Potato Diseases and Control

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Potato: Important crop

- Potatoes are an economical, low-cost source of energy.
- Rich in starch, vitamins (C, B1), and minerals.
- Composition: 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% fiber, 0.9% ash.

- An important food for human nutrition.

Photo by JA Group in Japan

Other diseases of potato

1. Early blight
2. Black scurf
3. Common scab
4. Bacterial wilt
5. Popato cyst nematode
6. Viruses

Remove diseased plants from the field and bury them deep to prevent the spread of pathogens.

1. Early blight –symptoms –

- Symptoms first appear on older leaves as dark brown circular, angular, or oval spots.
- Spots expand and merge, causing leaves to yellow, dry, and fall.
- In favorable conditions, stem infection at late growth stages may lead to early plant death.

Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

1. Early blight –pathogen-

- *Alternaria solani*

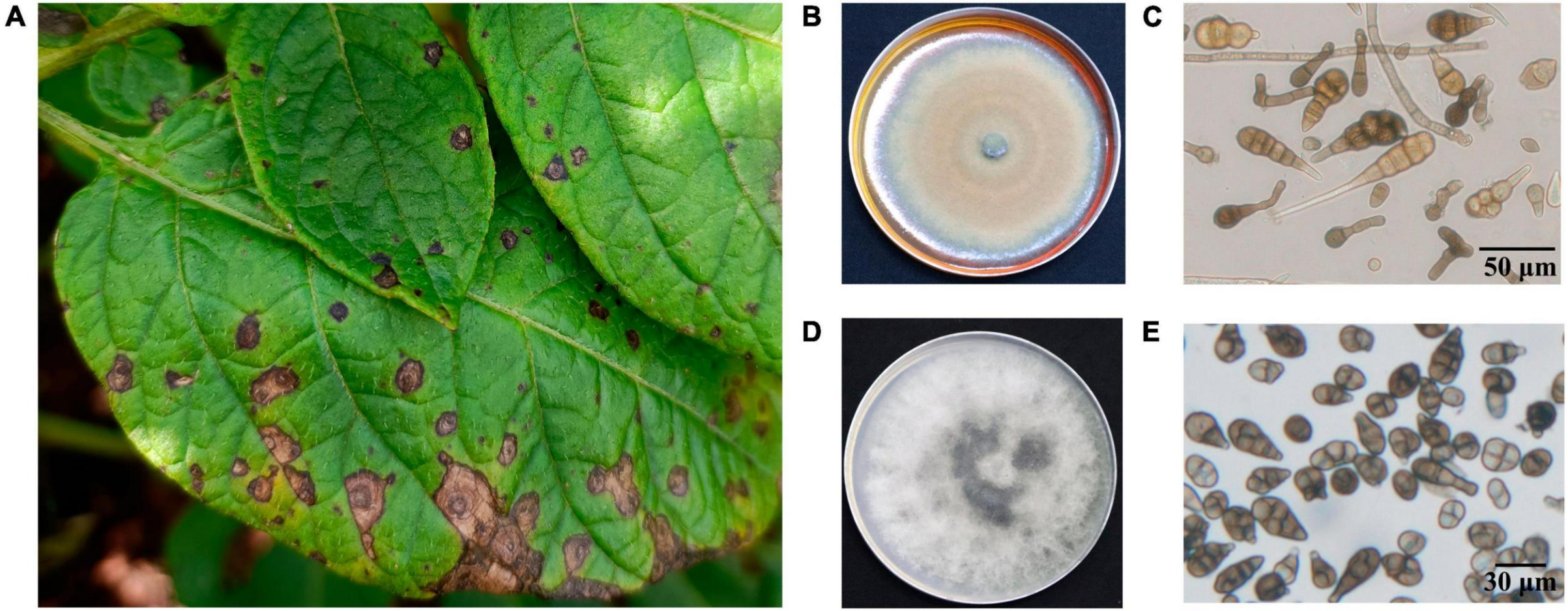


Photo by Li Q. et. al "Multi-omics approaches to understand pathogenicity during potato early blight disease caused by *Alternaria solani*" 2024 Sec. Microbe and Virus Interactions with Plants

