



National Onion Industry Biosecurity Plan

Appendix 2: Pesticides and Management Processes for Major Pests of *Allium Cepa*



Appendix 2: Pesticides and management processes for major pests of *Allium cepa*

This appendix contains information for the chemical control and management of some of the major pests of onions. The information was extracted from the 'Pest management in the future: A strategic plan for the Michigan Onion Industry' workshop proceedings, November 4-5th 2002, compiled by Dr Mary K. Hausbeck, Michigan State University, East Lansing, Michigan.

For further information on chemical pesticide use in an Australian context visit the Australian Pesticides and Veterinary Medicines Authority (APVMA) website at <http://www.apvma.gov.au/index.asp>. Where applicable links to the APVMA have been provided for specific active constituents, for a list of all APVMA's standards for active constituents visit <http://www.apvma.gov.au/actives/standards.shtml>.

Any of the chemicals listed in this guide should be used only in accordance with the approved APVMA label. The information listed in this guide was last updated on the 27 April 2007, and may have subsequently changed. All queries regarding the use of these chemicals should be directed at the APVMA.

Bacterial Pathogens:

Bacterial soft rot (*Erwinia carotovora* subsp. *carotovora*)

Warm wet conditions promote disease development. Commonly found where overhead irrigation is used. Affected scales become spongy, water-soaked and pale yellow to light grey. As rot progresses, the whole interior can break down to a sticky mass inside the dry outer scales. If infection occurs through an injury, the rot can progress from the site through several bulb scales, exacerbating bulb decay.

Centre Rot (*Pantoea ananatis*)

Symptoms of centre rot include the rapid death of the two centre leaves followed by a soft rot of the heart of the bulb. Little is known about the epidemiology and control of this disease.

Slippery skin (*Burkholderia gladioli* pv. *alliicola*)

Onions in the field may have 1-2 wilted leaves in the middle of the leaf cluster. Other early symptoms include neck softening and, if the onion is cut longitudinally, water soaked lesions are evident. The rot progresses from the top of the infected scales downward without spreading across adjacent scales. In advanced stages of disease, the bulb will appear to be dried out and shrivelled.

Sour skin (*Burkholderia cepacia*)

Young leaves may die back beginning at the tips. Onion may appear healthy on the outside except for minor neck softening. Decay occurs on inner bulb scales, which turn slimy and yellow to light brown.

Bactericides:

- Copper-based products: Efficacy – fair, but overall has not been thoroughly tested. Often used in small amounts due to concerns regarding phytotoxicity. Relatively inexpensive.

Other pest management aids for bacterial pathogens:

- Use furrow or drip irrigation.
- Remove old plant material.
- Avoid damaging bulbs during harvest.
- Store onions only when completely dry at 0°C and <70% RH with adequate ventilation.

Fungal Pathogens:

Basal rot (*Fusarium oxysporum f. sp. cepae*)

Long-lived, soil-borne pathogen causing above-ground symptoms such as bending, yellowing, and/or necrosis of leaves beginning at the tips and progressively developing downward. Infected bulbs may appear discoloured, and when cut, affected tissues appear brown and watery. Bulbs may display no decay/symptoms at harvest but subsequently rot in storage. A severe infestation can result in highly infested soil that is unsuitable for growing onions in the future. Disease incidence varies by locality, variety and cultural management.

Pest management aids for basal rot:

- Plant resistant varieties.
- Long term rotation with non-host crops for 4 or more years.

Black Mould (*Aspergillus niger*)

A major storage problem; a significant infection can reduce the value of the crop by 30% or more. Economically important due to disease development during transit and storage. Infected bulbs have a black discoloration at the neck, shallow lesions on the outer scales and streaks of black mycelium and conidia beneath the outer scales. Severe infections appear to predispose the bulb to bacterial saprophytes and pathogens. Cull piles and/or seeds could be a source of initial inoculum. Disease symptoms are not typically observed in the field. Storage conditions (temperature and humidity) appear to be an important aspect of disease control.

Pest management aids for black mould:

- Plant disease-free seed when available.
- Manipulation of storage environment to enhance quick drying.
- Avoid damaging bulbs during harvest and storage to minimize infection.

Botrytis leaf blight (*B. aclada* = *B. allii*, *B. cinerea*, *B. squamosa*)

Symptoms start as small white spots on the leaves surrounded by a green halo. Leaf death can occur, and results in smaller bulb size. The inoculum is soil-borne as sclerotia in the field. This disease can spread rapidly when environmental conditions are favourable for development, i.e. warm, humid evenings.

