Investigation of
Stinchfield Nursery Soil
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A Damping-Off Investigation of Stinchfield Nursery Soil

By

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Introduction

After the selection of any new forest nursery site and prior to the start of the production of stock it is advisable to study the problems and conditions relating to this area. Each new area presents conditions and problems which are peculiar to itself and must be studied before success in the venture can be fully achieved.

The provision for a definite amount of stock per year is, no doubt, one of the most essential considerations in good nursery practice. The factors which might upset such a plan are weather, insects, and fungi. The control of birds and rodents by using seed frames and covers and the control of moisture by proper shading and irrigation leave the damping-off fungi as the greatest damaging agent in causing seedbed losses.

Unless control measures are used, when they are necessary, to limit losses to as low a figure as possible, great financial loss is likely to be incurred and working plans seriously interfered with. It is, therefore, necessary to make a study of each new nursery site in order to determine the best methods of controlling the various factors which tend to disrupt specific plans.

Scope

The primary purpose of this study was to test the soil of the new nursery site of the School of Forestry and Conservation,

University of Michigan, in order to determine the intensity of the damping-off attack and the best probable method of control. It was the loss caused by the damping-off fungi which served as the basis of study and not the fungi themselves. In the determination of the method of control the economic factor of cost was not overlooked. In view of this fact, the lowest concentration that would prove effective for any of the treatments was sought.

It was decided that as a secondary objective it would be worth while to vary the amount of water given the plats for the purpose of ascertaining whether or not this change in moisture conditions was conducive to a more rapid development of the fungi.

Location and Description

The new nursery site is located on the Bell Eighty of Stinchfield Woods, which belongs to the School of Forestry and Conservation of the University of Michigan. The soil is a light sandy loam which goes to a depth of more than four feet. It is easily worked, holds moisture well, and does not cake upon drying. The topography, being typical of glacial country, is rolling. Drainage is good except at the western edge, which is the lowest and inclined to be a little heavy and damp. It is sheltered on all sides by low hills with the exception of a small draw at the southwest corner. There is a windbreak of juniper trees (Juniperus virginiana) on the north side. When all things are considered it is undoubtedly an ideal location for a nursery.

Methods and Treatments

It was impossible to carry on the experiment in the field prior to the growing period because of low temperatures, so it was necessary to take soil from the area into the laboratory and to conduct the experiment inside. Conditions in a room are, of course, different from those which are to be found on the area, but the results will show the relative merits of the treatments, although it will be impossible to conclude that a certain per cent of loss would occur in the seed beds because such was the case in the seed plats. The data are not sufficient to draw any such conclusions.

Norway pine (Pinus resinosa) seed was used because of its susceptibility to damping-off. Only this one species was used as it was thought better to use a greater variety of treatments rather than limit the treatments and use several species. This is in accord with what was set out under the heading "Scope," namely, to find the lowest concentration of any treatment that would prove effective. Because of the greater susceptibility of Norway pine, any treatment that would be satisfactory for this species would undoubtedly prove equally if not more effective for other species.

Plats one foot square and three inches deep were used. The soil was sifted into these plats until it was level with the top, and when this settled it was about one half inch from the top. Although it was not necessary to screen the soil, it was thought advisable to break up the lumps and remove foreign material. All plats were placed on a table near a window so as

to receive the maximum of sunlight. The temperature of the room was never lower than 70 degrees Fahrenheit. As soon as the weather permitted windows were opened and conditions regulated by the weather with the exception of moisture.

Each plat contained 100 seeds and each treatment was used on two plats. It was thought that the use of two plats of 100 seeds each for each treatment would show results more clearly than the use of only one plat of 200 seeds. The water in all instances was carefully measured and then applied to the plats from the top by the aid of a sprinkling device. Care was taken not to wash the soil away from the seeds. All plats actually received an average of 50 cc. of water daily. Some were given this amount every day, while others received 100 cc. every second day A daily record of each plat was kept, showing emergence and damping-off. Toothpicks were used to mark seedlings on their emergence and were removed as the plants damped off, making an accurate count possible.