1. Early blight –Disease Cycle –

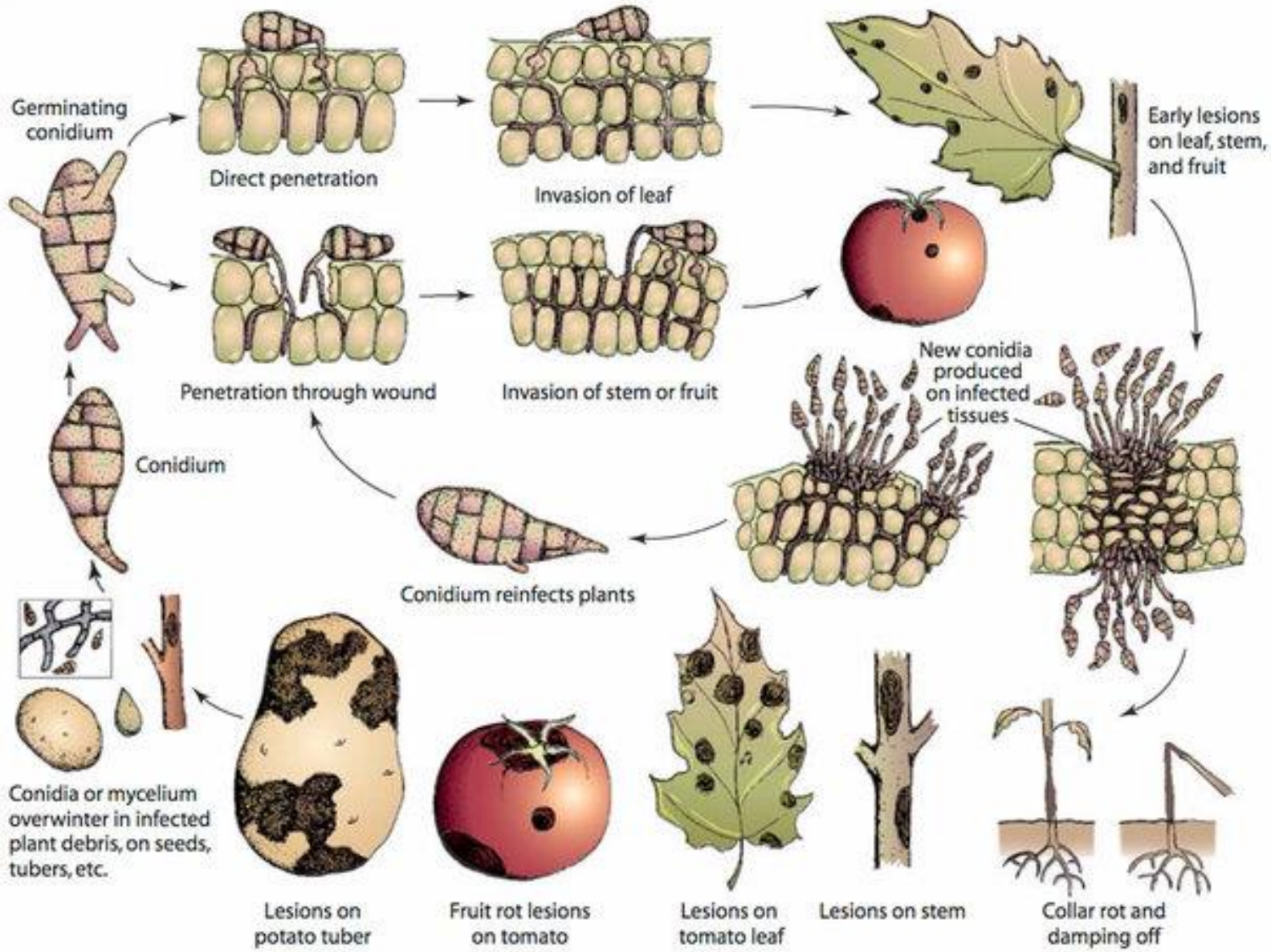


Figure by Adhikari P et. al
“Current Status of Early Blight Resistance in Tomato: An Update”
2017 International Journal of Molecular Sciences

1. Early blight –Control –

- Long-term crop rotation with nonhost crops, field sanitation.
- Chemical control;

  Chlorothalonil, mancozeb, hexaconazole, propineb on 15 days interval.

