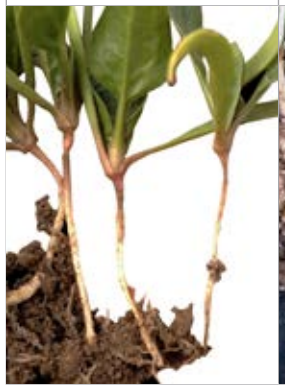
SPINACH, SILVERBEET AND BEETROOT

Aphanomyces root rot/damping off	Beet cyst nematode	Cercospora leaf spot
Page 244	Page 248	Page 252
		

Damping off, root rot or vascular wilt	Root-knot nematode
Page 256	Page 260
	

APHANOMYCES ROOT ROT/DAMPING OFF

Aphanomyces cochlioides

WHAT SHOULD I LOOK FOR?

Patches of wilting or dead seedlings with blackened stems near ground level. Cotyledons rarely wilt before the seedling dies, which helps distinguish it from symptoms caused by *Pythium* or *Rhizoctonia* spp.

Mariusz Sobieski, Bugwood.org

Lesions can appear anywhere on roots that (a) begin as water-soaked and later become dark and dry. If the disease progresses in beets (b) the lesion may penetrate further into the root

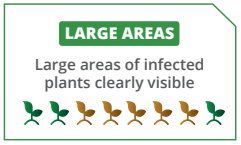
R. Harveson, University of Nebraska

WHERE WILL I SEE SYMPTOMS?

FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

• Infects >15°C
Optimum 20-30°C

DISTRIBUTION IN THE FIELD



• Often areas with poor drainage

HOW DOES IT SPREAD?

SURVIVAL TIME WITHOUT HOST | Less than 10 years

HOW DO I CONTROL IT?

FALLOW/COVER CROP

FARM HYGIENE
Stop movement of contaminated soil, water, plants and equipment

CROP ROTATION
Select non-host rotation or cover crops

HOST-FREE ZONE
Control volunteer host plants and weeds

BIO FUMIGATION
Grow a biofumigant crop

IMPROVE SOIL HEALTH
Add organic matter or amendments to boost beneficial microbes

- Quality compost (especially pine bark) addition to soils may help suppress disease

PLANTING PREPARATION

ADJUST DATE
Adjust planting/harvest date to reduce infection risk

- Disease losses are lower at soil temperatures below 15°C

AIR CIRCULATION
Increase row/plant spacing to improve air flow

NO RESIDUE AT PLANTING
Ensure no plant residues from host crops at planting

DRAINAGE
Plant on raised beds or well-draining soil

CROP SELECTION
Choose a resistant/less susceptible cultivar

- Beetroot and spinach are less sensitive than silverbeet

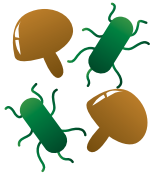
GOOD NUTRITION
Ensure plants' nutritional needs are met

- Ensure crops are supplied with adequate potassium and calcium

POST-PLANT

AVOID PLANT INJURY
Avoid any physical damage to plant

BIOCONTROL PRODUCTS



- Beneficial bacteria and fungi may suppress disease

IRRIGATION MANAGEMENT
Monitor crop and soil to optimize amount and timing

- Check APVMA or InfoPest website for current registered products

CHEMICAL FUMIGATION
Always use with care and as per label

USE CLEAN SEED OR SEEDLINGS
Source seed/ seedlings from a certified reputable source

HOST RANGE

Silverbeet, beetroot, spinach as well as related weeds such as fat hen & goose foot

BEET CYST NEMATODE

Heterodera schachtii

WHAT SHOULD I LOOK FOR?

Reduced plant stand, stunted growth, yellowing and wilting of aboveground plant, as shown in silverbeet

L. Tesoriero, Crop Doc Consulting

Increase in finer "whisker-like" roots with small white spherical cysts. Root vegetables may also develop lumps or swellings

Mactode Publications, Bugwood.org

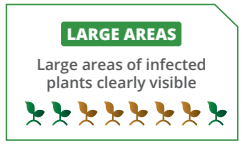
WHERE WILL I SEE SYMPTOMS?

FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

• 21-27ºC Up to 5 generations in one growing season is possible in warm conditions

• Seedlings particularly susceptible

DISTRIBUTION IN THE FIELD



HOW DOES IT SPREAD?

SURVIVAL TIME WITHOUT HOST | More than 10 years

HOW DO I CONTROL IT?

