The Elimination *of Ryegrass Blind-seed Disease*

The Seed Factor

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THE co-ordinated ryegrass blind-seed disease research programme is concerned at present with three main features:—

1. A plant-breeding approach in the search for disease-resistant ryegrass lines. 2. Blind-seed prevention as influenced by pasture management adaptation, e.g., topdressing and plane-of-nutrition trials; induced lodging and effects of ground cover; date of closing for seed; intensity of grazing. 3. The use of chemical sprays applied to maturing ryegrass ears.

It can be demonstrated from the results of our research programme to date,* and from the persistent seriousness of the disease in the field when seasonal weather conditions encourage the development of the causal fungus, that none of the above lines of approach is strikingly promising or suggestive of a quick solution. The programme, of course, must continue and on the two trial areas at Lincoln College, as on the many areas the Department of Agriculture has under trial, the observations are being continued within the scheme developed by the co-ordinating committee. Furthermore, from what I have seen personally of the success of plant breeding in disease prevention (in Canadian wheat for rust disease resistance) I am convinced that the efforts of the Grasslands Division in this particular study should be supported to the full, and we can reasonably continue to hope that the results of plant breeding will eventually release an agronomically-satisfactory ryegrass which also has some measure of blind-seed disease resistance.

Neill and Hyde (1939 and 1943) (1) laid an admirable foundation of knowledge concerning this disease, but since then the research work has been more notable abroad and our knowledge of fundamental aspects of the disease has been greatly enlarged by the work at Edinburgh of Wilson, Noble, and Gray (1945) (2), by Calvert and Muskett (1945) (3) in Northern Ireland, and more recently by Hardison (1948) (4) in Oregon. I think it is of the utmost importance for us to note that in Oregon, with environmental conditions similar to those of New Zealand's grass-seed-producing areas, a distinct measure of success in blind-seed prevention has followed the application of a programme which we in New Zealand have neglected or wrongly dismissed as being not applicable to our circumstances. I refer to the demonstrated benefit to be expected from an over-all scheme which aims first to distribute only disease-free seed regardless of germination percentage.

What might be referred to as the Oregon control measures may be summarised as follows:—

Recommendations for Seed Production

1. Sow disease-free seed which is officially approved or endorsed as such by the seed-testing authority.
2. If the seed is not guaranteed disease-free, hold it at least 24 months before sowing, when the fungus within the seed will have lost vitality.
3. Seed should be sown at least ½in. deep with complete soil coverage.
4. Plough up badly-infected fields when the post-harvest seed examination demonstrates a high blind-seed rating.
5. Where seed is not being harvested but the pasturage retained, top the area to prevent seed-head development.

From the outset of our interest in this problem at Lincoln we have been perturbed by the fundamental weakness or fault in our country-wide procedure, namely the continued use, year by year, of diseased seed. Such seed re-inoculates the soil with the *Phialea* fungus which, although it can be carried additionally on other grass species, is certainly largely dependent for persistence on the so-called "blind" ryegrass seeds infected one year and shed or sown in the following season.

As you know, primary infection results from the development of *Phialea apothecia*, which liberate ascospores from surface-sown or shed diseased seeds. From a slight primary infection secondary spread of the disease can be prodigious under those damp spring weather conditions which enable initial ear infections to be multiplied within the crop. But it should follow that if primary infection from the ground can be eliminated, the whole intensity or incidence of disease, dependent then entirely on wind-borne fungus spores from distant sources rather than from infection within the crop, must be significantly reduced. The fundamental principle of plant disease prevention, namely use of disease-free or disease-freed seed, has been accepted and applied

with conspicuous success in connection with the smut diseases of wheat. Many can recall the former seriousness of ball smut, now rarely found in harvested wheat as a consequence of years of universal use of disinfected seed; loose smut rarely occurs now in degrees more than a -"trace" because of the accepted system of hot-water treating nucleus lines subsequently bulked up for seed distribution.

Concerning the blind-seed disease. I fail to see why the same principle cannot practicably be utilised or exploited. We know that the ryegrass seed can be hot-water treated and the fungus within destroyed (50 degrees C. for 30 minutes, followed by drying), but there are certainly difficulties in arranging for a suitable agency to perform the treatment for all ryegrass produced. It would appear to me that if hot-water treatment of ryegrass seed is an economically unattractive proposition for commercial firms, a place like Lincoln College might well seek funds for the installation of the necessary gear and render the treatment as a service to the industry. On the other hand, "ageing" or holding the seed for two years more easily results in loss of viability of the fungus perennating within infected seeds. After this storage it is possible in some instances that total germination may be further reduced through factors associated with storage conditions, but ryegrass is an abundant commodity whose rate of field sowing can readily be increased to overcome germination limitations.

But this whole matter of ryegrass seed in relation to blind-seed now deserves urgent consideration for the reason that we are enjoying a respite. After a sequence of wet seasons which provoked heavy infections from the abundantly distributed ground sources of diseased seed, we have experienced one season (1947) characterised by such dry weather during ryegrass maturing that in many localities blind-seed infection failed completely. There is an indication that this (1948) season will likewise be dry in many parts of the Canterbury Plains when ryegrass is flowering or when young seed in the ears is at the normally susceptible stage. Such weather conditions prevent apothecia development from the blind seeds and, whereas in 1946 on a sown area we could find up to 20 apothecia per foot, last year. where diseased seed had been sown at the same rate, these spore-producing structures could not be found at all. On our trial areas at the College the seed harvested last January on plots heavily oversown (for inoculation purposes) with infected seed produced 95 to 98 per cent. germinating seed with no sign of *Phialea* as revealed by laboratory examination.

After the approaching harvest there should be a good supply of high-germinating, -disease-free ryegrass seed obtained from most. if not all. parts of Canterbury,. and I suggest that we should exploit this advantage and on it make a fresh start before the onset of those environmental conditions which precipitate heavy disease from widely-distributed infected seed. Now is the time to develop a concerted and determined programme ensuring the distribution and use of blind - seed - free ryegrass officially approved as such.

The recommendations submitted as the requirements of the programme are:—

1. The Department of Agriculture should certify or establish a category of "blind-seed-free" seed to be branded by the distributors as suitable for seed production. Merchants should be persuaded. of the importance, from a national viewpoint of distributing only this specially-certified, disease-free seed for seed production purposes.

2. If for ordinary pasture (grazing) sowings farmers and merchants choose not to use the certified lines which may be priced at a higher level they should be urged to sow seed at least two years old at whatever sowing rate is necessary to overcome germination limitations, and to sow this seed at a ½in. level (any apothecia which might still occur cannot fully develop and shed spores when so buried).

3. Grazed areas not being kept for seed should be topped when seed-heads appear to prevent the establishment and persistence in such fields of the annual disease cycle initiated by chance, wind-borne infection.

4. All extension and advisory services should bring to bear their full weight of influence to guide the acceptance of this line of approach by all farmers concerned.

This simple statement covers action which can be undertaken now while all-important but long-term research continues to pursue its objectives, but the action, to be effective, requires application by all who distribute and grow ryegrass.

* Minutes of meetings concerning blind-seed of ryegrass; Department of Agriculture reports 48/153, June 9, 1948, and No. 651 of April 30, 1947.

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4. Hardison, J. R. (1948) Phytopathology 38: 404-419.