

# CANTERBURY CHAMBER OF COMMERCE

## AGRICULTURAL BULLETIN

# RYEGRASS BLIND SEED DISEASE

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During the past 15 years New Zealand's perennial ryegrass seed has been obtained increasingly from superior persistent strains. These, though desirable in terms of persistence and leaf production, unfortunately are distinctly susceptible to blind seed disease caused by the fungus *phialea temulenta* (or *phialea mucosa*). With the change over from short-lived ryegrasses to perennial types maintained within the certification scheme, there appears to have been an increase of this malady largely confined to the now dominant susceptible true perennials. Blind seed disease now exists to the extent that annually in the seed growing districts farmers hardly expect to secure a high germinating seed. The problem is of economic concern while the demand for pedigree ryegrass remains buoyant.

During the past two seasons many hundreds of ryegrass samples from South Island districts have been examined at Lincoln College for pre-harvest infection. The following figures indicate the nature of losses which are occurring.

Per Cent of Samples Tested	Per Cent of Disease					
	0-10	10-20	20-30	30-50	50-70	70-100
1944-45	3	13	15	32	15	22
1945-46:	35	20	15	10	10	10

Farmers generally are aware of the seed-testing services which can be availed of in order to determine whether or not it is worthwhile harvesting a particular seed crop. But a certain amount of doubt remains in some farmers' understanding of the basic features of this disease. This bulletin therefore aims to offer a brief general account of the existing state of knowledge on the subject. Such knowledge

rests largely on the original researches in New Zealand of Neill and Hyde and in Northern Ireland of Calvert and Muskett.

### LIFE CYCLE OF INFECTION:

The significant phases in development of the fungus are:—

(1) Many infected seeds fall to the ground before or at harvest and the fungus within remains dormant until the following early summer months. If the soil surface beneath the grass cover is examined closely during November-December it is possible to see minute ( $\frac{1}{8}$ " diameter) mushroom-like fungus cups (Apothecia) projecting from the surface. (See photo plate I.). These are the fruiting bodies, comparable in function with the seed head of higher plants (the fungus itself is a lowly form of plant life). Careful lifting of these apothecia will show that they are outgrowths from an old ryegrass seed. (See plate).

At Lincoln College observations are being made to define the environmental factors which contribute to the development of these apothecia and the spores subsequently produced by them. As many as half a dozen apothecia per square inch have been counted.

(2) On the inner surface of these fungus cups large numbers of ascospores are produced which on ripening are forcibly ejected. (See drawing, plate II.). It seems possible by microscopic examination to determine when the ascospores are mature and the density of ascospore concentration at the time ryegrass is in flower.

(3) A certain number of ryegrass florets become infected by ascospores either from within the crop or from an outside source of infection. In these primary foci or centres of

disease a second and different generation of spores arises. These (Macroconidia) are produced in large numbers in the seed head of ryegrass, and are responsible for the spread of disease from plant to plant. A slimy condition has been described as a feature of this stage, but it may be difficult to observe this as more often than not the sliminess does not always extrude from the glumes..

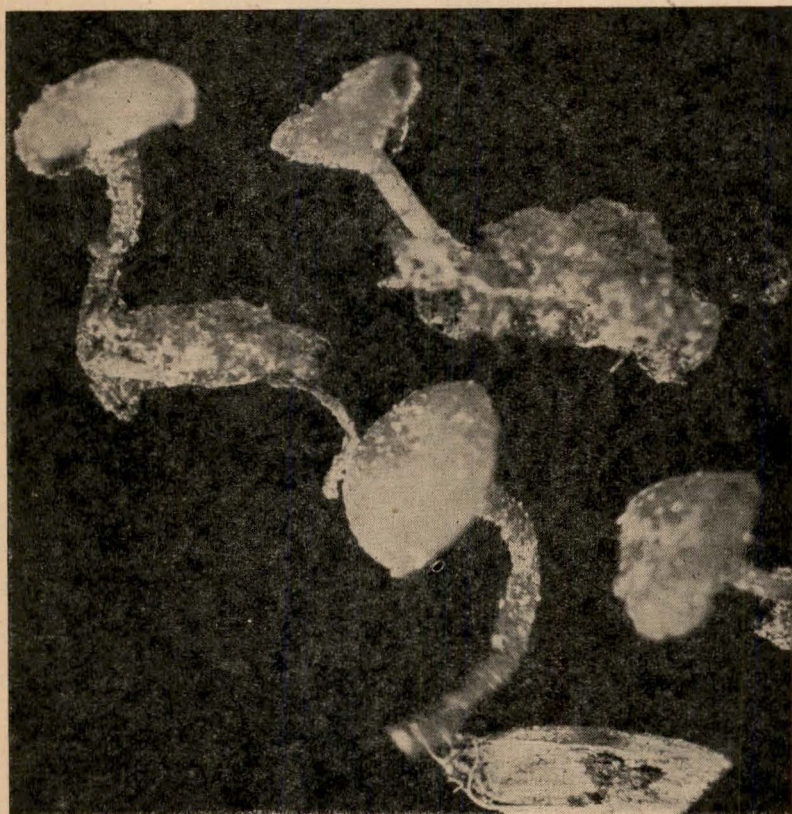
(4) It seems certain that the density of macroconidia on the grass head is directly related to damp weather conditions at the time. Inoculation experiments, however, have shown that the possibility of infection decreases rapidly after flowering has ceased. The length of time during which individual ryegrass flowers remain open also bears some relation to infection. In Ireland, for instance, it has been shown by Muskett and Calvert that some of the better ryegrass strains have a longer and later flowering period than some

commercial grade strains, the latter on this account developing less disease.

