Spraing Disease of Potato

Tubers showing external necrotic rings

Key facts

- Characterised by dark rings on the potato tuber surface. Brown necrotic arcs or flecks in the flesh of tubers and foliar symptoms affecting leaves and stems
- Two causal viruses, *Potato mop-top virus* or *Tobacco rattle virus* induce similar symptoms
- Both are soil borne but with different modes of transmission
- Although symptoms are similar, the viruses are very different
- *Potato mop-top virus* (PMTV) is vectored by the powdery scab fungus *Spongospora subterranea*
- *Tobacco rattle virus* (TRV) is vectored by free living nematodes in the genera *Trichodorus* and *Paratrichodorus*
- Symptoms can be confused with physiological problems, such as internal rust spot
- Symptoms may not be seen at harvest but can develop in store
- Planting diseased tubers in clean land could be a source of further spread of virus inoculum
- Chemical control is of limited use – ensuring disease free seed and knowledge of presence of vector and inoculum presence in field is essential to disease management

Tubers showing classic concentric arcs of spraing

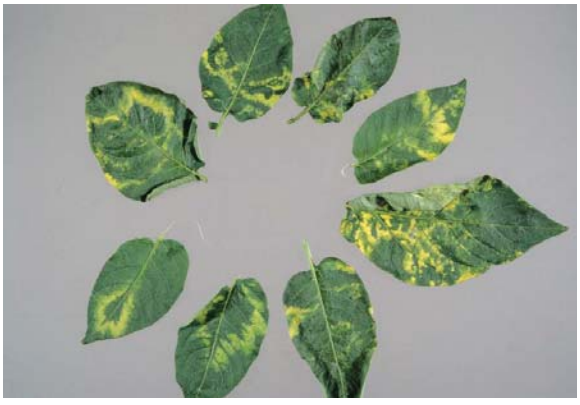
Introduction

Spraing is the term given to a range of internal and external symptoms in potato tuber flesh consisting of brown, necrotic rings, arcs and flecks. Two viruses can cause these symptoms, *Potato mop-top virus* (PMTV) and *Tobacco rattle virus* (TRV). In some cases external concentric rings may be visible on the surface of the tuber. The severity of symptoms in the tuber can range from mild (a few flecks or faint brown lines) to severe (heavy, dark chocolate coloured arcs with a corky texture). A few symptomatic tubers may be found or the stock could be heavily affected (>50%). Spraing symptoms may not be evident at harvest. Fluctuations in temperature during storage can exacerbate development of the internal tuber symptoms.

Potato mop-top virus

Foliar Symptoms

The most common foliar symptom observed is the development of bright yellow blotches or chevrons on lower and middle leaves. There is also a milder symptom of pale green chevrons on the young upper leaves. The term “Mop-Top” refers to another symptom of the disease, a shortening of internodes leading to a dwarfed, bunched appearance. Symptom expression is variety dependant, for instance Hermes exhibits the dwarf/bunched symptom whereas Estima exhibits the yellow blotches and chevrons. Foliage symptoms may be observed on leaves and stems of plants produced from infected tubers (secondary infection) and occur most readily in cool temperatures (<15^{O}C). Not all stems from an infected tuber will exhibit symptoms.



Foliar symptoms of PMTV

External ring induced by PMTV

Biology

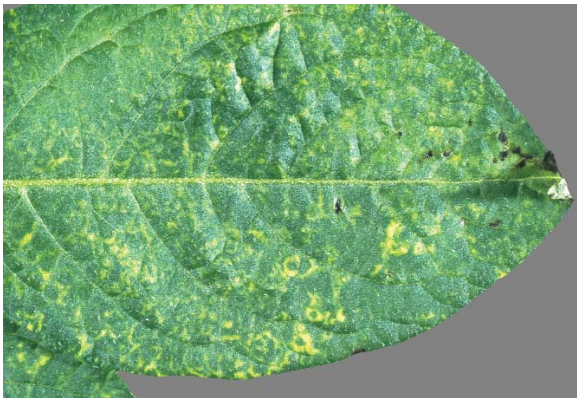
Infection by PMTV is linked to the vector, the powdery scab fungus *Spongospora subterranea*. No other vectors are known for this virus. Because this fungus is an obligate parasite of potato, it has not been possible to culture *Spongospora* in artificial media, hampering research on both the fungal and viral diseases. The relationship between vector and virus means that PMTV has a limited host range with potato being the only agricultural crop affected by the disease. The fungal vector is present in soils globally and therefore the potential range of the virus is also worldwide. The virus is carried in the resting spores or spore balls of the fungus that can remain viable in soil for many years.
The main routes of infection are through the roots, stolons and developing tubers. Although little is known of the timing of infection of the virus, the crucial period for powdery scab infection is a brief window between stolon formation and tuber set. Development of both PMTV and powdery scab can be dependant upon environmental conditions. Development of both diseases is less marked in warm, dry seasons.

