









# LETTUCE, ENDIVE AND ARTICHOKE

Anthracnose (shot hole or ring spot)	Black root rot	Bottom rot	Corky root rot
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Damping off	Lettuce big-vein disease	Sclerotinia rot (white mould)	Root-knot nematode
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# ANTHRACNOSE (SHOT HOLE/RING SPOT)

*Microdochium panattonianum*

## WHAT SHOULD I LOOK FOR?







Begins as small water-soaked brown lesions

M. Titley, AHR










Eventually centre of the lesion decays and falls out giving "shot hole" appearance

M. Titley, AHR

<p><b>WHERE WILL I SEE SYMPTOMS?</b></p>  <p>LEAVES</p> <ul style="list-style-type: none"> <li>• Lower leaves</li> </ul>	<p><b>FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT</b></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="481 1284 627 1428">  <p>COOL</p> <ul style="list-style-type: none"> <li>• 15-22°C</li> </ul> </div> <div data-bbox="638 1284 784 1428">  <p>HIGH HUMIDITY</p> </div> <div data-bbox="795 1284 952 1428">  <p>WET</p> <ul style="list-style-type: none"> <li>• Leaf wetness of 8 hours or more increases infection risk</li> </ul> </div> </div>
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<p><b>DISTRIBUTION IN THE FIELD</b></p> <p><b>SCATTERED</b></p> <p>Individual/small patches of infected plants</p> 	<p><b>HOW DOES IT SPREAD?</b></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="1624 1244 1780 1396">  <p>FREE WATER</p> </div> <div data-bbox="1780 1244 1937 1396">  <p>WIND</p> </div> <div data-bbox="1937 1244 2094 1396">  <p>MOVEMENT OF CONTAMINATED SOIL</p> </div> </div> <ul style="list-style-type: none"> <li>• Mostly through splash</li> </ul> <p><b>SURVIVAL TIME WITHOUT HOST</b>   More than 3 years</p>
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## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 
<p>• Minimum 4 year break</p>			
<p><b>PLANTING PREPARATION</b></p>	<p><b>CROP SELECTION</b></p> <p>Choose a resistant/less susceptible cultivar</p> 	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	
<p><b>POST-PLANT</b></p>	<p><b>IRRIGATION MANAGEMENT</b></p> <p>Monitor crop and soil to optimize amount and timing</p> 	<p><b>CHEMICAL TREATMENT</b></p> <p>Treat plant with registered foliar fungicide</p> 	
<p>• Avoid excess periods of leaf wetness</p>		<p>• Consult APVMA or InfoPest for current registered products</p>	

## HOST RANGE

Lettuce, prickly lettuce and endive



# BLACK ROOT ROT

*Thielaviopsis basicola*

## WHAT SHOULD I LOOK FOR?



Aboveground symptoms will appear in small scattered patches. Depending on the timing and severity of infection, plant may appear small and stunted but otherwise healthy. In more severe cases lower leaves will turn yellow or brown

*S. Koike, TriCal Diagnostics*













Belowground the main tap root may be severely stunted (left) compared to the root system of a healthy lettuce plant (right). Diseased roots also develop dark brown to black lesions, particularly on the fine feeder roots

*S. Koike, TriCal Diagnostics*

<p><b>WHERE WILL I SEE SYMPTOMS?</b></p> 	<p><b>FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT</b></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="548 1308 705 1460">  </div> <div data-bbox="728 1308 884 1460">  </div> </div> <p>• 17-25°C</p>
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<p><b>DISTRIBUTION IN THE FIELD</b></p> <div style="border: 1px solid green; padding: 5px; margin: 5px;"> <p><b>SCATTERED</b></p> <p>Individual/small patches of infected plants</p>  </div>	<p><b>HOW DOES IT SPREAD?</b></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="1668 1268 1825 1420">  <p>MOVEMENT OF CONTAMINATED SOIL</p> </div> <div data-bbox="1825 1268 1982 1420">  <p>CONTAMINATED PLANT DEBRIS</p> </div> </div> <div style="background-color: #8B4513; color: white; padding: 5px; margin-top: 10px;"> <p><b>SURVIVAL TIME WITHOUT HOST</b>   More than 10 years</p> </div>
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## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>BIO FUMIGATION</b></p> <p>Grow a biofumigant crop</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 
<p>• 5 to 6 year break from susceptible crops</p>				
<p><b>PLANTING PREPARATION</b></p>	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	<p><b>DRAINAGE</b></p> <p>Plant on raised beds or well-draining soil</p> 	<p><b>CROP SELECTION</b></p> <p>Choose a resistant/less susceptible cultivar</p> 	
<p><b>POST-PLANT</b></p>	<p><b>IRRIGATION MANAGEMENT</b></p> <p>Monitor crop and soil to optimize amount and timing</p> 	<p><b>AVOID PLANT INJURY</b></p> <p>Avoid any physical damage to plant</p> 	<p><b>GOOD NUTRITION</b></p> <p>Ensure plants' nutritional needs are met</p> 	
<p>• Minimise irrigation splash</p>				

