

# Stemphylium leaf-spot and other foliar diseases of hebe

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This Factsheet provides information on the newly identified leaf-spot disease of hebe caused by a *Stemphylium* sp. It also provides information on *Septoria* leaf spot and other foliar diseases affecting the crop. It should assist in their accurate identification and help in the implementation of appropriate control measures.

## Background

Following the occurrence of an unusual and severe leaf-spot affecting several hebe cultivars in the North of England in autumn 2003, an HDC project (HNS 128) was commissioned to investigate the distribution of the problem, its cause, biology and control. Previously, the predominant leaf-spot found on hebe has been caused by the fungus *Septoria exotica* which is characterised by the development of distinctive fungal fruiting bodies (pycnidia) in the centre of the lesions.

For many years, *Septoria* leaf spot has been successfully controlled using fungicides containing carbendazim (eg Delsene 50 Flo – see fungicide section). However, industry reports of poor control with conventional spray programmes containing carbendazim prompted further investigation to determine if the problem was arising as a result of fungicide resistance or whether there was some other cause.

The initial studies showed that *Septoria* was not present in the leaf-spot lesions but instead a different fungus, subsequently identified as a *Stemphylium* species (Figure 1), was consistently recovered. This latter fungus was

insensitive (resistant) to carbendazim. Also, preliminary inoculation studies at STC successfully reproduced leaf-spot symptoms and indicated that the fungus may be the primary cause of the new leaf-spot problem.



1 Hebe 'Red Edge' with a severe infection by *Stemphylium*

## *Stemphylium* leaf-spot

### Symptoms

The fungus produces large numbers of small (1–3 mm) dark brown/purple spots on the leaves (Figure 2 overleaf). These neither coalesce (merge) nor enlarge significantly. The centre of the lesion remains the same colour, unlike

*Septoria* which develops a dry pale centre to individual lesions, and which have a tendency to coalesce. The infected leaves either shrivel prematurely and hang on the plant or drop off.

### Distribution

A nationwide questionnaire was distributed to commercial hebe growers to determine how widespread the

leaf-spot problem was in the UK. The study also requested growers to submit samples of hebe with leaf-spot symptoms to ascertain the primary cause of the problem. Over 70% of the hebe samples subsequently received were confirmed as being infected with *Stemphylium* leaf-spot. Yet, none of the samples were found to be infected with *Septoria exotica*. This indicates a significant shift in the pathogen population on this host in the last few years.

The precise reason for such a dynamic shift is not clear, though, it has been speculated that it could have arisen as a result of selection pressure following repeated use of carbendazim-based products, over several years. This hypothesis was later supported when it was demonstrated in fungicide sensitivity tests in the laboratory that the *Stemphylium* species was highly resistant to carbendazim; and hence not controlled by the fungicide programme applied routinely on this crop.

## Infection and spread

The fungus produces moderate numbers of asexual spores (conidia) on infected leaves and these are believed to be the primary means of disease spread between plants on the nursery.

Some *Stemphylium* species are also reported to produce a perfect or sexual stage (Pleospora) under certain conditions and spores (ascospores) liberated from fruiting bodies (perithecia) could potentially account for over-wintering survival of the fungus and long distance dissemination. However, during the two-year investigation, the sexual stage of the fungus was not found associated with infected hebe plants or leaf litter material retained under a range of different temperature and moisture conditions.

The conditions under which the spores are formed, liberated and spread



2 Distinctive leaf spotting on Hebe caused by *Stemphylium*

are not known precisely though the pathogen does appear to spread more rapidly during periods of warm wet weather (above 25°C). Therefore, the disease is more likely to be problematic during summer and early autumn and this is when fungicides need to be applied more frequently to protect crops from infection. Spore trapping studies also supported this observation with few spores being detected during the cooler winter months.

## Nomenclature

A molecular examination of the new leaf-spot pathogen showed a 96% similarity with *Stemphylium solani* and this name will be used on a presumptive basis to describe this new pathogen of Hebe.

