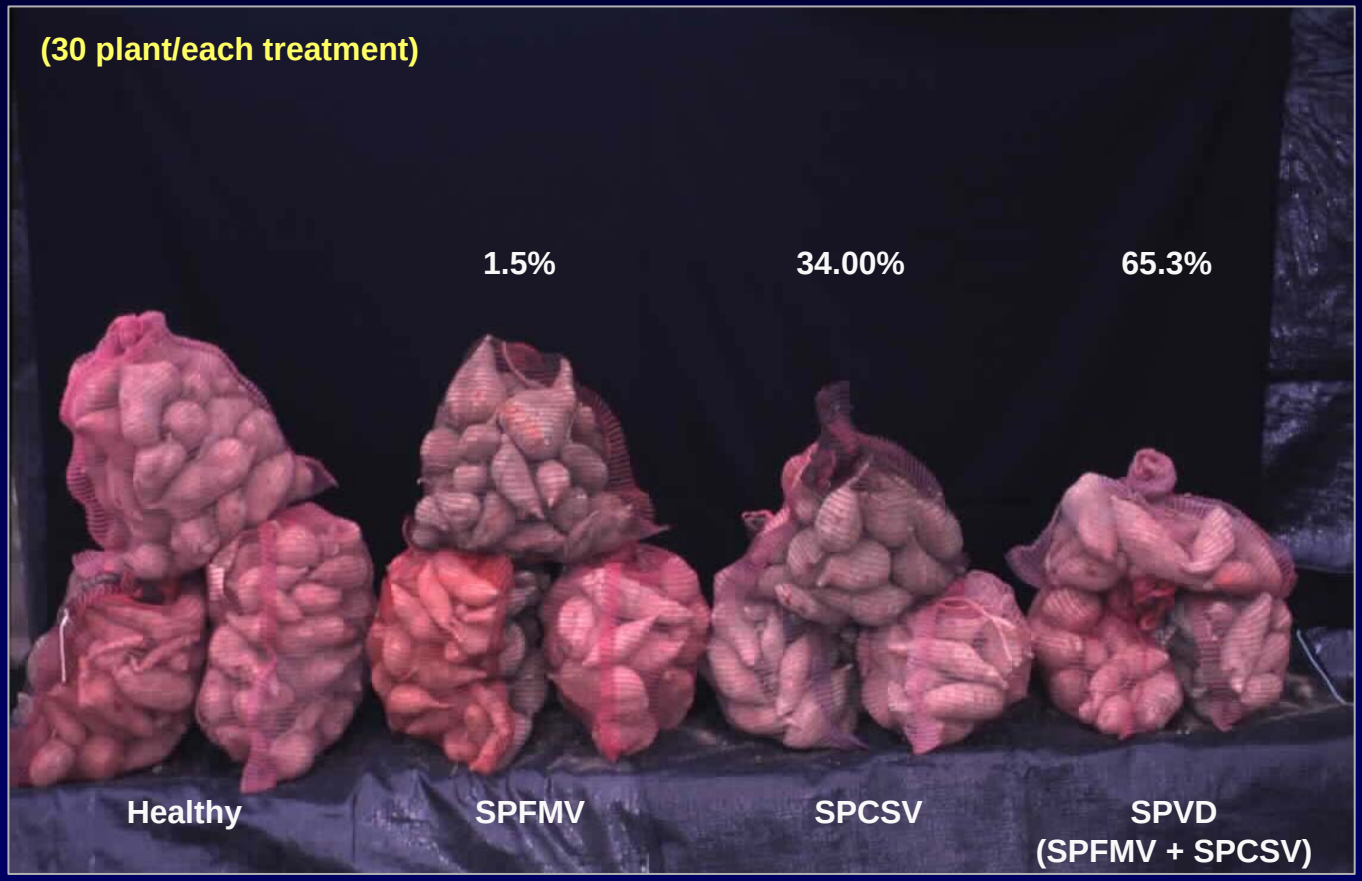
Apparently healthy SPVD

Yield reduction over 60%

Quantitative effect

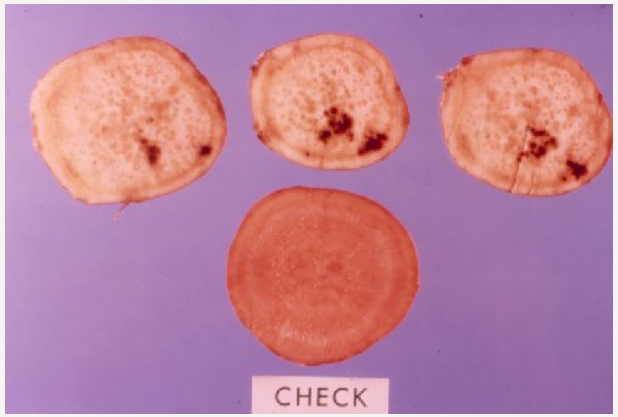


