A Study of Brown Spot Disease of *Lupinus* spp. caused by *Pleiochaeta setosa* (Kirchner) Hughes.

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INTRODUCTION

Lupins (Lupinus) are leguminous plants grown in most countries, from the hot equatorial lands of Egypt, North Africa, and Brazil, to the cooler climates of New Zealand and Chile. Over three hundred species have been described, including arborescent, herbaceous and ornamental forms.

Lupins are grown in different countries for various reasons, but their ability as a 'nitrogen-fixer', which enables them to grow in poor light soils and to increase fertility, is perhaps their main attribute.

In New Zealand Lupinus arboreus L., L.angustifolius L., and L.polyphyllus Lindhl., are the three most common species grown. The perennial arborescent L.arboreus is the form so prevalent on much of New Zealand's coastal sand country and along such rivers as the Manawatu and Rangitikei. In many places it is regarded as a weed and is treated accordingly. However, the New Zealand Forestry Department do make use of its tenacious capacity to grow on inhospitable exposed sand dunes where it is sown as an intermediary between marram grass (Ammophila arenaria) and pine trees. The consolidation of moving sand dunes by the use of marram grass and tree lupin has proved quite adequate to allow the establishment of large tracts of pine forests along areas of the west coast of the lower North Island.

Blue lupin (L.angustifolius) is an annual herbaceous form grown for stock food and/or seed, and for a green cover crop by the home gardner. As a fodder crop the popularity of blue lupin has risen and fallen. Inch (1947) writes in a New Zealand Department of Agriculture Bulletin:- "Over the past ten years, with the stimulus given by the development of a 'sweet' variety for lamb fattening,

they [blue lupins] have now become a crop of considerable economic importance in Canterbury, and their use is gradually spreading to other parts of New Zealand. They have a high nutritive quality, and are an excellent crop for raising the fertility of the soil."

Just on twelve years later Whatman (1959) writes: "Blue lupins are grown principally on the medium to light soils of Canterbury, particularly in those districts of less than average rainfall, either as a replacement for the turnip crop or to supplement turnips or other winter feeds." He then goes to point out that over the last ten or twelve years various factors have meant much less dependence on the lupin crop. These factors include: the improved fertility of light lands; the increase in lucerne area and in hay feeding; the greater use of other greenfeed crops such as 'Grasslands Paroa' Italian ryegrass and saved pasture. Personal correspondence with Whatman (1963) indicated a still further decline in the acreage of 'pure' stands of blue lupin grown from the approximately 5,000 acres grown in 1959. He now estimates that 1,000-2,000 acres are grown annually in the Ashburton district and that a further 5,000 acres occur in which lupins are sown at a light rate with other seeds, mainly turnips, and quite frequently with new grass in the autumn. Lupins can be extremely valuable when used in this manner and this constitutes one of their main uses today. They may be sown as a seed crop during the development of light land in order to obtain seed supplies for the grower's use as well as surplus for sale.

With more cereal cropping occurring now on light land, lupins can also fill an important role as a fertility restorative crop. White (1961), a lecturer in Plant Science at Canterbury Agricultural

College, considers that a crop of lupins following wheat on lighter land is desirable. Wheat causes a considerable drain on the soil fertility but a subsequent lupin crop helps considerably in ensuring a reasonable establishment of grass or lucerne.

Soil Conservation officers of the Department of Agriculture have demonstrated that bitter blue lupins, drilled with fertiliser, will grow vigorously and reseed freely on loose, windblown sand of any depth. Work in the Manawatu and Rangitikei districts (where there are about 150,000 acres of sand country) has shown that of the many plants tried for quick establishment on bare sand, blue lupin was the most promising. One to two years after the establishment of such a crop, a ryegrass-cocksfoot-white clover pasture can be established (Pearse 1958 and 1964). Despite the promising results obtained by this Department with lupins, farmers have, for various reasons, been slow to utilise them and only about 550 acres of moving sand has been reclaimed to pastures.

One of the main factors limiting increased use of blue lupins is the scarcity of seed in some years, and its high price compared with other forage crops. This is especially so with the sweet Borre variety which is generally more expensive than the bitter blue. Two factors cause the high seed prices—

(1) low seed yield, and

(2) difficulty of harvesting.

For blue lupins to increase in importance, a non-shattering, high yielding variety of lupin is required.

Russell lupin (L.polyphyllus) is the most common type of ornamental lupin grown in New Zealand, although the annual L.hartwegii Lindhl., and L.mutabilis Sweet, are also available.

