Importance of diseases in herbage seed production

G. C. M. LATCH
Plant Diseases Division, DSIR, Palmerston North

ABSTRACT. Yield and quality of herbage seed can be affected by many diseases. In New Zealand the most important diseases of grasses are rusts, especially stem rust on ryegrasses, cocksfoot and timothy; head smut of bromes; and ergot of paspalum. Blind-seed disease is of minor importance on ryegrass at present. Clover yield can be affected by rot, scorch and stem nematode. These diseases and others are discussed in relation to changing farming practices. and disease control measures are suggested.

Key words: Herbage seed production, diseases, *Puccinia graminis, Ustilago bullata, Claviceps paspali, Gloeotinia temulenta.*

INTRODUCTION

Over the past 20 years diseases have no: greatly affected the yield and quality of herbage seeds harvested in New Zealand. However. there was a time when the entire tyegrass seed trade was placed in jeopardy by the blind-seed disease fungus (Osborn, 1947). Although this disease has been relatively quiescent since 1958, the cause of its decline is not clearly understood. Changes in cultural practices have probably affected the life cycle of the blind-seed fungus, and continuing changes in farming methods may affect the importance of other diseases of herbage seed crops, To cite one example, we know that ploughing buries diseased crop debris and that diseases are less severe in the first year than in succeeding seed crops. What will be the effect of "no-till" farming on plant diseases?

Recently there have been attempts to multiply seed of overseas cultivars for re-export. Some of these crops have ended in failure because overseas cultivars are often more susceptible to New Zealand strains of disease organisms than are our own cultivars. The most desirable way of combating plant disease is to develop resistant cultivars. This is not possible when growing overseas cultivars for seed re-export, and so cultural practices and disease therapeutants must be relied upon to control diseases.

Plant diseases generally affect herbage seed crops more than grazed pastures because grazing removes much of the diseased plant material. Diseases can incubate in seed crops for several months and so become more severe. They may affect the quantity and quality of seed in three ways. First, foliage and root diseases reduce plant vigour and so may reduce the number of flowering tillers formed and the quantity of nutrients available to the developing seeds. Secondly, some diseases destroy the developing seed. Thirdly, many diseases contaminate viable seed with spores, mycelium, bacteria, viruses or nematodes within or on the seed. Many countries prohibit the imuortation of seed carving specific diseases. It is important that only disease-free seed is produced, and it should be ensured that seeds imported into New Zealand are also free of disease organisms. It is likely that cocksfoot stripe rust (*Puccinia striiformis* Westend. f.sp. *dactylidis* (Manners) Tollenaars) was recently introduced into this country as spores on imported seed (Latch, 1976). One serious fungus disease of herbage seed crops we do not yet have in New Zealand is choke (*Epichloe typhina* (Pers. ex Fr.) Tul.). This disease prevents emergence of the infiorescence because the fungus mvcelium binds the leaves together.

Changes in farming techniques, management practices. and in the species and cultivars grown can lead to a changing disease situation, but most specific disease problems can be overcome as they arise. However, seed producers must be aware that new disease problems can occur and they should seek specialized advice when they do.

Diseases present in New Zealand and affecting grass and clover seed production are outlined in this paper.

GRASS DISEASES

BLIND-SEED DISEASE (*Gloeotinia temulenta* (Prill. & Delacr.) Wilson, Noble & Gray)

The blind-seed fungus kills the seed embryo of many grasses, but ryegrass is especially susceptible. This disease has been the most important one affecting ryegrass seed production in New Zealand: however, it was last severe in 1957-8. During that season, 872 perennial ryegrass (*Lolium perenne* L.) seed crops were sampled for incidence of blind-seed just before harvesting, and an average of 44% of all seed was diseased, several crops having fewer than 5% viable seed. Italian (*L. multiflorum* Lam.) and Manawa (*L. hyhridum* Hausskn) ryegrass were less severely affected, their average infection being 22 and 20%, respectively (Latch, 1966).

Infected seeds fall to the ground before or during harvest or are sown along with healthy seed into new pastures. In spring these blind-seeds produce one or more cup-shaped fruiting structures called apothecia. Ascospores are discharged into the air from apothecia during the ryegrass flowering period and infect the ovary while the flowers are open. With early infection the ovary is destroyed and no seed develops. Later infection after the embryonic tissues have developed results in blind-seeds which cannot germinate. Secondary spread of infection within the crop is from conidia which are produced in great numb-rs on infected seeds and transmitted by rain splash or direct contact to other florets.

The incidence of blind-seed is closely associated with the weather in spring and early summer. Cool, wet weather in spring advances the formation of apothecia and prolongs the time that flowers are open, thus extending the period during which infection can take place. The disease is of little importance in dry seasons.

Control

(a) *Breeding* — A lengthy breeding programme in Northern Ireland has produced two perennial ryegrasses, Stormont Callan and Stormont Lagan, which have resistance to the disease (Anon., 1976). No New Zealand perennial ryegrasses show any great degree of resistance.