The three chemicals used for treatment were (1) sulphuric acid, concentrated; (2) formalin, commercial; and (3) semesan. Each chemical was applied in various concentrations and these will be taken up under their appropriate headings. In addition to the treated plats a series of untreated plats was run as a check to serve as the basis upon which to compare results.

No Treatment (check plats)

Six plats were seeded with 100 seeds each and watered as follows:

1. Two plats were given 100 cc. of water every day.
2. " " " " 100 cc. " " " second day.
3. " " " " 100 cc. " " " third day.

Sulphuric Acid Treatment

Six plats were seeded with 100 seeds each. Each of the following concentrations was then applied to two plats, using one pint of treatment for each plat:

1. 1/4 oz. H_2SO_4 and add water to make one pint. (1 gal. to 64 gals.)
2. 1/8 " " " " " " " " " (1 " " 128 ")
3. 1/16 " " " " " " " " " (1 " " 256 ")

The plats were watered daily with 50 cc. in order to keep the concentration of the acid low enough so as not to chemically injure the seedlings.

Formalin Treatment

In the case of formalin, which is injurious to seeds, it was necessary to treat the plats prior to seeding them. Eight plats were therefore treated as follows (two plats for each treatment):

1. 4/5 oz. formalin and add water to make one pint. (1 gal. to 20 gals.)
2. 3/5 oz. formalin and add water to make one pint. (1 gal. to 27 gals.)
3. 2/5 oz. formalin and add water to make one pint. (1 gal. to 40 gals.)
4. 1/5 oz. formalin and add water to make one pint. (1 gal. to 80 gals.)

It was two weeks before the seeds were planted, as it was necessary to wait this long for the disappearance of the formalin. These plats were given 100 cc. of water every second day.

Semesan Treatment

Due to delay in obtaining the semesan this series was not started until later than the others. Six plats were seeded with 100 seeds each and treated as follows (two plats for each treatment):

1. 2.362 gr. semesan to one pint of water (1 oz. to 1.5 gals.) (Half normal)
2. 1.181 gr. semesan to one pint of water (1 oz. to 3 gals.) (Normal strength)
3. .591 gr. semesan to one pint of water (1 oz. to 6 gals.) (Double strength)

These plats were given 100 cc. of water every second day with the exception of one of those treated with double strength which was watered every day.

Results

Tables 1, 2, 3, and 4 show the day-by-day record of all plats. For the purpose of ease in comparison and in order to smooth out the eccentricities somewhat, the results of each treatment were averaged, and served as a basis for the following:

No Treatment (check plats)

Results show that moisture condition of the soil is a very pertinent factor in the control of the damping-off organisms. In these plats weeds were quite abundant, as well as various agarics.

Plats given water every day had an average emergence of 82.5 seedlings. Of this number 70.5 damped off, or 85.5 per cent. Those plats watered every second day showed a damping off of 64.1 per cent, 55 out of 86 plants having succumbed. In plats which

Table 1 - No Treatment (Check Plats)

Seeds planted March 17, 1934.