(5) After infection has occurred seeds continue to develop, and complete sterility is not a feature of the disease. When growth is arrested diseased seeds range in form from those distinctly shrivelled to others of normal size. The former should be removed during cleaning. Normal sized but diseased seeds when peeled of husk or glumes generally appear rusty and with an atrophied or damaged embryo. But germination tests have shown that usually the number of seeds which fail to germinate is less than the total percentage of spore bearing seeds. Thus some infected seeds will at least germinate but are unlikely to produce seedling plants.

The life cycle is completed when diseased seeds fall to the ground or are sown.

The fungus has been isolated from the seed of Tall Fescue, Chewing's Fescue, Red Top, Creeping Bent,



Apothecia growing from diseased seeds.

*Poa pratensis*, *Poa trivialis*, Crested Dogstail, Yorkshire Fog. So far as can be determined it is not a recently introduced plant parasite. Probably it has been maintained on a range of host plants in this country for many years.

It is well known that commercial and shorter-lived perennial ryegrasses are not so susceptible to attack as pedigree and mother seed strains. Less infection also is recorded among Italian ryegrass seed crops but there is no proof that the latter is really resistant and many instances occur of severe blind seed infection in Italian seed.

#### SEED EXAMINATION:

In examining samples at Lincoln College the usual procedure is to place 100 peeled seeds under magnification and determine the degree of infection according to the condition of embryo development. Total infection, however, is more reliably determined by placing peeled seeds in drops of water or stain solution on a microscope slide and recording infection by the presence of macroconidia on each seed.

Occasionally these pre-harvest estimates of disease are lower than those reported by the final test after seed cleaning. In such cases the pre-harvest sampling was likely to have been made of very immature seed heads and subsequently much more infection occurred as flowering reached a maximum. In gathering seed heads for examination farmers are advised, therefore, to make sure that the seed is well-developed.

#### THE PROBLEM OF CONTROL AND PREVENTION:

(1) **Resistant Strains.** It has been stated that primary infection arises from apothecia on the ground. There seems no feasible way of limiting this infection, especially as wind carried ascospores from adjacent fields or roadsides are as potent as those developed in a field under observation.

There are nevertheless strains of perennial ryegrass which have consistently resisted serious infection and which appear to possess an hereditary measure of natural resistance. The most promising line of approach is in the undertaking of the Grasslands Division to combine by plant breeding methods the useful characters of ryegrass with those of blindseed resistance,

found notably in some strains grown for many years in Southland. There are some outstanding examples in world agriculture of successful accomplishments in plant breeding for disease resistance—of plants bred to withstand ravages of disease notwithstanding continued abundance of infective material. Thus it is reasonable to hope that blindseed in New Zealand ryegrass will be combated as successfully as stem rust of wheat in North America.

(2) **Crop Management:** Large numbers of farmers who have sent samples to Lincoln College have submitted details concerning affected crops. The analysis of this information so far establishes little not already known concerning the disease in relation to strain susceptibility, weather conditions, crop history or management. It is believed that a dense ground cover of clover minimises infection al-



Diagrammatic sketch of primary spore development: (1) Diseased seed in soil producing fungus Apothecia. (2) Surface of Apothecium on which spores are ripened.

though there are records of severe seed infection even in the presence of dense clover undergrowth. The inference here is that the undergrowth acts as a barrier checking at least the upward movement of ascospores produced within the crop. Likewise there is a tendency for lodged crops to reveal less disease than those remaining erect and open though the practical application of this tendency is problematical. Concerning rotations less infection occurs where a pasture for seed purposes is sown on an area that has been in arable crops for 3 or 4 years previously. In typically arable districts there is merit in planning a ryegrass seed crop at some distance from old grass fields and to consider the possibility of surrounding the area by "barrier" crops of cereals, root and forage crops.

The significance of closing date

requires investigation as there is evidence of less disease in crops closed from grazing either very early or very late in a season. In either case the crop may pass the susceptible flowering stage before or after the peak of ascospore dispersal and thus avoid the worst attack.

(3) **Seed Treatment:** The fungus within seeds dies after 18 months' storage, thus if infected seed still with intact embryos could be stored for use two years after harvesting there would be little danger of poor germination attributable to the original infection. There are, of course, many reasons for not developing this line of control especially when the demand for seed for pasture purposes, even of poor germination, is intense and while the fact remains of infection coming from neighbouring areas to offset the benefit of sowing disease-free seed in the particular field.

Seed disinfection with dry dusts does not destroy the fungus within seeds and the only possibility in this regard lies in hot water treatments. Calvert and Muskett in North Ireland have proved that the treatment of diseased seed for 30 minutes in water at 50°C. consistently eliminates infection. Provided treated seed is thoroughly

dried immediately after treatment they report no danger of impaired germination resulting from the heat treatment.. It must be emphasised also that the treatment does not actually improve a poor germinating line. It is no more than a disease elimination treatment.. For instance, no apothecia are produced from hot water treated seed. The treatment is no guarantee that a resultant crop will be disease-free as spores can be blown from apothecia or seed in hedges, on wasteland or in nearby pasture. Hot water treatment does however deserve greater application for the reason that the treatment will in the long run reduce the amount of material returned to the soil to maintain the accumulation of infection there.

At present this disease is of major concern in ryegrass seed production but the fungus has no effect on the ryegrass plant other than by way of germination losses. The pedigree strains of ryegrass were developed for their value as long lived pasture plants on which much of this country's livestock industry is now based. Poor germinating lines if sown thickly enough still remain capable of developing into good grazing pasture.

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