Fungicides:

Active constituent/s	Details	APVMA standard
Chlorothalonil	Efficacy – excellent/good. Broad-spectrum. Important as a rotational product in resistance management. It is cost effective.	http://www.apvma.gov.au/actives/standard_chlorothalonil.shtml
Copper	Efficacy – good. Cost effective. Important as a	http://www.apvma.gov.au

Active constituent/s	Details	APVMA standard
hydroxide / mancozeb	rotational product in a resistance management program.	/actives/standard_mancozeb.shtml http://www.apvma.gov.au/actives/standard_copper_hydroxide.shtml
Iprodione	Efficacy – good. Somewhat broad-spectrum systemic product. Development of resistance is a concern and has been documented. To delay resistance, this product should be used in a program with fungicides that have a different mode of action.	http://www.apvma.gov.au/actives/standard_iprodione.shtml
Mancozeb	Efficacy – good. Cost effective. Important as a rotational product with other fungicides for resistance management. Broad-spectrum.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Mancozeb / copper sulfate	Efficacy – good. Cost effective. Important as a rotational product with other fungicides for resistance management. Broad-spectrum.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Boscalid	Efficacy – good. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_boscalid.shtml
Cyprodinil / fludioxonil	Efficacy – good. Classified as a reduced-risk fungicide. Expensive. The preharvest interval is 7 days. Twelve month crop rotation limited to crops listed on the label.	http://www.apvma.gov.au/actives/standard_cyprodinil.shtml http://www.apvma.gov.au/actives/standard_fludioxonil.shtml
Pyraclostrobin/boscalid	Efficacy – good. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_boscalid.shtml http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml
Pyrimethanil	Efficacy – fair/poor. Classified as a reduced-risk fungicide.	http://www.apvma.gov.au/actives/standard_pyrimethanil.shtml

Other pest management aids for Botrytis leaf blight:

- Scouting helps alert growers to disease onset and prompts fungicide applications.
- Crop rotation helps reduce overwintering inoculum.

Damping off (*Pythium spp.*, *Rhizoctonia solani*)

Diseases caused by soil-borne fungi. Damping off occurs during cool, wet conditions. Infected seedlings wilt, or leaves develop a water-soaked, discoloured lesion on the stem at the ground level and topple over, resulting in plant death.

Fungicides:

Active constituent/s	Details	APVMA standard
Thiram	Efficacy – good activity against Rhizoctonia. Apply as a seed treatment.	http://www.apvma.gov.au/actives/standard_thiram.shtml
Metalaxyl-M	Efficacy – has known activity against Pythium. Classified as a reduced-risk fungicide. Used as an infurrow treatment. Expensive.	http://www.apvma.gov.au/actives/standard_metalaxyl-M.shtml

Other pest management aids:

- Avoid excessive irrigation between the flag leaf and first true leaf stage to lessen disease development.
- Plant in raised beds (currently used by many farmers) – may cause difficulty in harvesting.
- Long season crop can promote early disease problems.

Downy Mildew (*Peronospora destructor*)

Under favourable weather conditions the pathogen spreads quickly. First symptoms include purple sporulation of the pathogen on the leaves. Lesions can enlarge and girdle the leaves causing the tissue to collapse. Bulb infection can also occur resulting in storage rot. Field infections usually begin in small patches and progress rapidly throughout the field. In dry weather with relative humidity less than 80% and temperatures greater than 24°C, the fungal growth disappears, but the fungus may reappear and cause new lesions on neighbouring tissues when the weather becomes wet and cool and again.

Fungicides:

Active constituent/s	Details	APVMA standard
Chlorothalonil	Efficacy – fair. Long re-entry time (48 hours). Broad-spectrum.	http://www.apvma.gov.au/actives/standard_chlorothalonil.shtml
Mancozeb	Efficacy – excellent/good. Good rotational product; important in resistance management. Cost effective. Broad-spectrum.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Mancozeb / copper sulfate	Efficacy – good. Good rotational product; important in resistance management. Cost effective. Broad-spectrum.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Azoxystrobin	Efficacy – poor. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_azoxystrobin.shtml
Metalaxyl-M	Efficacy – good/fair. Expensive. Potential for the downy mildew pathogen to develop resistance.	http://www.apvma.gov.au/actives/standard_metalaxyl-M.shtml
Copper-based fungicides	Efficacy – fair/poor. Broad-spectrum.	http://www.apvma.gov.au/actives/standards.shtml

Active constituent/s	Details	APVMA standard
Dimethomorph	Efficacy – good/fair. Specific to this group of pathogens.	http://www.apvma.gov.au/actives/standard_dimethomorph.shtml
Pyraclostrobin	Efficacy – fair. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml
Pyraclostrobin/boscalid	Efficacy – fair. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_boscalid.shtml http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml

Other pest management aids:

- Eliminate cull piles and plant debris.
- Use a 3-4 year crop rotation.
- Scouting as an alert to initiate fungicide sprays.