FALLOW/COVER CROP

FARM HYGIENE

Stop movement of contaminated soil, water, plants and equipment

CROP ROTATION

Select non-host rotation or cover crops

- Select fields that have not grown a host crop in at least 5 years

SOIL TEST

Conduct a pre-sowing soil test to help predict level of risk

HOST-FREE ZONE

Control volunteer host plants and weeds

CHEMICAL FUMIGATION

Always use with care and as per label

- Not always effective as cysts can be difficult to penetrate. Check APVMA or Infopest website for registered products

IMPROVE SOIL HEALTH

Add organic matter or amendments to boost beneficial microbes

PLANTING PREPARATION

CROP SELECTION

Choose a resistant/less susceptible cultivar

ADJUST DATE

Adjust planting/harvest date to reduce infection risk

- Plant when soil temperatures are lower and nematodes are less active

SOIL SOLARISATION

Cover soil with a tarp and kill harmful pathogens

BIO FUMIGATION

Grow a biofumigant crop

- Use non-brassica crops e.g. biofumigant sorghum varieties

PLANT TRAP CROPS

Plant nematode resistant crops that prevent reproduction

HOST RANGE

Silverbeet, beetroot, rhubarb and brassicas

CERCOSPORA LEAF SPOT

Cercospora beticola

WHAT SHOULD I LOOK FOR?

Numerous circular leaf spots (1-5mm diameter) with a pale brown centre and a red margin
Yonghao Li, The Connecticut Agricultural Experiment Station, Bugwood.org

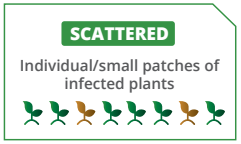
Fungal growth and small black survival structures (conidia) may be seen at the centre of older spots
Bruce Watt, University of Maine, Bugwood.org

WHERE WILL I SEE SYMPTOMS?

FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

- 20-25°C
- Especially leaf wetness for >8hrs, usually at night followed by daytime leaf drying
- Relative humidity 90-100%

DISTRIBUTION IN THE FIELD



HOW DOES IT SPREAD?

SURVIVAL TIME WITHOUT HOST | 3-10 years

HOW DO I CONTROL IT?

FALLOW/COVER CROP

FARM HYGIENE
Stop movement of contaminated soil, water, plants and equipment

CROP ROTATION
Select non-host rotation or cover crops

- At least a 2 year break from susceptible crop

HOST-FREE ZONE
Control volunteer host plants and weeds

BIO FUMIGATION
Grow a biofumigant crop

IMPROVE SOIL HEALTH
Add organic matter or amendments to boost beneficial microbes

- Quality compost (especially pine bark) addition to soils may help suppress disease

PLANTING PREPARATION

ADJUST DATE
Adjust planting/harvest date to reduce infection risk

- Disease losses are lower at soil temperatures below 15°C

AIR CIRCULATION
Increase row/plant spacing to improve air flow

- Dense plantings encourage spread from plant to plant

NO RESIDUE AT PLANTING
Ensure no plant residues from host crops at planting

DRAINAGE
Plant on raised beds or well-draining soil

CROP SELECTION
Choose a resistant/less susceptible cultivar

- Silverbeet is more sensitive than beetroot and spinach

CHEMICAL FUMIGATION
Always use with care and as per label

- Check APVMA or InfoPest website for current registered products

POST-PLANT

AVOID PLANT INJURY
Avoid any physical damage to plant

GOOD NUTRITION
Ensure plants' nutritional needs are met

IRRIGATION MANAGEMENT
Monitor crop and soil to optimize amount and timing

- Spores spread with water splash

CHEMICAL TREATMENT
Treat plant with registered foliar fungicide

- Check APVMA or InfoPest website for current registered products

USE CLEAN SEED OR SEEDLINGS
Source seed/ seedlings from a certified reputable source

HOST RANGE

Silverbeet, beetroot and chard

DAMPING OFF, ROOT ROT OR VASCULAR WILT

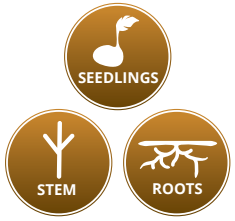
Pythium aphanidermatum | Pythium ultimum | Pythium irregulare | Rhizoctonia solani | Fusarium oxysporum f.sp. spinaciae (Fos)

WHAT SHOULD I LOOK FOR?

Plants will not germinate or will emerge with poor growth, leading to bare patches
D. Lucas, RMCG

Seedlings that do emerge may have yellow to light brown discolouration on stem at ground level. As the disease progresses stem eventually collapses leading to wilting and death *S. Grigg, Ag-Hort Consulting*

WHERE WILL I SEE SYMPTOMS?



FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

- 15-20°C optimum but can occur in warmer conditions

DISTRIBUTION IN THE FIELD

LARGE AREAS

Large areas of infected plants clearly visible

HOW DOES IT SPREAD?

