

Paper 8

RECOGNITION AND CONTROL OF FOLIAR DISEASES OF PEAS

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INTRODUCTION

This paper deals with the identification and control of diseases which directly affect the foliage of the pea plant, and in which the organism responsible can be isolated from this tissue. Pathogens affecting the roots may cause foliage symptoms such as yellowing and wilting, these are described by Scott, (1987). It is important to realise that disease is an interaction of cultivar, pathogen and climate and since each of these is variable, the symptoms produced may also show a high degree of variability.

This is not intended to be an exhaustive list of foliage diseases and thus covers only those diseases which are most frequently encountered. The diseases to be considered, ranked in current order of economic significance, are alfalfa mosaic virus, bean yellow mosaic virus, top yellows virus disease, pea seedborne mosaic virus, downy mildew, bacterial blight, ascochyta complex, and septoria blotch.

VIRUS DISEASES

In New Zealand all pea viruses are spread by aphids. If there were no aphids there would be no virus disease problems in peas. The appearance of the blue green lucerne aphid (*Acyrtosiphon kondoi*) and the pea aphid (*A. pisum*) in the late 1970s caused a considerable increase in virus problems of pea crops. Aphids may overwinter in lucerne and clover or on weeds. Populations increase rapidly in spring and winged aphids fly to emerging pea crops. They may carry with them viruses which were present in the overwintering crop.

Alfalfa mosaic virus (AMV)

This virus disease has increased tremendously since the introduction of blue green lucerne aphid and pea aphid, and is now found in over 50% of lucerne and clover plants. The spring aphid flights from those crops therefore consist mainly of virus carrying individuals.

The most characteristic symptoms of AMV infection in peas is a purpling of areas on the surface of the pod which later become sunken and blackened. The plant itself is yellow and there may be necrosis of the stem and veins in the upper leaves. Apart from yield reduction due to small seed, or plant death, the seeds that are produced may show brown discoloration of the seed coat.

Control

To date, no durable resistance to AMV has been found in several hundred pea lines screened. Pea crops should not be sown directly adjacent to lucerne or clover. Management of lucerne or clover crops by grazing and/or spraying to minimise aphid populations is advisable if peas are to be grown nearby. The application of synthetic pyrethroids to control the spread of AMV and other viruses in peas has shown promise and further evaluation of these materials will continue at Plant Diseases Division D.S.I.R., Lincoln.

Pea strain of bean yellow mosaic virus (BYMV)

BYMV (also called pea mosaic virus) produces distinctive mosaic patterns in susceptible pea cultivars. The first symptom of infection is a clearing of the veins of young leaves. Later, a more general mottle develops. Infected plants are usually stunted and pale with smaller leaves than normal. BYMV is not seed-borne and is spread to pea crops from the overwintering hosts clover (especially red clover), field beans and broad beans by any of the aphid species associated with these crops.

Control

All currently grown cultivars of processing peas are resistant to this virus but some of the field pea cultivars, such as Partridge 73, Pamaro, Maro and Rovar, are susceptible. Recently released field pea cultivars such as Huka and Whero are resistant. The incidence in susceptible varieties is generally too low to warrant use of control measures.

Pea seed-borne mosaic virus (PSbMV)

PSbMV has been known in New Zealand only since 1978 (Fry & Young, 1980). Because it is transmitted via seed, several countries have imposed quarantine restrictions on the movement of pea seed. These regulations vary from a requirement for field inspection of the growing crop to having a serological test performed on a sample of the seed.

Recognition of PSbMV in the field under New Zealand growing conditions is difficult, since symptoms are usually very mild. When they do occur, the main symptom is a downward rolling of the leaf margins and a slight clearing of the veins in the youngest leaves. In recent seasons, small

seeds with distinctive brown staining have occurred in some seedlots. A possible association of this problem with late infection by PSbMV and/or alfalfa mosaic virus is currently under investigation at D.S.I.R, Lincoln.

Control

Pea cultivars resistant to bean yellow mosaic virus are also resistant to the strain of PSbMV which occurs most commonly in New Zealand (Ovenden & Ashby, 1981) but other strains occur which can overcome this resistance. Pea cultivars grown in New Zealand do not possess the gene for resistance to these other strains. Quarantine restrictions currently require that pea seed to be used to produce crops for export to Australia are tested at the Seed Testing Station, Palmerston North, and shown free of PSbMV. Such lines should not be grown adjacent to untested seed lines.

Top yellows virus diseases

Top yellows is a disease caused by a virus belonging to the luteovirus group. In New Zealand, the main incitant of top yellows in peas is soybean dwarf virus (SDV, synonym subterranean clover red leaf virus) transmitted by the dock aphid *Aulacorthum solani*. The disease may also be caused by beet western yellows virus (previously misidentified in New Zealand as pea leaf roll virus) which is transmitted mainly by the green peach aphid *Myzus persicae*.

In susceptible cultivars these viruses cause a marked stunting and yellowing and plants become rigid and brittle. There is frequently a proliferation of shoots from nodal buds at the base of the plant and infected plants often succumb to secondary root rots. The main source of SDV and *A. solani* is white clover, and susceptible plants grown near to white clover are at considerable risk.

