Potato Diseases and Control

Ph. D. Sachiko Ikeda
Professional Engineer (Plant Protection)
Hokkaido Research Organization
Donan Agricultural Station

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

Diseases of potato

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

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

1. Late blight –symptoms (1) –

- Affects leaves, stems, and tubers.
- Symptoms start as pale green, water-soaked spots (2–10 mm) on leaf margins and tips.
- In moist conditions, spots enlarge, covering the whole leaf, which soon becomes necrotic.
- On the underside of leaves, whitish fungal growth with abundant sporangia develops around necrotic areas.

1. Late blight –symptoms (2) –

- Brown lesions weaken stems and petioles.
- Whole crop may turn black and die within a week.
- Tubers show reddish-purple blotches spreading inside.
- Secondary bacteria cause soft rot.

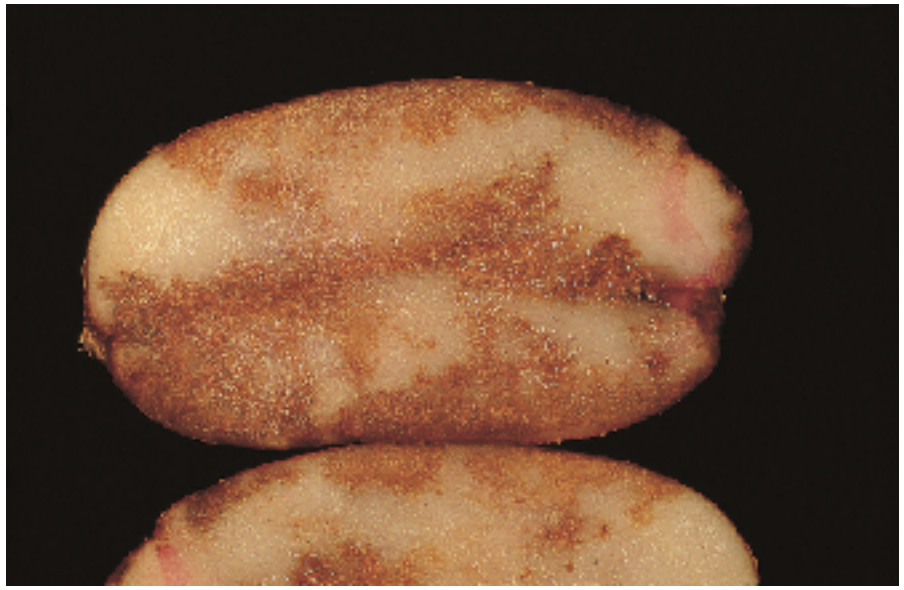


Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

1. Late blight –pathogen –

- *Phytophthora infestans*
- Also infects tomatoes, eggplants, and other Solanaceae.
- Optimum temperature: 18–20°C.
- Disease spreads rapidly in rainy conditions.

