Stemphylium leaf blight of onion

Figure 1. Pukekohe onion field with high incidence and severity of *Stemphylium* leaf blight [photo courtesy of Mike Blake]

Stemphylium leaf blight of onion is an important disease that occurs in most onion growing regions of the world. The disease damages the onion leaves causing defoliation that can reduce bulb yields and lower the quality and export potential of the produce. During the 2017-18 growing season, significant outbreaks of *Stemphylium* leaf blight occurred in commercial fields of onion in New Zealand, including the Pukekohe (Figure 1), Waikato, Hawke's Bay and Canterbury regions.

The disease

Stemphylium leaf blight (SLB) of onion occurs in most onion growing regions of the world. The disease can prematurely defoliate onion plants which can compromise bulb quality and make the crop more susceptible to secondary diseases that affect bulb quality (i.e. storage rots caused by bacterial pathogens). SLB affects all foliar parts of the onion crop, and severely infected crops develop small to no bulbs. Disease control is by means of agrichemicals and agronomic methods.

Historically, SLB has been a minor disease of onion crops in New Zealand. The two main foliar diseases of onion in this country are downy mildew (*Peronospora destructor*) and botrytis leaf blight (*Botrytis squamosa*), with purple blotch (*Alternaria porri*) of lesser importance.

The recent and widespread epidemic of SLB in New Zealand may indicate its emergence as a more aggressive disease than it has been in the past, and a potential threat to onion production in this country.

The pathogen

SLB of onion is caused by the fungus *Stemphylium vesicarium*. Not only does *S. vesicarium* cause disease in onion, but it can attack the leaves of many other crops including garlic, asparagus, pear, lucerne, mango and soybean. All of these crops develop typical leaf blight symptoms, including light brown lesions that turn dark brown when the pathogen sporulates, leaf blighting and death. Alternative crops can also serve as reservoirs of inoculum in the absence of onion crops.

Symptoms

In onion and garlic, infection usually remains restricted to the leaves and inflorescences, and does not extend to the bulb scales. Although SLB can be seen when the onion crop is at the 3-4 leaf stage, the disease most commonly occurs at plant maturity and when leaves begin to senesce. Typical SLB lesions are more commonly found on the side of leaves facing the prevailing wind.

The initial symptoms on onion leaves are small yellow to tan, water-soaked spots. These small spots develop into elongated light brown to tan leaf lesions which turn dark olive brown when the pathogen begins to produce dense masses of spores. Leaves may become completely blighted as the lesions coalesce. As the disease progresses, infected leaves undergo rapid necrosis from the tip down which can lead to desiccation of leaves and early dying of the crop. Sometimes, small, black, pin-like, raised fungal fruiting bodies called perithecia may appear in the blighted areas of the leaves and scape.

The symptoms of SLB can be confused with purple blotch. SLB and purple blotch lesions may occur on the same plant, and spores of each may develop on the same lesion. Confirmation that *Stemphylium* is associated with leaf blight symptoms can be had if the spores are viewed under a compound microscope.

Figure 2. Hawke's Bay onions showing Stemphylium leaf blight (SLB) symptoms [photo courtesy of Bruce Searle].

Figure 3. Stemphylium leaf blight (SLB) lesion [photo courtesy of WikiGardener].

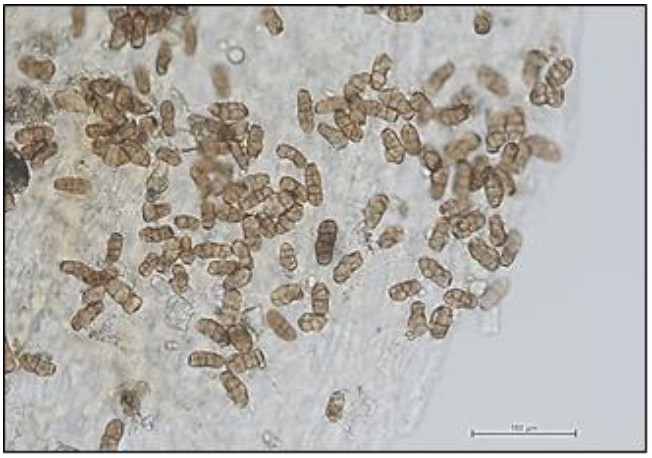

Figure 4. *Stemphylium* spores (conidia) from infected onion leaves as viewed under the compound microscope. Scale bar = 100 µm [photo courtesy of Joy Tyson].