## Varietal susceptibility

From observations on nurseries and in replicated studies it is evident that there are considerable differences in relative susceptibility between different hebe cultivars and types. Whilst no cultivars have been found which could

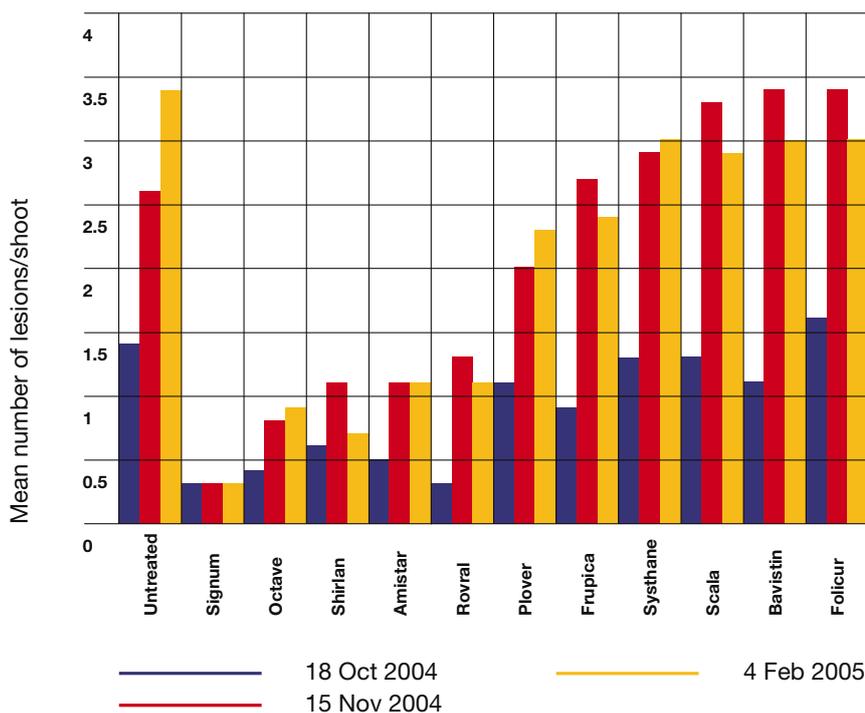
be regarded as immune, some cultivars do appear to be much less susceptible to *Stemphylium* leaf-spot.

## Cultural control

Attention to cultural control is important to minimise disease risk. Plants should be spaced out well to encourage good air circulation. This allows the leaves to dry out more quickly and reduces their vulnerability to infection from this, and other, leaf infecting pathogens. Similarly, on protected crops, overhead watering should be avoided, where possible, by using drip or sub-irrigation. Where this is not practical or economically viable, any overhead watering should be timed to ensure there is a chance for the foliage to thoroughly dry out during the day.

For outdoor crops, subject to intermittent rainfall, this is naturally more difficult and it is likely that alternative techniques to minimise disease risk will need to be deployed. As there continues to be a potential risk of carry-over on leaf litter, efforts should be made to remove infected leaf debris between crops.

Graph 1 Relative Performance of Different Fungicide Products against *Stemphylium* leaf-spot on Hebe 'Red Edge'



NB: Three assessments of leaf-spot incidence were conducted during the period October 2004 to February 2005.

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## Fungicide control

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As early studies demonstrated that the *Stemphylium* pathogen was not controlled by carbendazim, it was important to find alternative effective fungicides. A number of potential products were identified in a primary screen and subsequently assessed on the susceptible cultivar 'Red Edge'. Several products, including Signum (pyraclostrobin & boscalid), Octave (prochloraz-Mn), Amistar (azoxystrobin) and Rovral (iprodione), proved to be very effective in reducing the incidence and severity of *Stemphylium* leaf-spot in these studies (Graph 1). Whilst Shirlan (fluazinam) was also moderately effective, reports of skin sensitisation in particularly sensitive individuals may preclude its use where plants are likely to be handled regularly.

Limited studies undertaken to investigate fungicide timing suggest that it may be possible to secure

effective control of *Stemphylium* with a limited number of well-timed sprays. Ideally this would need to be aligned with information on climatic factors and disease risk eg inoculum (spore) load for optimum results.

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## Crop and cultivar safety

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The four products that significantly reduced *Stemphylium* (Amistar, Octave, Rovral & Signum) were tested at different rates of use (including double the recommended rate) and produced no evidence of crop damage on a broad range of commercially available Hebe types and cultivars. However, such tests were limited to one season, so growers are advised to test treat a small batch of plants to satisfy themselves of product safety on the cultivars being grown before making an application.