Mycelium and zoosporangia of *P. Infestans* on potate leaves

1. Late blight –Disease Cycle and Epidemiology –

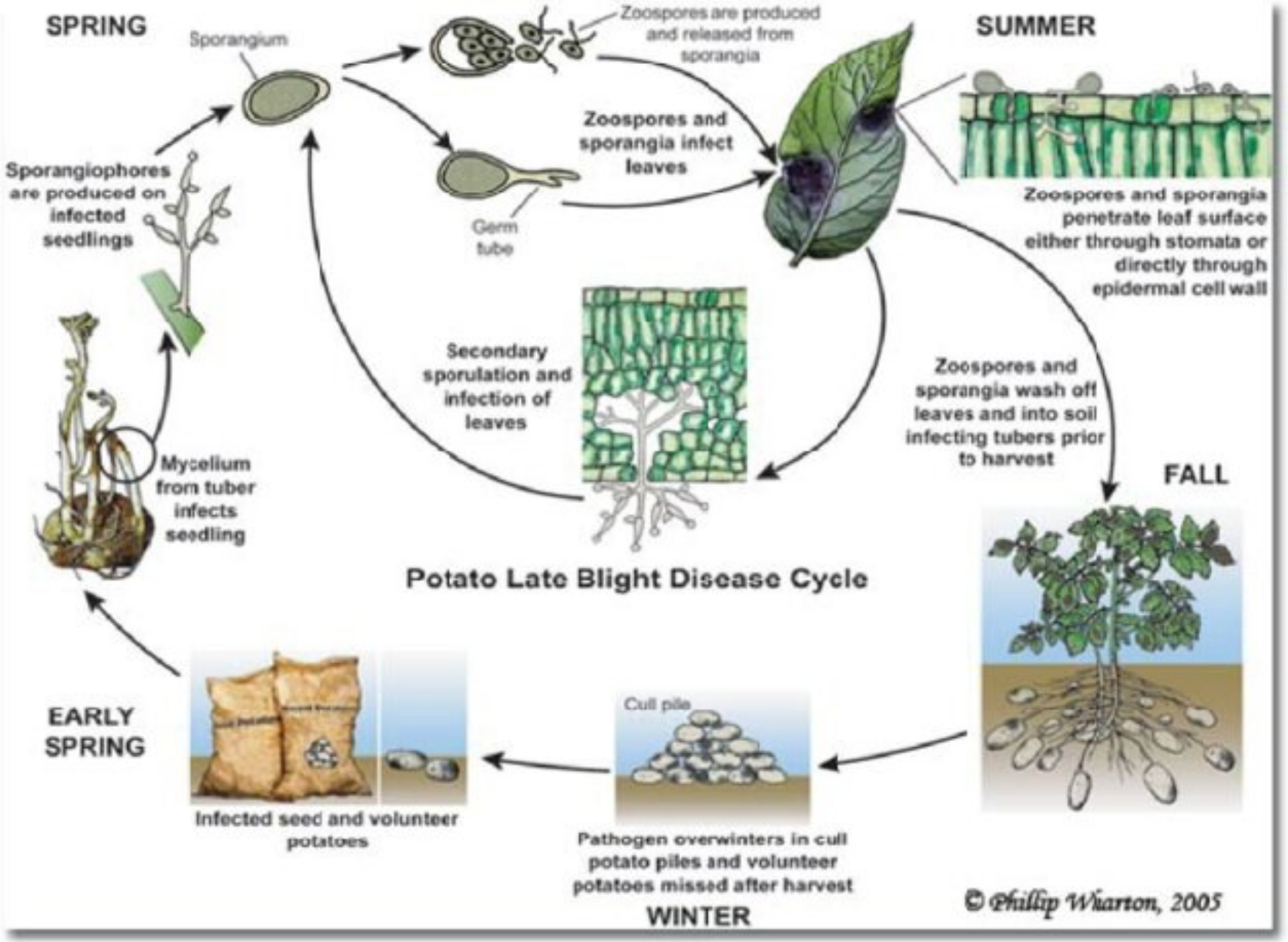


Figure by Tadesse Y et. al
"Plant Pathology & Microbiology Recent Advances in Potato Late Blight Disease Management Strategies"
2021 J Plant Pathol Microbiol 559

1. Late blight –Control –

- Resistant cultivars

- Chemical control

  Mancozeb, Fenamidone, Mandipropamid, Cyazofamid, Amisulbrom, Fluazinam, etc…

I will explain how to use chemicals later.

2. 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”

