A STUDY OF SOME FUNGAL LEAFSPOT DISEASES OF *DACTYLIS GLOMERATA* IN THE MANAWATU

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CHAPTER I

INTRODUCTION

New Zealand is unique in that the entire basis of her national economy is based upon livestock-pastoral farming. Of the fortythree million acres in occupation for agricultural and pastoral purposes, seventeen and a half million are of sown pasture and about thirteen and a half million of natural grasslands. The seventeen and a half million acres of sown pasture are down in imported grasses of which approximately one half has been surface sown and the remainder sown on cultivated land with high producing English grasses. These have been selected for such qualities as leaf area and density of leaves, form of the plant, resistance to drought and many other desirable agronomic properties. Regarding the disease factor, there has been no attempt in New Zealand at breeding for resistance to disease with the exception of Blind seed disease of Ryegrass caused by Gloeotinia temulenta (Prill. et Delacr.) Wilson, Noble et Gray.

It has been observed that fungal leafspot diseases of grasses are widespread throughout the country. One can only speculate on the importance of these leafspot diseases with respect to pasture yield. It may well be that losses are not particularly great since only rarely do they attract the attention of the farmer or extension worker. However, according to Chester (1948) the farmer usually is not concerned with a plant disease until losses reach fifteen per cent of the crop, and rarely does he take action until

they amount to twentyfive percent. If this is so, it is reasonable to suggest that fungal leafspot diseases of pasture grasses are of some importance in this country.

Chester (1945) has made a special study of estimating disease losses and calculating their importance. Employing an artificial defoliation technique he was able to obtain evidence of the extent of losses sustained by crops that have lost foliage as a result of disease or insect attack. Wheat was found to have a yield reduction of twenty to twentyeight per cent if one quarter of its functional leaves were lost between rosette and boot stages. Yield reduction was greatest near the mid-season of the plant. This is understandable when one realises that in the early life of the plant the leaves that are removed or reduced are replaced by others, while as maturity approaches the leaves have largely outlived their usefulness. In mid-season the photosynthetic activity is most essential to the storage of food. His experimental work with cereals showed that losses of foliage in mid-season resulted in a very marked yield depression, ranging from thirtyseven to ninetynine per cent. It follows then, that so-called negligible or "trace" damage at this period is in fact quite serious.

As well as the reduction in yield Chester found there was a reduction in the quality of the grain produced. In addition, maturity was considerably delayed.

Jacques (1937) ascertained the effects of different intensities of defoliation on early root growth of ryegrass, cocksfoot and crested dogstail. He found that root deterioration increased with the severity of defoliation. Weinmann (1948) also demonstrated the close relationship between leaves and roots. Thus, foliage-yield

relationship is not entirely a direct one. Reduction in leaf area leads to reduction in root development and in turn to a reduction in water intake. This is reflected in further loss in quantity and quality of yield.

Chester experimented with cereals but his findings are equally applicable to grasses. The grass seed trade is of considerable importance to New Zealand. In 1955, over one and threequarter million bushels of Ryegrass and approximately thirteen million pounds of other pasture seeds were machine dressed in this country. Thus any factor which contributes towards a reduction of quality and quantity of harvested seed must be regarded as of some consequence.

The seed trade, however, is incidental to the primary purpose of growing grass in New Zealand. The maximum yield of dry matter per acre is aimed at in order that the maximum number of stock can be carried per acre. Whereas Chester was concerned mainly with the grain yield, the more important aspect to the pastoral farmer is the foliage yield. A reduction in photosynthetic tissue as caused by leaf spot diseases for example, will affect the formation of fresh leaves as is borne out by the old axiom "leaf makes leaf".

There are many reports indicating the importance of foliage diseases. Tabulated on the following page are two independent estimates of the percentage loss caused by some leaf spot fungi on common pasture grasses.