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## Action points for the control of *Stemphylium* leaf-spot

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- Growers should acquaint themselves with this new disease and monitor crops closely.
- Where leaf-spotting appears, submit a sample to a diagnostic laboratory to confirm the primary cause.
- Once the pathogen has been identified accurately, consider the various options for cultural control.
- Adjust the fungicide spray programme, as necessary, to secure improved efficacy against this fungus (see fungicide section).
- Reduce the risk of resistance developing by alternating at least two but preferably three fungicide products with different modes of action.

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## Other leaf diseases in hebe

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In addition to *Stemphylium* leaf-spot there are a number of other

important pathogens that affect the quality of hebe plants. The most economically important of these are *Septoria exotica* (as mentioned above), downy mildew (*Peronospora grisea*), grey mould

(*Botrytis cinerea*) and web blight (*Rhizoctonia solani*).

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## *Septoria* leaf-spot

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### Background

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*Septoria* leaf-spot (*Septoria exotica*) has been regarded for the last 25 – 30 years as the most common leaf-spot disease in commercial hebe crops. Consultant plant pathologists have previously advocated the use of carbendazim-based fungicides to maintain effective control (see fungicide section). When leaf-spot problems recently increased in severity, it was initially assumed that it was caused by the same pathogen, but investigations showed that it was not.

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### Symptoms

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The symptoms caused by *Septoria* are slightly different to those of *Stemphylium*. The lesions are more variable in size, generally being larger,

with a tendency to merge or coalesce. The centre of the lesion is pale with small fungal fruiting bodies (pycnidia) embedded in the decaying leaf tissues (Figure 3); though these may only be visible with a hand-lens.

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### Infection and spread

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The fruiting bodies produce prolific numbers of spores which are dispersed by water-splash and hence the disease is most severe in wet seasons.

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### Control

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Whilst it is likely that carbendazim or other benzimidazole (mbc) fungicides would still provide effective control of *Septoria*, no tests have been undertaken recently to confirm this. However, it is important to note that as part of the EU pesticide review process,



3 Typical symptoms caused by *Septoria exotica* with distinctive fruiting bodies in centre of lesions

carbendazim has been revoked and at the time of printing, is in a use-up phase. The future availability of alternative mbc fungicides in the UK also remains uncertain. As such,

it is not possible to make specific recommendations for the future use of mbc fungicides and alternative products may need to be sought. Some of the newer products found

to control *Stemphylium* leaf-spot may have some activity against *Septoria*, though this has not been tested (see fungicide section).

## Downy mildew (*Peronospora grisea*)

### Background

Downy mildew is probably one of the most common and damaging foliar diseases of hebe with some cultivars being particularly susceptible (Figure 4).

### Symptoms

The symptoms of the disease are varied and particularly influenced by the overall susceptibility of the cultivar(s) being grown, the prevailing weather conditions, the inoculum or disease pressure and the age of the plants when they were first infected. Some downy mildew fungi produce a white fungal growth on the under-surface of the leaves (eg Lettuce). In contrast, on Hebe a brown/mauve felt-like fungal growth appears on the under-surface of the leaves (Figure 5). The fungus can also, under some circumstances, cause a systemic shoot infection leading to leaf necrosis and ultimately shoot dieback.

Whilst the fungus can usually be identified quite readily during visual

examination by looking for the felt-like fungal growth on the underside of the leaves, when systemic shoot infection occurs sporulation can be limited and closer microscopic examination by a qualified pathologist in the laboratory may be necessary for accurate diagnosis.

### Infection and spread

The fungus requires cool wet weather for infection and spread. Where pos-

sible, prolonged periods of leaf wetness should be avoided. If employing overhead irrigation (Figure 6), it is best to irrigate in the morning on suitable days to ensure the foliage has time to dry quickly. Alternatively, employing capillary irrigation will reduce the risk of further infection.

For outdoor crops exposed to regular rainfall, space plants out to encourage good air circulation between plants and orientate the rows in line with the prevailing wind if possible. As some cultivars are more susceptible than



4 Downy mildew (*P. grisea*) on *Hebe franciscana variegata*



5 Downy mildew produces a white fungal growth in lettuce (left) but a brown growth in Hebe (right)



6 Careful management is required if employing overhead irrigation

others it is advisable, where appropriate, to select those that are more tolerant of the disease.

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## Control

Fungicides that control *Stemphylium* and/or *Septoria* leaf-spot diseases in hebe are unlikely to provide effective control of downy mildew. Instead, specific oomycete fungicides are needed to provide the most effective control of this disease.