Disease cycle

The main primary source of SLB-pathogen inoculum is infected plant residues on the soil on which *S. vesicarium* asexual conidia are formed. The disease cycle of SLB is characterised by sexual and asexual phases, and pseudothecia may develop on the blighted leaves. The SLB fungi are also introduced into onion fields by windblown spores from nearby plants.

Infection of onion leaves by *S. vesicarium* spores occurs mainly through (1) stomatal openings, (2) via wounds caused by other diseases, insect pest feeding or physical damage such as hail and herbicide damage, and (3) direct infection of dead or dying leaves. Without leaf tissue damage, the incidence and severity of SLB is reduced. *S. vesicarium* can be a secondary invader of downy mildew, botrytis leaf blight and purple blotch lesions and can ultimately 'take over' becoming a very aggressive leaf defoliator. Onion plants subjected to heat stress are more susceptible to SLB.

Older onion leaves and mature plants are more susceptible to infection than young leaves. When onions reach maturity their foliage naturally dies back as the plant transfers nutrients from the leaves to the bulb, making infection by *S. vesicarium* more likely since it readily colonises necrotic leaf tissue under favourable environmental conditions. Onion plants that died prematurely, 'standing up', often have many more bulb rots at harvest.

SLB infection and disease development is favoured by temperatures between 18-25°C, humid conditions and long periods (>8h) of leaf wetness. Sporulation usually occurs at the site of initial lesions and is observed 6-14 days after the development of initial lesions.

In recent years in the United States of America (USA) and Canada, outbreaks of SLB have become more common and severe than previously experienced, causing several local onion experts to suggest that SLB has transformed from being a secondary disease of necrotic tissue, to an aggressive onion disease that can cause excessive leaf dieback.

Disease Control

Although no single tactic will manage SLB, integrating several control practices can help onion growers to maintain crop quality while minimizing economic losses due to the disease. Control of SLB of onion has been attempted in various ways including:

1. Maintaining a healthy crop

Since the pathogen is likely to enter leaves that have been physically damaged or infected by other diseases, it is important to maintain healthy plant stands and control other common foliar diseases of onions such as downy mildew and botrytis leaf blight. Avoid injuring bulbs during production. Do not over-fertilise the onion crop with nitrogen because excessive N applications can increase SLB severity.

2. Crop rotation

Because the SLB pathogen can survive in soil for long periods on decomposing plant material, crop rotation with non-hosts plays an important role in reducing the inoculum levels in onion fields. A 3- to 4-year rotation to reduce the amount of inoculum present and to reduce SLB disease incidence is recommended.

3. Treated seed

Fungicide seed treatments (e.g. carbendazim, thiram, procymidone) are not effective in eradicating the SLB pathogen from onion seed. Hot water soaking seed at 50°C for 20 min reduced *S. vesicarium* in seed but germination was also reduced.

4. Reducing leaf wetness duration

Methods to reduce leaf wetness duration to reduce the incidence and severity of SLB include (1) increasing plant spacing in seedbeds to facilitate air movement and rapid drying of the foliage, (2) aligning rows of plants to follow the direction of the prevailing wind, and (3) irrigating crops during the late morning or early afternoon to allow leaf surfaces to dry rapidly.

5. Cultural controls

Cultural methods for management of fungal diseases such as SLB aim to reduce the pathogen numbers and to create conditions that are unfavourable for infection. Burying plant residues at the end of the onion growing season by deep tillage reduces SLB by facilitating decomposition and increasing the action of pathogen antagonists.

Removing culls and volunteer plants from the field since these can be a source for both pathogens and insects that cause wounding on onion plants.

If SLB-infected onions are dying standing up when they should be toppling, they should be pulled. It may take longer for the necks of these onions to dry, and they also have a higher risk of rotting in storage than healthy onions.

6. Biological control

Although biological control agents such as *Bacillus subtilis, Saccharomyces cerevisiae, Pseudomonas fluorescens* and *Trichoderma* species reduced the severity of SLB in onion under controlled conditions, these products do not provide effective management of SLB when used as the sole management strategy under field conditions.

7. Resistant cultivars

Although genetic resistance is a fundamental and effective weapon for disease control in many crops, currently there are no commercially available onion cultivars that are resistant to SLB.

8. Disease forecasting

Various disease forecast systems have been used or developed to predict incidence of diseases similar to SLB, with the goal of reducing the number of fungicide applications. Models such as Tom-Cast, STREP and FAST use the relationship between the duration of wetness or humidity and temperature to determine disease infection periods and to predict disease risk.

9. Fungicides

The most effective way to manage SLB on onion is regular applications of preventative fungicides, but few fungicides have been reported to be effective in the management of this disease.