(b) *Management* — The fungus in blind-seed dies if stored For 2 years, so infected lines can be safely sown if kept for this time, although seed germination may be low. First-year seed crops generally have less disease than succeeding crops. In subsequent years there may be greater blind-seed infection because lighter seeds which have fallen during harvesting will have produced apothecia. Burning of grass stubble in Oregon, U.S.A., has dramatically reduced the level of blind-seed in succeeding crops by destroying crop debris. However, there is opposition to the air pollution caused by the smoke, and so alternative solutions will need to be found (Hardison, 1976). Spraying crop debris with systemic fungicides such as triadimefon, nuarimol and fenarimol shows promise but is still at the experimental stage (Hardison, 1978) .

Blind-seed has not been a problem in New Zealand since 1957-8, although a few ryegrass seed crops have shown moderate infection over the past 2 years. The reasons for this general decline are not clear, but the increased use of nitrogenous fertilizers on seed crops produces denser swards and possibly hinders movement of ascosnores. Trials in Northern Ireland have shown that nitrogenous fertilizers appreciably reduced the incidence of blind-seed (Stewart, 1964) Experients at the Seed Testing Station in Palmerston North suggest that nitrogen fertilizers mav suppress apothecial formation (D. J. Scott, pers. comm.).

ERGOT (*Claviceps purpuren* (Fr.) Tul. and C. *paspali* Stev. & Hall)

Large, cylindrical, purplish-black sclerotia called ergots can often be found protruding from the seedheads of grasses. They vary in size depending upon the grass species, and on tall fescue they may be as long as 20 mm. Ergots replace the seed and serve to carry the fungus over from one year to the next. They are toxic to humans and animals, causing constriction of blood vessels and ulceration of the bowel.

The life-cycle of thc ergot fungus is rather similar to that of the blind-seed fungus. Ergots ovetwinter on the ground and germinate in spring to produce apothecia from which ascospores are discharged into the air to infect unfertilized flowers. Secondary spread of infection within crops is by conidia which develop in great quantities in an insect-attractant honeydew on the surface of infected ovaries. Thus, secondary infection is accomplished by plant contact, rain-splash and insects,

Wet weather favours ergot infection, and in wet seasons up to 20% of the ryegrass seed can be replaced by ergots. Careful seed dressing can reduce this level to 1%, but when such a seed line is sown these contaminating ergots will develop apothecia in spring to infect the new crop.

Paspalum dilatatum Poir. is the only grass in New Zealand on which ergot is of great importance. This ergot fungus (*Claviceps paspali*) is a different species from that attacking other grasses. The ergots are roughly spherical in shaae, black on the outside and pinkish-white to dark-grey inside. Paspalum may be especially susceptible to ergot because it is apomictic and hence the flowers are susceptible to infection for a longer period than other qt-asses (Burton and Lefebvre, *1948) Claviceps paspali* causes animals to stagger and among the several toxic compounds present in paspalum ergot are the lysergic acid amides.

In the past, paspalum seed has been imported from Australia. Recently, Grasslands Division has developed an improved paspalum and this will be grown and harvested in New Zealand. Ergot infection has been as high as 85% in seed crops in wet seasons in the Manawatu (M. J. A. Barber. pers, comm.) . To harvest seed with a consistently low percentage of ergots, paspalum seed crops should be grown in areas with low summer rainfall. Such climatic conditions would also favour seed harvesting because paspalum is a difficult crop to harvest in humid or moist weather.

HEAD SMUT (*Ustilago bullata* Berk.) OF BROMES

Many brome grasses in New Zealand, including the agriculturally important prairie grass 'Grasslands Matua' (*Bromus willdenowii* Kunth), can be attacked by the head smut fungus. Black, powdery spores replace the seed, and usually all seedheads on an infected plant are destroyed. This is because the fungus mycelium grows within the plant and is present in all seedheads. Infection occurs when seeds contaminated with smut spores germinate in the soil. The smut spores also germinate and penetrate the seedling, and the mycelium keeps pace with the plant's growing points. Healthy mature plants may also become infected when smut spores germinate in the leaf axil or sheath (Falloon, 1979). Mature plant infection usually results in both healthy and smutted heads on the one plant. Smutted plants appear normal until heading, but their growth is reduced and they may die if overgrazed or exposed to moisture stress (Falloon, 1976).

Breeding prairie grass cultivars resistant to head smut has been unsuccessful because there are many races of the pathogen. If seeds are treated with fungicide, all contaminating smut spores are killed (Latch, 1965). It is important that only fungicide-treated seed is sown when a seed harvest is contemplated, and present recommendations are to use benomyl at the rate of 10 g of product per 1 kg of seed (J. G. Hampton, pers. comm.) . Unfortunately, prairie grass seed and awncd grass seeds do not flow easily and many seed companies are reluctant to treat these grass seeds with fungicides. There is a need to develop satisfactory equipment in order to overcome this problem.

