European Commission

Better Training for Safer Food
Initiative

Neil Giltrap

Important pest of potato and their Control Directives

Session 5

Food safety

Outbreak Scenario

You are the Head of your NPPO

Your country produces seed and ware potatoes

You have never had an outbreak of :

1. Ring rot (*Clavibacter michiganensis sepedonicus)*
2. Brown rot (Ralstonia solanacearum)
3. *Epitrix papa*
4. *Zebra chip disease (Cls plus vector)*

Q: Which one of above would be worst possible outbreak for your potato industry?

Q: Which would be the least serious to have?

Quarantine Bacterial Diseases of Potato (brown rot and ring rot)

Ralstonia solanacearum (Rsol)

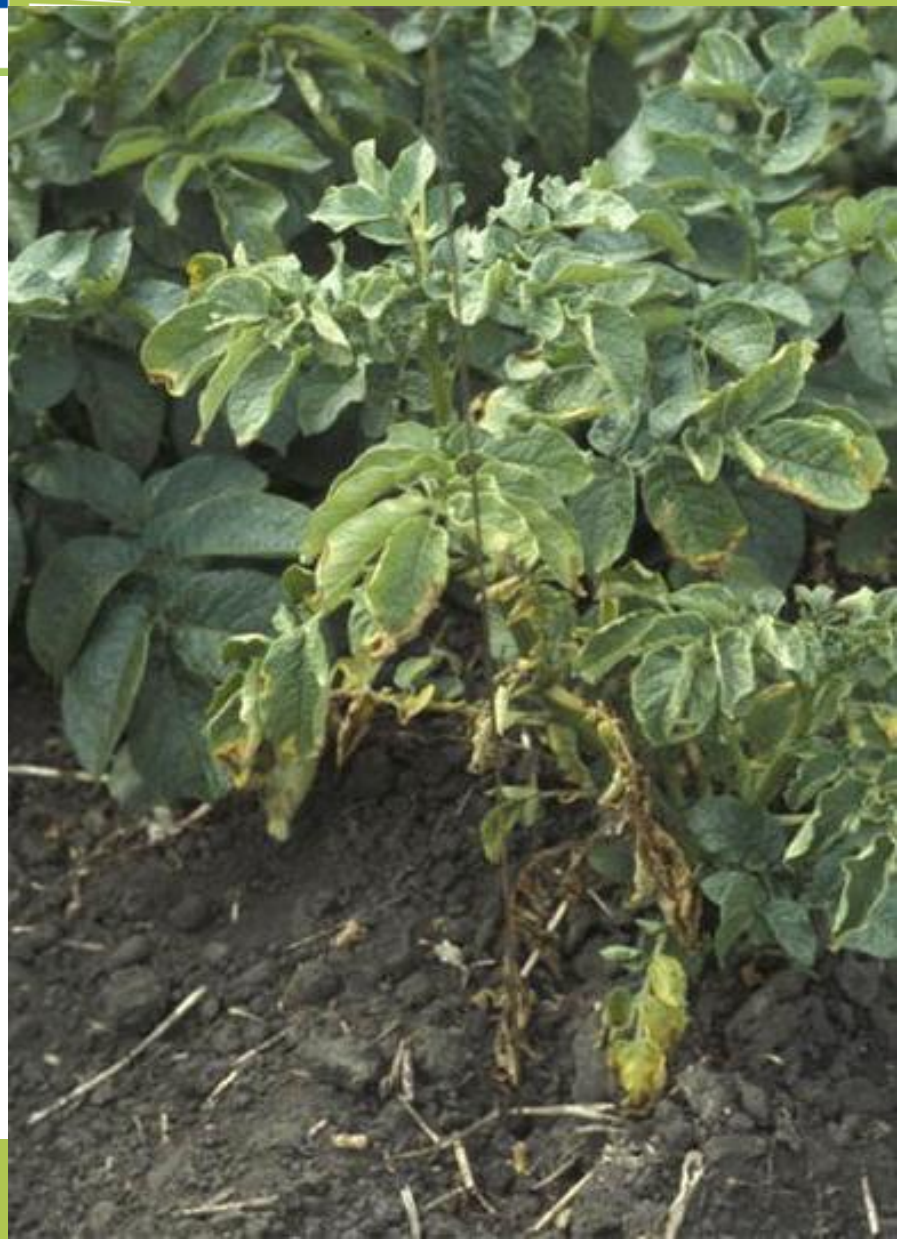
& *Clavibacter michiganensis* subsp. *sepedonicus (Cms)*

European Commission

Ring rot symptoms

PLANTS

- symptoms develop late in the growing season
- yellowing /chlorosis and slight rolling of the leaf margins
- in late stage yellowing of veins and entire stem which later turn brown and look like they are burned
- wilting developed in lower leaves (either all around the plant or only on one side of one stem)
- <u>symptoms are enhanced by hot, dry weather conditions</u>



Ring rot symptoms

TUBERS

- infection occurs through the stolon
- earliest infections – first evident at vascular ring (tissue) near the stolon as pale yellow zones tissue end
- more advanced infections - yellowish to light-brown zone surrounds all the vascular tissue
- when the cut tuber is squeezed pearls of milky (cheese-like) white bacterial ooze appear
- in the final stage the vascular tissue turns dark, the skin cracks
- advanced symptoms can't be distinguished from other tuber rots

Biology of Cms

Host

- Potato and weed (*Solanum rostratum*)
  - **plus tomato (Belgium, 2016)**

Sources/means of spread

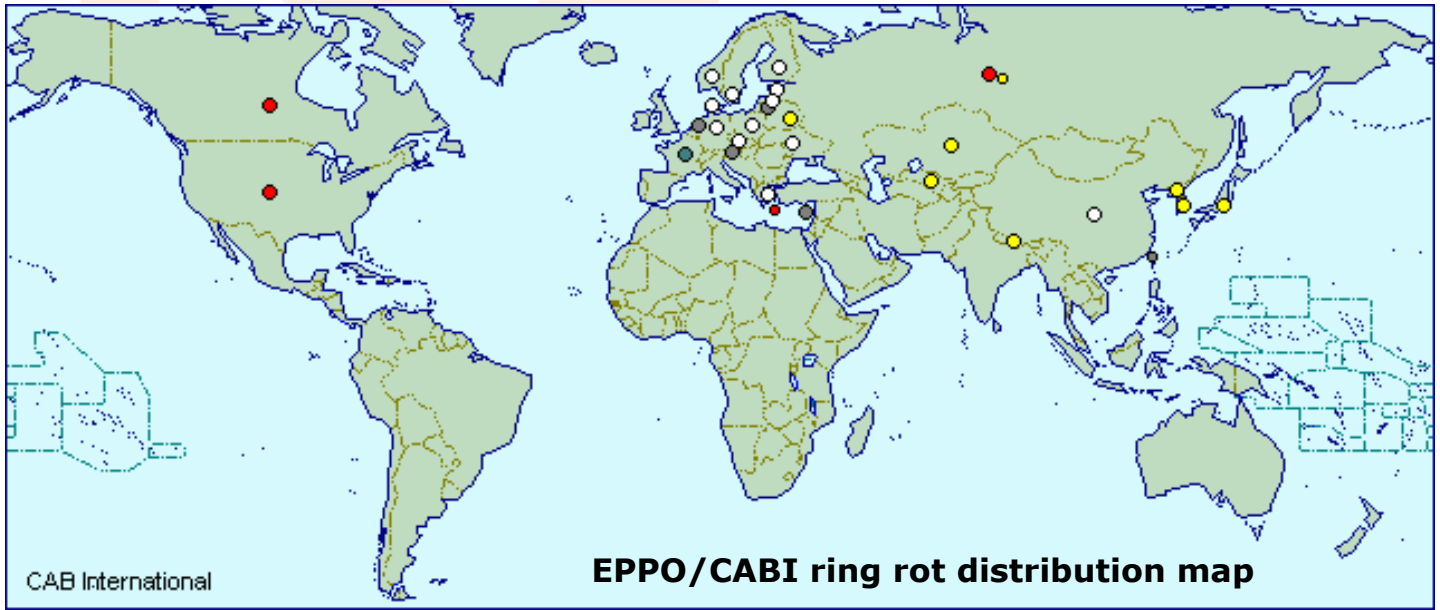
- **seed potatoes, farm-saved seeds (FSS) (latent infection), contaminated boxes, machinery, stores** etc.

Survival

- potatoes (seed, FSS and volunteers)
  - **survives several years in dry state**
  - persists in water (weeks), soil (months) and on dry surfaces (years)

Distribution of Cms

- Rather cool climate disease
- Quite spread in the EU
- MS which have never had a finding: IE, LU, ML, PT & SI & CY (years ago)
- MS without finding in last few years: AT, DK, ES, EL, IT, BE, SE, UK
- MS with the highest number of findings: PL, RO



EPPO/CABI ring rot distribution map

Ring rot outbreaks since 2011

			2011	2012	2013	2014	2015*
EU TOTAL	Number of samples	- seed	63,448	59,719	56,895	59,257	61,281
		- ware	24,830	25,375	23,895	22,999	23,122
	Positive lots	- seed	18	32	8	17	29
		- ware	1,106	1,164	1,075	981	936

*No results on the total number of samples taken by IE and IT

Ring rot summary

- **Disease situation improving – worse than brown rot**
- **Eliminate main sources of infection**
  - **Infected seed potatoes and FSS – latent infection**
  - **Employ good hygiene measures**
- **Long lived and persistent bacterium**
- **Eradication more difficult than with brown rot**

Brown rot symptoms

PLANTS

- wilting, which usually starts at the top of a single stem; in short period all leaves of the stem will wilt and other stems will start to will too
- leaves turn pale green and then brown, they do not roll
- the wilting may start soon after emergence (if infection from seed potatoes)
- milky jet of slime containing bacteria will thrust out bottom end of stems (in water test)

Brown rot symptoms

TUBERS

- infection occurs through the stolon (via vascular tissue of mother plants) or from external sources growing growth, harvest and storage
- in advanced infection stage from half cut tubers glistening drops of pale-cream slime will be formed on the vascular ring (without squeezing)
- later the ring becomes light brown to brown discoloured and necrosis can extend into internal tissue
- slime exudes also from the eyes (dirty eyes when soil adheres to the slime)

Biology of R sol

Host:

- potatoes (race 3/biovar 2), tomatoes, aubergine
- weeds – *Solanum dulcamara*

Sources/means of spread:

- seed potatoes, farm-saved seeds (FSS)(latent infection)
- contaminated surface water (temperature <15°C)
- contaminated boxes, machinery, stores etc.

Survival – limited outside a host

- potatoes (seed, FSS and volunteers)
- *Solanum dulcamara*

Contamination of surface irrigation/spraying water with Rsol

***Solanum dulcamara* –**
perennial woody nightshade

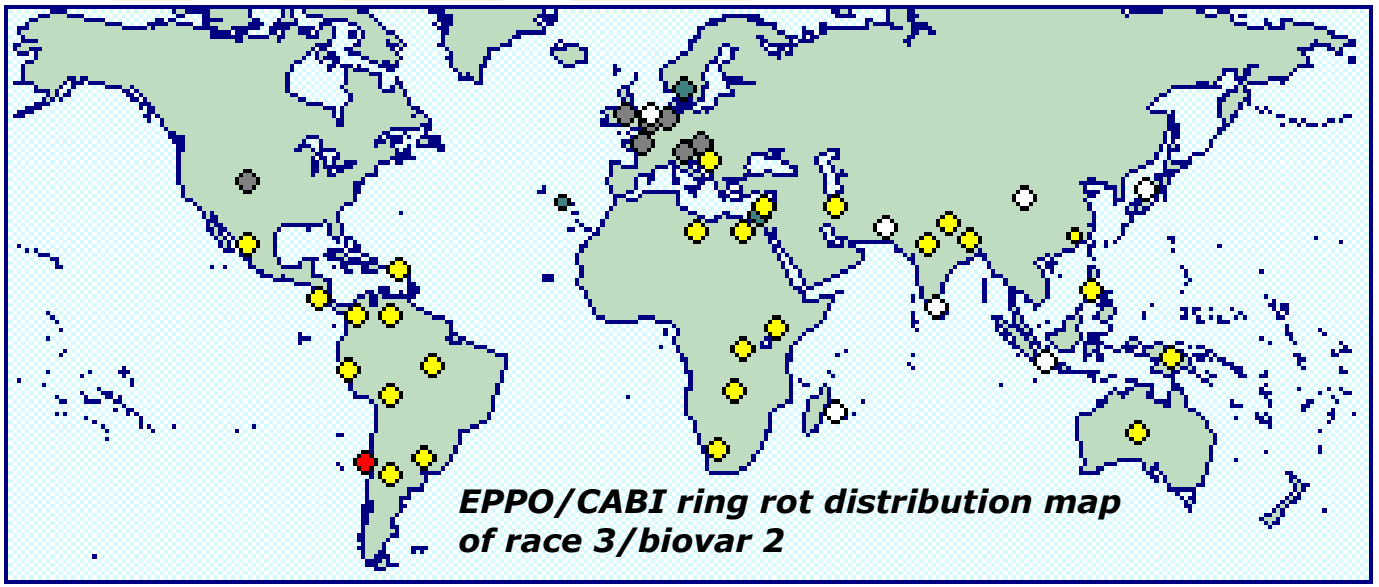
- Alternative host
- Aquatic roots infected
- Waterways contaminated (difficult to eradicate)

