Factsheet 14/11

Field vegetables

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Leek rust

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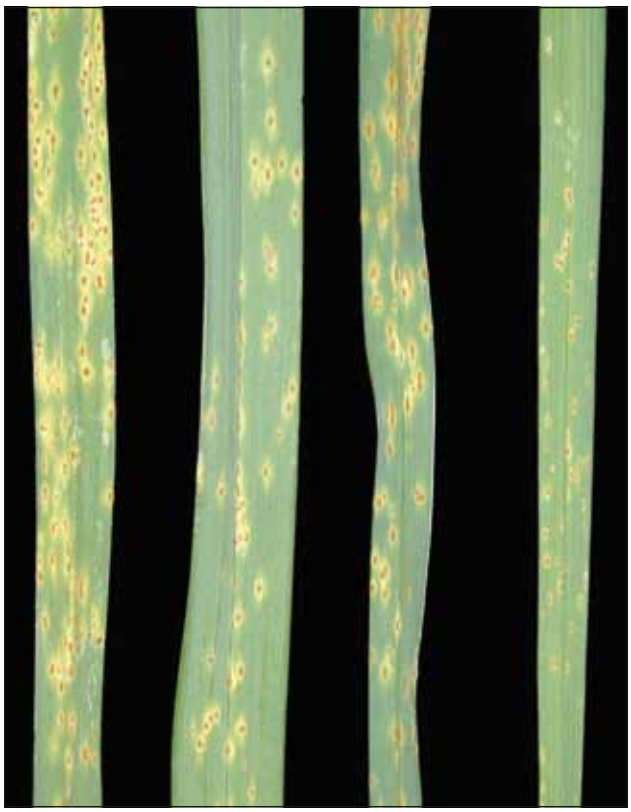
Background

Leek rust caused by the fungus *Puccinia allii* is the most important foliar disease of leeks in the UK (Figure 1). While severe attacks can reduce yield directly (Figure 2), the main economic impact is from its importance as a leaf blemish that downgrades the quality. As leek rust is active for most of the year, it remains a challenge for control as numerous fungicide treatments may be required on overwintered crops.

Related Allium species such as garlic, chives and onions are also affected by rust. The fungus *P. allii* is regarded as a species complex with some specialisation to different host species. It has been reported that European leek strains can affect garlic and onions. In California, some garlic isolates affect onions and chives but not leeks.

In late autumn and winter, epidemic progress is slowed or stopped due to low temperatures and then continues in the spring causing damage to overwintered and newly planted crops. Optimal conditions for leek rust epidemics generally occur from mid-August onwards in the UK. The shortest latent period for *P. allii* in the field was between August and September.

Choosing the correct control strategy is essential if yield losses are to be reduced to a minimum and it is therefore important to determine strategies for fungicide use which will maximise efficacy. Important factors affecting fungicide performance are: the level of rust infection at the onset of control treatments, application interval, application timing and fungicide dose.



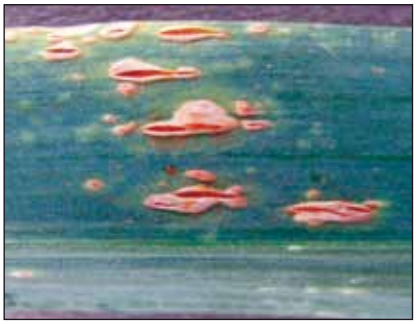
1 Leek rust is the most important foliar disease of leeks in the UK

2 A leek plant severely affected by leek rust

Symptoms

The first symptoms of leek rust are usually noticed when there is a scattering of bright orange pustules on the lower leaves (Figure 3). The older pustules are raised blisters 3-5mm long that have erupted between the leaf veins and split open to reveal the mass of rust spores (urediniospores). The pustules can occur on both the upper and lower leaf surfaces and occur singly or in clusters. Distinct bands of pustules can often be found at various positions along the length of individual leaves (Figure 4). This banding is associated with favourable conditions for infection at the leaf base or as the leaf was emerging.

When rust is developing actively, it may be possible to identify small white or yellowish spots that are early rust symptoms that appear before the sporulating pustules develop.