- Fungus gnats

SURVIVAL TIME WITHOUT HOST | More than 10 years

HOW DO I CONTROL IT?

FALLOW/COVER CROP

FARM HYGIENE
Stop movement of contaminated soil, water, plants and equipment

CROP ROTATION
Select non-host rotation or cover crops

- At least a 2 year break from susceptible crop

HOST-FREE ZONE
Control volunteer host plants and weeds

BIO FUMIGATION
Grow a biofumigant crop

IMPROVE SOIL HEALTH
Add organic matter or amendments to boost beneficial microbes

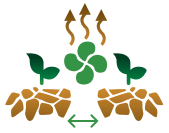
USE CLEAN SEED OR SEEDLINGS
Source seed/ seedlings from a certified reputable source

PLANTING PREPARATION

CROP SELECTION
Choose a resistant/less susceptible cultivar

- Some spinach varieties are resistant to Fusarium

AIR CIRCULATION
Increase row/plant spacing to improve air flow



- Dense plantings encourage spread from plant to plant

NO RESIDUE AT PLANTING
Ensure no plant residues from host crops at planting

CHEMICAL TREATMENT
Use registered soil drench at planting

CHEMICAL TREATMENT
Treat seed/ seedlings with registered fungicide

- Check APVMA or InfoPest website for current registered products

DRAINAGE
Plant on raised beds or well-draining soil

POST-PLANT

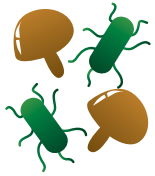
AVOID PLANT INJURY
Avoid any physical damage to plant

GOOD NUTRITION
Ensure plants' nutritional needs are met

CONTROL PESTS
Control insect pests that spread spores

- Ensure crops are supplied with adequate potassium and calcium

BIOCONTROL PRODUCTS



IRRIGATION MANAGEMENT
Monitor crop and soil to optimize amount and timing

- Avoid periods of saturated soil

CHEMICAL FUMIGATION
Always use with care and as per label

- Check APVMA or InfoPest website for current registered products

HOST RANGE

Silverbeet, chard, beetroot and spinach. *Pythium* spp. and *Rhizoctonia* spp. have a wide host range, while *Fusarium oxysporum f. sp. spinaciae* is specific to spinach

ROOT-KNOT NEMATODE

WARM-CLIMATE SPECIES: *Meloidogyne incognita | Meloidogyne javanica | Meloidogyne arenaria*

COOL-CLIMATE SPECIES: *Meloidogyne hapla | Meloidogyne fallax*

WHAT SHOULD I LOOK FOR?

Aboveground plants may appear chlorotic and stunted. Belowground, roots develop characteristic swelling and galls. *G. Holmes, California Polytechnic State University, Bugwood.org*

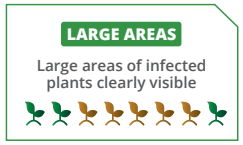
Swelling and galls on roots of beetroot caused by root-knot nematodes.
G. Holmes, California Polytechnic State University, Bugwood.org

WHERE WILL I SEE SYMPTOMS?

FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

- Active 15°C+
- Active 8.5°C+

DISTRIBUTION IN THE FIELD



HOW DOES IT SPREAD?

SURVIVAL TIME WITHOUT HOST | Less than 3 years

HOW DO I CONTROL IT?

FALLOW/COVER CROP

FARM HYGIENE

Stop movement of contaminated soil, water, plants and equipment

HOST-FREE ZONE

Control volunteer host plants and weeds

CROP ROTATION

Select non-host rotation or cover crops

CHEMICAL FUMIGATION

Always use with care and as per label

- Check APVMA or InfoPest website for current registered products

BIO FUMIGATION

Grow a biofumigant crop

- Consider growth of biofumigant crops such as arugula (*Eruca sativa*) cv. Nemat

SOIL TEST

Conduct a pre-sowing soil test to help predict level of risk

- Consider pre-plant soil testing. If numbers are high consider fallow or non-host break crop

PLANTING PREPARATION

CROP SELECTION

Choose a resistant/less susceptible cultivar

SOIL SOLARISATION

Cover soil with a tarp and kill harmful pathogens

IMPROVE SOIL HEALTH

Add organic matter or amendments to boost beneficial microbes

ADJUST DATE

Adjust planting/harvest date to reduce infection risk

- Select planting date to maximise growth in cool conditions when nematode activity is reduced. Bring forward harvest to minimise damage in high risk situations

HOST RANGE

Very wide with over 2000 plant species acting as hosts to root-knot nematode