It is worth noting that if fungicide drenches are applied for the control of root diseases such as *Phytophthora*, incidental control of downy mildew may be expected due to the systemic nature of some of the products. It would be inadvisable however to use the same fungicide for drench and foliar application as this could increase the risk of fungicide resistance developing.

Products containing metalaxyl-M + mancozeb (eg Fubol Gold), fosetyl aluminium (eg Aliette) and

propamocarb hydrochloride (eg Filex or Proplant) are likely to provide good control, though there are several other effective products that can potentially be used on non-edible ornamental crops either through the 'Long Term Arrangements for Extension of Use' (LTAEU) (see fungicide section) or Specific Off-Label Approvals (SOLA's). Such products are used at the growers own risk.

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## Grey mould (*Botrytis cinerea*)

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### Background

Grey mould, caused by the fungus *Botrytis cinerea*, is a ubiquitous air-borne pathogen and is very common, affecting many plant species including, occasionally, some specific hebe cultivars eg 'Green Glow'.

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### Infection and spread

The fungus requires cool wet conditions for optimum infection and it can usually be found in consignments of plants that have been packed too tightly where air circulation has been reduced. As an opportunist fungus it can also

be found causing shoot dieback on weakened or damaged plants as this provides ideal conditions for infection and subsequent colonisation.

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### Control

As for downy mildew, close attention to improved air circulation is important to ensure the foliage dries out quickly, though in this case, minimising damage is also important due to the opportunist nature of this fungus.

Strict attention to hygiene on the nursery is also important to minimise the risk of carry-over of the pathogen on decaying leaf litter and other crop debris.

In some circumstances, it may be necessary to consider employing preventative fungicide applications, but as with other pathogens it is important

to 'ring the changes' to minimise the risk of resistance developing.

Previous use of carbendazim based products has led to the development of resistant strains in the pathogen population and it is now largely ineffective against *Botrytis cinerea*. There is also good evidence of strains developing reduced sensitivity to iprodione (Rovral), and again here effective disease control may be compromised.

Fortunately, there are several alternative fungicide products with activity against *Botrytis* eg pyrimethanil (Scala), mepanipyrim (Frupica) and fenhexamid (Teldor) and these, where possible, should be used in conjunction with some of the older multi-site inhibitor fungicides like chlorothalonil (eg Bravo 500) as this will help to minimise the risk of further resistance problems developing.

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## Web blight (*Rhizoctonia solani*)

Occasionally, on particularly susceptible cultivars such as 'James

Stirling', *Rhizoctonia solani* can be problematic where it causes a stem base infection and web blight. Correct diagnosis is important here and, where necessary, it is advisable to submit suspect samples to a

diagnostic laboratory for analysis and identification. Where web blight is confirmed, treatment with an effective fungicide eg tolclofos-methyl (Basilex) may be necessary.

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## Summary of effective fungicides for use against foliar diseases

There are currently a wide range of fungicides available to hebe producers through full approvals,

specific off-label approvals (SOLAs) and (at the time of printing) via the Long Term Arrangements for Extension of Use (LTAEU). It should be noted however that the future of the LTAEU are uncertain and growers will need to check further before using products via the LTAEU to ensure they are operating within the regulatory framework.

For the purpose of this factsheet, it was considered appropriate to list some of the more commonly used fungicide products that are known to have activity against specific pathogens, that can be used on both outdoor and protected crops, and that offer differing modes of action drawn from contrasting fungicide groups (Table 1 overleaf). The alternation of such products in a spray programme will

effectively reduce the potential for development of fungicide resistance and prolong the useful life of the fungicide.

using fungicides on ornamentals do so at their own risk and to ensure crop safety, it is advisable to test treat a small batch of plants if the product has not been previously used on the nursery.

For environmental protection it is important to note all statutory and advisory information on the product label.

## Crop safety

With the exception of those with a full on-label recommendation, growers

If the product is to be used under protection, ensure there is an approved use for this activity to ensure spray operators are protected.

