

## Vegetable Industry Development Program

# Mega Pests

## Managing Foliar Diseases



This fact sheet summarises the information you'll need to get started on the sustainable management of some difficult foliar threats to your crops. While there are no biological organisms that have proved reliable in the control of these foliar pathogens, reduced crop damage and on-farm costs have been widely achieved with strategies that consider weather, irrigation timing, plant varieties and spacing. Many growers have implemented this Integrated Crop Protection (ICP) approach and achieved success in the management of these pests.

ICP (also referred to as Integrated Pest Management (IPM)) considers the production system as a whole, including all pests, the crops and soil health.

Many growers have found that a useful starting point is working with a trusted and experienced ICP consultant or researcher. Good management will also be assisted by:

- A commitment to farm sanitation
- Monitoring – crop stage, symptoms and their distribution, weather (especially temperature, humidity and leaf wetness)
- The ability to detect early symptoms on your crops
- Awareness of relevant disease prediction models
- Use of resistant and tolerant varieties and appropriate crop rotation sequences

### What is the nature of these fungi?

Fungi with the common name 'mildew' are numerous, and they attack many vegetable and cucurbit species. Each of the fungi has different life cycles and preferred hosts. Downy mildews<sup>1</sup> and powdery mildews behave very differently and thrive under different conditions. Downy mildews prefer cool and wet weather for infection and are favoured by free moisture (dew or moisture from rain or irrigation) on leaves. Powdery mildews like warm and dry weather and are inhibited by free moisture on leaves. Mildew fungi survive in infected plant material (weeds, commercial crops or seeds), and each has specific or preferred hosts.

<sup>1</sup> In this article "fungi" includes "fungi-like" related pathogens

Another important foliar disease is white blister caused by *Albugo candida*, which is related to other water-loving fungi like the downy mildews. It attacks all above-ground parts of most cruciferous and Brassica crops and weeds. It survives in soil, plant debris and infected seed and may be spread long distances in infected plant material, and by wind.

There is a range of chemicals registered for controlling mildews but very few chemicals are effective on white blister. Growers and nursery operators have variable success with chemical treatments because spray coverage and spray timing affect the level of control achieved, especially by non-systemic products.

Foliar pest management requires a good understanding of:

- The fungi involved
- The periods during which the crops are most susceptible
- The environmental conditions that favour the pathogens

### ICP tips for managing foliar diseases

- Read the fact sheet: Mega Pests – The Basics of Protecting Your Crops
- Use resistant or tolerant varieties
- Use clean transplants
- Implement high-level farm sanitation
- Understand the influence of plant spacing and air circulation
- Minimise free moisture and high humidity periods
- Understand the implications of irrigation timing
- Understand the influence of planting time and overlapping crops in strip cropping
- Monitor crops regularly and use predictive models where available
- Understand fungicide resistance and rotation of chemical groups



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## Downy Mildews

These fungi generally form spores on the underside of leaves when they are damp or wet. High humidity and mild temperatures favour downy mildew, but not all hosts are equally susceptible. Resistant and tolerant varieties of cucurbits and some *Brassica* species exist but clean transplants are essential to give all crops a good start.

Leaf wetness favours downy mildew so avoid morning watering and high humidity. Dataloggers that record temperature and relative humidity provide some direction on when to irrigate. Direct sun and good ventilation help reduce disease threat even in the most susceptible varieties. Cultural methods such as leaf trimming and plant spacing can also improve air circulation and reduce the wetness period.

## Powdery Mildews

These fungi are very common in vegetable crops especially those grown in greenhouses. Cucumbers, capsicums, tomatoes, peas, and carrots suffer but some tolerant or resistant varieties exist and these have the best potential of growing and producing as expected.

The fungi grow best at 20-25°C and the first symptoms appear in spring. The symptoms include powdery patches on most above-ground surfaces, especially on leaves. In some crops, such as capsicums and tomato, the patches on the upper leaf surfaces are yellow rather than white.

Fungicides have been the most commonly used method of control, but the disease pressure often results in fungicide overuse and development of resistance to systemic fungicides.

## White Blister

ICP approaches to white blister disease management are very important. There are very few effective fungicides registered to control this disease. White blister requires 3-4 hours of free moisture in mild (6-24°C) temperatures for spores to germinate and infect leaves or heads of developing cauliflower and broccoli plants. These conditions occur frequently in greenhouses and in fields during spring and summer mornings. Watering in the morning (around 4 am) rather than at dusk, and avoidance of overhead irrigation, are important steps in the integrated management of this disease.

## How can I protect my vegetable crops and seedlings from these diseases?

Get started by:

1. Ensuring your seedling supplier uses clean seed, and provides the highest quality seedlings and transplants. Check all incoming seedlings and isolate them from your production areas.
2. Cleaning up your production site and practise the highest level of sanitation in and around all blocks. Because spores spread from infected plant material, make sure the cropping area is free of plant debris, volunteer hosts and weeds.
3. Limiting the spread of spores to a new planting on your farm. New plantings should not be next to old or infected crops. In strip cropping, promptly remove and destroy all infected crop debris as soon as harvesting is completed.
4. Planting tolerant varieties whenever possible. Very few vegetables have resistance to the mildews. White blister may develop on some broccoli and cauliflower varieties, but most cabbages are tolerant or resistant.