- Transmission through irrigation spraying

Ban irrigation if risk (e.g. NL all surface water for seed potatoes production)

Distribution of Rsol

- Warmer climate disease
- Spreading in the EU
- MS which never had a finding: BE, CY, DK, EE, FI, LT, LV, LU, ML
- MS with finding in 5 last growing seasons (potatoes): BE, BG, PL, FR, DE, EL, HU, PT, ES
- findings in water: CZ, FR, DE, HU, NL, PT, ES, UK (rather stable situation in last few years)



EPPO/CABI ring rot distribution map of race 3/biovar 2

Brown rot outbreaks since 2011

		2011	2012	2013	2014	2015*
Number of samples	*- seed*	*60,555*	*56,227*	*55,448*	*56,483*	*60,817*
	- ware	*23,412*	*24,390*	*23,996*	*25,005*	*30,215*
Positive lots	*- seed*	**5**	**1**	**4**	**0**	**0**
	- ware	**44**	**11**	**14**	**19**	**24**

**No results on the total number of samples taken by IE and IT*

Brown rot summary

- **Disease situation improving - eradication**
- **Eliminate main sources of infection**
  - Infected seed potatoes
  - Contaminated irrigation water
    - **Stop rivers becoming contaminated (safe waste disposal)**
    - **Ban irrigating if risk (UK some rivers, NL all surface water)**
    - **Treat contaminated irrigation water**
- **Limited survival outside a host**

Ring Rot and Brown Rot

Council Directives

- Ring rot 93/85/EEC (amended by Commission Directive 2006/56/EC)
- Brown Rot 98/57/EC (amended by Commission Directive 2006/63/EC)

The amendments in 2006 - Commission Directives can only deal with Annexes of Council Directives

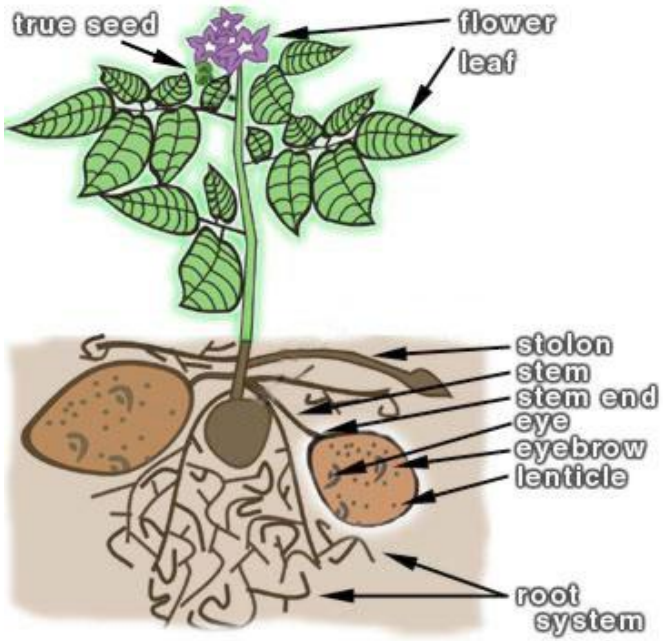
amendments mainly to:

- diagnostic techniques
- actions when the diseases are found

Objectives of the Directives

Specify the detailed measures to be taken by MS:

- to locate the diseases
- to determine their distribution
- to prevent their occurrence and spread
- if found, to control them and prevent spread with the aim of eradication



Requirement to Conduct systematic official surveys (Art. 2 of CD 98/57 (brown rot) and 93/85 (ring rot))

Extent decided by the NPPO on the basis of ”sound scientific and statistical principles“ and local production systems

Sampling rates of Member States vary, e.g. (2013) ring rot / ware potatoes / average for UE

- one sample per 62 ha ware grown
- (NL – sample per 18 ha; SE – sample per 434 ha)

Samples shall be taken:

- from both seed and other potatoes (brown and ring rot)
- water/other host plants (tomatoes, *S. dulcamara*) (brown rot)

New sampling kit

Fig 3: New sampling device in action

Fig 4: Potato cores are collected direct into disposable screw cap tubes

Potato cyst nematodes (PCN) (*Globodera rostochiensis & Globodera pallida*)

PCN symptoms

- infected area in the field sometimes distinctly delimited; infected plants are dark and flower later
- root system is bushy; in severe cases is reduced
- young female cysts visible as white “pinheads” on the roots about 6-8 weeks after planting
- cysts change colour
  - *G. rostochiensis* – *via* golden yellow and ochre to brown
  - *G. pallida* – *via* dirty white to dark brown
- damage depends on the variety; smaller tubers are produced; yield losses may cause 50%

Biology of PCN

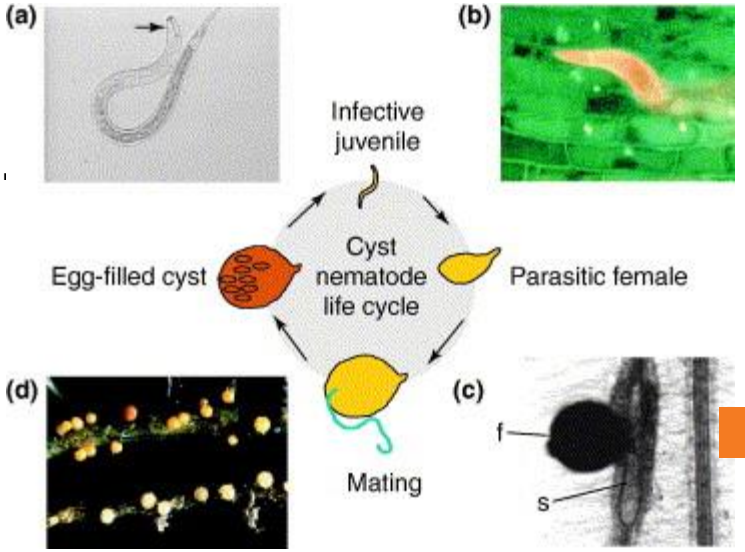
PCN declines in absence of hosts (potato, tomato, aubergine and pepper)

Gradual release of juveniles over many years but most in first six years – rate of decline faster for *G. rostochiensis* than for *G. pallida;* PCN can survive in soil for 25 years

Spread: mainly introduced by cysts in soil attached to

- seed potatoes (lower risk) and FSS (higher risk)
- Machinery
- transplanted crops with roots
- soil returned to fields from graders etc.

Cysts can be spread locally by wind and flood water.



PCN distribution

(EU/2013 harvest)

No PCN findings:

LU, RO, SK, SI

Both species:

BE, BG, CY, DK, FI, FR, DE, EL, IE, IT, NL, PT, ES, UK

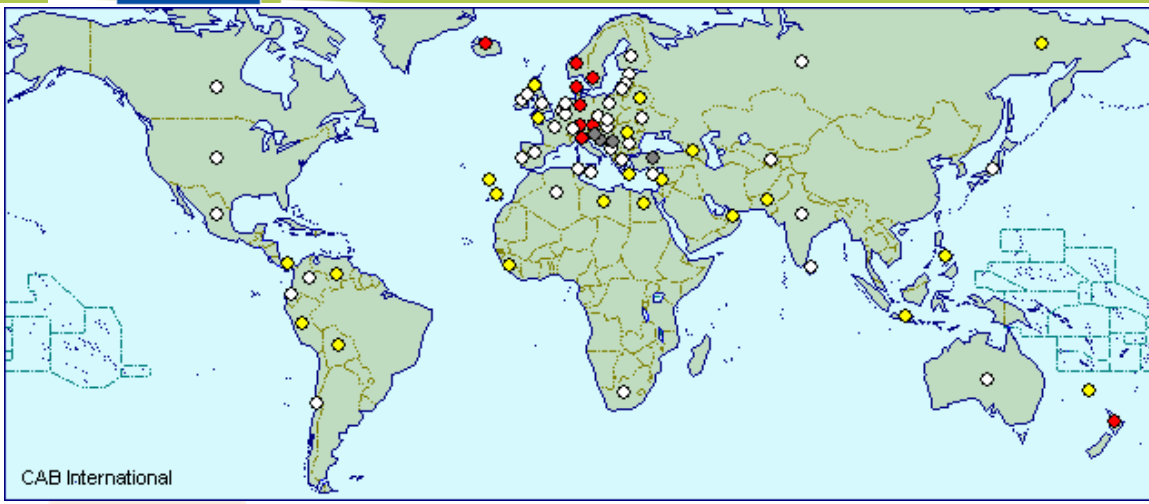
***G. rostochiensis* only:**

HR, CZ, EE, HU, LV, LT, MT, PL, SE

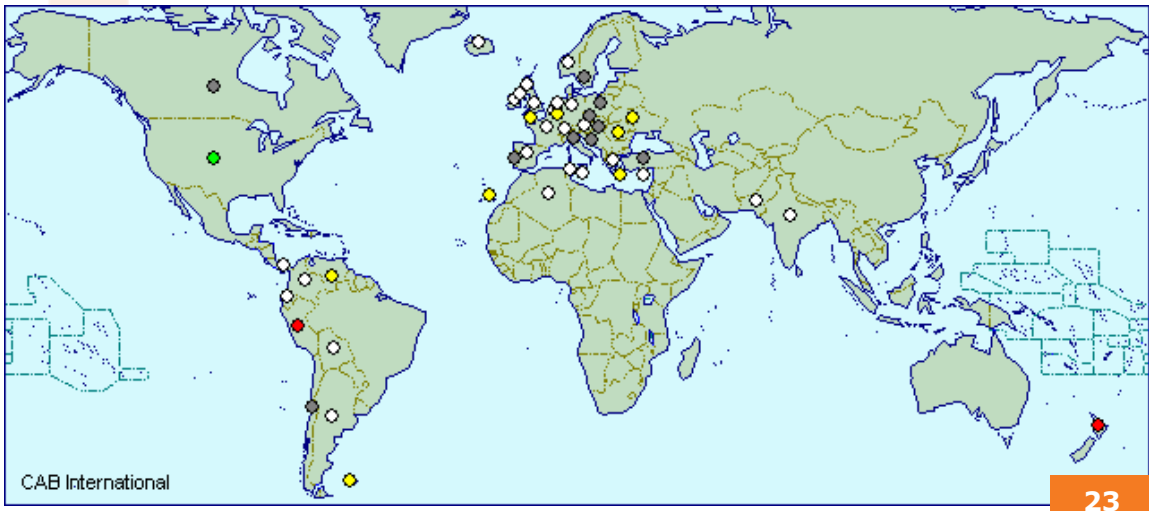
***G. pallida* only:**

AT

FI, LV, SK and SI are in the UE the protected zones for *G. pallida*



G. rostochiensis



G. pallida

Council Directive 2007/33/EC on the control of potato cyst nematodes, repealing Directive 69/465/EEC

Objectives of the Directive

Establishes the measures to be taken by the Member States against European populations of Potato Cyst Nematodes in order:

- to determine their distribution
- to prevent their spread and to control them

MS obligation – **official investigation** (Art. 4 of 2007/33/EC) the

- plants listed in Annex I, intended for the production of plants for planting
- seed potatoes intended for the production of seed potatoes

Sampling shall involve a soil sample at least 1,500 ml soil/ha (in certain cases it's possible to reduce the size of a single sample – min. 400 ml soil/ha (history of field, based on results of previous testing, size of field – larger than 4 and 8 ha))

- collected from at least 100 soil sampling points/ha
- preferably in a rectangular grid of not less than 5 metres in width and not more than 20 metres in length between sampling points covering the entire field

MS obligation - **official investigation** (Art. 4 of 2007/33/EC)

Plants listed in Annex I

(1) *Capsicum, Lycopersicon lycopersicum, Solanum melongena*

(2) (a) Other plants with roots: *Allium porrum, Beta vulgaris, Brassica, Fragaria, Asparagus officinalis*

(2) (b) Bulbs, tubers and rhizomes, grown in soil and intended for planting (not intended for sale to final consumers not involved in professional plant or cut flower production), of: *Allium ascalonicum, Allium cepa, Dahlia, Gladiolus, Hyacinthus, Iris, Lilium, Narcissus, Tulipa*

MS obligation - **official surveys** (Art. 6 of 2007/33/EC)

- on fields used for the production of ware potatoes

<u>Official surveys:</u>

- shall involve sampling and testing
- on at least 0.5 % of the acreage
- with a min. sampling rate of soil of at least 400 ml/ha

(in certain cases it's possible to reduce the size of a single sample – min. 200 ml soil/ha (based on result of previous testing, size of field – larger than 4 and 8 ha))

PCN soil testing

- impossible to detect low populations
- 10 litres of soil/ha needed to reliably detect small PCN foci (50 cysts/kg)
- Testing is just one aspect of PCN control

PCN summary

Long lived and very persistent nematode

Reduce spread with main sources of infection

- Infected seed potatoes and FSS
- Transplants (strawberries)

Eradication virtually impossible – long period before infestation can be detected and during which time spread occurs

Potato Wart Disease (PWD) (*Synchytrium endobioticum*)

