SEED INFESTATION OF FLAX IN ALBERTA WITH THE FUNGUS CAUSING BROWNING OR STEM–BREAK

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Abstract

seed samples of four varieties of flax (Linum usitatissimum L.) from different parts of Alberta were examined by artificial culture on potato sucrose agar for the presence of the browning or stem–break fungus Polyspora lini. Infestation was detected in seed of each of the four varieties Noralta, Raja, Redwood, and Redwing, with the incidence of infested samples ranging from 16 to 40%. Clean samples were obtained from widely separated parts of the province but most commonly from the drier areas.

Introduction

Browning or stem–break of flax has been known for about half a century. It was first reported in Ireland by Lafferty in 1921 **(6).** He described the disease and proved it was caused by a fungus. In North America it would appear that the disease has been present for as long a period as in Europe, though not recognized as the same until after Lafferty's report from Ireland. It was first reported in Canada from Saskatchewan in 1923 (1) though collected there as early as 1920 (3); it was reported in Alberta in 1926 **(7).** Additional early reports from Canada and the united States may be found in references by Flor (2) and Henry **(2,3,4).**

The dual name which Lafferty gave the disease indicates the two types of symptoms produced. Browning refers to brown blotches which develop on all above–ground parts and which are most conspicuous while the plants are still green. Stem–break on the other hand indicates a tendency of some affected plants to break over just above the soil surface. Brown lesions tend to develop most prominently on stems and leaves but they may also be found on floral parts, such as sepals and seed capsules. In fact the seed itself may be attacked, contaminated and damaged in varying degrees. It is with this latter effect that we are chiefly concerned here.

CAUSE AND METHODS OF TRANSMISSION

The causal organism was described by Lafferty (6) as an imperfect fungus which he named Polyspora lini n. gen. n. sp. in 1921. Recently (1965) the perfect state of this fungus was found in New Zealand by Sanderson on wild Australian flax, Linum marginale A. Cunn. **(8).** He described this as a new ascomycete which he named Guignardia fulvida Sanderson sp. nov. He also found that cultures from ascospores were similar to those from conidia and could infect cultivated flax and produce symptoms similar to those resulting from conidial infections.

The conidial or imperfect stage of the fungus is the one commonly found in North America on cultivated flax (Linum usitatissimum L.) It is characterized by an abundance of single–celled hyaline oval to cylindric conidia in tiny creamy masses on the surface of the brown lesions on the host. Diseased tissues plated on potato sucrose agar normally yield white yeast–like colonies which soon turn shiny black. These colonies produce a great abundance of conidia but only a limited amount of mycelium. Occasionally variant colonies consisting mainly of mycelium are formed in culture but these are not the typical form of the fungus **(4).**

Transmission of the causal fungus from year to year is made possible mainly by the use of infested seed or by establishing a crop in close association with diseased residues of a previous crop. Primary infection is initiated by inoculum on or in such seed or residues and is followed by the production of conidia which produce secondary infections during wet periods throughout the growing season. Conidia are dispersed by various agents such as wind, drifting rain and insects to living flax plants in the vicinity. Under favorable weather conditions the disease tends to become more severe as the season advances due to the continued production of conidia and possibly to an increase in susceptibility of the host with age.

IMPORTANCE OF SEED INFESTATION

Seed–borne inoculum is in an especially favorable position for establishing infection

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in a new crop started from infested seed. However much of the inoculum on the surface of the seed may fail to initiate infection because it is inactivated (5) by soil microorganisms or by chemical action if the seed is treated with fungicides. However internally-borne inoculum is often present in contaminated seed and is likely to survive and prove effective in disease initiation. The pathogen can survive in infested seed for at least 3-4 years under farm storage conditions. Therefore the use of infested seed is an efficient means of establishing numerous infection centers from which secondary spread throughout a crop may occur. Moreover the distribution of infested seed through commercial channels is bound to occur and this can result in the rapid and serious spread of the pathogen over a wide area.

The direct loss from seed infestation may be substantial. Not only is the yield of the crop grown from such seed likely to be reduced but its quality as well. The seed from a diseased crop is likely to be infested and its value for propagative purposes lowered appreciably. The main purpose of the present study was to determine the extent of infestation of Alberta flax seed with Polyspora lini.

Materials and methods

The seed examined consisted of 118 samples; 28 were obtained from several Alberta Municipal Seed Cleaning Plants and 90 from the Federal District Seed Analyst, Plant Products Division, CDA, Edmonton, Alberta. These samples were from widely scattered districts of Alberta and included seed of four varieties, most of them (82%) being of the Noralta variety.

Polyspora lini was detected by plating 100 untreated seeds from each sample on acidified potato sucrose agar. When ikfested or surface contaminated seeds are incubated on this medium for 5-7 days typical colonies (Figure 1) of P. lini are produced, that can usually be identified without the aid of a microscope.

Results

The results of the survey are given in Tables 1 and 2 and are illustrated in Figure 2. They show that flax seed from widely separated parts of Alberta was infested with the browning or stem-break fungus, the percentage of infested samples per variety ranging from 16.6% to 40%. As indicated by the map, infestation was most common in samples from western and central Alberta and least common in the dry southeastern part. In the western part it was noted in samples as far south as Claresholm and as far north as Falher in the Peace River area.

The percentage of infested seed per sample was not particularly high but if only 1% of the seeds in a sample were infested, such a seed lot could establish a very large number of infection centers per acre.

However clean samples were obtained from all parts of the province surveyed (Figure 2) and all samples received from some areas were found to be clean.

Discussion

The most alarming fact brought out by the data in Tables 1 and 2 was that a high percentage of samples of seed of all four major varieties tested, namely Noralta, Raja, Redwood, and Redwing, proved to be infested with Polyspora lini.