Neck rot (*Botrytis* spp.), Stalk rot (*B. aclada*)

A serious disease of stored onions. The fungus enters directly through wounded tissue and causes the neck region to become soft and spongy. Infected areas of the onion are water-soaked and brown. In severe cases sclerotia form and are observed in the bulb tissue. Disease may be held in check when fungicides are applied to control other foliar diseases and if bulbs are not rolled prior to harvest. If broad-spectrum products are not available then neck rot may become a greater problem.

Fungicides:

Active constituent/s	Details	APVMA standard
Iprodione	Efficacy – good/fair. Development of pathogen resistance is a potential problem.	http://www.apvma.gov.au/actives/standard_iprodione.shtml
Mancozeb	Efficacy – fair/poor.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Pyrimethanil	Efficacy – fair/poor. Classified as a reduced-risk product.	http://www.apvma.gov.au/actives/standard_pyrimethanil.shtml

Other pest management aids:

- Destroy onion cull and debris piles which may serve as sources of inoculum.
- Manage timing of irrigation so foliage can dry rapidly.
- Avoid rolling tops and other handling practices that cause wounding, providing an entry point for the pathogen.

Pink root (*Phoma terrestris*)

Pink root is a common problem in onion production regions and is most serious during hot summers. Disease symptoms include discoloured roots that turn light pink then purple. Roots become very weak and plants may lodge prematurely. The fungus overwinters in soil and is most prevalent in growing regions with warmer climates. Economic losses result from small bulb size and poor marketability.

Fungicides:

Active constituent/s	Details	APVMA standard
Dichloropropene / chloropicrin	Efficacy – good. Very expensive and can be difficult to apply.	http://www.apvma.gov.au/actives/standard_1,3-dichloropropene.shtml

Other pest management aids:

- Tolerant commercial varieties should be planted when possible.
- Long-term (4-6 years) crop rotation with non-host crops.
- Soil fumigation.

Purple blotch (*Alternaria porri*)

Older leaves are more susceptible than younger leaves. Symptoms begin as water-soaked spots with a white centre that eventually become surrounded by brown and red lesions. When the lesions expand and coalesce, the leaf becomes girdled and dies. The disease can progress rapidly throughout the entire field if left untreated.

Fungicides:

Active constituent/s	Details	APVMA standard
Chlorothalonil	Efficacy – excellent/good.	http://www.apvma.gov.au/actives/standard_chlorothalonil.shtml
Copper hydroxide / mancozeb	Efficacy – fair.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml http://www.apvma.gov.au/actives/standard_copper_hydroxide.shtml
Iprodione	Efficacy – excellent/good.	http://www.apvma.gov.au/actives/standard_iprodione.shtml
Mancozeb	Efficacy – good.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Mancozeb / copper sulfate	Efficacy – good.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Azoxystrobin	Efficacy – excellent. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_azoxystrobin.shtml
Boscalid	Efficacy – excellent/good. Classified as a reduced-risk fungicide. Development of	http://www.apvma.gov.au/actives/standard_boscalid.shtml

Active constituent/s	Details	APVMA standard
	pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	
Copper-based fungicides	Efficacy – fair/poor.	http://www.apvma.gov.au/actives/standards.shtml
Cyprodinil / fludioxonil	Efficacy – good. Very expensive compared to the older protectant fungicides, mancozeb and chlorothalonil. Classified as a reduced risk fungicide.	http://www.apvma.gov.au/actives/standard_cyprodinil.shtml http://www.apvma.gov.au/actives/standard_fludioxonil.shtml
Pyraclostrobin	Efficacy – excellent. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml
Pyraclostrobin/boscalid	Efficacy – good. Classified as a reduced-risk fungicide.	http://www.apvma.gov.au/actives/standard_boscalid.shtml http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml

Other pest management aids:

- Rotate away from Allium spp. for two or more years.
- Manage irrigation to minimize the duration of leaf wetness.

Smudge (*Colletotrichum circinans*)

Disease occurs late in season and continues to occur during storage. Disease appears as dark green to black rings around the neck and on the surface of the outer scales. In extreme cases the bulb may shrivel and prematurely sprout. White onions appear to be most susceptible. Disease may be held in check through fungicides applied for the control of other foliar diseases.

Pest management aids:

- Rotate away from Allium spp. for two or more years.
- Manage irrigation to minimize the duration of leaf wetness.