2. Black scurf –Symptoms (1)–

- Disease occurs in two main stages: stem canker and blight, and black scurf.

- Stem canker and blight stage

(1) Growing tips of sprouted tubers are killed before emergence.

(2) Sunken or shallow brown cankers form on growing plants.

(3) Stem girdling stops carbohydrate translocation, causing accumulation at the top.

(4) Leaves turn purple due to excess anthocyanin.

2. Black scurf –Symptoms (2)–

- Stem symptoms:

(1) Stem buds near the soil may swell unusually.

(2) New leaves appear bunched, and leaf tips may roll abnormally.

- Black scurf phase:

(1) Dark brown to black, uneven lumps adhere to tuber surfaces.

(2) Sclerotia form on tuber skin, stick tightly, and are hard to remove.

(3) Black scurf serves as a source of infection for stem canker.

Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

- Heavily diseased plants produce fewer, smaller tubers and greatly reduced yields.

2. Black scurf –pathogen–

- *Rhizoctonia solani* Kuhn (Teleomorph: *Thanatephorus cucumeris*)
- AG3 (Anastmosis Grouping 3)

- Optimal condition: soil pH 5.2-8.0, soil temperature of 20- 22 ℃, low soil moisture.

Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

2. Black scurf –disease cycle–

- The fungus overwinters as sclerotia formed at the end of the season.
- It can also survive on infected tubers, soil, and plant debris.

2. Black scurf –control–

- Use disease – free healthy tuber seeds (sclerotia are not adhered to tuber skin).
- Follow a few years crop rotation with nonhost crop.
- Seed treatment (whole tuber) with chemical: azoxystrobin, impilfluxam, fluxapyroxad…., and so on.

3. Common scab –symptoms –

- Symptoms appear only on tubers, not on foliage.

- Lesions are irregularly rounded, elevated, brown, corky, and 5–10 mm in diameter.

Photos from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

3. Common scab –pathogen –

- *Streptomyces scabies, Streptomyces turgidiscabies, Streptomyces spp.*

3. Common scab –disease cycle –

- Primary infection: from infected tubers or soil-borne inoculum (long-term survival)
- Spread mainly via: infected seed tubers, contaminated soil, irrigation water
- Most susceptible: small tubers at initiation stage
- Entry through lenticels, stomata, wounds, or cuticle

3. Common scab –control –

- Use only disease-free tubers.
- Use chemicals. Ex) Soak seed potato tubers in oxytetracycline and streptomycin sulfate to disinfect them (but not perfect) .
- Irrigate the crop frequently at tuberization stage.
- Long term crop rotation with cereals crops.

3 Common scab –control – IPM method in Hokkaido

Scab incidence in the previous potato	Countermeasures
6-15 %	After cultivating soybeans or wild oats, plant potatoes. Maintain soil pH at 5.0. Use resistant varieties.
16-30 %	A four-year crop rotation system is implemented for wheat, adzuki beans, beets, and potatoes. Maintain soil pH at 5.0. Use resistant varieties.
31-80 %	Use highly resistant varieties
≥81%	No effective measures for table potatoes. Cultivation limited to processing potatoes.

Economic Threshold Level: <15% disease incidence

In case of control trial to scab in Nagasaki, Japan

- Rice in summer, potatoes in winter

- Hypothesis: flooding may kill scab fungus

- Flooding alone reduced scab density
- Flooding + rice planting did not reduce scab
- Reason: rice roots release oxygen, allowing fungus survival

4. Bacterial wilt – symptoms -

- Streaky brown discoloration appears on stems from soil level as the disease progresses, with bronze coloration developing on leaves.