**Table 1 Examples of fungicides for use either outdoors or under protection<sup>1</sup> for the control of the primary leaf diseases on hebe The list is not exhaustive. No criticism is implied of products not included.**

P = protectant, S = systemic, T = translocated, TL = translaminar, C= contact, Cu = curative, E = eradicant (information based on BCPC UK Pesticide Guide 2007)

please see the footnotes at the end of table on the next page for explanations

Primary or Key Target	Active ingredients (examples only)	Product(s) (examples only)	Mode of Action	Fungicide Group (FRAC Code)	Additional comments
Downy mildew	Metalaxyl-M <sup>2</sup> + mancozeb	Fubol Gold WG	S, P	4 + M3	A very effective acylalanine or phenylamide and dithiocarbamate fungicide. Moderate-high resistance risk <sup>2</sup>
	Fosetyl-aluminium	Aliette 80 WG	S	33	A useful systemic phosphonate fungicide
	Propamocarb-HCl	Filex or Proplant	P, T	28	An effective carbamate fungicide with a different mode of action to products above
<i>Stemphylium</i> leaf-spot	Pyraclostrobin + boscalid	Signum	P, S	11 + 7	Very effective QoI (strobilurin) and carboxamide fungicide. Likely to be reasonably broad-spectrum
	Prochloraz-Mn	Scotts Octave	P, E	3	A good broad-spectrum DMI or imidazole fungicide
	Azoxystrobin	Amistar	S, TL, P	11	An effective broad-spectrum QoI or strobilurin fungicide
	Iprodione	Rovral WP	P, E	2	An effective dicarboximide protectant product
<i>Septoria</i> leaf-spot	<b>Carbendazim<sup>3</sup></b>	<b>Delsene 50 Flo</b>	<b>S, P, Cu</b>	<b>1</b>	<b>An older but effective systemic MBC or benzimidazole fungicide – but ineffective against <i>Stemphylium</i></b>
	Azoxystrobin	Amistar	S, TL, P	11	Potential for activity against this target – but untested
	Prochloraz-Mn	Scotts Octave	P, E	3	Potential for activity against this target – but untested
	Pyraclostrobin + boscalid	Signum	P, S	11 + 7	Potential for activity against this target – but untested
<i>Botrytis</i> grey mould	Iprodione	Rovral WP	P, E	2	Partially effective – but some strains with reduced sensitivity

Table continued...

Primary or Key Target	Active ingredients (examples only)	Product(s) (examples only)	Mode of Action	Fungicide Group (FRAC Code)	Additional comments
<i>Botrytis</i> grey mould	Prochloraz-Mn	Scotts Octave	P, E	3	Some activity against this target expected
	Mepanipyrim	Frupica SC	P	9	An anilino-pyrimidine (AP) fungicide with good activity against <i>Botrytis</i>
	Pyrimethanil	Scala	P	9	An anilino-pyrimidine (AP) fungicide with good activity against <i>Botrytis</i>
	fenhexamid	Teldor	P	17	A good protectant hydroxyl-analide fungicide with a different mode of action to AP products
	chlorothalonil	Bravo 500	P	M5	A multi-site protectant chloronitrile (phthalonitrile) fungicide useful in the early stages of disease development
<i>Rhizoctonia</i> web blight	Tolclofos-methyl	Basilex	P	14	An effective aromatic hydrocarbon fungicide
	azoxystrobin	Amistar	S, TL, P	11	Some activity against <i>Rhizoctonia</i> demonstrated on other crops

<sup>1</sup> Subject to the statutory conditions of approval and, where SOLA's and 'Long Term Arrangements for Extension of Use' apply, at the growers own risk.

<sup>2</sup> Resistance to fungicides containing metalaxyl-M has been reported in some downy mildews (eg *Bremia lactucae* in lettuce) and the risk of breakdown should be considered moderate-

high. Avoid repeated use of this fungicide by alternating with different mode of action products. If poor control of downy mildew is observed following the use of this fungicide then switch to an alternative product from a different FRAC group. Report the incident to FRAG-UK using the on-line resistance reporting form: [www.pesticides.gov.uk/rags.asp?id=644#Reporting](http://www.pesticides.gov.uk/rags.asp?id=644#Reporting)

<sup>3</sup> It should be noted that as part of the EU pesticide review process, carbendazim has been revoked and at the time of printing, is in a use-up phase. Growers should check the approval status carefully before use.

## Suggested fungicide programmes

Different circumstances on different nurseries mean that it is not possible to be prescriptive with respect to a single fungicide programme but the following provides an example spray programme as a guide that may be helpful for some growers.

### Propagation and liner stage

It is particularly important to protect crops during propagation from downy mildew & *Stemphylium* leaf-spot infection, although consideration should also be given to the other pathogens mentioned, especially on cultivars known to be susceptible. The source of the cutting material

can have a significant bearing on infection levels in propagation and every effort should be made to ensure the mother stock is free from foliar (and root) pathogens at the outset.