Date	Amount of Water Per Square Foot											
	100 cc. H_2O Every Day				100 cc. H_2O Every Second Day				100 cc. H_2O Every Third Day			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
April 1	1	-	-	-	1	-	-	-	-	-	-	-
2	1	3	-	-	3	-	-	-	4	-	-	-
3	-	2	-	-	-	2	-	-	1	1	-	-
4	3	12	-	-	5	6	-	-	3	3	-	-
5	4	13	-	-	9	7	-	-	5	5	-	-
6	22	24	-	-	30	22	-	-	9	8	-	-
7	11	8	-	-	11	16	-	-	11	10	-	-
8	8	5	-	-	6	4	-	-	10	9	-	-
9	12	4	4	3	5	8	-	-	16	12	-	-
10	13	4	2	-	9	8	-	-	12	8	-	-
11	3	4	1	1	2	2	1	-	5	7	-	-
12	4	-	-	-	4	1	-	-	1	7	-	-
13	-	2	1	1	3	1	2	1	1	1	-	1
14	-	-	-	3	-	1	-	-	2	-	-	-
15	-	1	1	3	1	-	2	1	2	-	-	-
16	-	-	3	5	1	2	2	-	1	3	1	-
17	-	-	3	-	-	1	-	-	-	1	-	-
18	-	-	-	4	-	-	4	-	-	1	-	-
19	-	-	7	8	-	-	5	2	6	1	1	-
20	-	-	2	4	-	-	5	-	-	-	-	-
21	-	-	3	6	-	-	-	-	-	-	-	-
22	-	-	3	8	-	-	2	3	-	-	-	-
23	-	-	3	5	-	-	4	3	-	-	1	1
24	-	-	-	7	-	-	-	-	-	-	-	-
25	-	-	7	10	-	-	1	1	-	-	1	-
26	-	-	8	3	-	-	2	-	1	-	1	-
27	-	-	1	2	-	-	-	-	-	-	-	-
28	-	-	1	-	-	-	-	-	-	-	-	-
29	-	-	4	5	-	-	2	1	-	-	2	-
30	-	-	-	-	-	-	3	-	-	-	-	-

Table 1 - No Treatment (Check Plats) (continued)

Seeds planted March 17, 1934.

Date	Amount of Water Per Square Foot											
	100 cc. H_2O Every Day				100 cc. H_2O Every Second Day				100 cc. H_2O Every Third Day			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
May 1	-	-	1	-	-	-	7	-	-	-	-	-
2	-	-	-	-	-	-	4	-	-	-	-	-
3	-	-	1	1	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	3	2	-	-	4	-
5	-	-	2	-	-	-	1	-	-	-	2	-
6	-	-	1	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	2	-	-	-	-	-
9	-	-	-	-	-	-	2	-	-	-	-	-
10	-	-	1	-	-	-	1	-	-	-	-	-
11	-	-	-	-	-	-	2	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	2	2	-	-	-	-
14	-	-	2	-	-	-	4	3	-	-	3	2
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	5	-	-	-	-	-
17	-	-	-	-	-	-	-	1	-	-	-	2
18	-	-	-	-	-	-	-	1	-	-	-	-
19	1	-	-	-	-	-	3	2	-	-	-	1
20	-	-	-	-	-	-	2	-	-	-	3	3
21	-	-	-	-	-	-	1	1	-	-	4	-
22	-	-	-	-	-	-	5	1	-	-	5	2
23	-	-	-	-	-	1	-	3	-	-	8	3
24	-	-	-	-	-	-	-	2	-	-	-	-
25	-	-	-	-	-	-	1	-	-	-	-	-
Totals	83	82	62	79	90	82	80	30	90	77	36	15

Table 2 - Treatment With Sulphuric Acid (H_2SO_4)

Seeds planted March 17, 1934.

Date	Amount of Treatment Per Square Foot											
	1/4 oz. to 1 pint H_2O				1/8 oz. to 1 pint H_2O				1/16 oz. to 1 pint H_2O			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
April 1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	-
4	-	-	-	-	-	-	-	-	4	-	-	-
5	-	-	-	-	1	2	-	-	5	1	-	-
6	-	-	-	-	2	1	-	-	8	3	-	-
7	-	-	-	-	3	3	-	-	5	5	-	-
8	-	-	-	-	2	2	-	-	7	4	-	-
9	1	2	-	-	4	2	-	-	3	12	-	-
10	-	-	-	-	7	3	-	-	4	7	-	-
11	-	-	-	-	3	3	-	-	1	.7	-	-
12	-	-	-	-	3	3	-	-	3	5	-	-
13	-	-	-	-	2	3	-	-	3	6	-	-
14	-	-	-	-	2	3	-	-	3	5	-	-
15	-	2	-	-	1	3	-	-	1	4	-	-
16	-	3	-	-	3	2	-	-	3	4	-	-
17	1	2	1	-	2	1	-	-	2	1	-	-
18	-	1	-	-	2	1	-	-	1	1	-	-
19	-	2	-	-	2	1	-	1	1	-	-	1
20	-	-	-	-	4	1	-	-	-	-	-	-
21	-	-	1	-	-	-	-	-	2	-	-	-
22	-	-	-	-	2	1	-	2	2	-	2	-
23	1	-	-	-	-	3	-	-	-	1	1	1
24	1	-	-	-	-	-	-	-	-	-	1	-
25	-	2	-	-	2	2	-	-	1	1	-	1
26	-	-	-	-	1	1	2	-	-	-	-	1
27	-	-	-	-	2	2	-	-	-	-	-	-
28	-	-	-	-	1	-	-	-	-	-	-	-
29	1	5	-	-	-	3	-	-	-	1	-	-
30	-	-	-	-	-	1	-	-	-	-	-	-