## HOST RANGE

Wide host range, including beans, peas, cotton, lettuce, lucerne, lupin and soybean

LETTUCE, ENDIVE AND ARTICHOKE  
**BOTTOM ROT**

*Rhizoctonia spp.*

**WHAT SHOULD I LOOK FOR?**



Starts as brown spots on underside of leaf midrib and develops to rot on midrib leaf blade  
 Gerald Holmes, California Polytechnic State University, Bugwood.org

















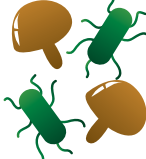
Heads can be slimy brown to dark brown/black as they collapse. Brown mycelium can grow over lesion with small brown sclerotia. Brown rot of root may also be seen  
 G. Holmes, California Polytechnic State University, Bugwood.org

<p><b>WHERE WILL I SEE SYMPTOMS?</b></p>	<p><b>FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT</b></p> <p>•25-27°C</p>
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<p><b>DISTRIBUTION IN THE FIELD</b></p> <p><b>LARGE AREAS</b></p> <p>Large areas of infected plants clearly visible</p>	<p><b>HOW DOES IT SPREAD?</b></p> <p><b>SURVIVAL TIME WITHOUT HOST</b>   3-10 years</p>
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## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>BIO FUMIGATION</b></p> <p>Grow a biofumigant crop</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 
<p>• Minimum 3 year break</p>					
<p><b>PLANTING PREPARATION</b></p>	<p><b>CROP SELECTION</b></p> <p>Choose a resistant/less susceptible cultivar</p> 	<p><b>DRAINAGE</b></p> <p>Plant on raised beds or well-draining soil</p> 	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	<p><b>AIR CIRCULATION</b></p> <p>Increase row/plant spacing to improve air flow</p> 	<p><b>SOIL TEST</b></p> <p>Conduct a pre-sowing soil test to help predict level of risk</p> 
<p>• Select cultivars with upright architecture to reduce soil contact</p>					
<p><b>POST-PLANT</b></p>	<p><b>AVOID OVER IRRIGATION</b></p> <p>Saturated soils favour disease development and spread</p> 	<p><b>CHEMICAL TREATMENT</b></p> <p>Treat plant with registered foliar fungicide</p> 	<p><b>AVOID PLANT INJURY</b></p> <p>Avoid any physical damage to plant</p> 	<p><b>GOOD NUTRITION</b></p> <p>Ensure plants' nutritional needs are met</p> 	<p><b>BIOCONTROL PRODUCTS</b></p> 
<p>• Excess periods of leaf wetness encourage disease</p> <p>• Consult APVMA or InfoPest website for current registered products</p>					

## HOST RANGE

Lettuce, endive

# CORKY ROOT ROT

*Sphingomonas suberifaciens*

## WHAT SHOULD I LOOK FOR?



Aboveground plants appear stunted and wilted, as seen in infected lettuce on the right, compared to a healthy lettuce on the left. Belowground symptoms begin as yellow banding on the root which turns brown.