2. Early blight –pathogen-

- *Alternaria solani*

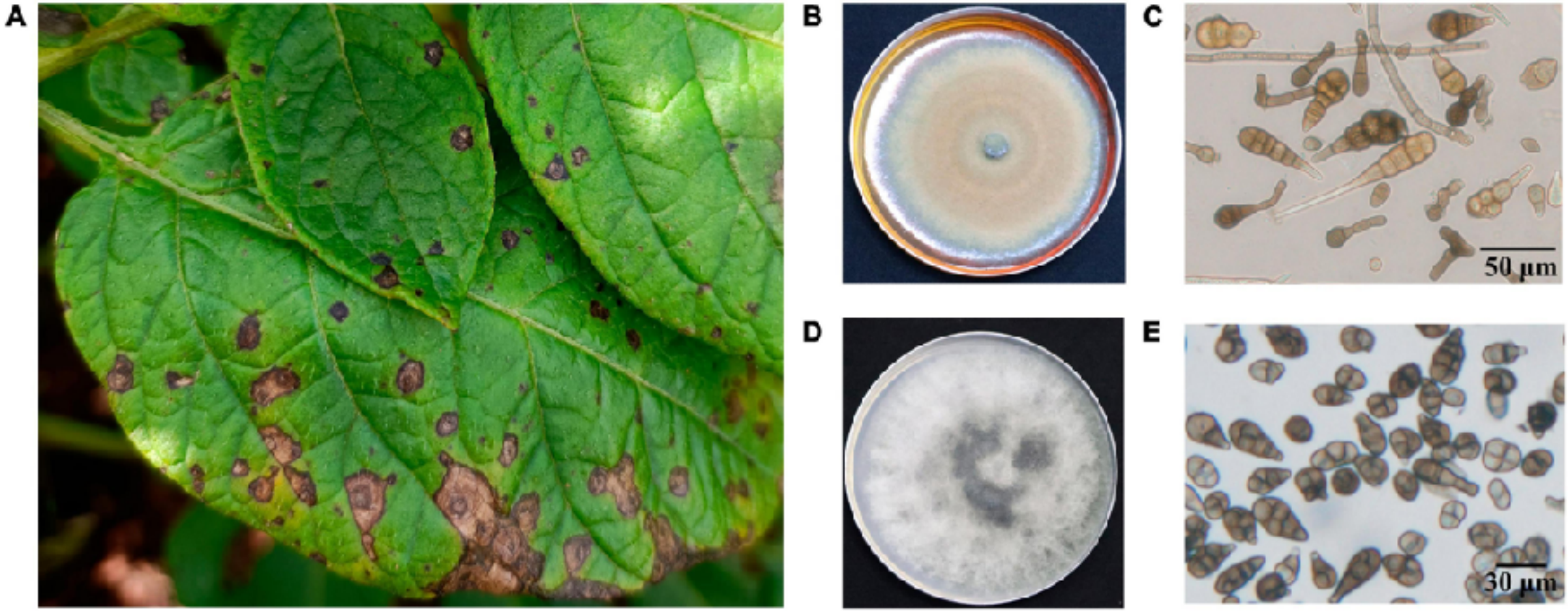


Photo by Li Q. et. al “Multi-omics approaches to understand pathogenicity during potato early blight disease caused by *Alternaria solani*” 2024 Sec. Microbe and Virus Interactions with Plants