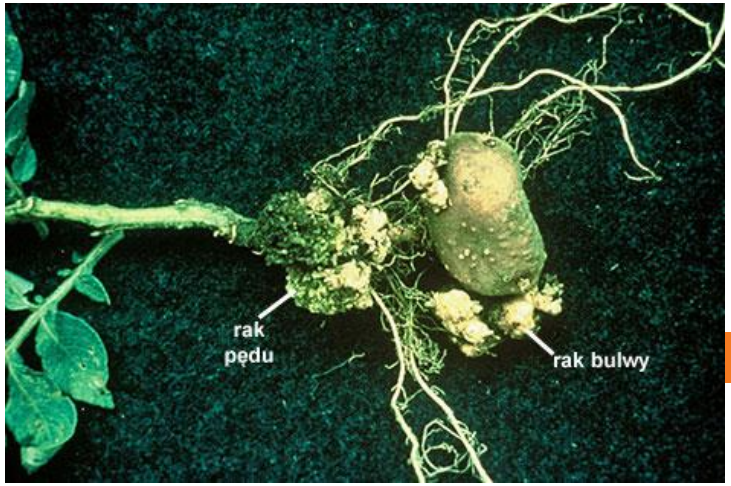
PWD symptoms

Galls of various sizes are formed on the eyes

- irregular in shape
- initially white, resembling the curd of a cauliflower
- turn green on exposure to light
- eventually darken with age

Can be confused with other diseases or disorders

- cankerous form of powdery scab
- proliferation of buds in the eyes
- glyphosate damage



Spread

- mainly infected seed potatoes
- contaminated soil attached to tools and machinery
- on soil attached to plants and potatoes grown in infested fields
- manure from animals fed on infected potatoes (spores resist digestion)

Conditions favouring disease

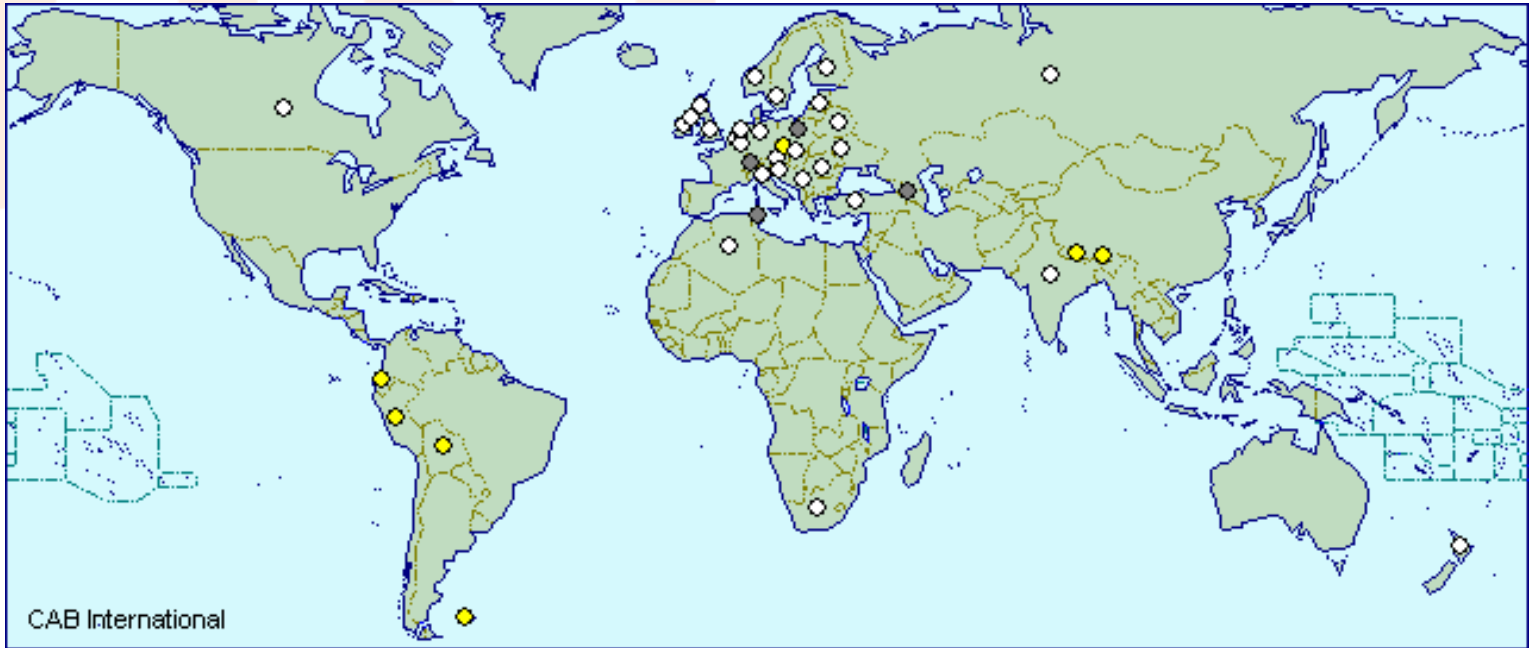
- cool wet soils
- severity of attack depends on soil conditions during tuber development and the potato variety
- small warts may be overlooked at lifting, especially after a dry season
- symptoms usually develop in the store and diseased tubers may be seen at grading

PWD Distribution

First introduced to Europe with breeding material from South America

Spread to nearly all potato growing countries in Europe (statutory measures finally restricted its spread)

In most European countries, including the UK, it is now found only locally (DK - new findings in area of starch potatoes production)



Council Directive 69/464/EEC

Concerns the minimum measures to be taken within the Member States to control PWD and to prevent this cryptogamic disease from spreading (art. 1)

When found, MS shall demarcate the contaminated plot and a safety zone large enough to ensure the protection of the surrounding areas (art. 2)

A plot shall be regarded as being contaminated when symptoms of PWN have been found on at least one plant from that plot (art. 2)

Restrictions on contaminated plots (art. 4):
(a) no potatoes may be grown
(b) no plant intended for transplanting may be grown, stored

Epitrix species

Epitrix species - Outline of Talk

- Damage
- Biology
- Situation in Portugal and Spain
- Potential spread to other MS
- Emergency Decision (2012/270/EU)

Four *Epitrix* species cause damage to tubers

- All native to North America
- **Canada** – *Epitrix tuberis* most damaging species
- **Portugal** – damage seen 2004. *Epitrix* confirmed 2008
  - *Epitrix similaris* and *E. cucumeris*
- **Spain** – *E.similaris* only so far.... Now ***E.papa***
  - 2010 – first outbreaks in Galicia
  - 2014 – outbreaks in Asturias
  - 2015 - outbreaks in Andalusia


Records of Epitrix potato beetles in Portugal and Spain (April 2015)
Oviedo
Santander
Vitoria
Logrono
Santiago De Compostela
Viana Do Castelo
Braganca
Valladolid
Vila Real
Aveiro
Guarda
Coimbra
Madrid
Castelo Branco
Leiria
Toledo
Portalegre
Merida
Lisbon
Evora
Setubal
300 km
Beja
Faro
KEY
2015 Epitrix
2014 E. similaris
2011 E. similaris
2009 E. cucuumeris
2009 E.similaris
km
0 25 50 100 150 200

Demarcated areas in Spain (April 2016)

Portugal

Epitrix similaris

Epitrix cucumeris

HOST PLANTS - *E.similaris & cucumeris*

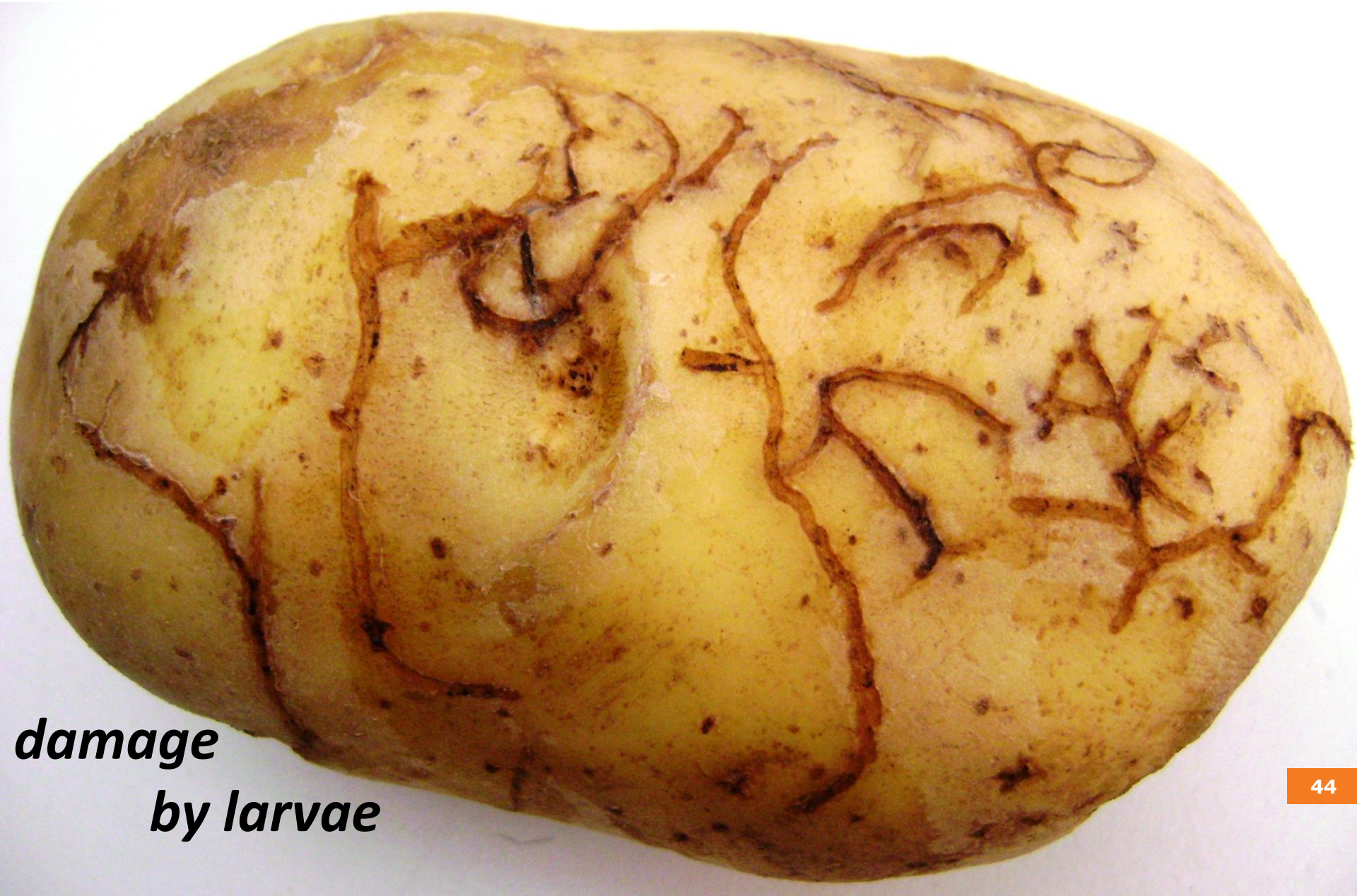
Main hosts

Potato, tomato, aubergine

sweet pepper not favoured

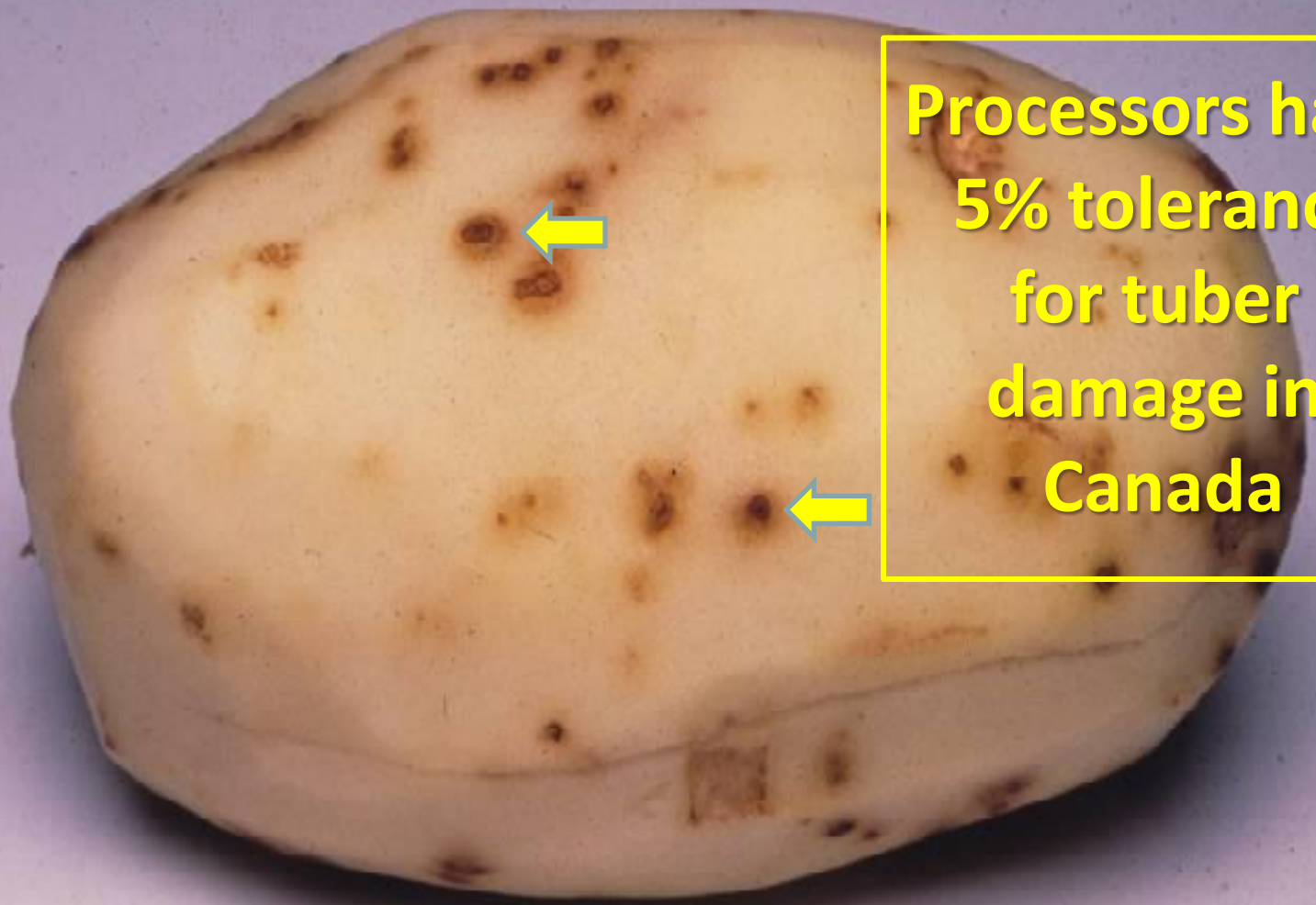
Epitrix similaris and Epitrix cucumeris in Portugal