*B. Mou, ARS-USDA*



Eventually roots become swollen, cracked, rough and stop functioning. Side roots are reduced and become brittle, as shown in infected root (right) compared to healthy roots from a corky root resistant variety (left)

*C. Ochoa & R. Michelmore, University of California, Davis*

### WHERE WILL I SEE SYMPTOMS?



### FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT



• 20-25°C

### DISTRIBUTION IN THE FIELD

#### LARGE AREAS

Large areas of infected plants clearly visible



### HOW DOES IT SPREAD?












**SURVIVAL TIME WITHOUT HOST**

3-10 years



## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 
<p>• Minimum 18 months</p>				
<p><b>PLANTING PREPARATION</b></p>	<p><b>CROP SELECTION</b></p> <p>Choose a resistant/less susceptible cultivar</p> 	<p><b>FERTILISER SELECTION</b></p> 	<p><b>TRANSPLANTS</b></p> <p>Use seedling transplants - not direct seeding</p> 	
<p>• Nitrate form of fertiliser may increase severity</p>				
<p><b>POST-PLANT</b></p>	<p><b>AVOID PLANT INJURY</b></p> <p>Avoid any physical damage to plant</p> 	<p><b>GOOD NUTRITION</b></p> <p>Ensure plants' nutritional needs are met</p> 		
<p>• Avoid excess nitrogen</p>				

## HOST RANGE

Lettuce, prickly lettuce, sow thistle, endive

# DAMPING OFF

*Pythium* spp. | *Rhizoctonia solani* | *Phytophthora* spp. | *Fusarium* spp.

## WHAT SHOULD I LOOK FOR?





Seeds may not germinate, or plants may rot soon after emergence, leading to large bare patches. Plants that do emerge may be stunted. *N. Cattlin, Alamy Stock Photo*





Seedlings may have yellow to light brown discoloration on stem at ground level. As the disease progresses stem collapses leading to wilting and death. *E. Tubb, AHR*


### WHERE WILL I SEE SYMPTOMS?

### FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT

  
**COOL**

  
**WATERLOGGED SOIL**

  
**DELAYED SEEDLING EMERGENCE**

• 15°C-18°C  
Some *Pythium* spp. prefer warm weather i.e. >24°C

### DISTRIBUTION IN THE FIELD

**LARGE AREAS**

Large areas of infected plants clearly visible



### HOW DOES IT SPREAD?

  
**WIND**

  
**FREE WATER**

  
**MOVEMENT OF CONTAMINATED SOIL**














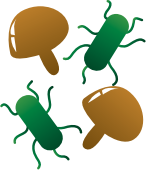

  
**CONTAMINATED PLANT DEBRIS**

  
**INSECTS**

**SURVIVAL TIME WITHOUT HOST** | More than 10 years



## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 	<p><b>CHEMICAL FUMIGATION</b></p> <p>Always use with care and as per label</p> 	<p><b>CHEMICAL TREATMENT</b></p> <p>Treat seed/seedlings with registered fungicide</p> 
<p><b>PLANTING PREPARATION</b></p>	<p><b>DRAINAGE</b></p> <p>Plant on raised beds or well-draining soil</p> 	<p><b>TRANSPLANTS</b></p> <p>Use seedling transplants - not direct seeding</p> 	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	<p><b>SOIL TEST</b></p> <p>Conduct a pre-sowing soil test to help predict level of risk</p> 	<p>• Consult APVMA or InfoPest website for current registered products</p>	
<p><b>POST-PLANT</b></p>	<p><b>IRRIGATION MANAGEMENT</b></p> <p>Monitor crop and soil to optimize amount and timing</p> 	<p><b>AVOID PLANT INJURY</b></p> <p>Avoid any physical damage to plant</p> 	<p><b>CONTROL PESTS</b></p> <p>Control insect pests that spread spores</p> 	<p><b>BIOCONTROL PRODUCTS</b></p> 	<p><b>GOOD NUTRITION</b></p> <p>Ensure plants' nutritional needs are met</p> 	

## HOST RANGE

Lettuce, endive

# LETTUCE BIG-VEIN DISEASE

*Mirafiori lettuce big-vein virus transmitted by fungal vector *Olpidium virulentus* (oomycete)*