Yield reduction on sweetpotato cv Costanero caused by viruses (Peru)

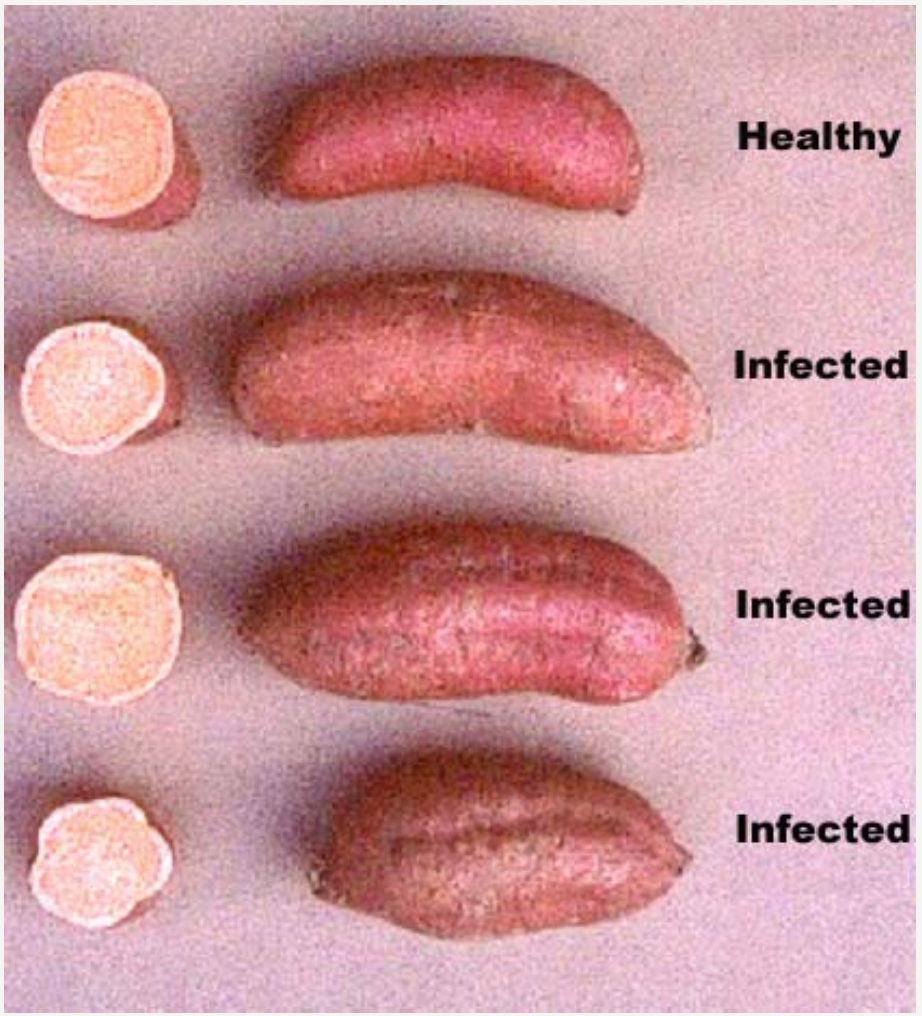


Qualitative effect

Russet crack



Internal cork



Grooving

How viruses are disseminated?

