Downy mildew

P J Wright, Crop and Food Research, Pukekohe

Downy mildew is a fungal disease that can cause serious reductions in yield and quality of onion bulbs. Extensive crop loss may result if suitable control measures are not taken when weather conditions favouring disease development occur during the growing season. The severity of downy mildew infection can vary from season to season depending on field locality, prevailing weather conditions and fungicide applications.

Downy mildew of onion is caused by the fungus *Peronospora destructor*. The fungus can infect onions at any stage of the plant's growth from seedling to maturity. The first symptoms of the disease are seen on the leaves as small, pale green spots, about 1-3 mm in diameter, which finally become a greyish-white. If weather conditions are suitable, the spots increase in size and number and the foliage develops a flecked or streaky appearance. On the surface of the foliage the fungus produces spores on structures called sporangia, which often appears as a greyish-purple downy growth - hence the name downy mildew. The fungal growth is more noticeable in the early morning when plants are wet with dew, but may not be easily seen in dry weather. Diseased leaves may become covered with a sooty mould but this is a secondary invader. Infected leaves usually turn a pale green colour at first, then yellow, and finally shrivel and die. The older leaves are usually attacked first, followed by younger leaves if conditions favourable for infection continue. Badly infected plants are usually stunted, with distorted and twisted leaves. The bulbs of diseased plants are often smaller than those of healthy plants and are more susceptible to post-harvest attack from soft-rotting fungi and bacteria, and are also prone to premature sprouting in store. In seed crops the disease can attack seed stems causing stalks to bend or break.

The fungus survives in the soil from season to season as spores on infected onion debris and as mycelium in infected bulbs. The disease usually starts where there are areas of concentrated inoculum ("hotspots") in the field and is spread by wind and rain to surrounding areas causing new infections. Downy mildew requires cool, moist nights and mild day temperatures for optimum development. Infection is also favoured by heavy dew, high relative humidity, and cloudy weather. Although dry weather slows the spread of infection, the disease will continue to spread in wet weather if control measures are not applied.

Downy mildew of onion is effectively controlled by fungicide applications. However, once established in a crop, the disease can become difficult to control. A fungicide spray programme should be initiated as disease symptoms appear. The timing of applications is determined by the severity of infection and weather conditions. A fungicide programme should consist of regular applications of a protectant fungicide together with the use of a fungicide with systemic activity when conditions of high humidity develop. Crop management practices that can be applied to reduce losses including the planting of onions in fields with good drainage and air movement, adopting rotations of at least 3 years, and the removal of diseased onion refuse from fields after harvest. Weed control is also important as excessive weed growth can create humid conditions which favour the development of the disease. Over-fertilisation with nitrogen should be avoided as plants with lush foliage are more susceptible to fungal attack. Overhead irrigation also increases the risk of downy mildew infection. •

Fungicides registered for control of downy mildew in onion

Protectant	Systemic & protectant
Antracol	Ridomil MZ 72 WP
Captan	
Copper oxychloride	
Dithane Z-78	
Euparen	
Mancozeb	

About 10 percent of time lost as a result of back problems was more than one week. Another 12 percent were off work for less than a week.

The biggest cause of back pains, again, not surprisnlgy came from lifting, 32 percent. Most back injuries are diagnosed as disc or slipped disk injury, 42 percent; muscular, 39. percent

Eye and ear injuries

Eye injuries occurred to about one eight of the survey group and in half of these cases medical treatment was necessary.

Eye protection was practised by about 30 percent of the survey group.

Hearing loss occurred at some time in the past for about 16 percent of respondents. Over half of respondents who use tractors or chainsaws wear ear protection when using those implements.

Allergies

Allergies also ranked high on illnesses — 28 percent reporting that they had a problem with this condition. Hay fever plagued 63 percent of those suffering from allergies, followed by skin rashes/hives at 25 percent; asthma 21 percent and others at 19 percent. Most, 89 percent, however had not had their farming routine affected by the allergy.

Work hours

Only 20 percent of the group work less that 40 hours a week; 22 percent work between 41 and 50 hours; 24 percent work between 51 and 60 hours and 32 percent qualify as workaholics working longer than those hours.

(One consolation for growers: at least vegetables don't fight back. Livestock do, it seems, and account for quite a high rate of injury. Twenty two percent of the sample were injured by animals; cattle were the biggest problem and bruises were the biggest injury with about 38 percent of that group having to take time off work.)

Lessons to be learned? Nothing new, according to the ACC. People still take silly gambles with chemicals or don't wear protection, a lot of people still use their backs to lift heavy weights; too many people still don't wear hats, and they do expose themselves too much to the sun. Some reports even suggest that our rate of skin cancer is higher than it is among similar occupational groups in Queensland.