3 Bright orange pustules are typical first symptoms of rust

4 Distinct bands of pustules occur when conditions are favourable for the disease

On leeks, it may sometimes be possible to find black or blackish violet pustules on heavily infected leaves from late summer onwards. These are producing a second type of rust spore, the teliospore. The teliospore stage appears to be rather more common than in the 1980's when it was first recorded because of higher summer temperatures.

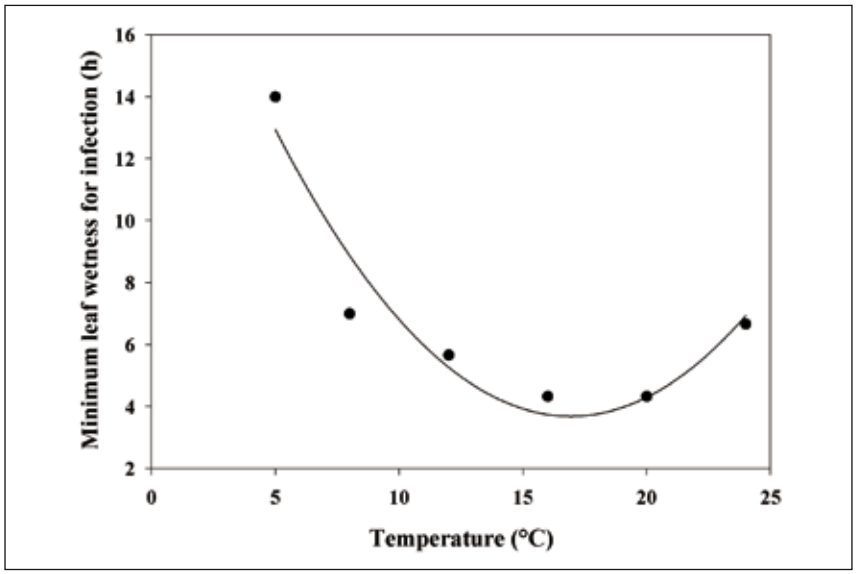
When leaves are severely affected by rust, there is dieback from the leaf tip, yellowing and death of the leaves. This reduces plant growth and ultimately the yield. Heavily infected leaves are more prone to frost damage.

Epidemiology

P. allii spores can germinate at a wide range of temperatures. The highest rate of germination is between 12 and 21°C. The fungus can successfully infect leek leaves between 7 to 22°C. Infection is reduced in the autumn and winter because temperatures are often below 7°C. Average temperatures above 22°C do not occur often enough to have a significant effect on the disease.

The number of leek rust pustules increases with spore density on leek leaves. The leek rust latent period (time between infection and symptom appearance) is also affected by temperature, being shortest (about 10 days) at average temperatures between 19 and 22°C.

Leek rust spores require leaf wetness for germination and infection. The minimum temperature and leaf wetness duration required for leek rust infection is 4 hours at temperatures of 15-20°C (Figure 5). At lower temperatures between 6 and 14 hours of wetness are required for leek rust infection. Leaf wetness is present in leek crops on many nights during the growing season but the durations may not be sufficiently long for successful germination and infection by rust spores. Epidemics of leek rust are more likely to occur if periods of wetness (rainfall) occur during the day than at night.



5 Minimum leaf wetness duration required for *P. allii* to infect leek leaves in relation to temperature

If leek crops are planted outside the normal cropping period, epidemics are often less severe with a considerably reduced impact on marketable yield. Temperature (and its interaction with leaf wetness duration) and spore density on leaves are the important factors affecting leek rust epidemiology in the crop.

Life cycle

Overwintered crops are the main source of rust for spring-planted crops. Rust can survive on volunteers and green crop residues. Thus

packhouse waste may also be the source of the disease when it is returned to the field in fresh condition. The spread of rust is mainly by means of airborne spores (urediniospores) that can disperse the disease over long distances. Rust will be more evident where there are local sources of the disease.

If early plantings become infected they can be a source of infection for later plantings nearby. Rust is often evident by July in spring-planted crops. It will continue to spread and develop throughout the year except when there are low temperatures (frosts). There are some reports of teliospores which may assist survival of rust when high temperatures (>25°C) adversely affect urediniospores.

Puccinia allii can infect both leeks and some onion species. The importance of this arises from the recent greater use of *Allium fistulosum* and *Allium cepa* crosses within the salad onion industry. Leek rust can infect *Allium fistulosum* more readily, so salad onion crops may be a source of infection for leek crops.