2. Early blight –Disease Cycle –

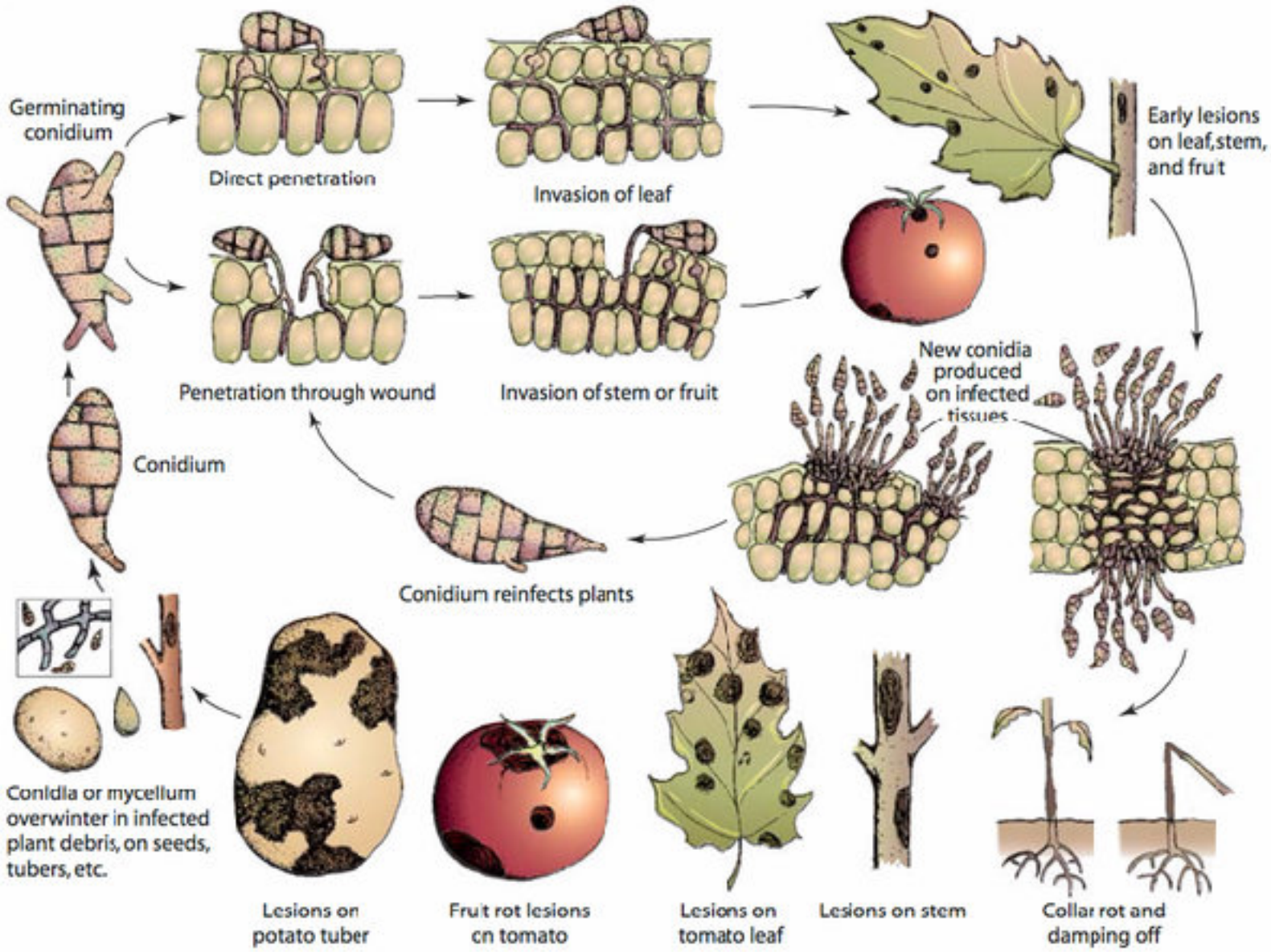


Figure by Adhikari P et. al
"Current Status of Early Blight Resistance in Tomato: An Update"
2017 International Journal of Molecular Sciences

2. Early blight –Control –

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

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

3. 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.

3. 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.

3. 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”

3. 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.

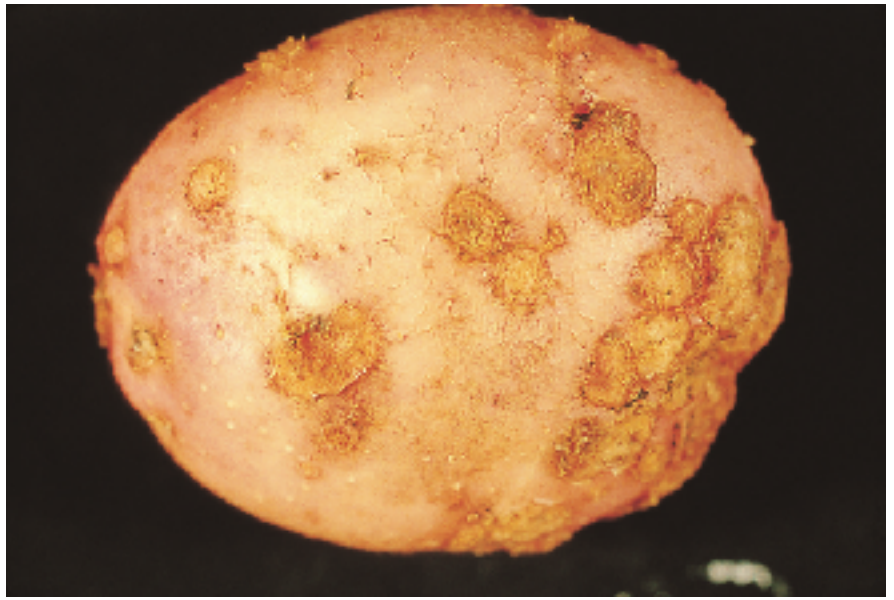
3. Black scurf –control–

- 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.