Control

Most currently grown cultivars except Puget are tolerant to top yellows and these viruses now pose little threat to pea growing.

BACTERIAL DISEASES

Bacterial blight is the only bacterial disease of economic significance to pea growing in New Zealand.

Bacterial blight

Symptoms of bacterial blight, caused by *Pseudomonas syringae* pv *pisi*, may occur at any time after infection. The bacteria may be carried by the seed both internally and externally.

Bacterial blight may cause significant losses when environmental conditions favour its development. Wet cool conditions favour transmission and thus autumn sown crops of field peas frequently become infected.

Bacterial blight lesions may affect all above-ground parts of the plant but usually occur first at the nodes and on the stipules. Infection initially appears on the underside of leaves as watersoaked lesions which appear dark green or brown on the upper surface. Older lesions are papery and

light brown in colour with a darker border. Pods may become severely infected, the lesions being roughly circular, watery and sunken. It is through the pod that the seeds become infected. Irregular maturity results when the growing tip is killed by blight and new stems grow from the base.

Control

In New Zealand, bacterial blight is controlled mainly by the use of clean seed, and a testing service to check seed lines for blight is offered by the MAF Seed Testing station. Field inspection has also been used as a means of ensuring blight free seed crops. A suitable crop rotation should be practised to avoid any contact with residue or straw from previous pea crops. The organism does not survive in the soil once infected tissue has decomposed. Walking through crops or using machinery that will damage crops (for example rollers) should be avoided during damp cool weather. Use of a sterilizing agent such as 1% sodium hypochlorite or an antibiotic like streptomycin will reduce infection carried on the seed but not that carried within the seed. Overseas, resistant cultivars have been used though none is resistant to all races. In New Zealand, none of the cultivars currently grown is resistant to both races of bacterial blight known to occur in this country.

FUNGAL DISEASES

In New Zealand, downy mildew is the fungal disease most frequently encountered in pea crops. Fungi of the aschochyta complex occur less frequently but may be damaging, especially in autumn sown crops. Septoria blotch is of minor importance.

Downy mildew

Downy mildew of peas (*Peronospora viciae*) may cause substantial losses in plant population, quality and yield. The disease is most prevalent in wet, cool seasons. Early sown vining peas are most susceptible.

Infection of peas by downy mildew falls into three categories:

- Systemic.
- Local foliar, tendrils, flower sporulation.
- Pod infection.

Systemic infections usually occur before flowering and are associated with stunting, and distortion. A dull mealy growth develops on the plant causing it to wither and die. If sporulation is inhibited by unsuitable weather conditions the infected areas turn greyish white. Growth in systemically invaded seedlings is severely limited and the plants either die in 2-3 weeks or produce new branches. Systemic infections later in maturity may be restricted to the growing point, with infection spreading to lower leaves.

Localized lesion infections resulting from wind blown spores appear as yellow to brown blotches on the upper leaf surface with areas of fluffy white to bluish cottony mycelium on the under surface (Hagedorn, 1974). Further development produces chlorotic patches on leaves and sometimes stems (Kirk and Koshevskii, 1976). Young

lesions are 0.2-2 cm in diameter, light green with brown blotches on the upper surfaces. Symptoms begin on the lowest leaves and progress up the plant.

Pod infections, stimulated by high humidity, have yellow lesions on the outer surfaces. If pods are formed on systemically infected plants they are flattened, yellow, distorted and rarely set seed. A white felty growth develops internally accompanied by a velvet growth on the pod exterior, preventing the seed from maturing.

Young leaves immediately after emergence are highly susceptible to infection, becoming more resistant as they mature.

Control

There are few chemical measures available to control downy mildew of peas. Recently developed systemic fungicides such as metalaxyl and aluminium ethyl phosphonate have had varying success.

Apron 70SD, a mixture of metalaxyl and Captan, is selective for the peronosporales and is systemic. Applied as a seed treatment, Apron gives excellent control of primary infection but has little control over secondary, non-systemic infection.

Initial trials have shown that an experimental product, Alliette, can reduce primary systemic infection. Reduction in secondary infection has been shown with the use of the herbicide Sinox SE.

Resistance to downy mildew is at present confined to non-commercial cultivars.

Peronospora viciae produces oospores which can survive for long periods in plant debris and soil. To effectively control the pathogen, all plant debris should be removed and burned. Deep tillage and extended crop rotations are also useful for reducing the concentration of inoculum in the soil. Mobile pea vipers, on the other hand, macerate the haulm leaving an ideal inoculum for further spread of the pathogen.

Ascochyta complex

Three closely related fungi, *Ascochyta pisi*, *Mycosphaerella pinodes* (the perfect stage of *A. pinodes*) and *Phoma medicaginis* var. *pinodella* (formerly *A. pinodella*) are responsible for the group of diseases often called the ascochyta complex.

Leaf and pod spot and collar rot are all symptoms of attack by the complex, and even a slight infection can result in significant losses.