Varietal resistance

The use of varieties with good resistance to rust is an important part of disease management. Breeding for rust resistance is a priority and breeders make claims for rust resistance for some of their varieties. Breeders are improving the resistance to rust as they develop new F1 hybrids. There is limited recent data for the resistance of varieties to leek rust. Work at East Malling carried out in an EU-funded Interreg project has identified F1 hybrids can be separated into resistant and susceptible varieties as follows:

- Resistant - Antiope F1, Belton F1, Nun 6202 (released as Duration F1).
- Moderately resistant - Poulton F1, Triton F1, Lexton F1, Longton F1, Megaton F1.
- Susceptible - Kenton F1.
- Highly susceptible - Roxton F1, Harston F1.

Under the test conditions over 95% of plants of susceptible varieties had rust compared with less than 30% plants affected in resistant varieties. This range is comparable to that obtained in previous work at NIAB where the more resistant varieties showed rust levels that were still likely to justify fungicide treatments.

Fungicides

Good control can be achieved with fungicide treatments provided sprays are used from disease onset and continued to maintain protection while weather conditions remain favourable for rust development.

Symptoms can appear in 10-14 days under optimum conditions and 4-5 weeks at temperatures around 7°C so there is opportunity to exploit curative ("kick-back") activity of products. As new leaves are produced these also need to be protected regularly by using sprays at 2-3 week intervals.

Table 2. Fungicides with full label recommendations for leek rust control

Active ingredient	Product (examples)	Max number applications	Harvest interval
azoxystrobin	Amistar	4	21 days
azoxystrobin + difenoconazole	Amistar Top	2	21 days
prothiocoanazole	Rudis	3	21 days
tebuconazole	Folicur	3 (potentially more up to total dose of 3.0 l/ha)	14 days
tebuconazole + trifloxystrobin	Nativo 75WG	3	21 days

Products

New fungicide recommendations have been developed for leek rust control in recent years (Table 2). There are single actives or mixtures available from different fungicide groups: the strobilurins (eg azoxystrobin and trifloxystrobin) and azoles (eg prothioconazole and difenoconazole).

As these fungicides also have "kick-back" activity against other diseases of leeks, it is important to use different fungicides in a programme to reduce the risks of selecting fungicide-resistant strains. To date, the strobilurin fungicides have continued to give good control of rust diseases in other crops.

Dose

Previous studies have shown that leek rust development is affected by fungicide dosage (based on experiments using azole fungicides). The recommended dosage of azole fungicide reduced the rate of new pustule appearance by 41-65% while a 25% dosage reduced the rate by only 8%. Lower doses of azole fungicides were therefore ineffective in reducing the rate of appearance of new rust pustules. However, leek rust spread between plants is more sensitive to lower fungicide dosage. Applying lower dosages of fungicides during periods when the crop is disease free may be a useful method of protecting the crop and reducing fungicide application rates. Fungicide applications generally become less effective as the minimum latent period is approached, therefore higher fungicide doses would be recommended with increasing time from infection when disease is present in the crop.

Agronomy issues

There is high risk of rust where new crops are planted near to overwintered crops and where sequential plants are made in the same field or adjacent fields. Ideally, overwintered crops should be harvested before new crops are planted nearby.

High rates of nitrogen, dense crops and sites with low soil potash are more prone to rust.

In organic systems it may be appropriate to use a single planting of a resistant variety to minimise the risks of rust. Any infected plants or diseased patches can be harvested early (selectively) to assist management of the disease.

Regular crop monitoring is required to detect the first signs of rust. Sheltered fields are more prone to rust than open fields with good air movement present in the crop.

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6 Overwintered crops should be harvested before new crops are planted nearby.

Action points

- Select resistant varieties for use in locations where rust occurs regularly and leek cropping continues throughout the year.
- Avoid sequential plantings in the same or adjacent fields to limit spread of rust between crops.
- Disease risk can be decreased by using only a single planting.
- Check crops regularly for first signs of rust – particularly from early July onwards.
- Apply fungicides from the first signs of rust and maintain protection using a diversity of fungicide types at 2-3 week intervals.
- Dispose of infected crop residues promptly by composting or incorporation into soil.

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