Downy mildew infected zucchini leaf  
(Source: Chrys Akem, DEEDI, Queensland)



Severe powdery mildew on capsicums  
(Source: Chrys Akem, DEEDI, Queensland)



White blister on broccoli (Source: Caroline Donald, DPI VIC)



"The Vegetable Industry Development Program is funded by HAL using the vegetable levy and matched funds from the Australian Government".



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## If these diseases are already on my property, what can I do?

There are no registered or consistently effective biological control agents for the mildews. This is why fungicides have been routinely used in their management. Many chemicals within different classes are registered and therefore chemical rotation to slow the development of resistance is possible, and should be practised along with effective spray technology.

Sulphur is the most widely used fungicide for powdery mildew control and despite resistance development being unlikely, sulphur is not suitable for use on all crops, especially during hot weather. Copper may be effective on some downy mildew infections, but on cucurbits the active constituents dimethomorph and metalaxyl are very effective if applied at the onset of the disease.



*Powdery mildew on pumpkin (Source: Chrys Akem, DEEDI, Queensland)*

## Growers are controlling the foliar fungi

ICP approaches for controlling foliar diseases are well-developed and have allowed progressive vegetable growers to reduce their dependence on chemicals while improving their produce quality, and reducing their costs and the threat of chemical residues and chemical resistance.

## Grower success stories – growers adapting their practices

Growers have had disease control success in many areas and their stories have common threads. Each disease, season and crop system is different but many growers have learned to assess and integrate the available ICP elements to maximise the protection of their crops.

## Managing the Mildews

Most success stories with downy mildew control in vegetables are those of growers who have integrated the planting of resistant or tolerant varieties, strict farm sanitation, excellent weed control, monitoring for early symptoms on older leaves and specific cultural actions - irrigation (and humidity) timing, nutrition levels, and sometimes crop-free periods.

Lettuce growers have found that avoiding high ammonium nitrate in their crops has provided added protection against downy mildew.

The growers who have successfully implemented ICP for powdery mildew management have a good understanding of the 'at risk' periods. For greenhouse crops this period is on-going, but in most other environments crops are at risk until hot weather arrives. Where sulphur remains the basis of disease management, growers still monitor crops carefully – both for disease symptoms and to ensure the sprays are achieving maximum coverage of emerging and susceptible plant tissue.

A cucurbit grower in northern Queensland who uses cover netting to protect his squash crops from insects capable of vectoring cucurbit viruses, has demonstrated an additional benefit of this practice. The netting has resulted in reduced powdery mildew also! For a long period the grower has not required any fungicides to control powdery mildew in his netted crop, despite the need for frequent spraying to control the disease in adjacent open blocks.

## Managing White Blister

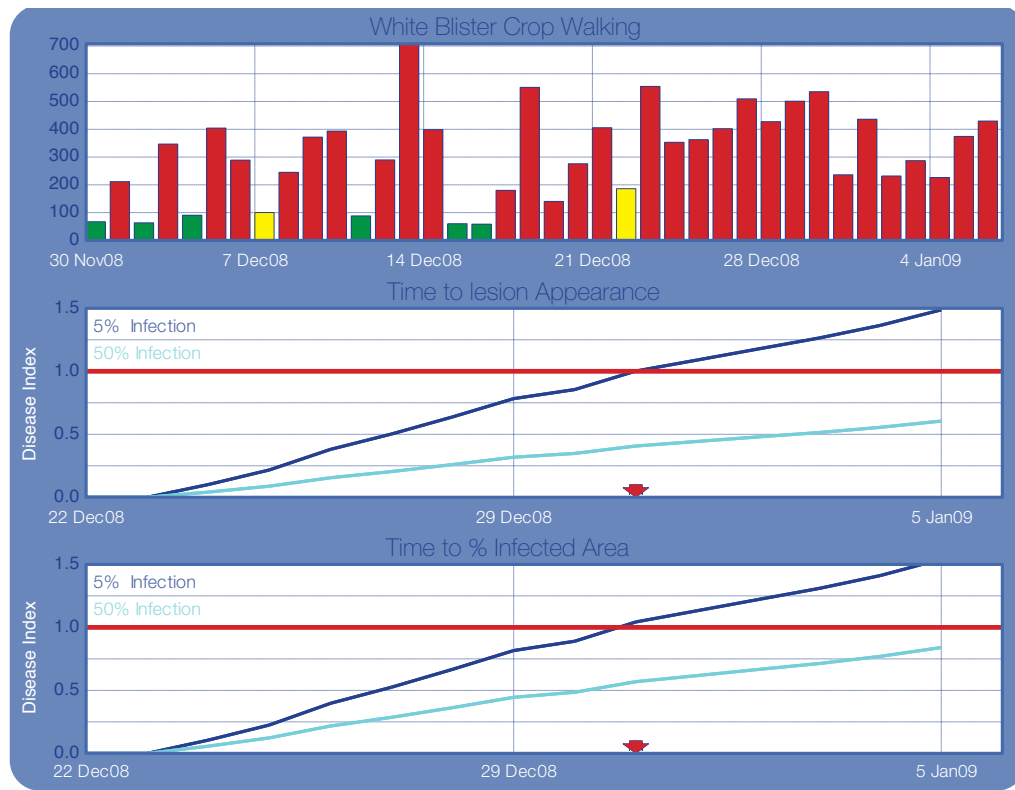
The impact of white blister on some susceptible crops has been greatly reduced by strategies that integrate irrigation timing and resistant varieties. A predictive model (BrassicaSpot™) that predicts an infection period through assessment of temperature and leaf wetness has been developed. This model in association with spore trap results has given growers information on the likelihood of infection, and therefore justification for a well-timed chemical treatment. In some cases it has resulted in growers reducing their weekly broccoli head sprays by 90 percent. Copper sprays continue to be effective in white blister programs but trials with sodium lauryl sulphate and with the organism *Streptomyces lycidicus* look promising but have given inconsistent results so far.