- Tubers decay and emit a foul odor.

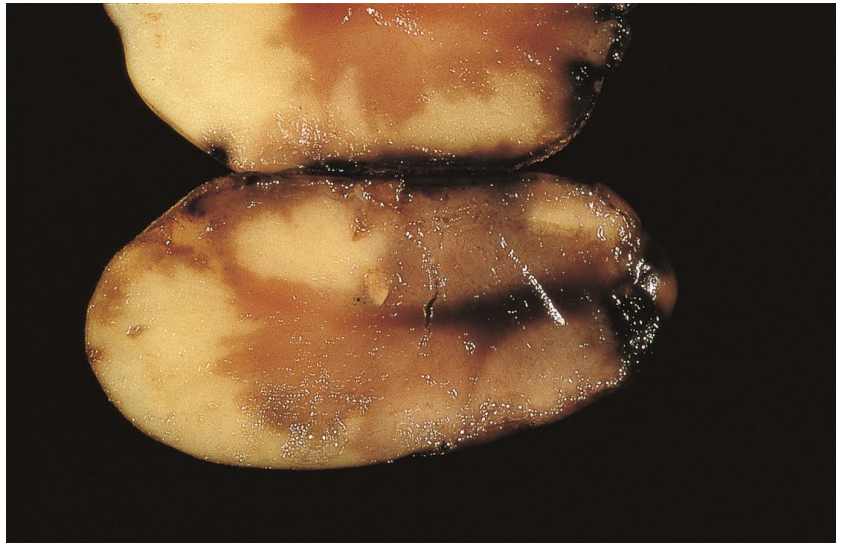


Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

4. Bacterial wilt – causal organism –

- *Ralstoniasolanacearum*
- Gram negative bacterium

4. Bacterial wilt – epidemiology –

- Moderate to high soil temperature (25- 30℃)
- Soil moisture >50%

4. Bacterial wilt – control –

- Do not damage the stems, stolen and roots.
- Remove the weed host or infected plant debris as pathogen can also perpetuates on roots and weed hosts.

5. Nematode

- Small, thread-like animals; females lay many eggs
- Dead bodies form cysts that protect eggs up to 10 years
- Eggs hatch → attack potato roots → repeat cycle
- Hard to eradicate; serious pest in Hokkaido since 1972
- Symptoms: weak growth, yellow leaves, plant death; severe cases reduce roots
- Spread through soil → avoid moving soil from infested fields
- Main control: use resistant varieties

6. viruses

- Potato leaf roll virus (PLRV): Spread by winged aphids, which acquire the virus from infected weeds.
- Potato viruses X, Y, A, and mosaic V (PVX, PVY, PVA, PVMV):

(1) Primary infection source is infected tubers.

(2) Highly contagious; transmitted mechanically through contact with diseased leaves, roots, or tubers.

(3) Spread via cutting knives, cultivation, spraying equipment, and aphids.