Damage in Portugal



damage by larvae

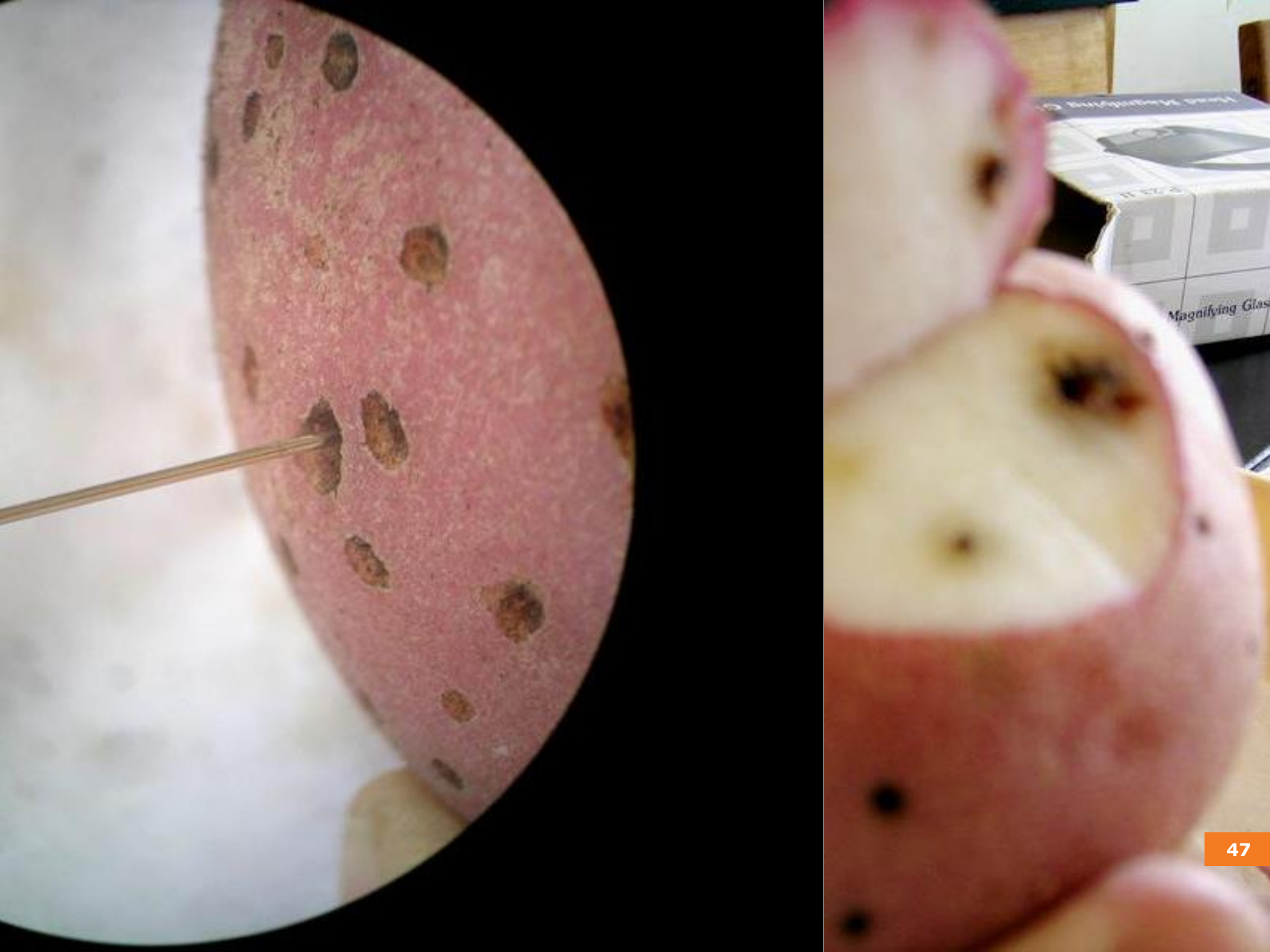
Damage by *Epitrix tuberis* larvae in North America



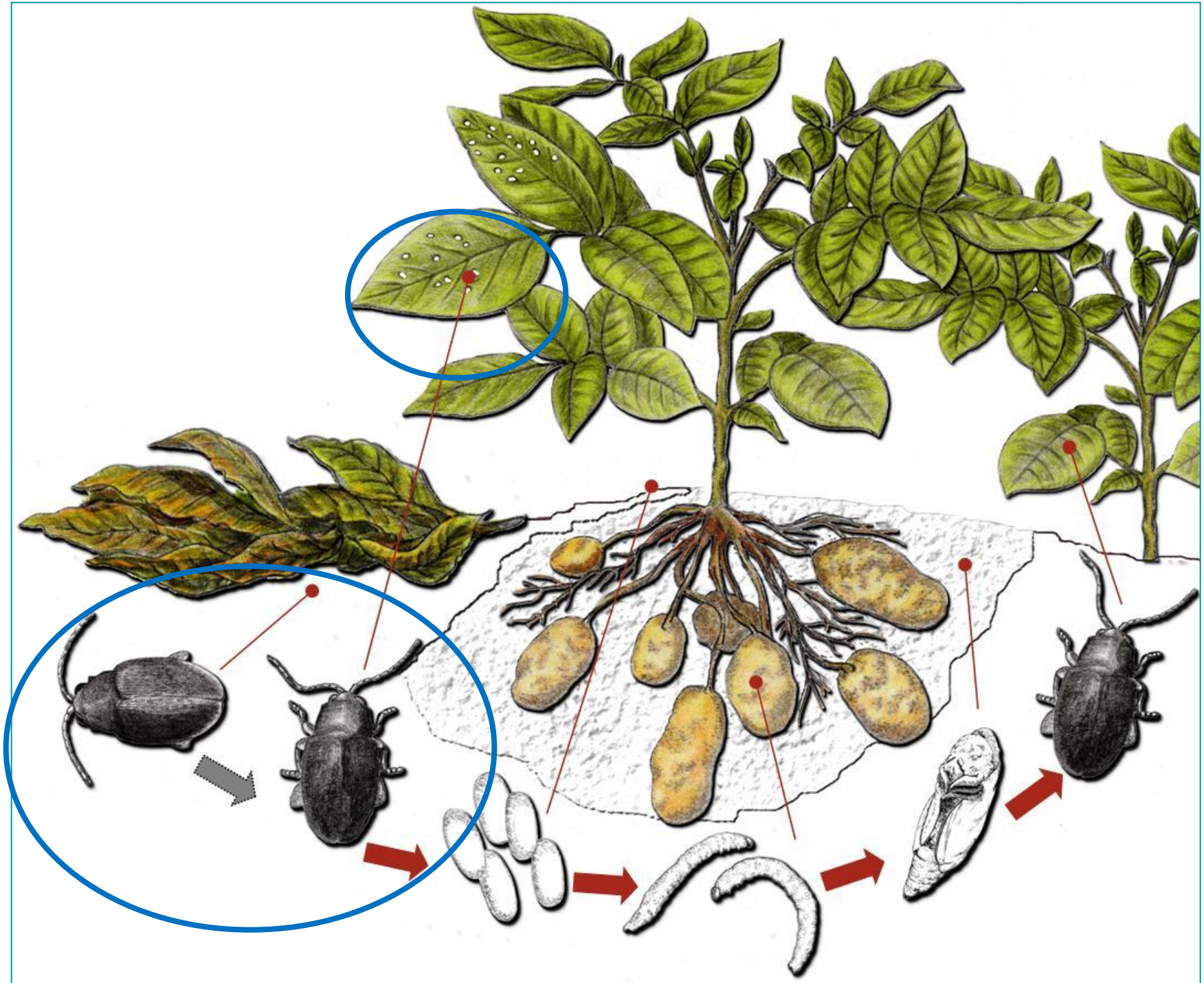
Processors have 5% tolerance for tuber damage in Canada

Tuber with potato skin removed

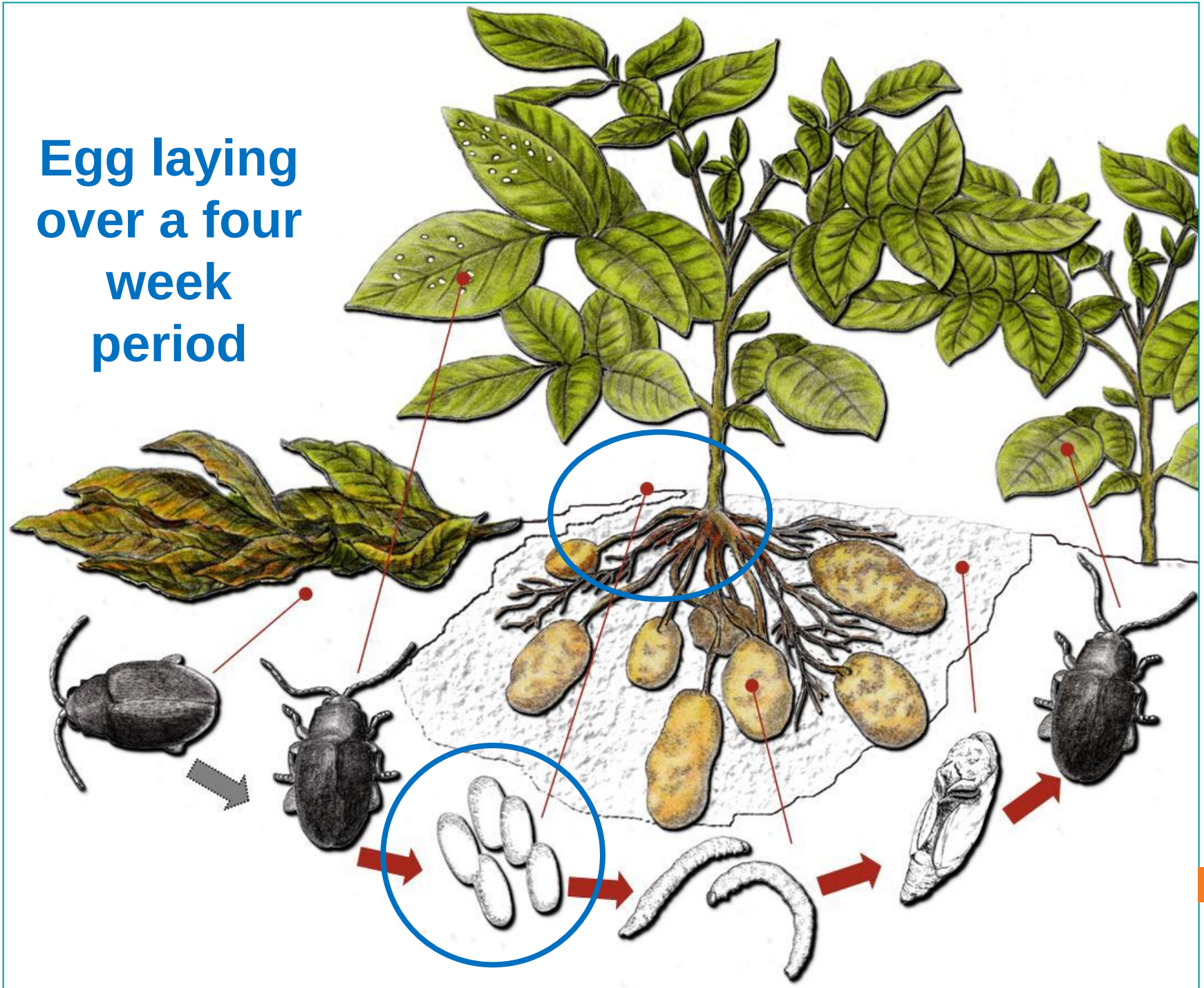
Deep holes produced in variety Rudolf by *Epitrix similaris*