Onion Smut (*Urocystis colchici*, *U. magica* = *U. cepulae*)

Seedlings that are infected often die within six weeks of emerging. Older plants exhibit disease symptoms on leaves, neck and bulb. Dark streaks are the most visible symptom on any part of the plant. Mature lesions contain dark patches of mycelium with dark dusty spores. There is a short time frame in onion development during which effective treatments may be made.

Fungicides:

Active constituent/s	Details	APVMA standard
Mancozeb	Efficacy – excellent. In mfurrow treatment used in combination with seed treatment PRO-GRO.	http://www.apvma.gov.au/actives/standard_mancozeb.shtml
Carboxin / thiram	Efficacy – fair. Most effective when used in combination with an in-furrow treatment of mancozeb.	http://www.apvma.gov.au/actives/standard_carboxin.shtml http://www.apvma.gov.au/actives/standard_thiram.shtml

Other pest management aids:

- Crop rotation (3-4 years).

Stemphylium leaf blight (*Stemphylium vesicarium*)

Infection by *S. vesicarium* causes yellow or brown water-soaked lesions on leaf tissue. As the fungus spreads, the lesions turn black as sporulation occurs. The fungus can be seed-borne. This pathogen may enter the bulb through mechanical wounding and insect damage. Senescing leaves as a result of pink root are susceptible to *Stemphylium* leaf blight. Disease may be held in check through fungicides applied for the control of other foliar diseases, especially purple blotch.

Fungicides:

Active constituent/s	Details	APVMA standard
Pyraclostrobin/boscalid	Efficacy – excellent. Classified as a reduced risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_boscalid.shtml http://www.apvma.gov.au/actives/standard_pyraclostrobin.shtml

Other pest management aids:

- Rotate away from *Allium* spp. for three or more years.
- Use clean, treated seed.
- Destroy cull piles.

White rot (*Sclerotium cepivorum*)

One of the most serious diseases of onions on the west coast of the US and Canada. Initial disease symptoms include yellowing and wilting of older leaves. The infection eventually moves to the onion bulb and root system. A soft rot will develop in the bulb and die-back of the foliage occurs. Predominance of this pathogen in other onion growing regions indicates that it is a potential threat to all regions.

Fungicides:

Active constituent/s	Details	APVMA standard
Thiophanate-	Efficacy – currently not known.	http://www.apvma.gov.au/actives

Active constituent/s	Details	APVMA standard
methyl		/standard_thiophanate-methyl.shtml
Azoxystrobin	Efficacy – currently not known. Classified as a reduced-risk fungicide. Development of pathogen resistance is a concern. To delay the development of resistance, this fungicide needs to be used in alternation with a fungicide with a different mode of action.	http://www.apvma.gov.au/actives/standard_azoxystrobin.shtml

Other pest management aids:

- Prevent introduction of the pathogen into non-infested areas.

Insect pests:

Aster leafhoppers (*Macrostelus quadrilineatus*)

Nymphs and adults vector a phytoplasma causing aster yellows disease. The phytoplasma has a wide host range including many crop and weed species that may act as reservoirs of pathogen inoculum. Frequent aster leafhopper flight in and out of onions and the relatively short residence time in the crop makes management difficult. Populations may be held in check through insecticides applied for the control of thrips.

Pest management:

- Weed control of alternate hosts in and around fields.
- Scout adjacent fields for leafhoppers and aster yellows disease.

Onion maggots (*Delia antiqua*)

The most serious insect pest of onion in temperate growing regions. Onion maggots are highly specific to plants in the onion family. First generation larvae cause the greatest damage by feeding on the underground bulb tissue of seedlings in the spring, resulting in death. A single larva can destroy 20 to 30 seedlings and readily move between adjacent plants. The feeding from the third generation can lead to storage rot as onion maggots can introduce bacteria into feeding wounds. The insects over winter as pupae in the soil associated with onion culls in the field.

Insecticides:

Active constituent/s	Details	APVMA standard
Chlorpyrifos	Efficacy – good. Use cyromazine as a seed treatment at planting. Resistance management is a concern. The preharvest interval is 60 days. Not effective against adults.	http://www.apvma.gov.au/actives/standard_chlorpyrifos.shtml
Diazinon	Efficacy – poor.	http://www.apvma.gov.au/actives/standard_diazinon.shtml
Malathion	Efficacy – poor. Not used by growers due	http://www.apvma.gov.au/actives

Active constituent/s	Details	APVMA standard
	to the development of insect resistance.	/standard_maldison.shtml
Cypermethrin	Efficacy – poor. Not used by growers due to the development of insect resistance.	http://www.apvma.gov.au/actives/standard_cypermethrin.shtml
Cyromazine	Efficacy – excellent. Used as a seed treatment.	http://www.apvma.gov.au/actives/standard_cyromazine.shtml
Lambda-cyhalothrin	Efficacy – poor. Not used by growers due to the development of insect resistance.	http://www.apvma.gov.au/actives/standard_lambda-cyhalothrin.shtml
Permethrin	Efficacy – poor. Not used by growers due to the development of insect resistance.	http://www.apvma.gov.au/actives/standard_permethrin.shtml

Other pest management aids:

- Crop rotation.
- Cull pile management. Tillage to reduce culls.