A. pisi attacks pods, seeds, leaves and sometimes stems and is commonly known as leaf and pod spot. Early infection can result in death of the plant. Lesions caused by *A. pisi* can be distinguished from those caused by *M. pinodes* and *P. medicaginis* var. *pinodella* in being slightly sunken, tan and sharply delineated by a prominent margin. On leaves the spots are circular and on the stems they are usually elongated. Characteristic pycnidia (fruiting bodies) are usually visible as black dots near the centre of the lesions.

M. pinodes causes ascochyta blight, characterised by numerous small, irregular, angular, dark brown or purple

spots on the leaves, stems, pods and base of stem. Under favourable environmental conditions, the spots may enlarge to become circular and zoned. They always remain much darker than *A. pisi* lesions.

Lesions caused by *M. pinodes* and *P. medicaginis* var. *pinodella* cannot be readily distinguished. *P. medicaginis* var. *pinodella* exhibits typical symptoms as described for *M. pinodes* although the lesions may be smaller and a little darker. However, in addition *P. medicaginis* var. *pinodella* causes severe damage to the underground parts of the plant in and around the seed zone. This damage results in plants being stunted and breaking off at the base of the stem, a symptom commonly referred to as collar rot.

All three fungi are seed-borne and all are capable of overwintering in plant debris. In addition, they are easily spread by spores in the wind and in rain splashes.

Control

The use of long rotations may reduce the incidence of the disease complex but *M. pinodes* can be quite persistent in the soil. Seed treatment can reduce the seed-borne level of ascochyta and can prolong storage. Pea straw should be ploughed under immediately after harvest to prevent dispersion of spores by wind and rain and seed crops should be produced in dry areas.

The use of resistant cultivars is not practical because of the lack of any cultivars with a good tolerance to all three diseases of the complex.

A number of races of *A. pisi* exist and although some cultivars exhibit tolerance to one race, none have shown resistance to all races. Resistance to *M. pinodes* may occur in seedlings but decreases with maturity, thus the stage at which the peas are exposed to the disease is critical. Genetic resistance to *P. medicaginis* var. *pinodella* is not known in processing peas but some field peas are tolerant. This tolerance appears linked to the purple flower character and the associated presence of anthocyanins.

Septoria blotch

Septoria blotch caused by the fungus *Septoria pisi* is rarely of economic significance because it occurs mainly on senescing plants.

Moderately high temperatures (above 18°C) and high relative humidity favour disease development. The disease is spread primarily by spores produced on infected peas remaining from a previous crop. Secondary spread occurs during the growing season by rainsplash and windblown water. It is not seed borne.

The first noticeable symptoms are small, yellowish areas which develop into light brown necrotic blotches. These irregular blotches are elongated and limited by the veins of the leaves. The pycnidia appeared as minute, light brown dots which darken with age. Infection may spread over leaves, stems and pods. Severe infection on young plants may result in wilting and death but on more mature plants death rarely results.

Control

Crop rotation is the most important control measure

with an interval of at least 2 years between pea crops. All crop residue should be either deep ploughed or burnt. Pea cultivars differ in their susceptibility. Immunity has not been identified but in general, later maturing cultivars are more tolerant.

SUMMARY

Alfalfa mosaic virus is considered to be currently the most significant disease affecting pea crops and durable resistance has not been detected despite extensive screening. Bean yellow mosaic and virus top yellows disease are well controlled in most commercial crops by the use of resistant cultivars. They remain potential problems to seed companies wishing to screen or bulk up overseas cultivars in New Zealand unless these cultivars possess the appropriate genes for resistance. Pea seed borne mosaic virus is still considered to be a problem, mainly because of the necessity to test lines intended to produce export seed crops. Its possible contribution to the occurrence of small stained seed is presently being examined.

Downy mildew is ranked as the most significant of the fungal diseases of peas since the control measures available are of varying effectiveness and the organism has a long lived carryover in plant debris and soil. *Ascochyta* can be

significant but care in selecting seed from healthy crops, preferably grown in dry areas, and the use of seed treatment can reduce seedborne *Ascochyta* to non-damaging levels. Septoria blotch is a common disease of peas in New Zealand but is rarely economically significant because it occurs primarily on senescing foliage.

REFERENCES

- Fry, P.R., Young, B.R. 1980. Pea seed-borne mosaic virus in New Zealand. *Australasian Plant Pathology* 9: 10-11.
- Hagedorn, D.J. 1974. Recent pea anthracnose and downy mildew epiphytotic in Wisconsin. *Plant Disease Reporter* 58: 226-229.
- Karik, N.N., Koshevskii, I.I. 1976. Downy mildew of pea pods. *Zaschita Rastenii* 4: 22.
- Ovenden, G.E., Ashby, J.W. 1981. The effect of pea seedborne mosaic virus on yield of peas. *Proceedings Agronomy Society of NZ*. 11: 61-63.
- Scott, R.E. 1987. Root-rot and soil compaction problems in peas. In *Peas: Management for Quality*. W.A. Jermyn and G.S. Wratt (eds.). *Agronomy Society of N.Z. Special Publication* 6: 45-50.