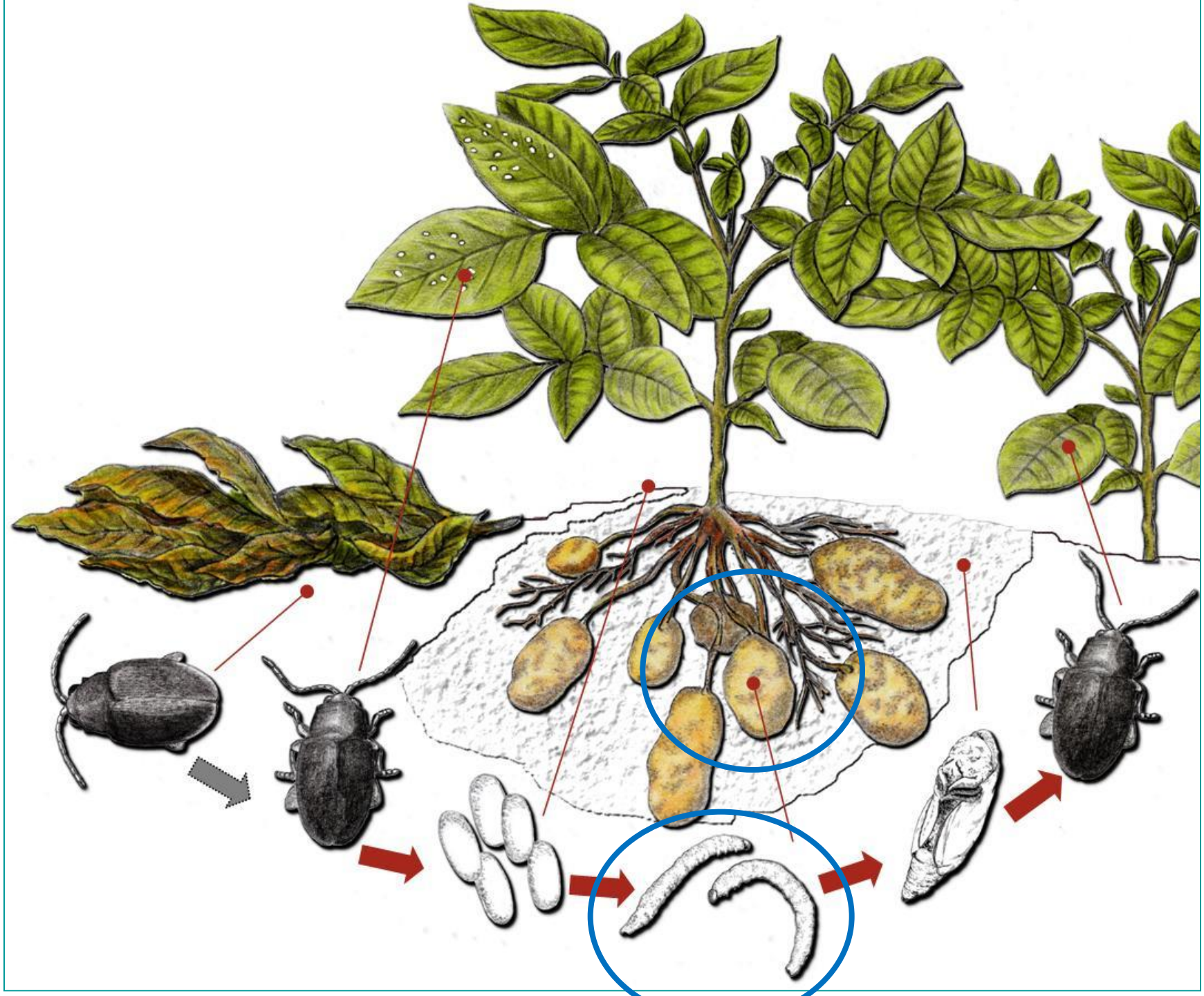

Magnifying Glas

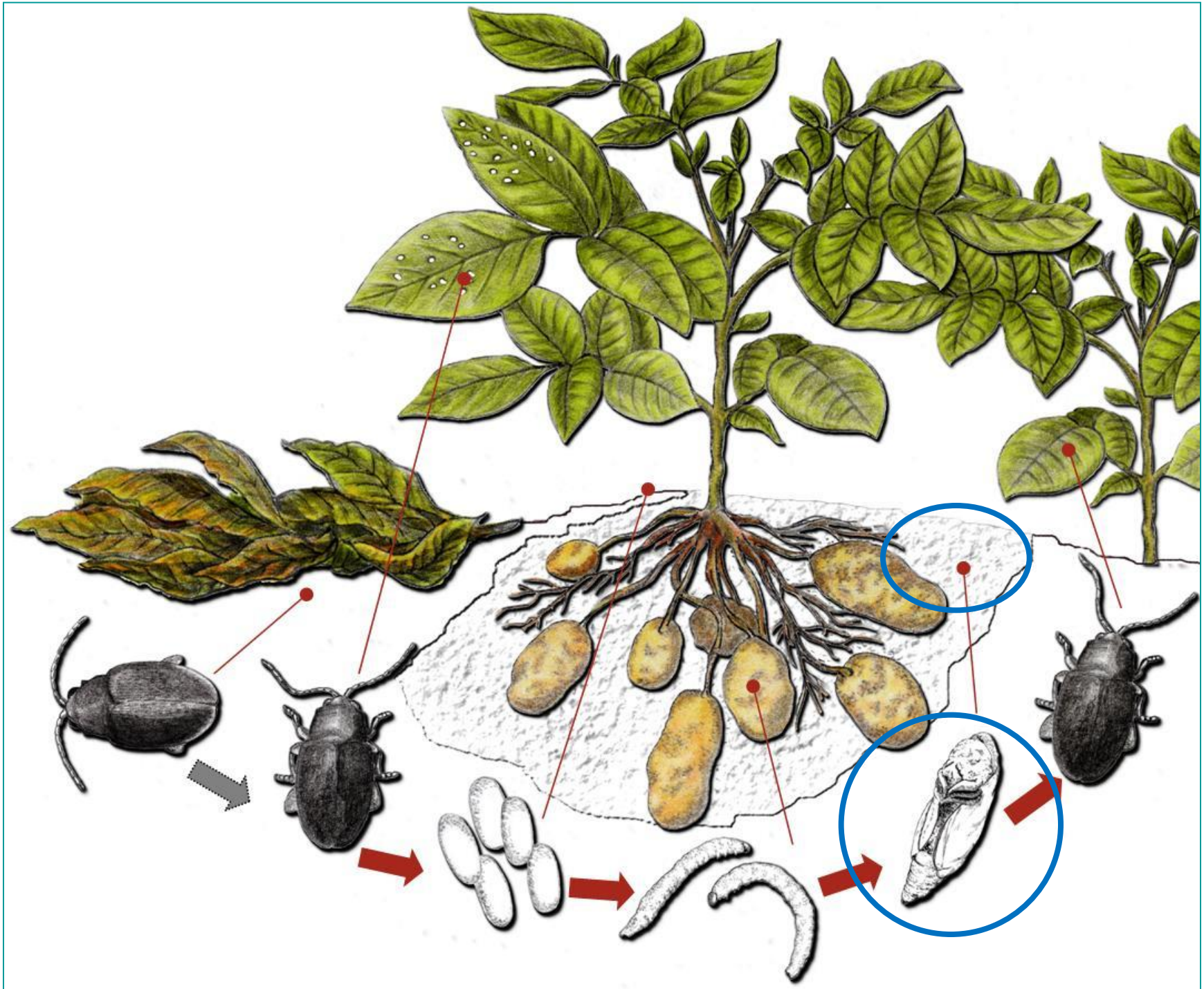

Superficial holes produced by
Epitrix similaris



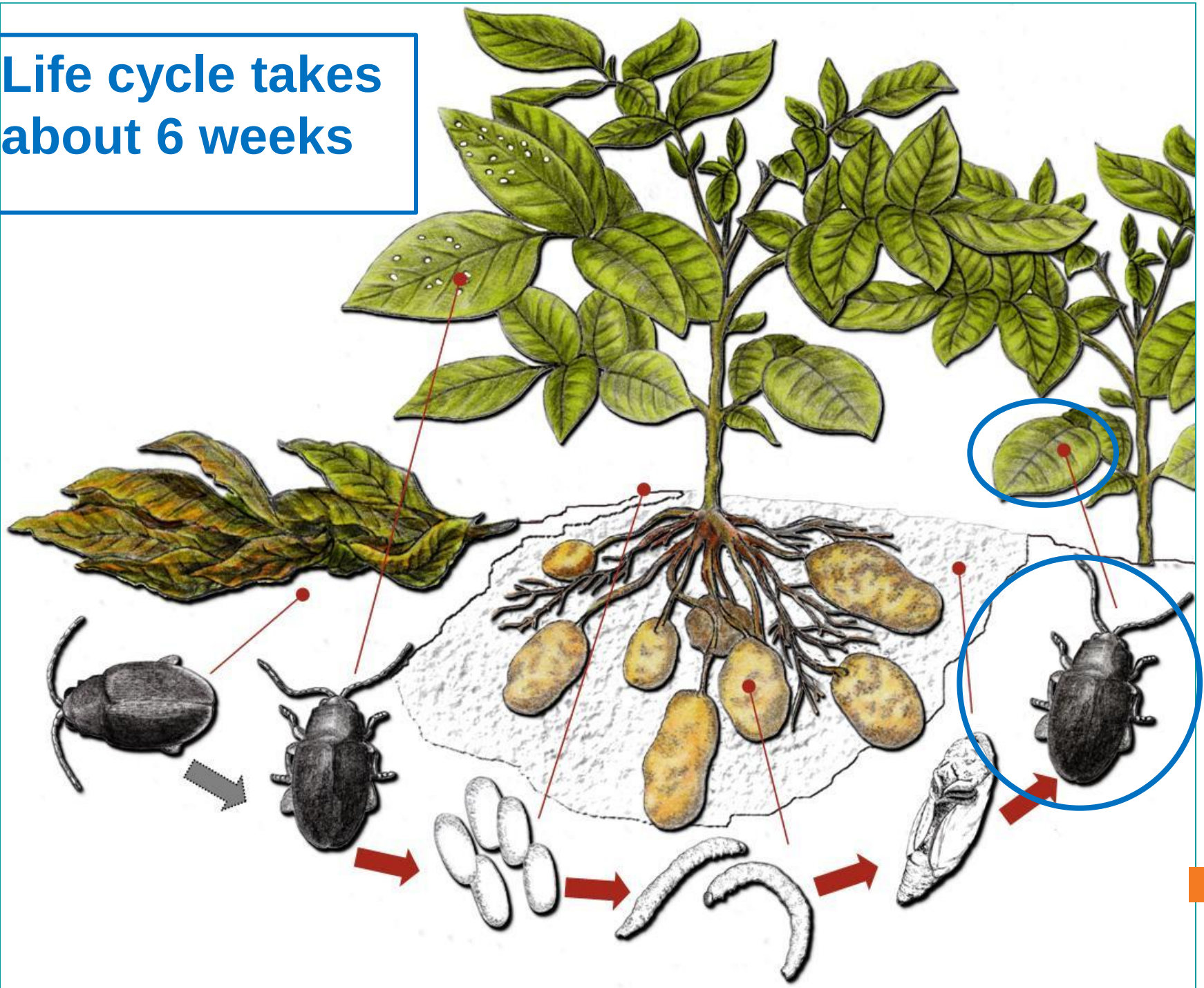
Egg laying over a four week period



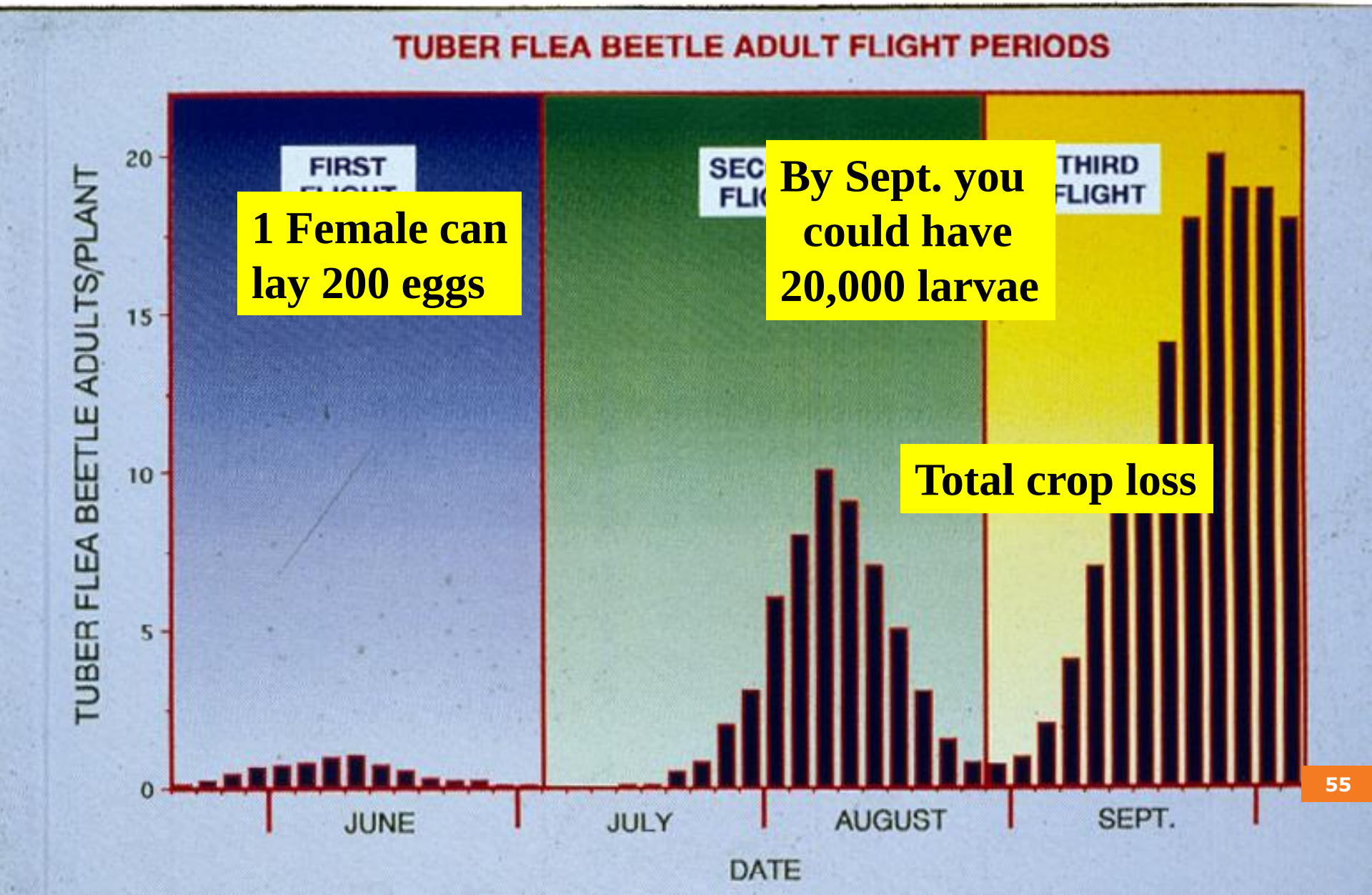




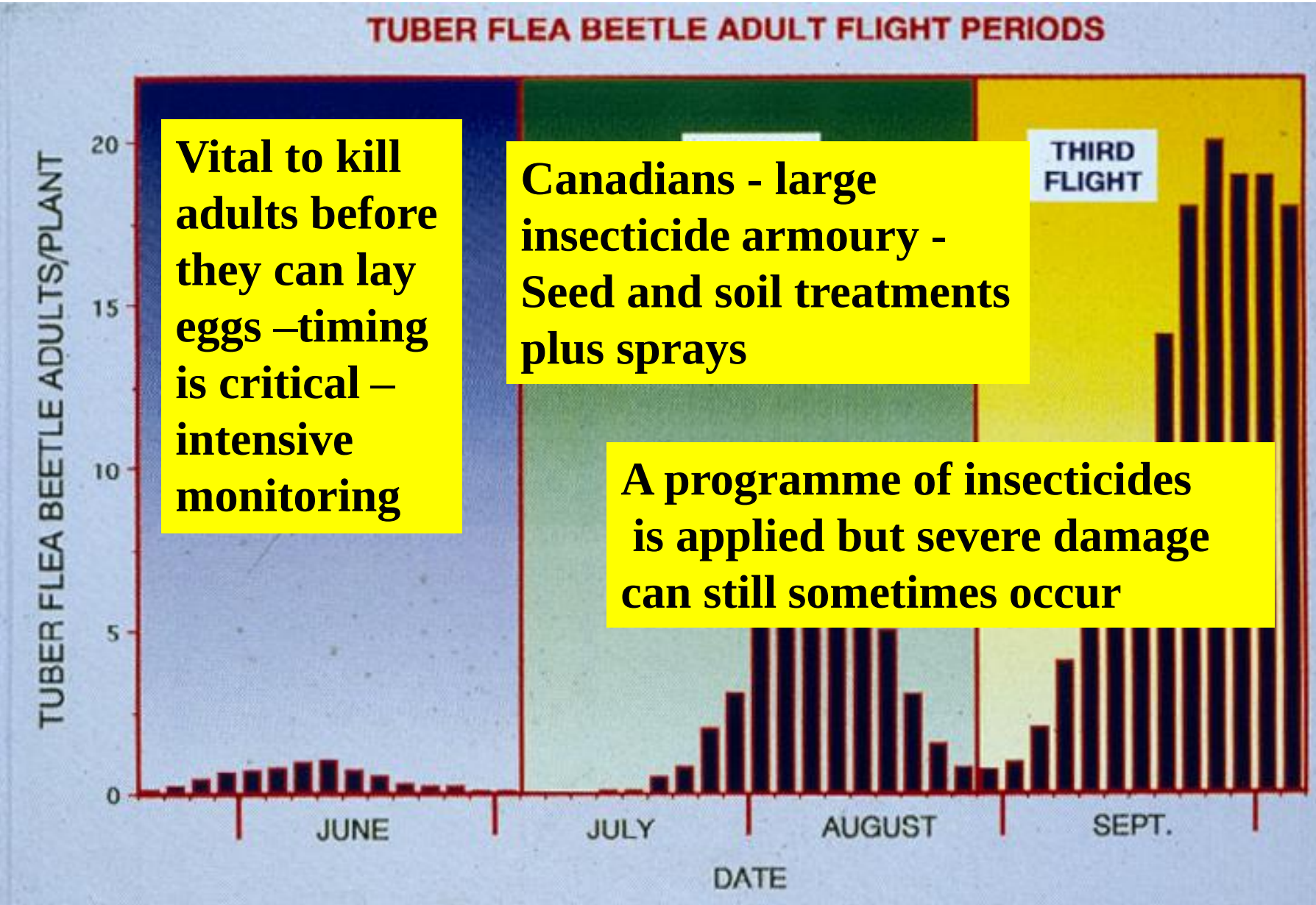
Life cycle takes about 6 weeks



Epitrix tuberis in North America



Control of *Epitrix tuberis*

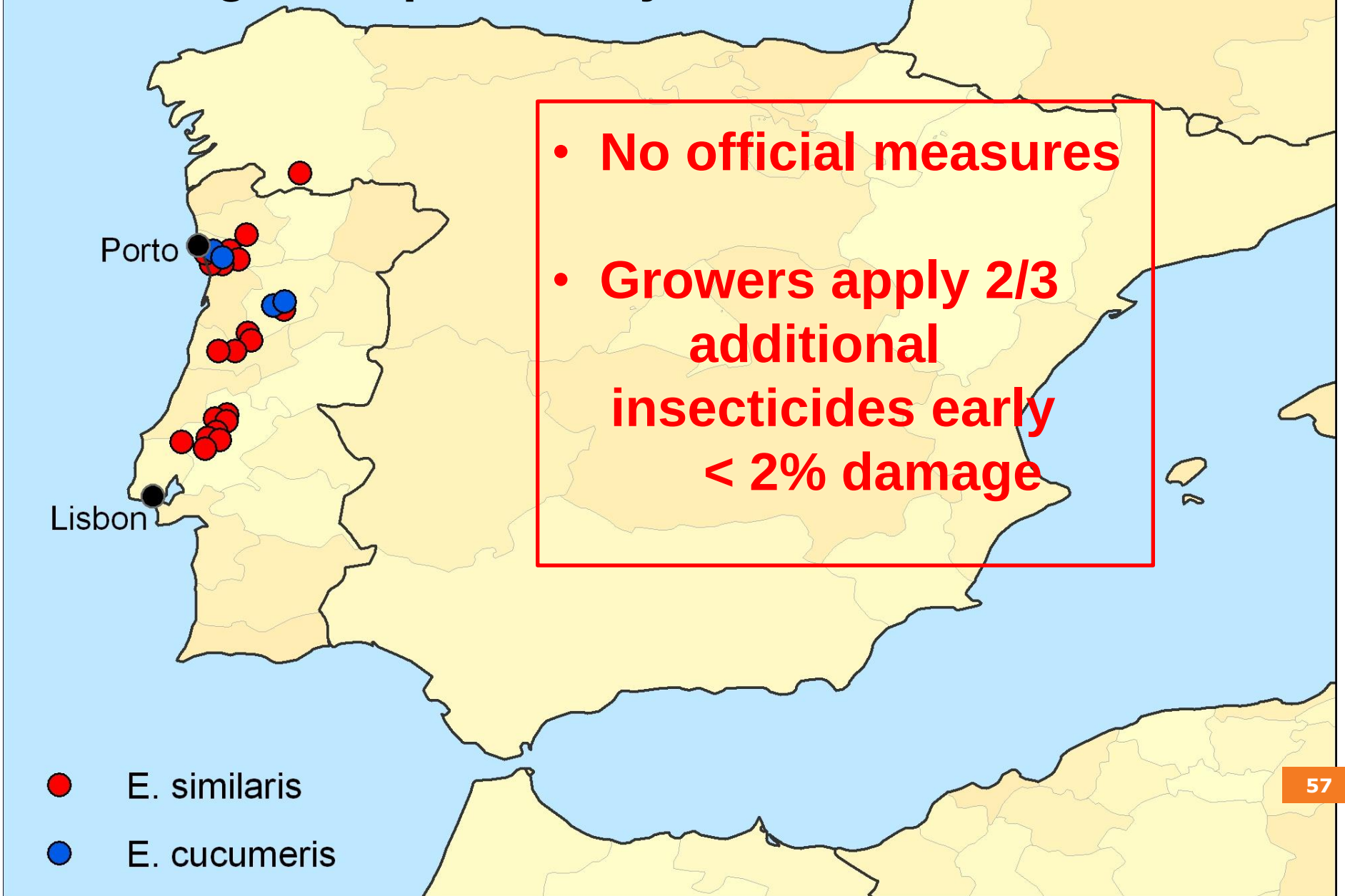


Vital to kill adults before they can lay eggs –timing is critical – intensive monitoring

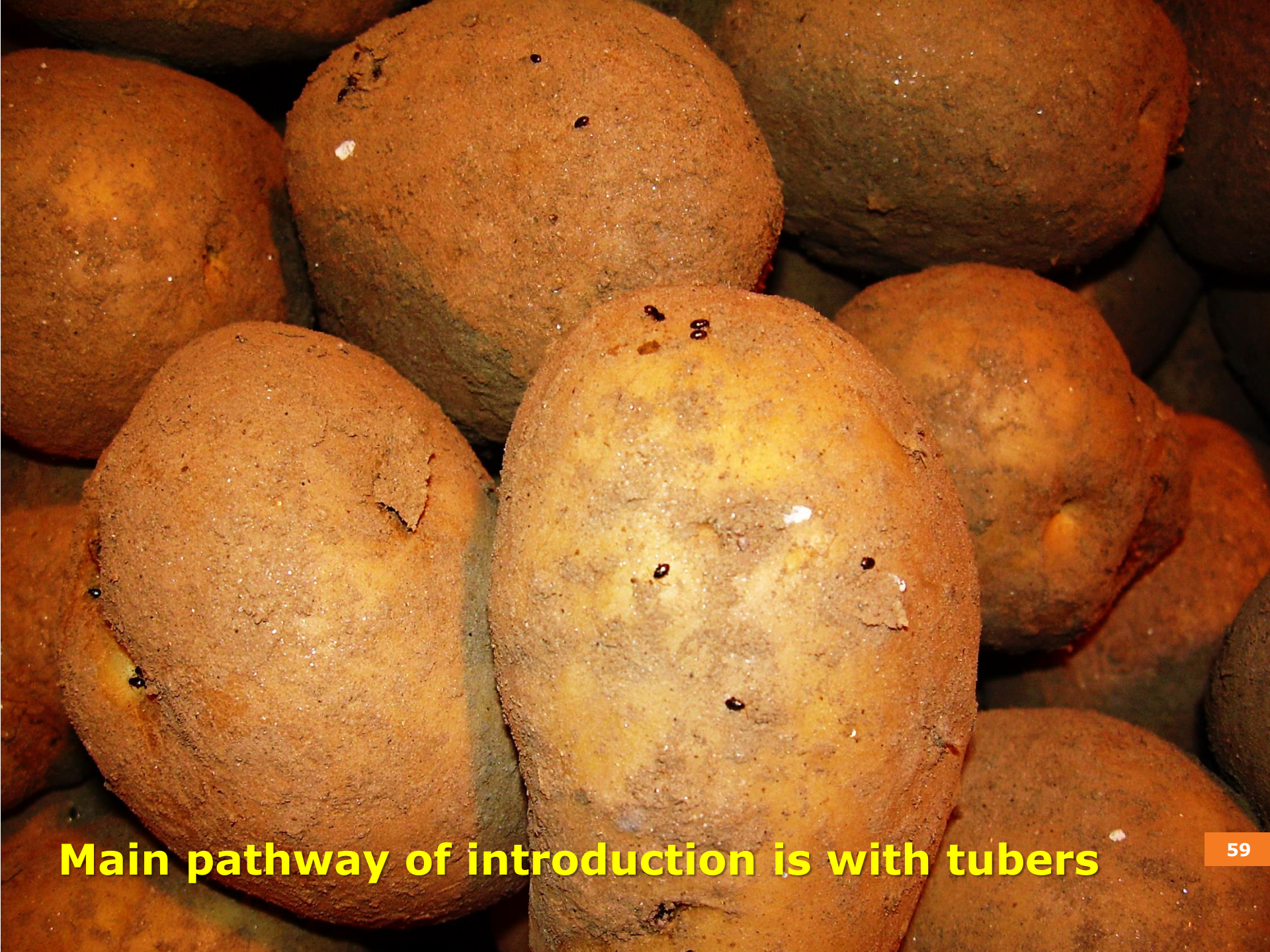
Canadians - large insecticide armoury - Seed and soil treatments plus sprays

A programme of insecticides is applied but severe damage can still sometimes occur

2008 - *Epitrix* findings in fields where tuber damage had previously occurred



- **No official measures**
- **Growers apply 2/3 additional insecticides early < 2% damage**


Main pathway of introduction is with tubers

Main pathways of introduction

- Movement from infested areas of adults, pupae (& larvae?):

Highest risk

- Seed potatoes [and farm saved seed] with soil attached
- Ware potatoes with soil attached

EPPO PRA - Conclusions

Measures needed to reduce risk of entry

- Import from Pest Free Areas

OR

- Brushing and/or washing prior to export to guarantee pest and soil freedom of consignments

Emergency Decision for *Epitrix* (2012/270/EU)

Survey requirement for pest by MS

Canada

- Pest Free Area production OR
- Brushing and/or washing to remove soil and pest

Demarcated areas (Spain and Portugal)

Emergency Decision - Demarcated areas

Infested zone

- at least infested field

Buffer zone

- width of at least 100m beyond the edge of infested zone

Measures

- eradication or containment required – no specific requirements
- washing or brushing of tubers so less than 0.1% soil

How effective are the Emergency Measures in stopping the spread of *Epitrix*?


