A REVIEW OF DAMPING-OFF OF DOUGLAS FIR SEEDLINGS IN BRITISH COLUMBIA[1]

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ABSTRACT

Except in new nurseries, damping-off in British Columbia forest nurseries has remained below serious levels. Modification of nursery practices has served to reduce losses. The use of a suitable, sandy cover soil has been effective. Lowered fertility of the soil, though a problem in itself, appears to decrease incidence of damping-off. The acidity of the soil in coast nurseries may have afforded some natural control of the disease. From investigations on the control of damping-off, there appears to be promise in the use of peat as a planting medium for stratified seed, and, based on experiments with unstratified seed, in the application of fungicides to cover soil. In view of the present low degree of the disease, there would appear to be an opportunity for research directed to the biology and control of fungi known to be capable of causing sudden outbreaks, without the urgent need of finding immediately effective control measures.

INTRODUCTION

The purpose of this paper is to bring together observations made by several investigators on damping-off in British Columbia nurseries.

Forest nurseries in British Columbia are utilized chiefly in the production of 2-0 stock of Douglas fir of which the average annual production in the last five years has been approximately 8,000,000 seedlings. Of the four nurseries operated by the British Columbia Forest Service, the three on the coastal areas possess fairly acid soil while the one in the interior has alkaline soil. Almost all the Douglas fir seed used is unstratified, and the nursery methods employed are those developed at the Green Timbers Forest Nursery (15) with modifications to suit local conditions. Within the framework of these conditions and practices damping-off losses remain low. Damping-off is present every year and the losses it causes are irregular in occurrence, but the deviations from expected losses are not sufficient to affect seriously the planting program of the British Columbia Forest Service. The practice of compensating for expected seedling loss by sowing more thickly has during a considerable number of years given adequate results in the coast nurseries. In its interior nursery, the Forest Service has

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observed little damping-off although the pH of the soil there may be within the optimum range for the development of the disease. Data[3] of the Forest Service indicate that loci of high alkalinity and salinity as such constitute the most pressing nursery problem there (8).

The following discussion is based on observations made only at the coast nurseries on damping-off of Douglas fir, but literature from other sources is cited wherever pertinent.

Fungi Associated With Damping-Off

In the three coast nurseries, *Rhizoctonia* in particular has been associated with early damping-off losses while *Fusarium* spp. have been associated with later losses, at least as frequently as *Rhizoctonia*. *Phthium* spp. at all times appeared to be less important. Observations made outside of the province indicate that virulent damping-off associated with Fusaria is uncommon (5) or imply that it occurs under special conditions (6). At the Duncan nursery, however, *Fusarium oxysporum* Schlect. is the fungus almost always associated with late damping-off and, at that nursery, it may cause a large part of the total damping-off losses (4, 11).

Acidity Of The Soil

It is believed that the acidity[4] of the soil in the three coast nurseries is influential in reducing damping-off and in determining to some extent the fungi associated with damping-off. High acidity of the soil is generally considered beneficial in reducing damping-off (7, 10, 14), at least that caused by *Pythium* spp.

Use Of Stratified Seed

Although rapid germination may cause many seedlings to escape damping-off (5, 10), the British Columbia Forest Service uses unstratified Douglas fir seed that requires an extended period for germination. Bier's (2) observations during three years at the Green Timbers Forest Nursery, British Columbia, indicated that the usage of dry-stored seed may have been a factor in preventing serious losses from damping-off. The nearly simultaneous germination of stratified seed might facilitate a sudden spread of the disease under favorable conditions if no control measures were practiced. More recent tests by the Forest Service at its Duncan nursery, which are being continued, have not shown excessive damping-off of seedlings from stratified seed.

