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# THE TREATMENT OF DAMPING-OFF IN CONIFEROUS SEEDLINGS.

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## THE TREATMENT OF DAMPING-OFF IN CONIFEROUS SEEDLINGS.

### INTRODUCTION.

Experiments have been carried on by the writer for several years in testing the effect of various chemicals upon the damping-off diseases of tender coniferous seedlings. These troubles are great obstacles to the successful production of such seedlings in large numbers for use in replanting waste or unoccupied land. They are caused by a number of different fungi which are being studied and will shortly be described.

The results of the first experiments, which were carried on entirely in the greenhouse, were taken as indications of what might be expected in actual nursery practice. It was felt, however, that the work should be extended to field conditions, and upon testing the preliminary results there it was found that they could be taken only as very meager and insufficient indications of the results to be obtained in the field.

During the season of 1907, field experiments were conducted in several nurseries of the New York Forest, Fish, and Game Commission (one of which is operated in cooperation with the Forest Service of the United States Department of Agriculture) and of the Vermont State Forestry Commission, located, respectively, at Saranac Inn, N. Y., and Burlington, Vt. These experiments yielded very interesting results, but because of their preliminary nature it is felt that without further very rigid tests along similar lines they can not be accepted as furnishing conclusive proof of the comparative value of the chemicals used.

The great interest centering about these diseases, however, makes of value every scrap of practical information concerning methods of prevention. Until conclusive results are obtained the present ones may therefore prove useful to nurserymen, but they should be accepted with the distinct understanding that they are preliminary and are subject to later modification.

The tests here outlined are being continued on a more extensive scale, and it is hoped that the present season's work will give such results that there can be no doubt as to the conclusions to be drawn from them.

#### PROCEDURE IN EXPERIMENTS.

The plots used were located in seed beds 12 feet long and 4 feet wide, each bed being divided into three equal parts 4 feet square. The chemicals were used in fine powders or in solutions, according to their original form and nature. The solutions were applied with an ordinary sprinkling can, while the powders were sifted on the beds with a very simple form of duster having a perforated bottom, through which the powder was shaken. The solutions were applied to the soil before the seeds were sown, and then again about five days after the seedlings had come up. The powders were applied to the beds only after the seedlings had been up for three or four days. They were applied in very light coatings, which were renewed promptly after each rain. This renewal is not necessary except for a period of about two weeks, beginning three or four days after germination, when the seedlings are most susceptible to the attacks of the damping-off fungi.

#### POWDERS USED.

*Sulphur.*—Sulphur was obtained in three forms: Washed, resublimed, and precipitated. Favorable results were given by all, but the first led the others slightly. It was noted, too, that a distinct odor of sulphur could be detected at least 8 inches above the surface of the plot treated with washed sulphur, while no perceptible odor could be detected over the other two at a greater distance above the surface than 1 or 2 inches. This difference was as marked several days after the sulphur had been applied as it was immediately after the application was made.

*Dry Bordeaux mixture.*—Dry Bordeaux mixture made according to Scott's formula<sup>a</sup> was also tried, but the method of preparation is too tedious and time consuming to be of use in the case of a disease like damping-off unless the mixture is made up some time in advance. It is seldom practicable for the nurseryman to give the necessary time for its preparation, owing to the pressure of other duties at this period of the year. This powder was accordingly discarded for a copper sulphate and lime mixture which is easily and quickly made up as required and apparently should give as good results as the Bordeaux preparation.

*Copper sulphate and lime.*—Powdered sulphate of copper was mixed with powdered lime, at the rate of 1 pound of the former to

<sup>a</sup> Waite, M. B. Fungicides. U. S. Department of Agriculture, Farmers' Bulletin 243, pp. 11-12. 1906.



10 pounds of the latter, in the following way: Fresh stone lime was slaked with as little water as would keep the slaking in progress. In this way slaked lime was obtained in the form of a fine powder. This was screened and very thoroughly mixed with the powdered copper sulphate, and was then ready to be used. Attention is called to the need of thoroughly mixing the two ingredients, as disastrous results are likely to ensue if the copper sulphate is not properly diluted with the lime.

This mixture was used very freely after the seedlings had come up. Absolutely no injurious results could be noted, even when the applications were made early in the morning while the seedlings were still wet with dew so that the powder stuck to them. It may be said that the better time to apply the powders and also the solutions is late in the afternoon. The powders will then adhere very slightly to the plantlets and practically all of the powder will fall on the soil, where it is wanted.

This copper and lime mixture was used upon the following species: *Pinus sylvestris*, *P. ponderosa*, *P. strobus*, *P. resinosa*, *Picea rubens*, *P. excelsa*, and *Pseudotsuga taxifolia*. Very good results were obtained in checking the damping-off with it, and it is believed to be one of the mixtures tested which may prove of value commercially.

#### SOLUTIONS USED.

*Potassium sulphid and permanganate.*—A solution of potassium sulphid, made at the rate of 1 ounce of dry chemical to 1 gallon of water and applied to the soil before sowing the seed, gave no definite results because of the absence of the disease in the experimental plots. This was also true of a solution of potassium permanganate, mixed at the rate of 1 gram of chemical to 1 gallon of water and similarly applied.

*Formalin.*—Commercial 40 per cent formalin, used at the rate of 4 ounces to 3 gallons of water, when applied to the soil before seeding and not afterward repeated, seemed to have no effect whatever upon the disease. The check plot, indeed, was much better, as were all of the other plots, both treated and untreated, located in that section of the nursery. When applied as stated and repeated after the seedlings had come up, the results were poor. It is now believed that formalin is of little value with the damping-off diseases of coniferous seedlings unless supplemented after the germination of the seed with some other efficient chemical. The results were disappointing when compared with those obtained with some of the other chemicals.

*Sulphuric acid.*—The best results were obtained with weak solutions of sulphuric acid. A solution mixed at the rate of 1 ounce of acid to 1 gallon of water was applied to the soil several days before sowing

the seed, until it was thoroughly drenched, and the treatment was repeated about a week after the seedlings came up. The treated plot was in excellent condition in December; there was a very good stand of fine, healthy seedlings and the soil was entirely free from algæ and moss. The check plot, on the other hand, had practically no seedlings left, and the soil was green with algæ and moss.

This solution of sulphuric acid was applied to young seedlings of a number of different species, and but one showed any ill effects. This was Norway spruce (*Picea excelsa*). It is not advisable to use an acid solution as strong as this upon the plants. Kraemer <sup>a</sup> has shown that a solution of sulphuric acid at the rate of 1 to 500 is as strong as should generally be used upon plant tissues, and this is recommended rather than the much stronger one used in these experiments. For soil treatment the stronger solution will probably prove preferable.

Approved:

JAMES WILSON,

*Secretary of Agriculture.*

WASHINGTON, D. C., April 6, 1908.

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<sup>a</sup>Kraemer, Henry. Dilute Sulphuric Acid as a Fungicide. Proceedings, American Philosophical Society, vol. 45, pp. 157-163, 1906.