- Apply Aliette 80 WG either as a drench or coarse spray or via compost incorporation. This will provide control of downy mildew and *Pythium*/*Phytophthora* root rots. Follow this with foliar sprays of Fubol Gold or Flex/Proplant at 14 – 21 day intervals during conditions of high disease pressure.
- For leaf-spot control, apply Rovral WP followed by Signum to maintain good protection through the propagation period, repeating applications at approximately four week intervals. Also, while it remains available for use, introduce occasional sprays of carbendazim (eg Delsene

50 Flo) to maintain effective control of *Septoria exotica*. However, it is important to note that as part of the EU pesticide review process, carbendazim has been revoked and at the time of printing, is in a use-up phase (see fungicide section).

- If *Botrytis* becomes evident it may be necessary to adjust the programme slightly to include specific *Botrytis* fungicides such as prochloraz-Mn (Octave), pyrimethanil (Scala), mepanipyrim (Frupica) or fenhexamid (Teldor).
- If *Rhizoctonia* is diagnosed as a problem on specific cultivars during the propagation stage then also introduce either tolclofos-methyl (Basilex) or azoxystrobin (Amistar) into the programme.

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## Potted plants

With potted plants, consider the seasonal nature of some of the pathogens. Downy mildew is rarely a problem during the summer, unless it remains cool, wet and humid, whereas *Stemphylium* leaf-spot spreads most aggressively during this period. Spray programmes should be constructed to take account of this and target specific pathogens when the crops are most vulnerable. However, a degree of flexibility should be built in to take account of the vagaries of the UK weather and the possible occurrence of unexpected or new problems in the crop. Unusual leaf symptoms should be examined by a plant pathologist by submitting samples to a diagnostic plant clinic (see below).

- In early spring the risk of downy mildew infection is high, so Aliette 80 WG should be applied as a drench (also to provide control of *Pythium* and *Phytophthora* root rots), followed by a foliar application of a product with a different mode of action such as Fubol Gold or Filex/Proplant.

Alternatively it may be possible to consider some of the newer blight fungicides as approved on potatoes, subject to statutory conditions of use as specified on the product label and the continued availability of the Long Term Arrangements for Extension of Use (LTAEU).

- From late spring onwards, the focus should turn to controlling leaf-spot fungi (assuming downy mildew has not carried through from early spring). Use alternating applications of Rovral WP, Signum & Octave at approximately 2 – 4 week intervals. Amistar may also be substituted here if a broader spectrum of activity is required eg *Rhizoctonia* control. If *Septoria* is considered a risk then substitute occasional sprays with carbendazim (eg Delsene 50 Flo). However, it is important to note that as part of the EU pesticide review process, carbendazim has been revoked and at the time of printing, is in a use-up phase (see fungicide section).

- Assuming the temperatures drop in the autumn it should be possible to significantly reduce the frequency of spray applications for leaf-spot control, though continued monitoring will remain necessary.
- From late August and September, the risk of downy mildew (and *Botrytis*) increases again and the frequency of appropriate fungicide applications should be increased accordingly.
- On *Botrytis* susceptible cultivars, it is likely to be necessary to strengthen the fungicide programme through the inclusion of *Botrytis*-specific fungicides such as Scala, Frupica or Teldor.
- Continue to check susceptible cultivars for web blight and if *Rhizoctonia* is diagnosed then use either tolclofos-methyl (Basilex) or azoxystrobin (Amistar) as necessary.

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## Further information

### Other useful publications

- HDC Factsheet 04/04 – Projects HNS 53 and HNS 79: Control of downy mildew diseases on hardy nursery stock and herbaceous perennials.
- HDC Factsheet 25/02 – Project PC/HNS 121 – Controlling humidity to minimise the incidence of grey mould (*Botrytis cinerea*) in container-grown ornamentals: heated glasshouse crops.

- HDC Factsheet 24/02 – Project PC/HNS 121 – Control of grey mould (*Botrytis cinerea*) in container-grown ornamentals: heated glasshouse crops.
- HDC Factsheet 23/02 – Project PC/HNS 121 – Control of grey mould (*Botrytis*) in container-grown ornamentals: unheated greenhouse crops.
- HDC Pesticide checklist 2007 – shrubs.

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Further information: A full copy of the final report for HDC Project HNS 128 is available from the HDC office (01732 848383).

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