In some areas there is a ripe scenario for accidents: using sharp knives daily, for instance, is a risk. This is recognised in the freezing industry where steel mesh protectors are worn on at risk hands.

Using a tractor can be a risky business. The ACC has a special book on safety which is available on request to any branch. •

Onion soft-rot

C N Hale; J A Fullerton, Hort and Food ; P J Wright, Crop and Food.

Onions are New Zealand's fourth largest horticultural revenue earner after kiwifruit, apples, and squash. New Zealand produces approximately 80,000 tonnes of onions annually, of which about half is exported, principally to Europe and Japan. The Pukekohe district of South Auckland accounts for 75% of the national crop and all exported onions. Exports of onions to Japan dropped from 78.7% of total exports in 1984 to 20.7% in 1987. Sales to Canada, Netherlands, West Germany and United Kingdom have increased but do not make up for the decrease in exports to Japan. The decline in export sales of onions to Japan has been directly attributable to a loss of market confidence in New Zealand onions due to disease problems in exported bulbs. The most important disease affecting exported onions is bacterial soft rot.

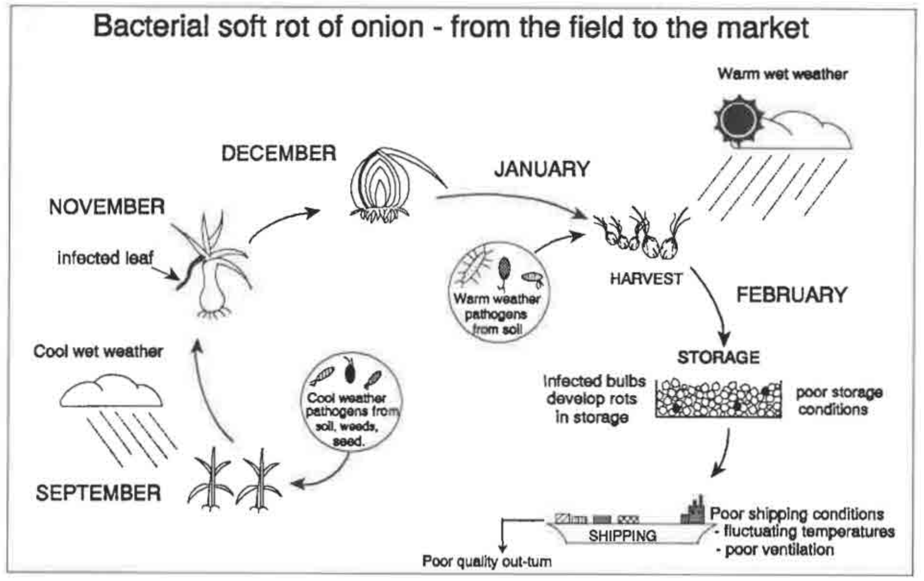

Figure 1. Bacterial soft rot of onion — the cycle from the field to the market

Bacterial soft rot of onions does not have a defined disease cycle as several pathogens are involved that can infect the onion at different stages of the plant's growth, from seedling emergence through to storage and shipping (Fig. 1).

Early in the growing season (August - September) diseased plants show a slimy, grey-brown rot at the base of some leaves. Infected plants may collapse completely and often have a characteristic 'vinegary' smell.

Early season disease is favoured by cool, wet conditions, and usually is most destructive if heavy rain or hail has damaged the foliage. Bacteria may enter the neck tissue of bulbs through dead or senescent leaves and progress down one or more scales.

The cutting of tops at harvest facilitates infection. Warm, wet conditions at maturity and during field curing increase the incidence of diseased onions in storage. The early stages of soft rot are not noticeable at grading and, as a consequence, the export of infected onions can occur. Infected onions will rot in transit if storage and shipping conditions favour disease development.

Several species of bacteria can cause soft rot of onion bulbs including *Pseudomonas marginalis*, *P. viridiflava*, *P. gladioli pv. alliicola*, and *Erwinia carotovora*. These organisms can exist as saprophytes in the soil and in plant debris. The relationship between soft rots that occur during the growing season and those seen in storage is not clear as the spectrum of bacteria associated with disease of growing plants may differ from those isolated from rotted bulbs. The incidence of storage rots does not appear to be related to the severity of field infection, as in recent years levels of disease in the field were low whereas severe post harvest rotting was often reported. Soft rot is a major problem in the onion industry due to the complex nature of the disease and because no effective chemical control measures are known.

Field trials

Field experiments were carried out at the DSIR Pukekohe Research Station in 1987-88 and 1988-89 to study the onion soft rot disease under field conditions and to examine the effects of i) supplementary water applied throughout the growing season, ii) chemical sprays for control, and iii) inoculation of plants with soft-rotting bacteria, on the severity of bacterial storage rots in bulbs of the onion cultivar Pukekohe Longkeeper (PLK).