Records of Epitrix potato beetles in Portugal and Spain (April 2015)
Oviedo
Santander
Vitoria
Logrono
Santiago De Compostela
Braganca
Valladolid
Viana Do Castelo
Vila Real
Aveiro
Guarda
Coimbra
Madrid
Castelo Branco
Toledo
Leiria
Portalegre
Merida
Lisbon
Setubal
Evora
300 km
Beja
Faro
Gibraltar
Ceuta
KEY
2015 Epitrix
2014 E. similaris
2011 E. similaris
2009 E. cucuumeris
2009 E.similaris
km
0 25 50 100 150 200

European Commission

Summary

- *Epitrix* very damaging
- Control relies on increased insecticide use
- Damage can still occur – rejection of crops
- Highest risk pathway – infested seed and ware potatoes
- Pest very difficult to eradicate
- Current Emergency Decision effective?

'*Candidatus* Liberibacter solanacearum'

Zebra Chip Disease

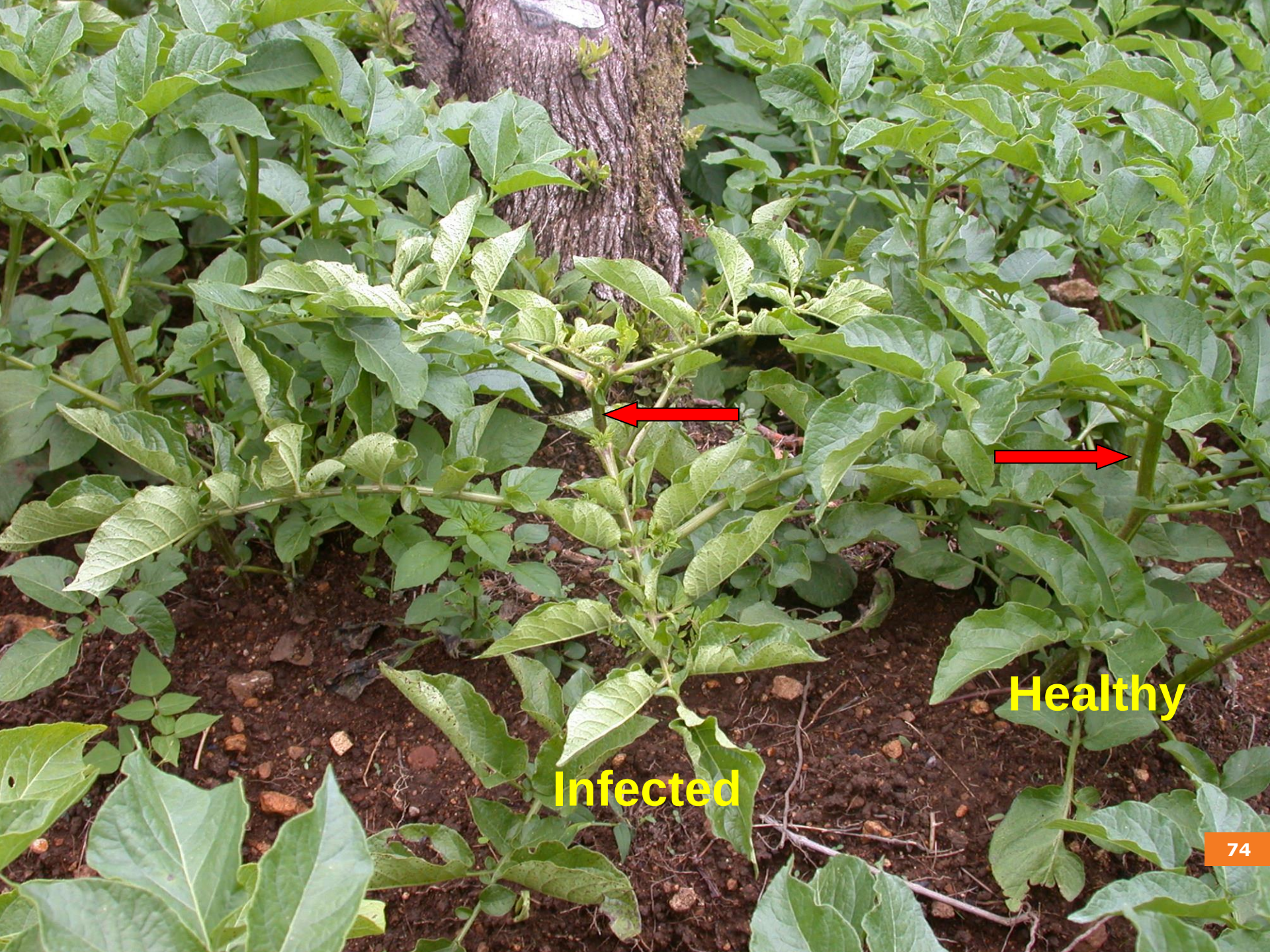
Bactericera cockerelli - vector

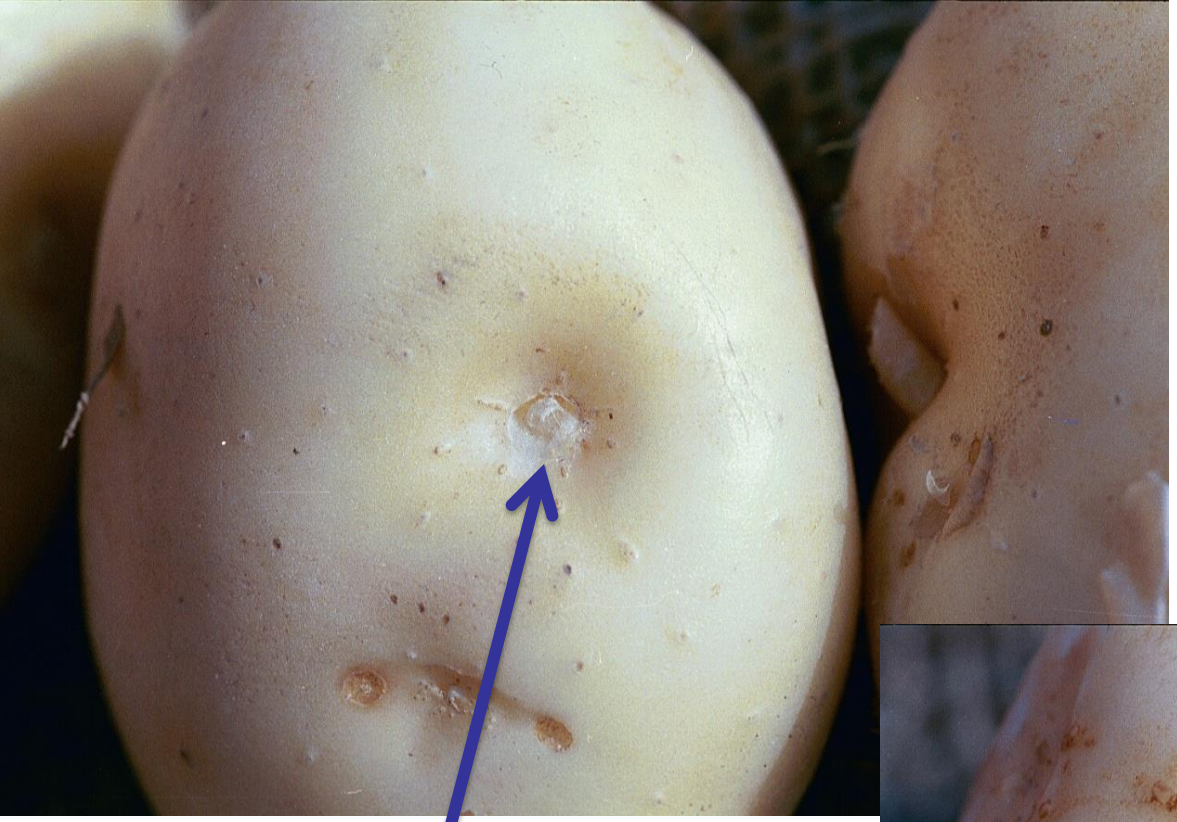
'*Candidatus* Liberibacter solanacearum'

Haplotypes 1 and 2 – vectored by the potato/tomato psyllid

- Potato
- Tomato
- *Capsicum* (pepper and chilli)
- Aubergine (*Solanum melongena*)
- Other solanaceous plants: *Solanum betaceum* (tamarillo) and *Physalis peruviana* (Cape gooseberry).

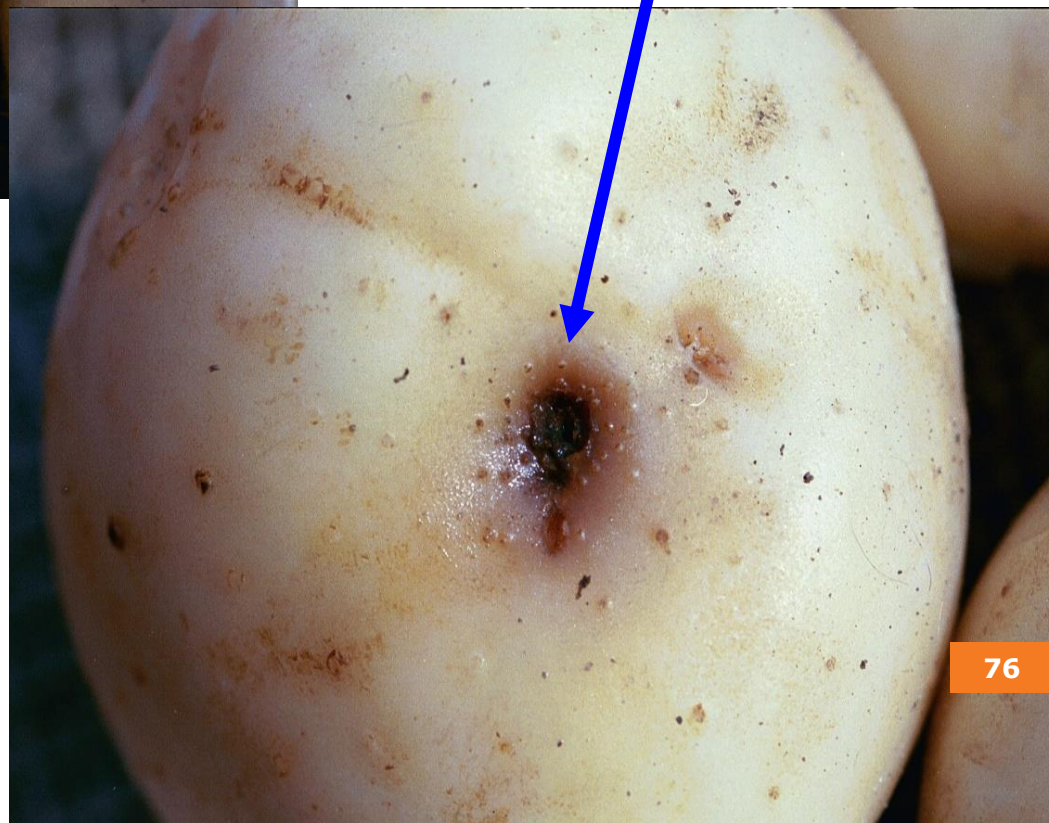

New Zealand
(March 2010)
No obvious pathway for introduction
and establishment not predicted