*Disclaimer: These fact sheets are coordinated and edited by RMCG (ph: 03 9882 2670). RMCG produces these fact sheets with the expectation that users exercise their own skill and care with respect to their use. Before relying on or altering any business practices, users should carefully evaluate the accuracy and relevance of the information for their purpose and should obtain appropriate professional advice relevant to their particular circumstances.*





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## Brassicaspot™ model

Source: E. Minchinton DPI VIC

### Top graph

Original Brassicaspot™ model  
Disease pressure bars (top)

■ High ■ Moderate ■ Low

### Lower graphs

Updated Brassicaspot™ model

**Red horizontal line** = threshold.  
Spray when red line is crossed  
(red arrow)

**Dark blue line** = predicted  
maximum spore release from 5%  
of the crop. Spray when threshold  
crossed (date at red arrow)

**Aqua line** = progression to 50%  
crop infection

## A selection of helpful resources

There are many additional useful resources that can be accessed within the secure area of the AUSVEG website. Go to the Technical Insights page and then to the R+D Insights Database (search engine) where you can initiate a Search using Key Words.

Available resources include:

1. **Managing Downy and Powdery Mildew, Anthracnose and White Blister.** 2010. A factsheet produced by the Vegetable Pathology Program. Download using the following link: [http://www.vgavic.org.au/pdf/VG07070\\_Foliar\\_Diseases\\_brochure.pdf](http://www.vgavic.org.au/pdf/VG07070_Foliar_Diseases_brochure.pdf)
2. **Best Practice - Downy Mildew in Vegetables TL173 and Best Practice - Powdery Mildew in Vegetables TL175.** Two factsheets produced by the Vegetable Pathology Program. Information on economic and sustainable control of the diseases. Access: Login to the secure area of the AUSVEG website. Go to the 'Technical Insights' page, click on 'R+D Insights Database (search engine)' and use 'best practice' in Keywords area. Click 'Search' for TL173 and TL175.
3. **Downy mildew of brassicas.** A factsheet downloaded from: [http://vegetablesvictoria.com.au/pdf/r&d\\_NY9406\\_Downy\\_Mildew\\_seedling\\_factsheet.pdf](http://vegetablesvictoria.com.au/pdf/r&d_NY9406_Downy_Mildew_seedling_factsheet.pdf)
4. **Sustainable integrated control of foliar diseases in greenhouse vegetables.** This website reports on fungicides screened for powdery mildew, downy mildew and Botrytis sp.; strategies for greenhouse growers moving to integrated management. Individual fact sheets from: [http://www.sardi.sa.gov.au/pestsdiseases/horticulture/horticulture\\_pathology/foiar\\_diseases\\_of\\_greenhouse\\_vegetables](http://www.sardi.sa.gov.au/pestsdiseases/horticulture/horticulture_pathology/foiar_diseases_of_greenhouse_vegetables)
5. **Diseases of Vegetable Crops.** Persley D. et al. 2010. This book is a key reference for diseases affecting vegetable crops in Australia and includes a diagnostic guide. It may be ordered via: <http://www.publish.csiro.au/nid/18/pid/6057.htm>
6. **Integrated disease management in greenhouses.** Information on integrated practices for effective disease management in greenhouses. <http://www.dpi.nsw.gov.au/agriculture/horticulture/greenhouse/pest-disease/general/idm>
7. **Management of White Blister (*Albugo candida*) on Broccoli** is a web-based factsheet that can be accessed via: <http://www.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/vegetable-diseases/white-blister-on-broccoli/management-of-white-blister>

### Acknowledgement

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