Thrips (Thrips tabaci)

Onion thrips feed on onions leaves by piercing the plant tissue with their mouthparts and sucking up the plant juices. Populations of thrips thrive in hot, dry conditions. In most cases of severe infestation, onions can ripen prematurely, be reduced in bulb size, or die. Onion thrips over winter as an adult in plant debris, onion bulbs, or in standing winter crops. Airborne dispersal is an important method of spread for onion thrips. Thrips can be possible vectors for disease pathogens. A severe thrips infestation has the potential to promote storage diseases. No one product provides excellent control, therefore all products are needed unless new, effective chemistries become available.

Insecticides:

Active constituent/s	Details	APVMA standard
Diazinon	Efficacy – poor.	http://www.apvma.gov.au/actives/standard_diazinon.shtml
Malathion	Efficacy – poor. Not used by growers due to the development of insect resistance.	http://www.apvma.gov.au/actives/standard_maldison.shtml
Cypermethrin	Efficacy – good/fair. Cost effective. Insect resistance may develop.	http://www.apvma.gov.au/actives/standard_cypermethrin.shtml
Lambda-cyhalothrin	Efficacy – good/fair. Rotational product. Cost effective. Classified as an OP alternative.	http://www.apvma.gov.au/actives/standard_lambda-cyhalothrin.shtml
Permethrin	Efficacy – fair. Rotational product. Cost effective.	http://www.apvma.gov.au/actives/standard_permethrin.shtml
Parathion-methyl	Efficacy – fair.	http://www.apvma.gov.au/actives/standard_parathion-methyl.shtml
Methomyl	Efficacy – excellent/good. Used in rotation with other products. Expensive.	http://www.apvma.gov.au/actives/standard_methomyl.shtml
Oxamyl	Efficacy – fair. Occasionally used. Expensive.	http://www.apvma.gov.au/actives/standard_oxamyl.shtml

Nematodes:

Northern root-not nematode (*Meloidogyne hapla*)

Shoot system symptoms include wilting, stunting, yellowing and low bulb yield. Roots branch prolifically and galls may be observed on root tissue. However, onions form an abscission layer in response to this infestation and shed the gall.

Needle nematode (*Longidorus elongatus*)

Shoot symptoms include yellowing, stunting and low bulb yield. Root symptoms include excessive branching and swelling of root tips.

Root lesion nematode (*Pratylenchus penetrans*)

Symptoms occur in patches in heavy infestations. Shoot symptoms include stunting, wilting, yellowing and low bulb yields. Root systems can be stunted with necrotic lesions.

Stem and bulb nematode (*Ditylenchus dipsaci*)

Shoot system symptoms include swollen seeding bases, and twisted, wilted, stunted, and yellowed leaves. Bulbs soften and have mealy-bloated scales. Young roots and bulbs may rot. A significant offensive characteristic odour is associated with this infectious disease.

Stubby-root nematode (*Paratrichodorus spp.*)

Plants are stunted, with yellow leaves, or may be wilting with low bulb yields. Roots are short and stubby with excessive secondary proliferation.

Nematicides:

Active constituent/s	Details	APVMA standard
Oxamyl	Efficacy – variable depending on the timing of application. Commonly used. Expensive. Can be used during growing season.	http://www.apvma.gov.au/actives/standard_oxamyl.shtml
Metam sodium	Efficacy – excellent/good. Cost prohibitive. Bare ground required. Applied either as a soil-injected fumigant or as chemigation through irrigation systems.	http://www.apvma.gov.au/actives/standard_metham-sodium.shtml
1,3-dichloropropene	Efficacy – excellent.	http://www.apvma.gov.au/actives/standard_1,3-dichloropropene.shtml

Other pest management aids:

- Green manure crops (i.e., oil seed radish, sudan grass) need to be plowed down, avoid legumes (clovers, alfalfa and vetch) unless established for two or more years.
- Crop rotation.
- Biofumigants (Brassicaceae spp.)