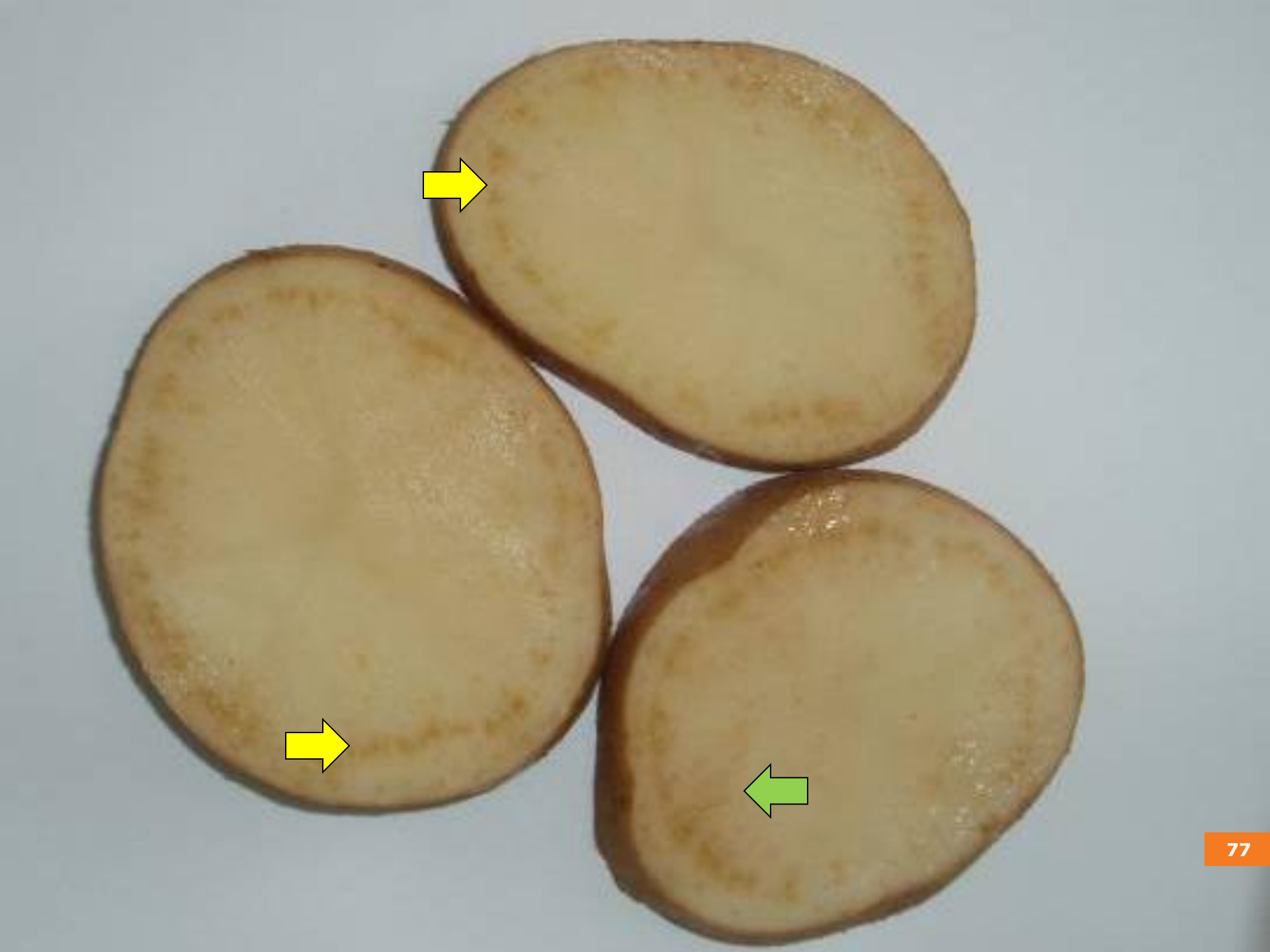

Healthy
Infected



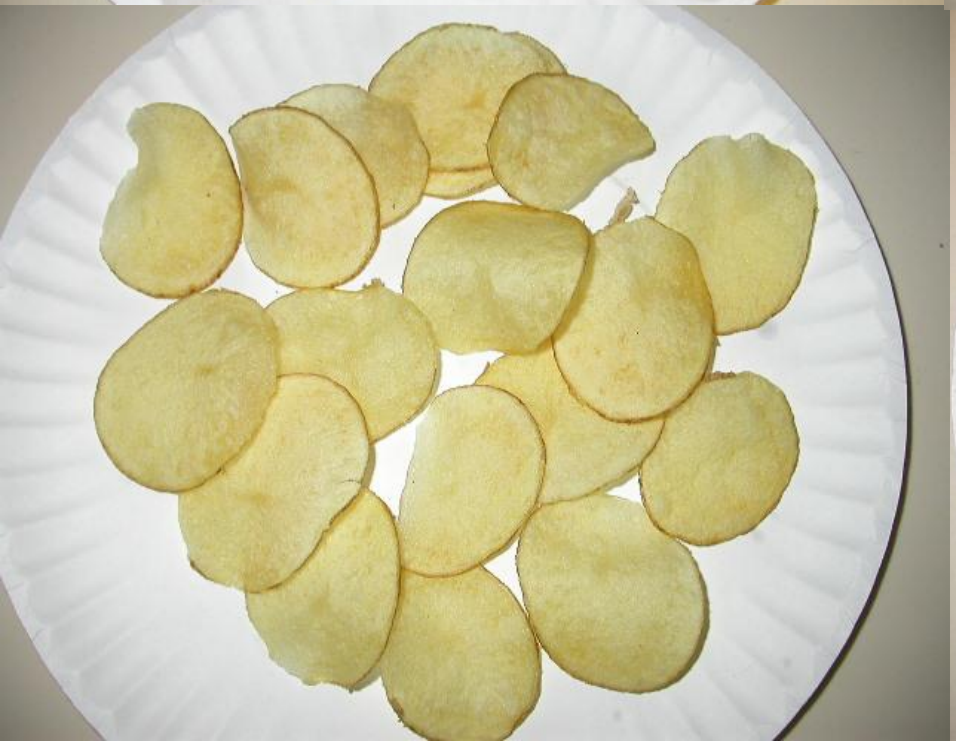
Healthy Tuber

Brown to pinkish (collapsed) stolons

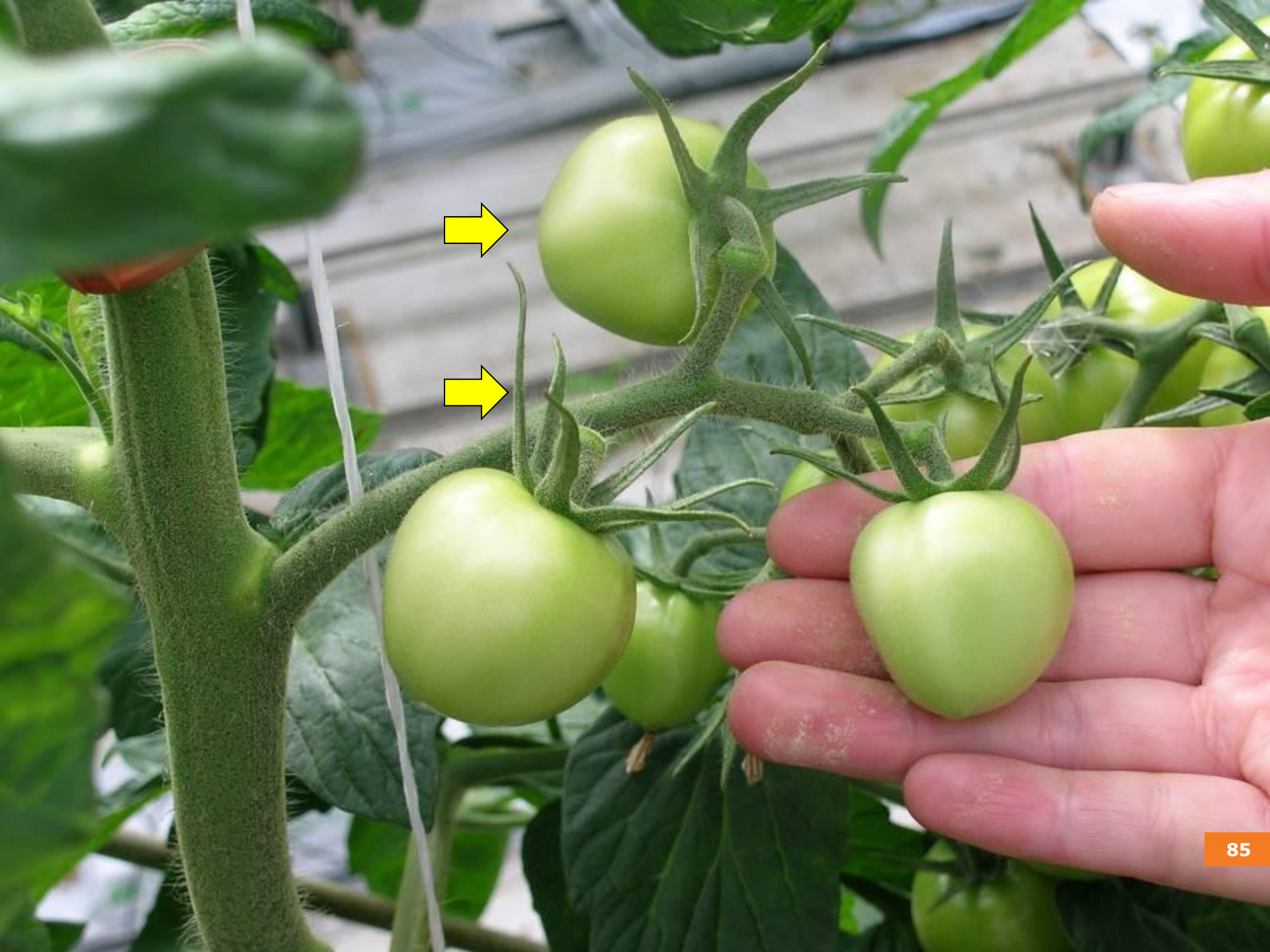









Tomato



History

- First identified in Mexico in 1994 also in Central America (Guatemala & Honduras)
- *In Texas* in 2000 (also in New Mexico, Nevada, Arizona and other southwestern US states)
- 2008 - ZC damage in New Zealand (16% losses in 2009)
- Millions of dollars in losses to the potato industry

The potato psyllid is native to North America and is distributed in western US and Mexico. It is a damaging pest and has been introduced into New Zealand

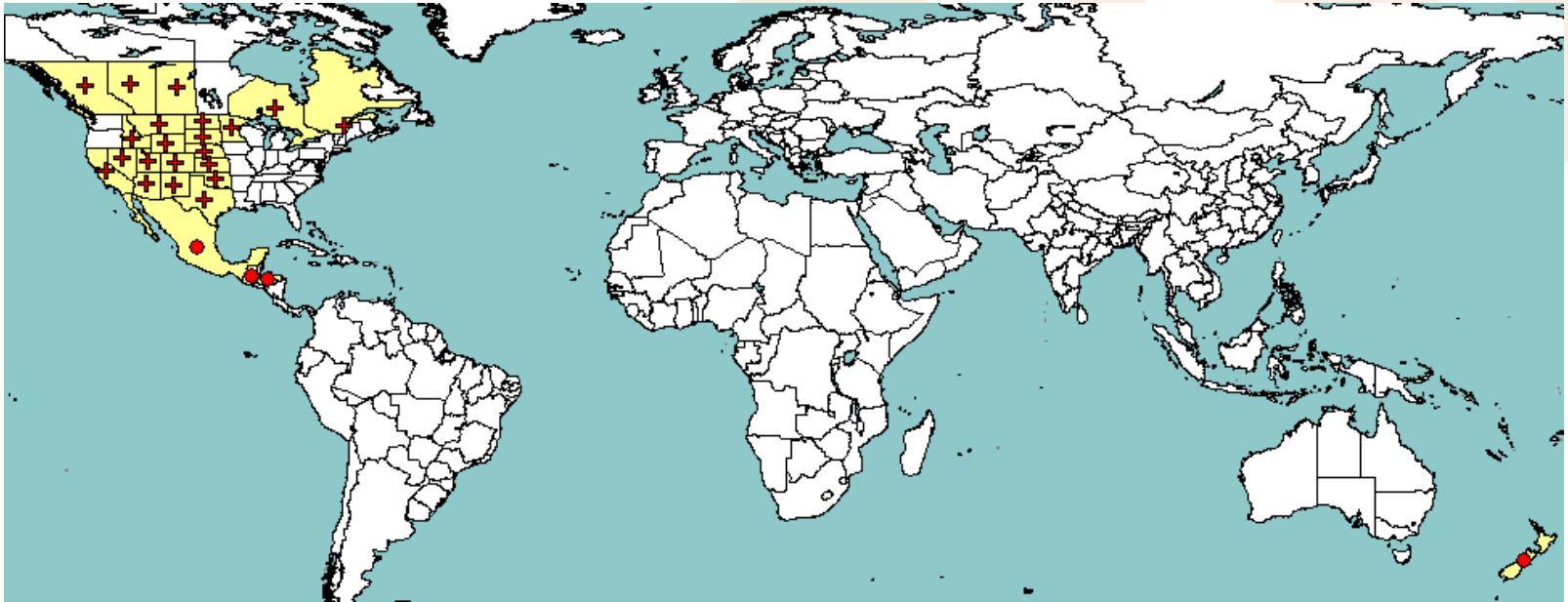
Potato Psyllid – Hosts

- Prefers *Solanaceous* hosts - Potato, Tomato, eggplant, Capsicum
- Wide host range? –20 families
- Complete life cycle on *Convolvulaceae* - sweet potato (*Ipomoea batatas) and Labiatae*
- NOT carrot or celeriac
- Pest is a good flier and spread very long distances on the wind

Distribution – Potato psyllid

EPPO region: absent

North America: Canada USA Mexico
Central America: Guatemala, Honduras
Oceania: New Zealand



Pathways of Entry

Main risk - introduction of bacterium with vector into the EU

Fruit of Solanaceae: main risk when packaging of imported fruit occurs in close proximity of where solanaceous hosts are grown. Vine tomatoes present a higher risk of introduction.

Plants for planting of Solanaceae (including potatoes): closed for the EU

Plants for planting of Micromeria chamissonis, Mentha spp., Nepeta spp: minimal volumes but not regulated

Summary

- Impact will be massive to potato (and tomato) if potato psyllid and CLS become established
- Very difficult to stop spread
- Potential pathways for entry into the EU exist

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Food safety

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