With the exception of Redwing these are relatively new varieties which have become widely grown and distributed in Alberta, this being especially true of Noralta. Moreover the seed samples tested are believed to have originated on Alberta farms. It is possible therefore that the use of seed of any of these varieties that was not tested and found free from Polyspora lini could result in the wider distribution of the pathogen.

Table 1. Incidence of Polyspora *lini* in flax seed samples supplied by five Alberta Municipal Seed Cleaning Plants*

Flax variety	No. of samples	No. of samples yielding P. *lini*	Samples infested (%)	Range of infestation (%)
Noralta	20	5	25.0	0-20
Raia	6	1	16.6	0- 2
Redwood	2	0		
Total	28	6		

* Located at Alliance, Blackie, Falher, Nanton, and Pembina.

Table, 2. Incidence of Polyspora *lini* in flax seed samples supplied by the Federal District Seed Analyst in Edmonton

Flax variety	No. of samples	No. of samples yielding P. *lini*	Samples infested (%)	Range of infestation (%)
Noralta	55	17	31.0	0-9
Raja	16	6	37.5	0-2
Redwing	5	2	40.0	0-3
Redwood	14	3	21.4	0-1
Total	90	28		

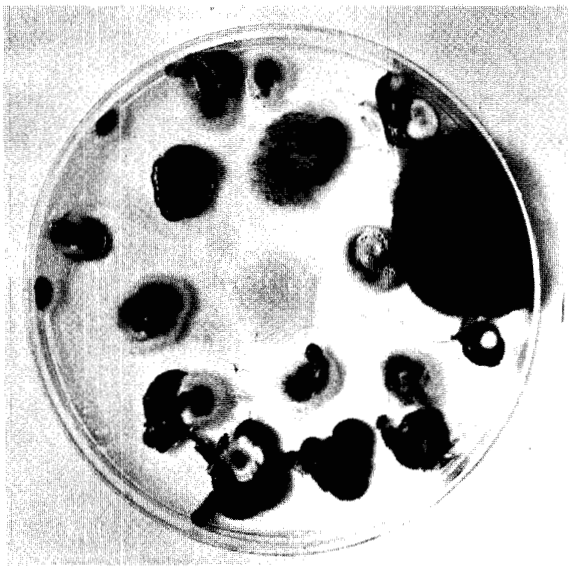

Figure 1. Isolates of Polyspora *lini* from infested seed of Noralta flax growing on potato sucrose agar. The shiny black colonies are typical of the pathogen.

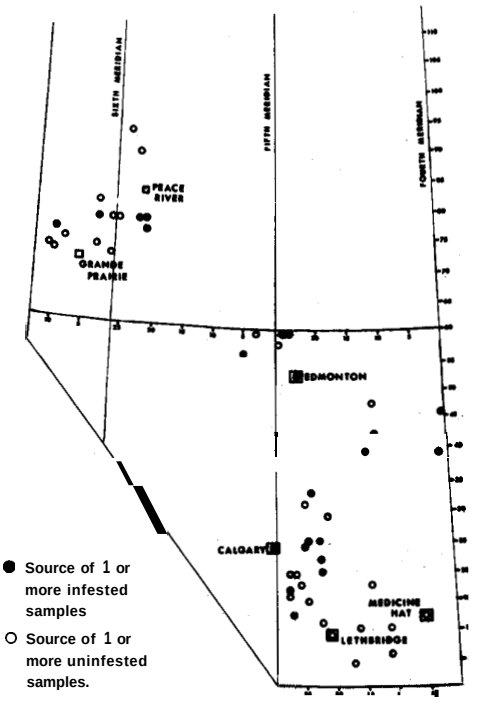

Figure 2. Distribution of Alberta flax seed samples examined for infestation with *Polysporo lini.*

While the data do not show differences in reactions to P. lini among the four varieties reported on here we have reason to believe that such differences exist. Field observations for instance indicate that Noralta is highly susceptible and that Raja possesses some resistance. It must be recognized however that P. lini is a variable fungus (4), probably consisting of many different races, so that resistance to one race may not necessarily mean resistance to all races. Among other varieties it has been noted that extreme reactions have been reported, e.g. Bison as highly susceptible and Rio a13 highly resistant.

It might be noted that three of the varieties examined here, Noralta, Raja, and Redwood possess considerable resistance to rust and wilt fungi. It would seem that the browning and stem-break fungus has become sufficiently important in Alberta to warrant the incorporation of resistance to it in new varieties that may be developed.

USE OF UNXNFESTIED SEED IN THE CONTROL OF THE DISEASE

The 'use of clean seed can play a major role in the control of the browning and stem-break disease. While our investigations show that many samples of Alberta farmers' seed are infested with the causal fungus, they also show that the majority are clean. Hence it is possible to obtain clean seed in Alberta.

If a farmer has to purchase seed to establish a crop he should be sure that he obtains clean seed. He should then be able to grow his own seed for an indefinite period with the expectation of producing crops free from this disease.

If, on the other hand, a farmer has infested seed he would be well advised to sell it for commercial purposes and buy clean seed with which to start his next crop.

Clean seed is more likely to be obtainable from areas which have a dry rather than a moist climate.

Visual examination of flax seed is not sufficient to detect infestation with P. lini. A cultural test such as that used In this investigation is necessary and could be made quite readily if seed testing laboratories were provided with the necessary equipment and qualified personnel.

ADDITIONAL CONTROL MEASURES

The use of clean seed is an essential control measure and might in certain circumstances be sufficient by itself, but other supplemental measures, such as crop rotation, seed treatment, and the growing of resistant varieites when suitable ones are available should be practised.

Acknowledgments

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