4. 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”

4. Common scab –pathogen –

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

4. Common scab –disease cycle –

- Primary infection comes from infected tubers or soil-borne inoculum, which can survive long-term.
- The disease spreads mainly via infected seed tubers, contaminated soil, and irrigation water.
- Small tubers at the initiation stage are most susceptible, with infection occurring through lenticels, stomata, wounds, or directly through the cuticle.

4. 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.

4. 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 (similar system)
- 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

5. 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.

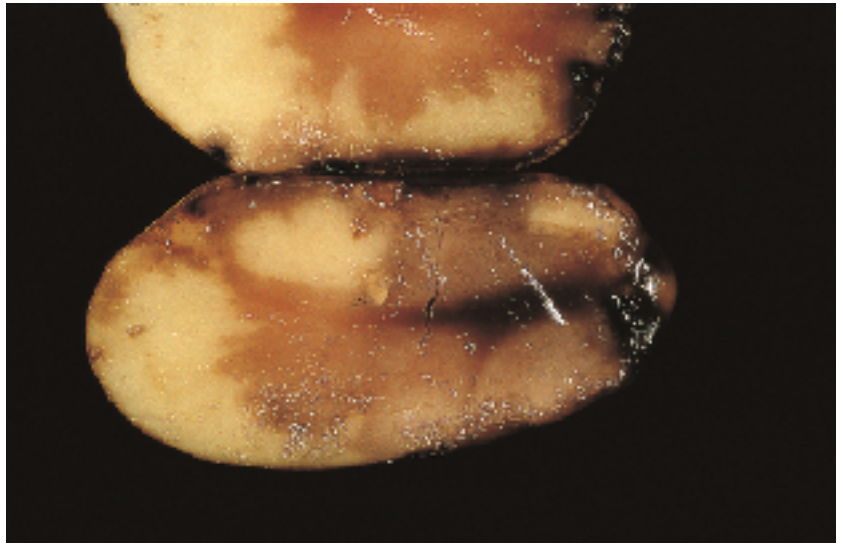


Photo from “Hokkaido Management Guide for Crop Diseases and Pests ver.7”

5. Bacterial wilt – causal organism –

- *Ralstoniasolanacearum*
- Gram negative bacterium

5. Bacterial wilt – epidemiology –

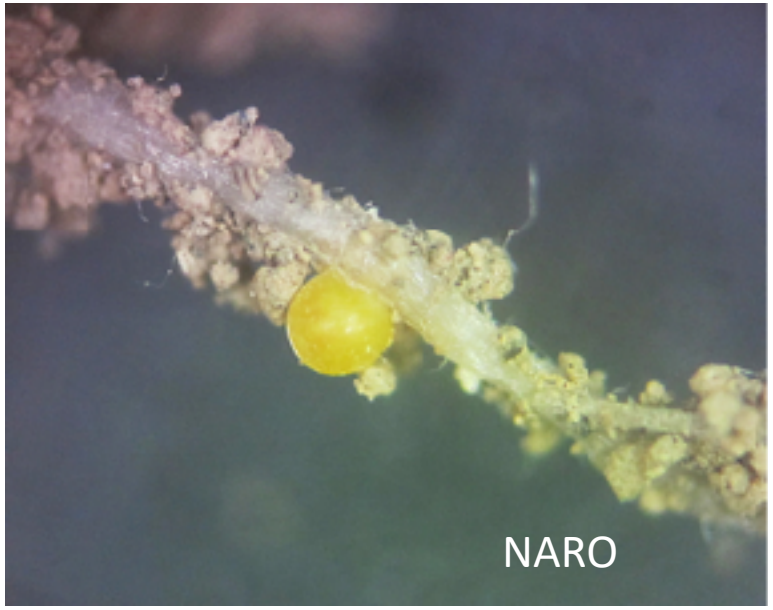
- Moderate to high soil temperature (25- 30°C)
- Soil moisture >50%

5. 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.