Symptoms

独立行政法人　農畜産業振興機構

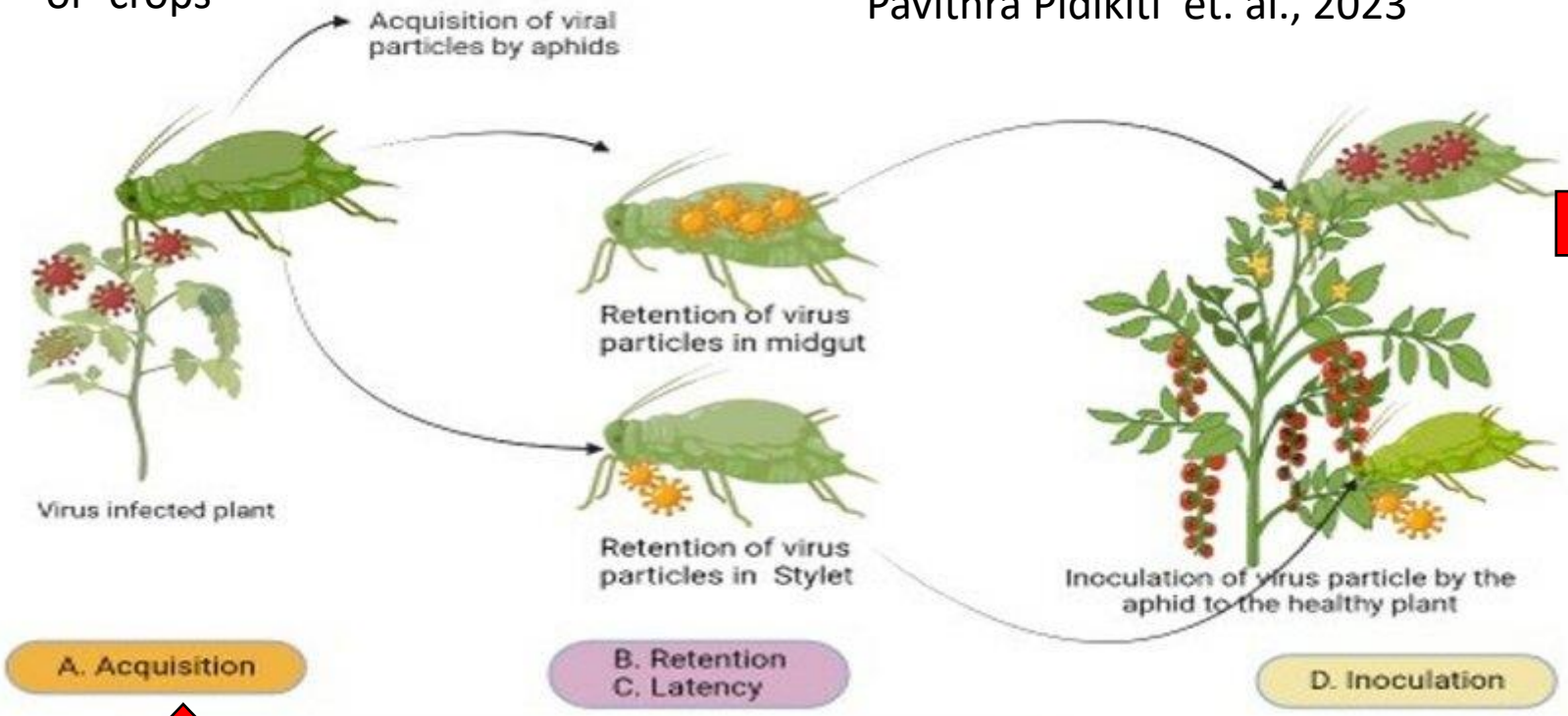
Continuing to use tubers from virus-infected fields as seed resulted in a 77% reduction in yield by the third season. Growth becomes severely stunted, but spraying nutrients does not improve the viral symptoms.