RUSTS

Although the most common and damaging rust on ryegrass pastures is crown rust (*Puccinia coronata* Cda.) , it is not as important on seed crops as stem rust (*Puccinia graminis* Pers.). Stem rust also attacks many other grasses, including cocksfoot and timothy (*Phleum pratense* L.) The brown pustules of stem rust can be found on leaves, sheaths, stems and seedheads. Rust infection on stems interferes with translocation of nutrients to the developing seed, resulting in shrivelled and sometimes non-viable seed. **Two** recently developed New Zealand perennial ryegrasses, Nui and Ellett, are more susceptible to stem rust than other local ryegrasses. Late-flowering cultivars from overseas are also very susceptible

to stem rust and there have been instances where New Zealand seed crops of some overseas cultivars were unsuccessful, e.g., R v P Vigor perennial ryegrass.

Stem rust can be controlled by fungicide sprays. There are several new systemic fungicides effective against most grass rusts, but they have not yet been approved for general use. The most promising of these is triadimefon. Hardison (1977) reported that two applications of this fungicide at the rate of 0.9 kg a.i./ha resulted in an elevenfold increase in ryegrass seed yield when compared with an untreated portion of the crop. It is important that the first spray is applied at the first sign of rust. Spraying when the crop is already severely rusted is a waste of effort.

Cocksfoot (*Dactylis glomerata* L.) seed yield can be reduced by stem rust and by stripe rust. Stripe rust is easily recognized by the bright yellow pustules which are formed in lines up to 10 cm long on leaves, culms and inflorescences. Both rusts are controlled by triadimefon.

Other rusts attack grasses, but they are of minor importance on the seed crop species and cultivars grown in this country.

OTHER GRASS DISEASES

Fungi can cause leafspots, crown rots and root rots, but generally these diseases are of minor importance to herbage seed producers.

A bacterial disease caused by *Corynebacterium rathayi* (E. F. Smith) Dowson has been noted on cocksfoot seedheads (Johnston. 1956). Affected plants are distorted and the heads become covered with yellow bacterial slime. A survey of cocksfoot seed crops showed this disease to have little effect on seed yield. Recently two more bacterial diseases have been found by the author on grass seedheads in New Zealand. These are *Xanthomonas campestris* pv. *graminis* Egli, Goto & Schmidt on ryegrasses and X. *campestris* pv. *cerealis* Hagborg on bromes. At the moment they do not appear to be of importance, but it should be realized that bacterial diseases can be seedborne.

A nematode (*Anguina agrostis* Steinb.) produces galls in the seedheads of browntop (*Agrostis tenuis* Sibth.), but this disease is also of minor importance.

Grasses are attacked by viruses, the main one in New Zealand being barley yellow dwarf virus. A report from Britain states that this virus reduces the number of flowering tillers on infected plants (Catherall, 1966). Barley yellow dwarf virus is common in New Zealand ryegrasses, especially in older pastures (Latch, 1977), but we do not know if it affects seed production in this country.

LEGUME DISEASES

Clovers are subject to a number of fungus, virus and nematode diseases, but in most seed crops they have only a minor effect on yield.

CLOVER ROT (*Sclerotinia trifoliorum* Erikss.)

While this fungus can destroy pure stands of red clover (*Trifolium prarerzsc* L.) and attack white clover (T. *rcpens* L.) to a lesser degree, severe damage is rare in New Zealand. Clover rot is easily recognized from the white mycelium on the surface of rotting plants and the spherical black sclerotia of the fungus which are present on the rotting plant stems. This disease is favoured by cool weather and high humidity and the fungus has a wide host range. If a legume crop is badly damaged a lengthy rotation is desirable as the sclerotia can remain viable in soil for several years.

CLOVER SCORCH (*Kabaticlla caulivora* (Kirchn.) Karak)

The fungus attacks petioles, stems and leaves of red clover, forming dark elongate lesions which girdle the petiolc and stem, causing the leaves to hang down and wither. In wet seasons this disease can reduce seed yield markedly.

OTHER DISEASES

Numerous leafspot fungi and rusts attack clovers but, like the leafspots on grasses, they generally have little effect on seed yield. Clovers are susceptible to several virus diseases, but it is not known what effect they have on seed production. Several species of nematodes attack clover roots causing plants to become unthrifty. One nematode, *Ditylenchus dipsaci* (Kühn) Filipjev, infests the stems of white and red

clover causing them to become thick and malformed: Severe infestations result in plant death, and G. S. Grandison (pers. comm.) claims that red clover seed crops in Marlborough and Southland have been ruined by this nematode. Stem nematode can be seed-transmitted.

Clover phyllody, a disease which affects the flowers of clovers so that they do not produce seed, is fortunately not yet present in New Zealand. This disease is caused by a mycoplasma.

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