In New Zealand, no fungicide is currently registered for control of SLB of onion. Fungicides registered in New Zealand for leaf spot of asparagus caused by *S. vesicarium* are:

1. Chlorothalonil (currently registered in New Zealand for the control of onion downy mildew; as Cobra™, in a mixture with dimethomorph)
2. Copper (also registered in New Zealand for onion downy mildew and bacterial blight)
3. Difenoconazole (not currently registered in New Zealand for onion diseases)
4. Iprodione (not currently registered in New Zealand for onion diseases)
5. Procymidone (also registered in New Zealand for onion white rot).

Because *S. vesicarium* readily invades onion leaves via dead or damaged tissues, controlling other foliar diseases such as purple blotch, downy mildew and *Botrytis*, and insect pests such as thrips is critical when managing SLB of onion. Fungicides effective against purple blotch are also effective against SLB, but fungicides that control downy mildew do not always control SLB (e.g. Mancozeb).

The fungicides reported as being the most effective for managing SLB belong to FRAC groups 3 and 7. FRAC group 3 and 7 fungicides, often used in product mixtures with other FRAC fungicides, are currently

used overseas for control of SLB of onion and include (FRAC groups in brackets):

- Difenoconazole (3)
- Propiconazole (3)
- Tebuconazole (3)
- Boscalid (7)
- Fluopyram (7)
- Fluxapyroxad (7) registered in New Zealand for white rot.

FRAC group 2 fungicides are also used for SLB of onion control overseas including:

- Procymidone
- Iprodione

FRAC group 11 fungicides used for SLB control overseas include:

- Azoxystrobin
- Pyraclostrobin

Fungicide resistance

Although FRAC Group 7 fungicides were the most effective in reducing SLB, it is recommended to rotate fungicides with different modes of action for fungicide resistance purposes. Timing of fungicide applications with effective fungicides is crucial to control SLB.

FRAC group 11 QoI (Quinone outside Inhibitors) fungicides and FRAC group 2 dicarboximides fungicides are considered 'at risk' for the control of *S. vesicarium*. Recent studies in the USA and Europe reported that *S. vesicarium* isolates from onions and pears were insensitive to FRAC group 11 fungicides.

Fungicide trials conducted in onions between 2013 and 2015 showed that protectant fungicides including Bravo (FRAC code M5) and mancozeb (FRAC code M3) had very little activity against SLB, and fungicides belonging to FRAC groups 9 (pyrimethanil), 20 (pencycuron), 12 (fludioxonil) and 2 (iprodione) had poor activity against SLB.

Fungicide recommendations given to USA onion growers for SLB control

Since the fungicides mentioned in Table 1, below, may not be available or registered for onions in New Zealand, the information in this section of the report is for educational purposes only, and does not constitute recommendations to New Zealand onion growers by the authors of this report.

Regular calendar preventive sprays are recommended for foliar diseases. Ideally, use products with two fungicides with preventative, systemic and curative properties (or tank-mix two different fungicides with different modes of action.

Include a FRAC group 3 or 7 fungicide in every spray, especially if high disease levels are likely. Because most new fungicides have only a single site of action, they are prone to the pathogen developing resistance to them. It is important to adhere to the fungicide resistance management strategy of rotating fungicides with different modes of action and not exceeding 2-4 applications in a growing season (read product label).

Table 1. Fungicides recommended for *Stemphylium* leaf blight (SLB) and downy mildew (DM) of onion in New York. *Since these fungicides may not be available or registered for onions in New Zealand, the information in this table is for educational purposes only and are not recommendations by the authors of this report.*

Fungicide	Active ingredient	FRAC group	SLB control	DM control
Quadris Top	azoxystrobin + difenoconazole	11, 3	Yes	Yes
Mervion	fluxapyroxad + pyraclostrobin	7, 11	Yes*	Yes
Viathon	phosphorous acid + tebuconazole	33, 3	Yes	Yes
Luna Tranquility	fluopyram + pyrimethanil	7, 9	Yes*	No
Luna Experience	fluopyram + tebuconazole	7, 3	Yes*	No
Inspire Super	difenoconazole + cyprodinil	3, 9	Yes	No
Endura	boscalid	7	Yes	No
Tilt	propiconazole	3	Yes	No
Rovral + Scala	iprodione + pyrimethanil	2, 9	Yes	No
Tanos	famoxadone + cymoxanil	11, 27	No	Yes
Mancozeb	mancozeb	M3	No	Yes
Ridomil Gold	mefenoxam	4	No	Yes

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