Soil inoculum is the main source of infection. Planting clean seed of a susceptible cultivar in soil containing infective spore balls can result in high levels of spraing which could render ware potatoes unfit for market. If a PMTV infected, spraing affected tuber is planted in clean soil, fewer than 50% of progeny tubers will be infected with the virus. Little is known about latent infection with PMTV.

However, some varieties are known to carry PMTV infection and be tolerant to spraing. Planting infected seed in clean land will result in low levels of affected tubers. However, this could result in spread of the virus and the vector into otherwise uninfected soil.

Tobacco rattle virus

Foliar Symptoms
Generally TRV spraing infected tubers produce healthy plants. However, in some cases several healthy and a symptomatic, stunted stem will be produced, this is termed Stem Mottle. Symptoms may present as pinching and "scorching" of the leaf tip, mottles, distorted/wavy leaf margins and occasionally finely etched lines and rings or chevron type markings reminiscent of PMTV.



Yellow ring spots induced by TRV

Leaf twisting with necrosis induced by TRV

Biology
Transmission of TRV is via free-living nematodes of the genera *Trichodorus* and *Paratrichodorus*. As a consequence of the biology of the vector TRV tends to be a greater issue on light, sandy soils. Nematodes favour wet conditions and heavy rainfall or over irrigation can exacerbate incidence of the disease in affected areas. The virus has been shown to have a very broad host range and can infect over 400 plant species. These include crops such as Beetroot (*Beta vulgaris*) and Spinach (*Spinacia oleracea*). In addition to these species the virus can also infect many common field weeds including fathen (*Chenopodium album*), chickweed (*Stellaria media*), knotweed (*Polygonum aviculare*), bindweed (*Polygonum convolvulus*), groundsel (*Senecio vulgaris*) and dandelion (*Taraxacum officinale*).

TRV affected tubers will rarely be systemically infected and will generally grow into healthy plants. Whilst spraing symptoms are still the most visible and economically damaging characteristic of this disease some commonly grown varieties will become systemically infected. These varieties can act as a reservoir of virus for non-infective nematodes which feed on the infected tubers and acquire the virus. It is important therefore to know whether land contains viruliferous nematodes and the varietal susceptibility to TRV.

Diagnosis

Diagnosis of spraing diseases has always been dependant upon symptom expression. Even to the expert eye the tuber symptoms induced by each virus are almost indistinguishable so laboratory based testing is recommended. In it's milder forms spraing can also be confused with other internal defects such as internal rust spot, a common problem caused by Calcium defficiency. The Fera Plant Clinic has developed a molecular based assay allowing the simultaneous detection of PMTV and TRV. To allow the grower to make an informed decision when planting their crops the Plant Clinic has also developed a soil bait test combining a bioassay using tobacco plants with a molecular assay to simultaneously detect infection by PMTV or TRV in the roots of the bait plant.

Control

As a consequence of the biology of PMTV and the vector there are no effective chemical control measures against this disease. Due to the nature of TRV vector transmission chemical control is difficult. Chemicals do not kill the nematode populations but simply suppresses them.
The main method of control for both viruses is through field intelligence and effective cultural control. By ensuring that seed tubers are free from spraing diseases the opportunity for these diseases to spread from field to field can be minimised. The soil bait test offered as a diagnostic service by the Plant Clinic can help growers make informed decisions on which fields to use by identifying fields infected with both the vectors and their respective viral pathogens simultaneously.

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