Yates's Garden Guide (1961) notes that the perennial type is very beautiful and more suited to the colder climates such as the South Island or the cooler central districts of the North Island and that the annual varieties grow better in Auckland and other northern districts.

Particularly in Europe, lupins are extensively grown and a number of diseases have been recorded in the literature. A disease commonly referred to as 'Brown Spot' (a rather nebulous title for a fungus disease), appears to be of considerable importance. Brown Spot disease of lupins (Lupinus spp.) was not officially recorded in New Zealand until July 1958 (Dingley 1959) when it was found on leaflets of seedling Lupinus angustifolius. No record can be found of the disease on any other species of lupin in New Zealand and any literature dealing with fungus diseases of lupins in New Zealand makes no mention of Brown Spot caused by Pleiochaeta setosa (Kirchner) Hughes.

Numerous records of this fungus occur in overseas literature, particularly its occurrence in European countries. According to Germar (1940), the Brown Spot disease was first described on lupins in Germany in 1898 by Wagner and Sorauer as a disease caused by the fungus Pestalozzia lupini. Subsequent investigations revealed this parasite to be the same as that described by Kirchner in 1892 on Cytisus plants.

That the fungus attacks a wide range of lupin species is certain from a cursory glance at the literature pertaining to it. Richter (1938) found the disease on a dozen lupin species including L.angustifolius, L.albus L., and L.luteus L., and these observations were later confirmed by another German, Germar (1940), who found 22

lupin species to be susceptible. These included L.albus, L.polyphyllus, and L.luteus. According to Pape (1927) the yellow lupin (L.luteus) and the white lupin (L.albus) are relatively resistant to the disease. Pulselli (1928) also notes that L.albus shows a certain degree of resistance to Brown Spot disease. However, work by du Plessis and Truter (1953) in South Africa fails to confirm these views on resistance.

In the literature, premature defoliation of the infected plants appears to be a common characteristic of the disease, for several writers make specific mention of this, in particular Pape (1927) on L.cruikshankii Hook and L.mutabilis Sweet, and Richter (1938) on L.albus. Hogetop (1938) in Brazil states that on young white lupin (L.albus) affected leaves are prematurely shed. He also notes that young white lupin plants are frequently killed after complete defoliation, and a reduction in yield invariably follows. Weimer (1952) in the United States makes similar observations on blue lupin (L.angustifolius).

A fungus disease that has the capability of becoming seed-borne often provides an ideal method of carry-over from crop to crop or from season to season. P.setosa has quite frequently been recorded as capable of this and du Plessis and Truter (1953) developed a technique which proved very satisfactory for isolation of the fungus from diseased white lupin seed. They suggest this infected seed offers ample opportunity for the transmission of the disease from infected areas to disease free areas, and further suggest that the disease was imported into the Union of South Africa by this means. Weimer (1952) opens his account of Brown Spot disease of lupins thus:- "The brown spot disease was probably brought here [the United States

of America], from Europe in the seed. It is now widespread in this country."

Preliminary investigations carried out on the three lupin species grown in the Manawatu have enabled ready isolation of P.setosa in all cases. Although recognising that lupins are not an important plant in New Zealand and thus diseases on them do not warrant study from this viewpoint, the following relative facts were noted:

(i) Despite the large number of records which have been made of this fungus overseas, few detailed studies have been made and these pay little, if any attention to the disease cycle, i.e. how the fungus is disseminated, carries out infection, and survives away from the host plant.

(ii) The fungus has only been officially recorded in New Zealand on blue lupins but is known to be prevalent on Russell and tree lupin also.

(iii) Overseas the fungus has been shown to be seed-borne and knowledge on this facet of lupins in New Zealand would possibly prevent us importing diseased seed and would at least lead to the possibility of either healthy seed being sown, or some treatment being devised to eliminate the fungus from the seed.

Consideration of these facts led to the following topic being chosen: "A Study of Brown Spot Disease of Lupinus spp. caused by Pleiochaeta setosa (Kirchner) Hughes", with the following objects of study:

(1) To isolate, identify, and prove pathogenicity of the fungal pathogen causing Brown Spot symptoms on tree, Russell and blue lupin.

(2) To study the fungus in pure culture.

(3) To investigate the disease on Russell, tree and blue lupin in the field.

(4) To study the disease cycle with particular reference to survival and spread.

(5) To investigate the possibility that the disease is seed-borne, and if this is verified, to develop satisfactory techniques to identify the fungus and determine the importance and form of the seed-borne inoculum.