Cultural Methods

It has been suggested by British Columbia Forest Service staff personnel that low available-nitrogen content has become limiting to damping-off fungi in the nursery soils from which repeated crops of seedlings have been removed[5]. Laboratory experiments carried out by Bier (2) and Buckland (3) gave promise that damping-off could be kept to a minimum even if stratified seed were used, provided that certain precautions were followed. Under the conditions of their experiments, the use of acid peat as a planting medium gave satisfactory

[3]Many seedlings with purplish green foliage were observed. Although most of the soil in the interior nursery has a pH about 7 to 7.5, the areas treated in the Forest Service experiment have a mean pH, before treatment, above 8.0.

[4]The pH at Green Timbers averaged about 5.5 in 1947 (11).

[5]Lowered fertility is a problem since many seedlings remain too small and are culled at planting time.

control. For nursery use a tendency for the peat to dry and blow away unless watered excessively would, however, have to be overcome[6]. Buckland (4) later found germination of unstratified seed was reduced when covered by peat at the Duncan nursery.

The British Columbia Forest Service has experienced damping-off as a problem in newly-established nurseries but has found in these nurseries that it can be reduced by various means following several years of operation. For instance, in the Duncan nursery, damping-off losses were high at first (4) and seedling growth was rapid for 2-0 stock (indicating high soil fertility). Later, damping-off was less, and the rate of seedling growth was moderate. Improved physical conditions of the soil and the practice of covering the seed with a sandy cover soil are believed to be important influences in reducing the losses from damping-off. Failure to apply "imported" cover soil in soil treatments has been observed to result in a reduction of the seedling stand (4). There is some difference of opinion regarding the effectiveness of suitable cover soil against damping-off. According to Davis et al (5), it is desirable to have soil cover which will not cake and delay the emergence of seedlings, although the use of pure sand does not have as much value in preventing damping-off as has been attributed to it. On the other hand, Riker et al (9) state, "The Evergreen Nursery, Sturgeon Bay, Wis. has eliminated its damping-off problem by covering the seed with Lake Michigan sand." Toumey (13) had uniform success in preventing loss from damping-off in spring-sown seed beds by practicing the following method. After the seed was sown, subsoil from a depth of two or more feet beneath the soil surface was used for covering the seed. This method was successful in the large New York State nurseries.

If the satisfactory stands obtained by present methods of nursery culture continue, the practicability of further control would depend on very low costs. A low-cost treatment, application of sawdust on cover soil, was tried out during the second year of operation of the nursery at Duncan. Increased stands resulted, in some instances (4). Application of sawdust was again tested in the following two growing seasons. Some reduction of seedling stand resulted. One test of the application of sucrose to the soil, made concurrently with the last of these experiments on the application of sawdust, gave a considerable reduction of the stand (11).

Fungicidal Control Of Damping-Off

Experiments on the control of damping-off with fungicides were also carried out at the Duncan nursery (11). For simplicity in application, a small number of fungicides were tested by applying them to the surface of planted beds. In 1948, Bordeaux mixture, Semesan, and Ferbam were applied just after the seedlings had started to emerge, and again, within two weeks. In 1949, Bordeaux was applied once, just before the seedlings began to emerge. The fungicides appeared to give some protection to seedlings as indicated by stand

[6]Personal communication from H. McWilliams, Forester-in-Charge, Reforestation Division, British Columbia Forest Service.

increases of approximately 10 percent. No appreciable increase in stand was obtained by dusting the seed with Semesan.

There is no guarantee that the present low level of damping-off will continue, particularly in the interior nursery at Cranbrook where the soil is alkaline. One instance (16) has been cited of a nursery where heavy losses occurred after 18 years of operation with no previous record of serious damping-off. Further research on damping-off would have value as insurance against future outbreaks of the disease. It is possible that efficient fungicidal treatments with low cost could be developed. Berbee et al report (1) that they obtained adequate protection of spring sown red pine from *Pythium irregulare* and *Rhizoctonia solani* by pelleting with as little as 2 oz. tetramethylthiuram disulphide and 1 oz. methyl cellulose per pound of seed.

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