Virus Transmission Cycle

Infected potato tubers

Infected weeds
or crops

Pavithra Pidikiti et. al., 2023



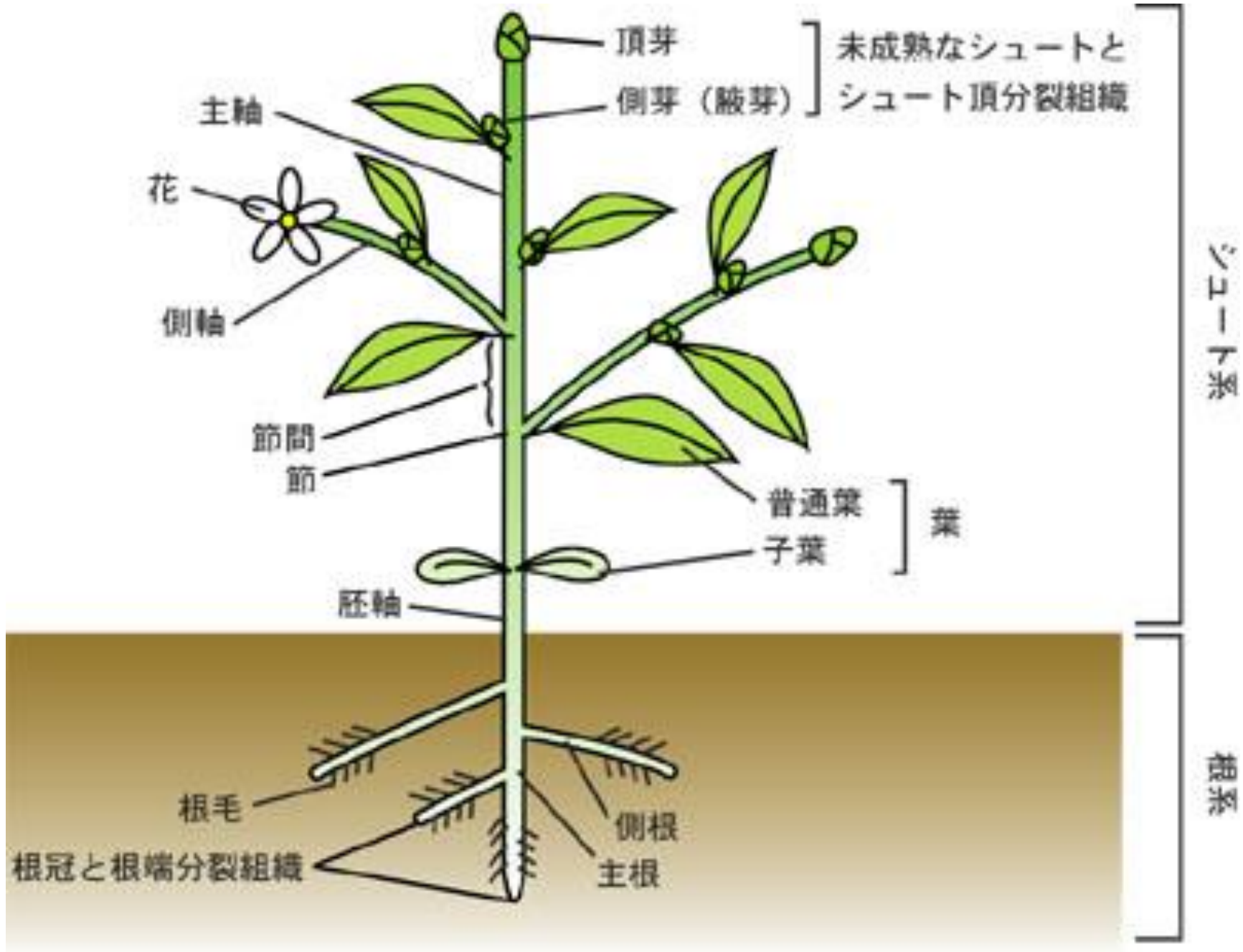
Infected potato

Viruses –control –

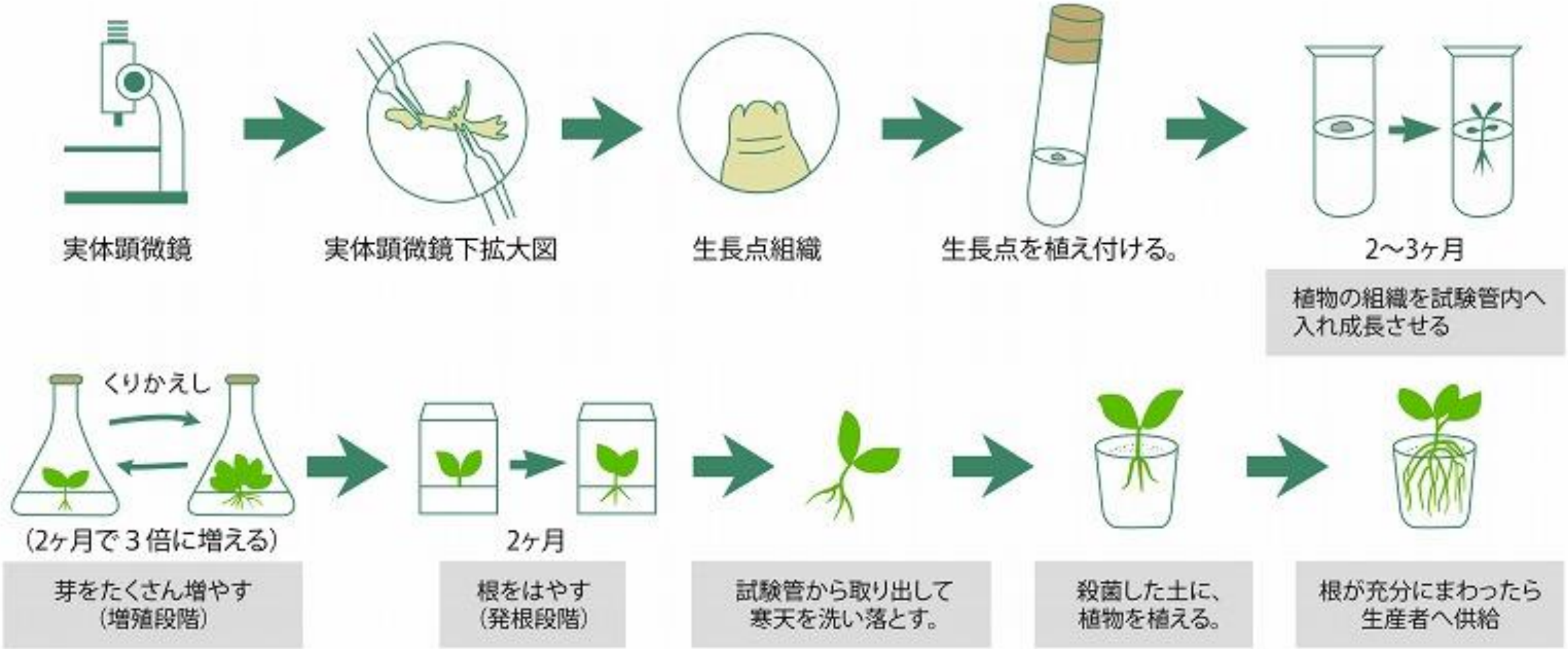
- **Use viruses-free seed tubers.**
- (Control aphids by chemicals, in some cases)

ジャガイモ博物館

How can we create a viruses-free seed tubers ?



Tsukuba Univ.


実体顕微鏡
実体顕微鏡下拡大図
生長点組織
生長点を植え付ける。
2～3ヶ月
植物の組織を試験管内へ
入れ成長させる
くりかえし
(2ヶ月で３倍に増える)
芽をたくさん増やす
(増殖段階)
2ヶ月
根をはやす
(発根段階)
試験管から取り出して
寒天を洗い落とす。
殺菌した土に、
植物を植える。
根が充分にまわったら
生産者へ供給

三和ベルティ株式会社


FAITHFUL

Breeder (National, or Prefectural Agricultural Experiment Station)	National Center for Seeds and Seedlings （NCSS) (Primary Seed Nursery)	Secondary Seed Nursery (Entrust cultivation to general farmers)	General Seed Nursery (Entrust cultivation to general farmers)	Cultivation for Food (General farm)
Developing A new variety 	Apical meristem culture ↓ Within a greenhouse covered with fine mesh, cultivate completely free of aphids to obtain tubers.	Cultivate in isolated fields and completely eradicate aphids. Clear weeds around the field perimeter to prevent aphid infestation. Conduct frequent inspections; remove any plants showing even slight viral symptoms from the field and completely destroy them.	Perform the same operation as on the left.	Cultivated as a food crop. The tubers produced in this field must never be used as seed tubers.

	First season	Second season	Third season	Fourth season

Isolated fields

黒松内町

種苗管理センター