Dissemination of viruses

- Presence of virus source (infected plants)

- Insect vectors

- Movement of infected stem cuttings as planting materials without sanitary control (Peru)


Apparently healthy
Virus-infected
VIRUS CONTROL

Control of SP viruses (e.g. SPVD)

1. Resistant cultivars to viruses or its vectors (conventional or transgenic)

- Superior local resistant cultivars
- Deployment of SPVD-resistant germplasm

2. Production of pathogen-tested (PT) planting materials (in protected environment)

- *In vitro* virus-free plants

- Positive selection

Yield increases: > 200%

Propagation of high-quality planting materials (Peru)

CIP / INIA

In vitro virus-free plantlets

INIA (E.E. Donoso, Huaral)

IRVG (Cañete)

Nuclear materials or basic (Screenhouse or net-house)

Further multiplication (“seed” fields)

Screenhouses built by farmers in Peru to protect mother plants

PT multiplication in the screenhouse

PT multiplication a selected field
(with low pressure of insect vectors)

Nethouses built by farmers in Philippines to protect mother plants

In situ virus detection

Samples collection

Processing samples

Spoting sap on NCM

Development of the reaction

Preventive measurements to reduce virus infection in PT fields

Application of insecticide

Roguing

Quality of PT reflected in the performance of the plants

Local farmer

High-quality planting materials

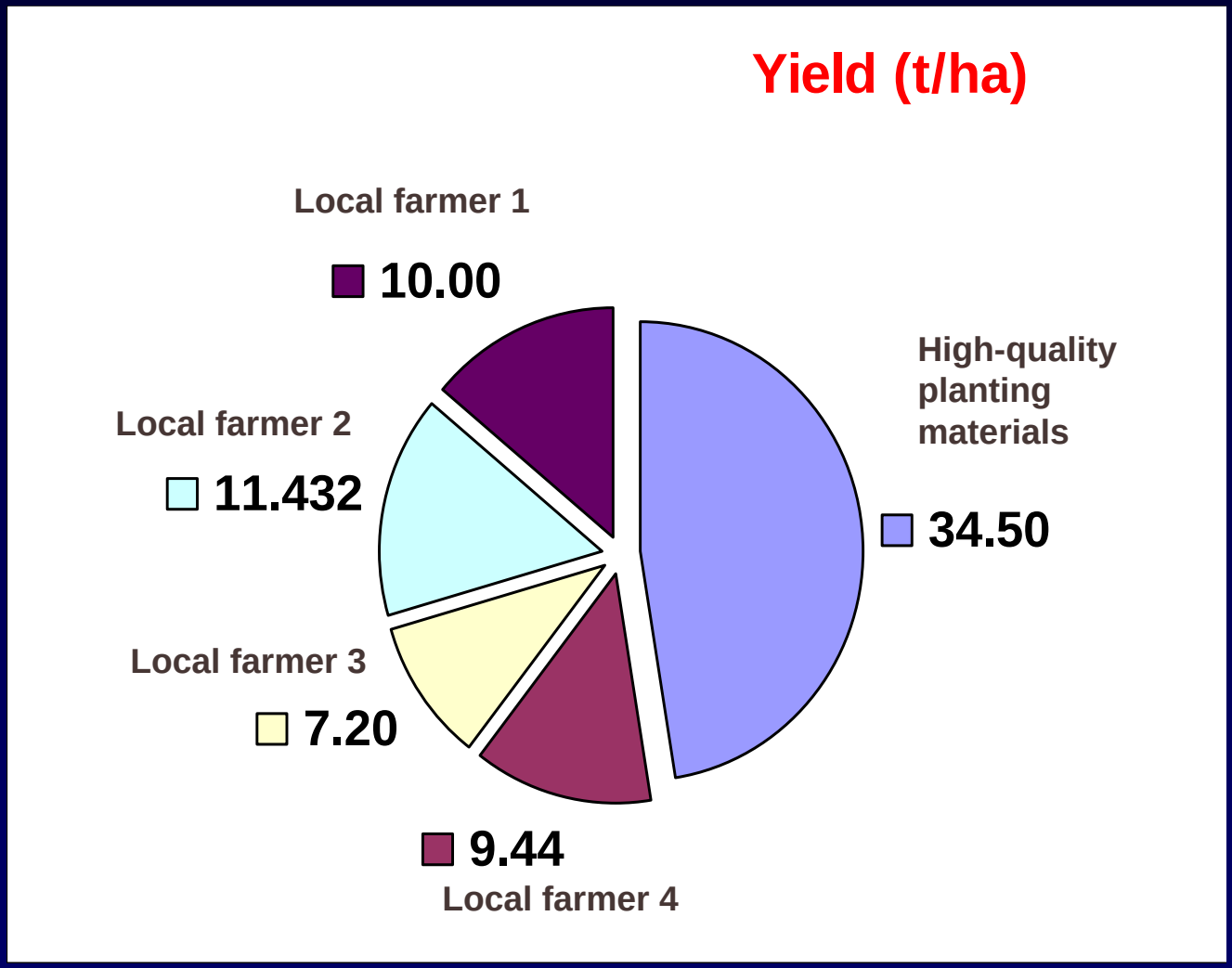
Benefit of using PT planting material

PT planting materials

Local farmer

Effect of quality of SP "seed" on production

INIA 100 INIA (2003)



Control of SP viruses (e.g. SPVD)

1. Resistant cultivars to viruses or its vectors (natural or transgenic)
   - Superior local resistant cultivars
   - Deployment of SPVD-resistant germplasm

2. Production of virus-free planting materials (in protected environmentand/or in low virus and vector pressure)
   - From in vitro
   - Positive selection

Complemented with phytosanitation practices

- Isolation:
  - Planting new fields 15-20 m far from old ones.
  - Barriers or intercropping with maize.

- Reducing virus sources:
  - Roguing (1 MAP) .
  - Eliminating wild *Ipomoea* spp.
  - Destroying crop residues.

Natural barriers of maize and barley minimize movement of insect vectors (whiteflies and aphids) in and out the experimental parcel and among treatments (Quilmana, Cañete, Lima, Octubre 2004 – Marzo 2005).

How long to renew healthy planting materials?

It will depend on the population of insect vectors and virus sources present in the planting area