Table I

Estimated Percentage Loss Caused by Leafspot Fungi in Washington in 1949. (Sprague 1950)[3]

Host	Pathogen	Percentage Disease Loss
Timothy	Selenophoma bromigena (Sacc.) Sprague and Johnson	2.5
	Rhynchosporium secalis (Oud.) Davis	0.8
	Scolecotrichum graminis (Fckl.)	2.0
Cocksfoot	S. bromigena	2.5
	R. orthosporum Caldwell	1.5
	S. graminis	2.0
	Mastigosporium rubricosum (Dearn. & Barth) Sprague	3.0
Brome	S. bromigena	2.5
	R. secalis	0.8
	S. graminis	2.0

Table II

Estimated Percentage Loss Caused by Leafspot Fungi
in New York for the Years 1952,53,55.
(Roberts et al. 1952,54,56)

Host	Pathogen	Percentage Disease Loss First Cut 1952	1953	1955	Second Cut 1952	1953	1955
Timothy	Heterosporium phlei Gregory	2.6	1.0	1.4	1.7	1.0	0.5
	Scolecotrichum graminis Fckl.	0.5	0.4	0.2	0.5	0.2	0.3
Cocksfoot	S. graminis	2.0	0.4	1.5	0.6	0.6	2.0
	Stagonospora maculata (G.) Sprague	2.0	0.8	1.5	0.4	0.4	1.5
	Rhynchosporium orthosporum Caldwell	1.1	1.0	1.5	0.3	0.6	2.0
Brome	Pyrenophora bromi (Died.) Drechsler	1.7	1.5	1.2	2.5	1.0	1.0
	Rhynchosporium secalis (Oud.) Davis	-	1.0	0.5	-	trace	1.5

Leafspot diseases of grasses also have an effect on the palatability of the pasture. Thus MacVicar and Childers (1955) report that in midsummer the yield and palatability of Dactylis glomerata was seriously affected by Rhynchosporium secalis Caldwell and Scolecotrichum graminis Fckl. Further, Granti (1953) demonstrated that in a crop with fortyfour per cent infection of Scolecotrichum graminis there was an overall loss of nutritive value of approximately 25.22 per cent.

In view of our dependence on pastures, it is surprising that so little work has been carried out in this country on such an important subject. In Table III are presented the recorded fungal leaf spot diseases of grass species in New Zealand.

Table III

Pathogen	Host	Authority
Mastigosporium rubricosum (Dearn. & Barth.) Sprague	Dactylis glomerata L.	Brien & Dingley 1951
Phyllachora cunninghamii Syd.	Festuca elatior L.	Sydow 1924
Rhynchosporium secalis (Oudem.) Davis	Agropyron repens Beauv.	Brien 1942
Rhynchosporium secalis (Oudem.) Davis	Hordeum murinum L.	Brien 1942

These three organisms comprise the total number of grass leaf spot fungi identified in this country. Compared with the many hundreds of leaf spot fungi recorded overseas, this list is surprisingly small. Most fungi are not restricted to one host and there are cases where over one hundred different species are attacked by the one pathogen. In New Zealand we can cite only one fungus

(R. secalis), as a pathogen of two different grass species. American workers in particular, have devoted much study to this field and comple textbooks have been written on diseases of pasture grasses.

In the majority of cases the control of foliage diseases of pastures is by selection and breeding for resistance. A pre-requisite to any such programme is fundamental knowledge of the diseases involved. It has been observed that in the Manawatu cocksfoot (Dactylis glomerata) in particular expresses a variety of leaf spot symptoms throughout the year, suggesting that a number of pathogens are involved. The overall aim of this research project was to determine what fungi were in fact contributing to the symptom complex. The particular aims were:-

(i) To isolate and prove pathogenicity of fungi causing leaf spot diseases of cocksfoot in the Manawatu.

(ii) To study the symptoms as induced by each pathogen under field and glasshouse conditions.

(iii) To study each causal organism in pure culture.

(iv) To study the seasonal succession of each disease.

(v) To determine for each disease the influence of temperature on: (a) the incubation period (as defined by Walker 1950).
(b) the severity of attack.