To determine the effects of water applications (simulating rainfall) at selected times during the growing season, four blocks of Pukekohe Longkeeper were provided with one of the following overhead irrigation regimes: a) supplementary water all season, b) supplementary water up until lifting, c) supplementary water only during harvest and the field curing period, and d) no additional water. Supplementary water was applied using microjet sprinklers to wet the foliage without creating conditions of excessive soil moisture.

To test the effectiveness of copper as a control measure against soft-rotting bacteria, copper hydroxide (as Kocide 101) was applied throughout the trial period at 7-10 day intervals. Artificial inoculations with bacteria associated with soft rots were applied by spraying a mixture of *P. marginalis* and *P. viridiflava* with carborundum abrasive added to cause a slight wounding to the onion foliage. Sampling was carried out monthly between November and June when the bulbs were cut in half and the incidence of soft rot recorded.

The trials demonstrated that the physiological maturity of the onion tops at the time of lifting and the moisture regime prevailing over the harvest and field curing periods are critical factors governing the incidence of bacterial soft rot disease (Fig. 2, over the page). Under 'normal conditions (regime - no supplementary water), the tops senesced, toppled as bulbs reached their maximum size, and dried off rapidly during curing. The bulbs had narrow, tight necks by the time they were topped and transferred to store. The loss from rots was approximately 5%.

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Weed control techniques

Patch spraying (using agrichemicals only in areas affected) has taken a step forward in Britain with the success of an experimental system designed to detect patches of weeds in a crop and control the sprayer to treat only those patches rather than the whole field.

The new tractor-mounted patch sprayer has been produced by the UK Agricultural and Food Research Council's (AFRC) Silsoe Research Institute to investigate localised herbicide application in the field. Project leader Dr Paul Miller says of it: "As an example of computer-aided technology, it is one of the most advanced and sophisticated systems currently under development."

With the Silsoe sprayer, a field map is generated using a combination of aerial photography with map-based image analysis, field walking or other field operations. The information is then stored in a computer, mounted in the tractor cab, which relays signals to a computerised sprayer control system.

The operator starts by telling the on-board computer where the sprayer is in relation to the map, achieved by distance measurement down a "tramline". The unit then uses integrated speed measurement to keep track of where it is in the field. In future, the location system could be based on an automatic method, such as the satellite-based Global Positioning System (GPS).

Once the field position has been identified, and the need for weed treatment defined, the spray output is controlled through a direct injection metering system that quickly responds to control signals. Solenoids are used to switch individual two-metre spray boom sections on and off, according to the map readings.

The sprayer consists of a conventional tank and a specially constructed 12m boom with twin spraylines, fed by small-bore pipes to give rapid response times. The advantage of direct metering is that the tank contains water only, with the chemical pumped straight from its original container into the water lines, adding to the environmental and safety aspects of the system.

By using two parallel spraylines, and controlling individual sections of the boom, the rate of application of a single herbicide, or a combination of herbicides, can be selected. This allows relatively small weed patches to be treated with targeted dose levels and appropriate herbicide mixtures. The research is ultimately working towards a fully automated system of weed detection and control.

A similar research programme is underway to develop techniques where pest and particularly fungus infections are targeted on a "patch" system. This requires a sophisticated system of monitoring for pests to be able to identify infestations before they are widespread.

Much of horticultural and agricultural research in Britain is now aimed at lower chemical usage techniques. This form of research is not only being carried out at Government run establishments but also by some of the major agrichemical companies.

Several research programmes are also underway to develop effective "flame guns" both for use in herbicide control and, a more ambitious but difficult programme, to develop the technique for some pests.

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When bulbs were kept moist during the field curing period (regime c), the incidence of losses from rots increased to 10%. Supplementary water applied only during the growing period (regime b) also caused 10% rots. When water was applied over the harvest and curing period (regime a) the incidence of rotted bulbs was approx. 30%. Plants which were heavily watered during the growing period, particularly during the drier months of December and January, retained lush green tops which did not senesce and topple at the usual harvest time. These plants had wide turgid necks and, when lifted, the tops dried off very slowly - especially when water (or natural rainfall) was applied during the curing period. The tops often became wet and slimy, creating conditions favourable for the entry of soft-rotting organisms through the neck of the onions. The trials carried out over two seasons showed that inoculation of plants with soft rot-causing organisms and the use of protective copper sprays had no significant effect on the incidence of rotting.

Further work has concentrated on climatic conditions over the late maturity, lifting, and curing periods and their effect on the incidence of soft rot. A number of husbandry practices which may ameliorate the soft rot problem will also be examined and reported at a later date. ●

Figure 2. Effect of irrigation treatments on the incidence of onion soft rot