SP field with apparently healthy plants

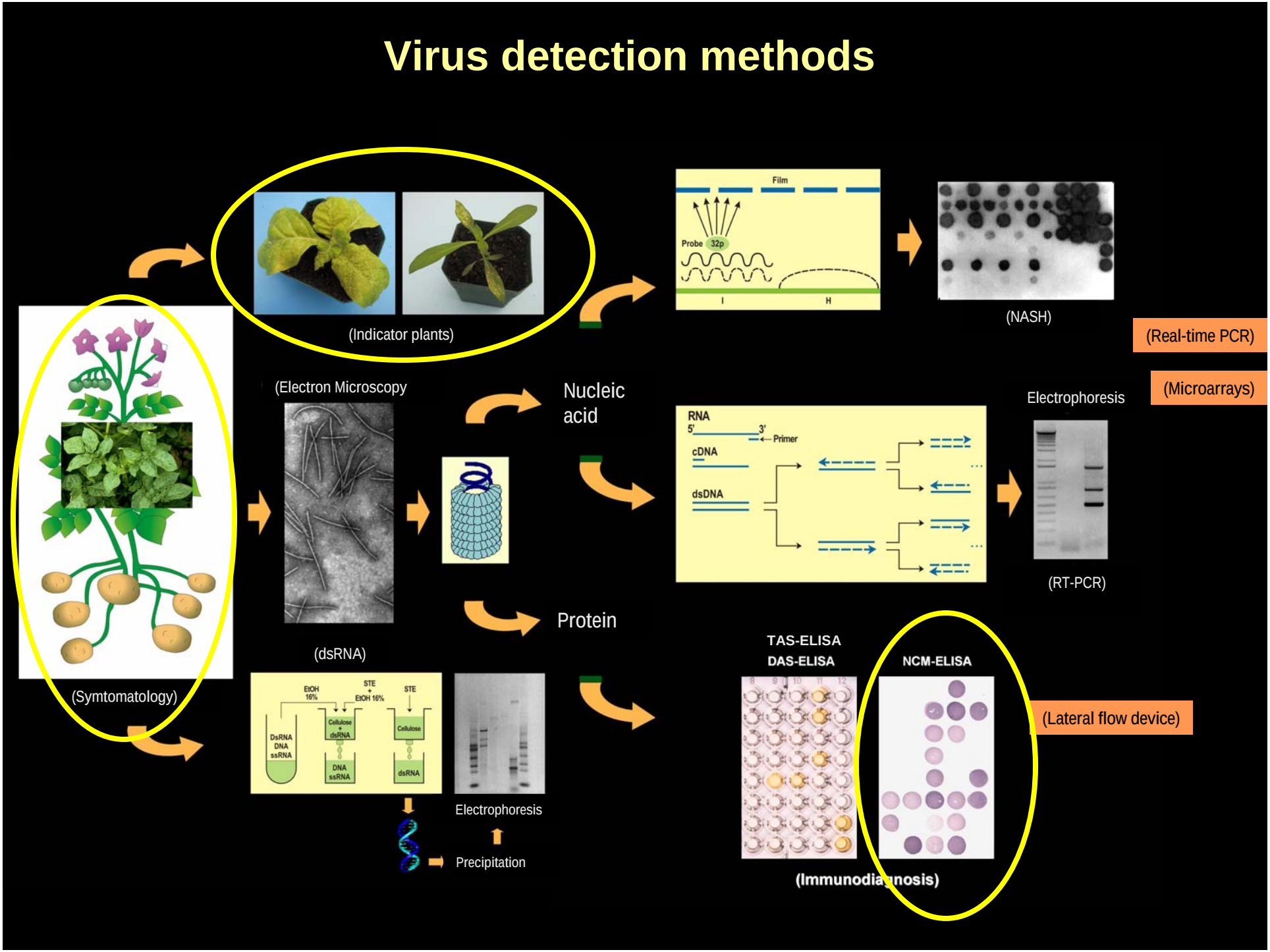
Good stand and high yield

SP field with virus-infected plants

Poor stand and low yield


Apparently healthy
Virus-infected
VIRUS CONTROL
VIRUS DETECTION

Virus detection methods



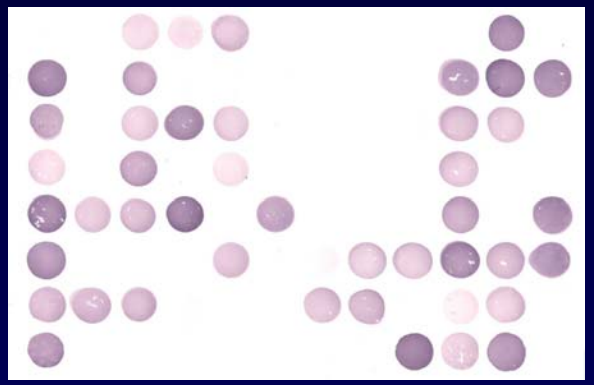
Vein clearing

Vein clearing

Chlorotic spots

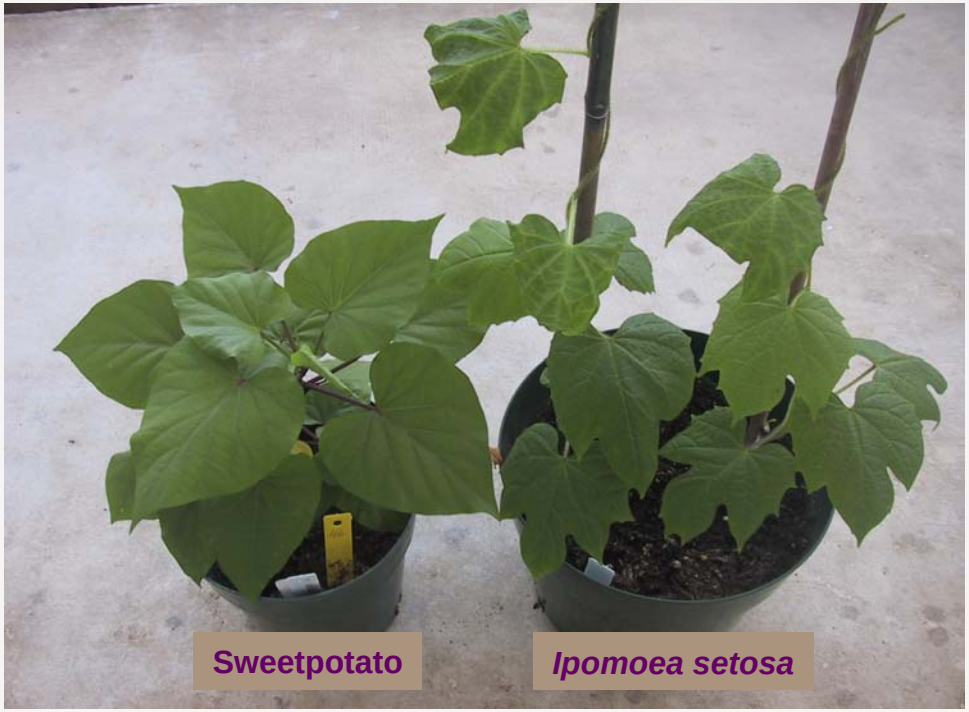
Serological test

NCM-ELISA test

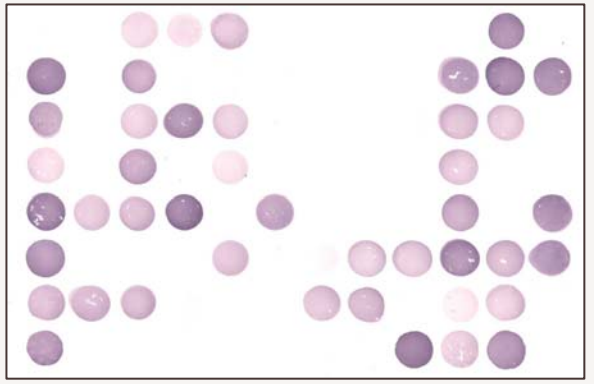


NCM-ELISA kit

Sweetpotato versus *Ipomoea setosa* versus serology



NCM-ELISA



- **Symptomless**
- **Low virus concentration**

Indicator plant **+** **Serology (ELISA)**

Reliable detection of viruses

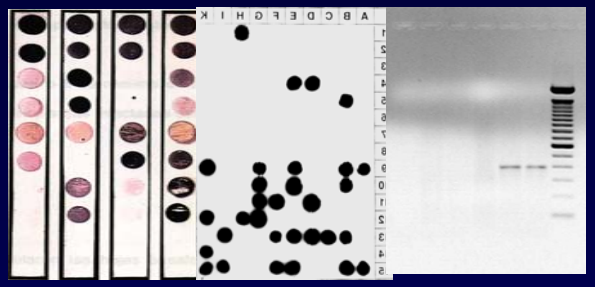
CONTROL OF VIRUS DISEASES

Effect of viruses
(yield reduction)

Identification and characterization

Nucleic acid analysis
Protein analysis
PCR
dsRNA
etc.

Virus Detection technology



ELISA NASH PCR Others

Virus-free plants **Resistance**

Higher yields


Thank you for your attendance