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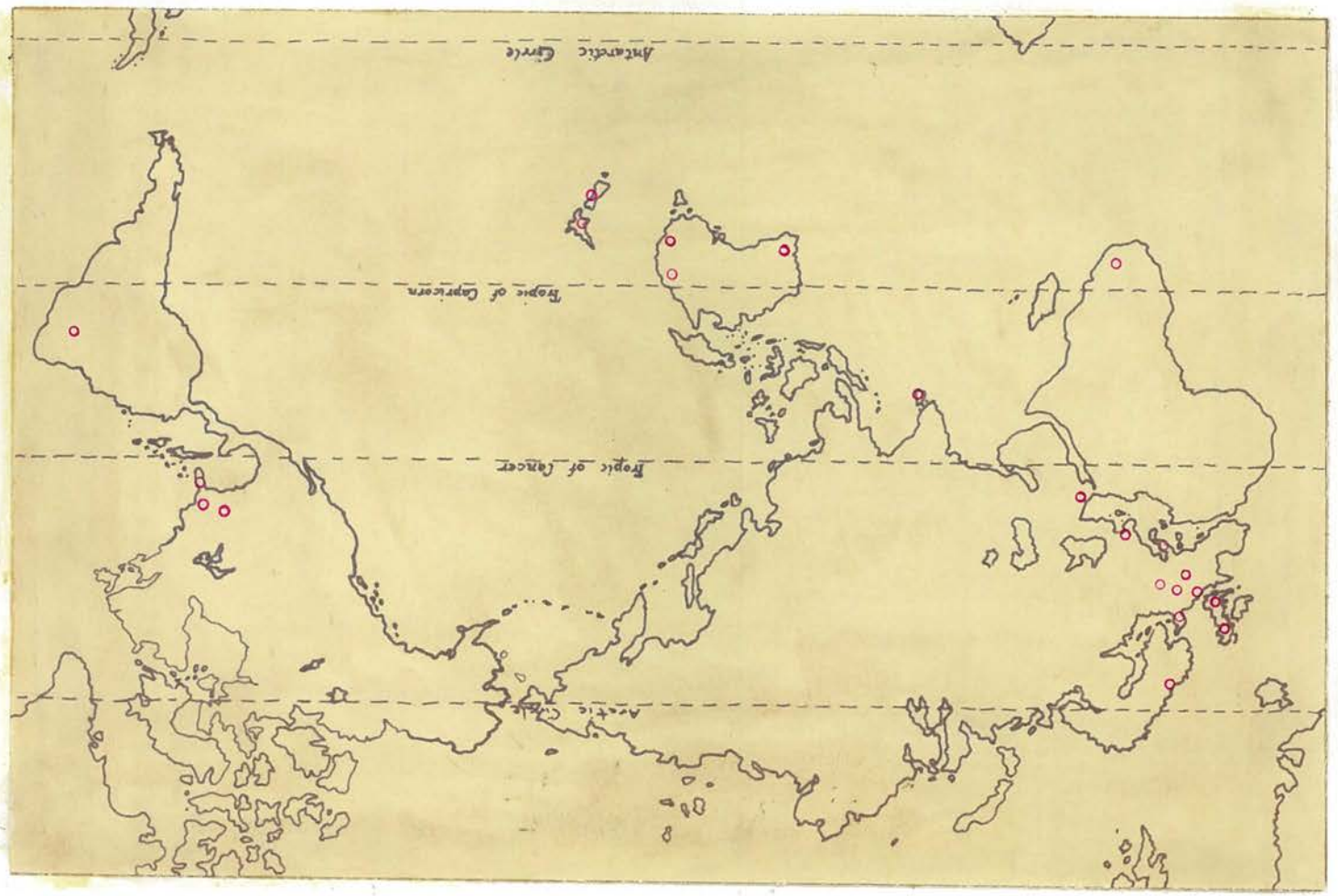
(R.A.M.—Review of Applied Mycology)

Illustration 1

MAP SHOWING WORLD DISTRIBUTION OF PLEIOCHAETA SETOSA (KIRCHN.) HUGHES ON SPECIES OF LUPINUS, CYTISUS, LABURNUM, CROTOLARIA, AND PHASEOLUS.



o Countries where P.setosa has been recorded:

Asia: Ceylon, Palestine.
Australia (Western Australia, New South Wales, and Queensland).
Europe: Bulgaria, Czechoslavakia, Denmark, England, Estonia, Germany, Holland, Italy, Latvia, Lithuania, Norway, Poland, Scotland, Switzerland.
New Zealand: North and South Island.
North America: United States (Alabama, Florida, Georgia). South America: Brazil.