## WHAT SHOULD I LOOK FOR?



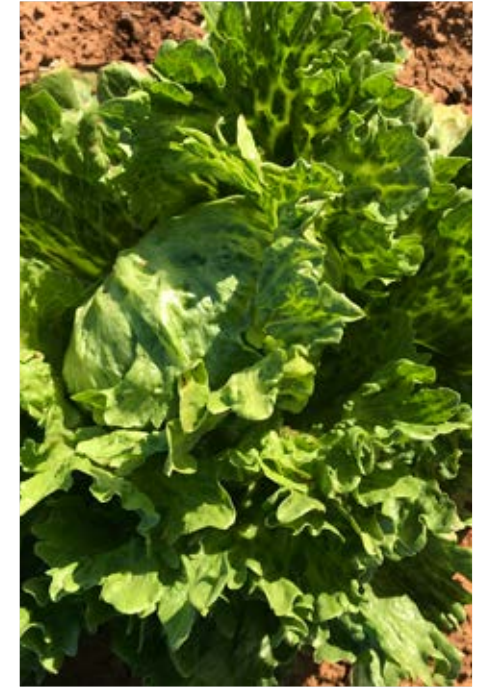
Abnormally large clear veins

S. Grigg, Ag-Hort Consulting



Leaves are often puckered or mottled and may appear thickened

S. Grigg, Ag-Hort Consulting



Head size may be reduced or in some cases no head will develop

S. Grigg, Ag-Hort Consulting

### WHERE WILL I SEE SYMPTOMS?



### FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT



• <16°C

### DISTRIBUTION IN THE FIELD

#### SCATTERED

Individual/small patches of infected plants



### HOW DOES IT SPREAD?













Transmitted by fungus *Olpidium virulentus*

#### SURVIVAL TIME WITHOUT HOST

More than 10 years



## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b> Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b> Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b> Select non-host rotation or cover crops</p> 	<p><b>IMPROVE SOIL HEALTH</b> Add organic matter or amendments to boost beneficial microbes</p> 	<p><b>BIO FUMIGATION</b> Grow a biofumigant crop</p> 	<p>• Minimum 18 months</p>
<p><b>PLANTING PREPARATION</b></p>	<p><b>DRAINAGE</b> Plant on raised beds or well-draining soil</p> 	<p><b>NO RESIDUE AT PLANTING</b> Ensure no plant residues from host crops at planting</p> 	<p><b>USE CLEAN SEED OR SEEDLINGS</b> Source seed/seedlings from a certified reputable source</p> 	<p><b>ADJUST DATE</b> Adjust planting/harvest date to reduce infection risk</p> 	<p><b>CROP SELECTION</b> Choose a resistant/less susceptible cultivar</p> 	<p>• No fully resistant varieties available but some lettuce types more susceptible e.g. iceberg</p>
<p><b>POST-PLANT</b></p>	<p><b>AVOID PLANT INJURY</b> Avoid any physical damage to plant</p> 	<p><b>REMOVE INFECTED PLANTS</b> Contain and dispose of infected plant material away from field</p> 				

## HOST RANGE

Lettuce and weed species such as sow thistle and chickweed may act as hosts

# SCLEROTINIA ROT (WHITE MOULD)

*Sclerotinia sclerotiorum* | *S. minor*

## WHAT SHOULD I LOOK FOR?



Symptoms begin as (a) watery soft lesions that (b) develops into fluffy white growth sometimes containing black survival structures (sclerotia). Lower leaves and stems are most affected.

*L. Tesoriero, Crop Doc Consulting*



Brown, soft decay eventually destroys the tissue around crown. Near maturity the entire plant will wilt and collapse.











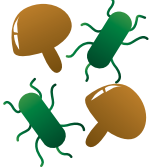
*B. Shew, North Carolina State University, Bugwood.org*

<p><b>WHERE WILL I SEE SYMPTOMS?</b></p>	<p><b>FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT</b></p> <p>• 13-18°C</p>
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<p><b>DISTRIBUTION IN THE FIELD</b></p> <p><b>SCATTERED</b></p> <p>Individual/small patches of infected plants</p>	<p><b>HOW DOES IT SPREAD?</b></p> <p><b>SURVIVAL TIME WITHOUT HOST</b>   3-10 years</p>
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## HOW DO I CONTROL IT?