6. 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



7. 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.

6. Viruses –control –

- Use disease- free seed tubers.
- Control aphids by chemicals

Control method in Japan

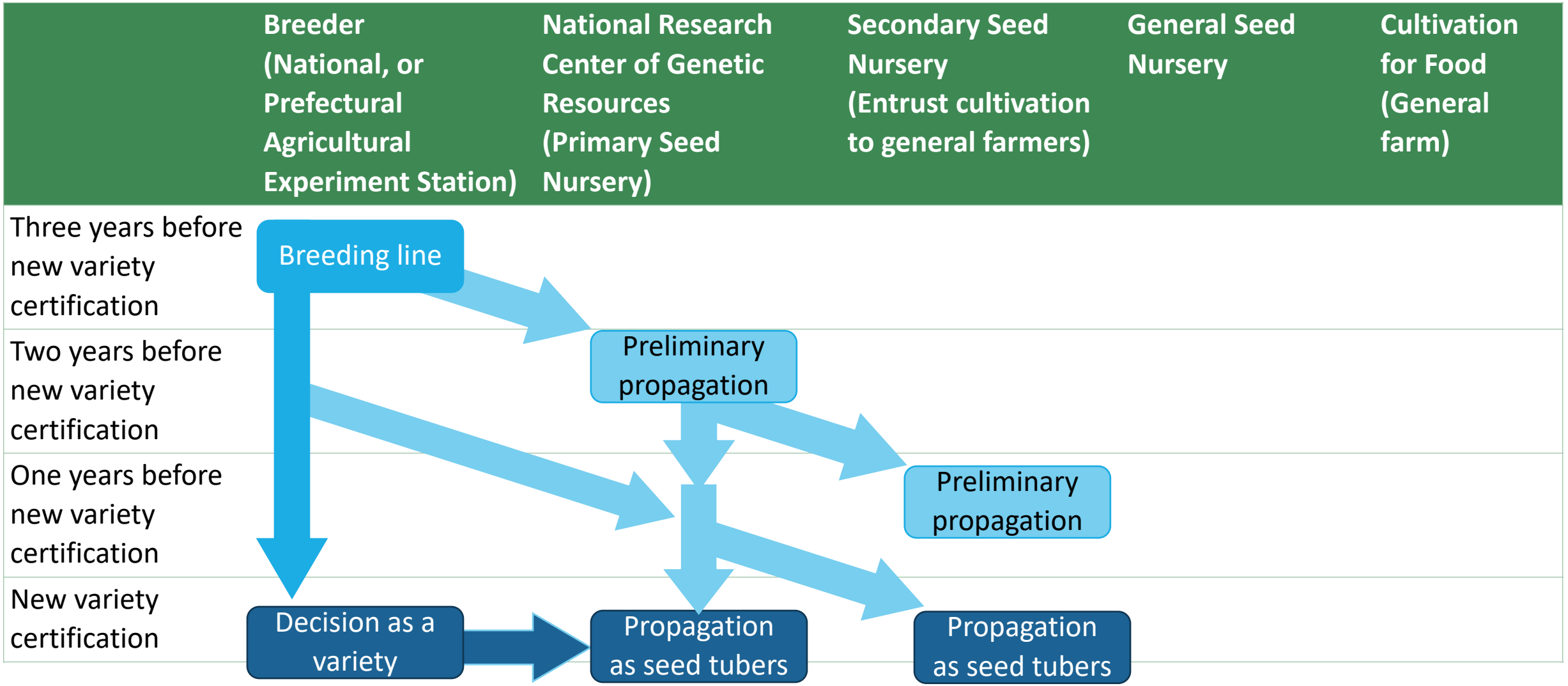
- Potatoes are grown in two types of fields: seed production and consumption.
- Tubers from consumption fields are never used as seed.
- In seed production fields:

(1) Aphids are controlled with pesticides.

(2) Fields are regularly monitored, and any plants showing virus symptoms are removed and destroyed.

- Seed-tuber fields are inspected and certified by government agencies.

Potato Seed Production in Japan
In the case of varieties under breeding



Potato Seed Production in Japan
In the case of cultivated varieties