<b>FALLOW/COVER CROP</b>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>BIO FUMIGATION</b></p> <p>Grow a biofumigant crop</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 
<b>PLANTING PREPARATION</b>	<p><b>DRAINAGE</b></p> <p>Plant on raised beds or well-draining soil</p> 	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	<p><b>AIR CIRCULATION</b></p> <p>Increase row/plant spacing to improve air flow</p> 		
<b>POST-PLANT</b>	<p><b>IRRIGATION MANAGEMENT</b></p> <p>Monitor crop and soil to optimize amount and timing</p> 	<p><b>CHEMICAL TREATMENT</b></p> <p>Treat plant with registered foliar fungicide</p> 	<p><b>BIOCONTROL PRODUCTS</b></p> 		

- Consult APVMA or InfoPest website for current registered products

## HOST RANGE

Very wide (more than 400 different plant species). Infects most vegetable crops including lettuce, endive and chicory

# 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 plant may appear chlorotic and stunted (left) compared to a healthy lettuce (right)  
Ontario Ministry of Agriculture and Food (OMAFRA)
















Belowground roots develop characteristic swelling and galls.  
D. Blancard, INRA

<p><b>WHERE WILL I SEE SYMPTOMS?</b></p>	<p><b>FAVOURABLE CONDITIONS FOR DISEASE DEVELOPMENT</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>WARM</p> <p>• Active 15°C +</p> </div> <div style="text-align: center;"> <p>SANDY SOIL</p> </div> <div style="text-align: center;"> <p>COOL</p> <p>• Active 8.5°C +</p> </div> <div style="text-align: center;"> <p>SANDY SOIL</p> </div> </div>
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<p><b>DISTRIBUTION IN THE FIELD</b></p> <p><b>LARGE AREAS</b></p> <p>Large areas of infected plants clearly visible</p>	<p><b>HOW DOES IT SPREAD?</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>FREE WATER</p> </div> <div style="text-align: center;"> <p>MOVEMENT OF CONTAMINATED SOIL</p> </div> <div style="text-align: center;"> <p>CONTAMINATED PLANT DEBRIS</p> </div> </div> <p><b>SURVIVAL TIME WITHOUT HOST</b>   Less than 3 years</p>
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## HOW DO I CONTROL IT?

<p><b>FALLOW/COVER CROP</b></p>	<p><b>FARM HYGIENE</b></p> <p>Stop movement of contaminated soil, water, plants and equipment</p> 	<p><b>HOST-FREE ZONE</b></p> <p>Control volunteer host plants and weeds</p> 	<p><b>CROP ROTATION</b></p> <p>Select non-host rotation or cover crops</p> 	<p><b>BIO FUMIGATION</b></p> <p>Grow a biofumigant crop</p> 	<p><b>CHEMICAL FUMIGATION</b></p> <p>Always use with care and as per label</p> 	<p><b>IMPROVE SOIL HEALTH</b></p> <p>Add organic matter or amendments to boost beneficial microbes</p> 	<p>• Consult APVMA or InfoPest website for current registered products</p>
<p><b>PLANTING PREPARATION</b></p>	<p><b>CROP SELECTION</b></p> <p>Choose a resistant/less susceptible cultivar</p> 	<p><b>ADJUST DATE</b></p> <p>Adjust planting/harvest date to reduce infection risk</p> 	<p><b>SOIL SOLARISATION</b></p> <p>Cover soil with a tarp and kill harmful pathogens</p> 	<p><b>NO RESIDUE AT PLANTING</b></p> <p>Ensure no plant residues from host crops at planting</p> 	<p><b>SOIL TEST</b></p> <p>Conduct a pre-sowing soil test to help predict level of risk</p> 	<p>• e.g. PREDICTA® B testing service. If numbers are high consider fallow or non-host break crop</p>	<p>• Maximise growth in cool conditions when nematode activity is low. Harvest early in high risk situations</p>
<p><b>POST-PLANT</b></p>	<p><b>AVOID PLANT INJURY</b></p> <p>Avoid any physical damage to plant</p> 	<p><b>GOOD NUTRITION</b></p> <p>Ensure plants' nutritional needs are met</p> 					

## HOST RANGE

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