Table 2 - Treatment With Sulphuric Acid (H_2SO_4) (continued)

Seeds planted March 17, 1934

Date	Amount of Treatment Per Square Foot											
	1/4 oz. to 1 pint H_2O				1/8 oz. to 1 pint H_2O				1/16 oz. to 1 pint H_2O			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
May 1	-	-	-	-	-	-	-	-	-	-	-	4
2	-	-	-	-	-	2	-	-	-	-	-	1
3	1	-	-	-	3	-	-	-	-	1	-	3
4	-	-	-	-	2	1	-	-	2	3	-	2
5	-	-	-	-	1	-	-	2	-	-	-	8
6	-	-	-	-	-	-	-	-	-	-	-	2
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	1
9	-	-	-	-	1	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	4	-	-	1	3	-	2	3	-	-	-
12	-	-	-	-	-	-	-	-	1	-	-	-
13	-	-	-	-	-	1	-	-	-	-	-	-
14	-	-	-	-	-	-	2	-	-	-	-	-
15	-	-	-	-	-	3	1	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	1	-	-	-	-	-	-	-
18	3	1	-	-	-	-	1	1	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	3
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	1
22	-	-	-	1	-	1	-	-	-	-	-	2
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	3
25	-	-	-	-	-	1	-	-	-	-	-	-
Totals	9	24	2	1	60	59	6	8	70	75	4	34

Table 3 - Treatment With Formalin, Commercial

Seeds planted April 3, 1934

Date	Amount of Treatment Per Square Foot															
	4/5 oz. to 1 pint H_2O				3/5 oz. to 1 pint H_2O				2/5 oz. to 1 pint H_2O				1/5 oz. to 1 pint H_2O			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
April 15	-	-	-	-	-	2	-	-	-	-	-	-	2	2	-	-
16	-	-	-	-	-	2	-	-	2	-	-	-	3	1	-	-
17	-	-	-	-	3	3	-	-	3	-	-	-	6	6	-	-
18	-	-	-	-	3	10	-	-	6	6	-	-	20	13	-	-
19	10	2	-	-	4	16	-	-	10	17	-	-	24	22	-	-
20	6	1	-	-	7	12	-	-	10	16	-	-	12	20	-	-
21	9	7	-	-	12	10	-	-	12	10	-	-	6	8	-	-
22	15	10	-	-	18	8	-	-	10	6	-	-	4	4	-	-
23	9	16	-	-	15	4	-	-	9	8	-	-	4	3	-	-
24	6	6	-	-	8	3	-	-	1	2	-	-	4	1	-	-
25	5	17	-	-	5	5	-	-	8	9	-	-	2	4	-	-
26	6	4	-	-	2	2	-	-	3	4	-	-	-	3	-	-
27	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
28	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-	-
29	2	7	-	-	4	1	-	-	2	3	-	-	-	-	-	-
30	-	4	-	-	-	-	-	-	-	-	-	-	3	-	-	-
May 1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
3	4	4	-	-	-	-	-	-	2	-	-	-	1	-	-	-
4	3	1	-	-	1	-	-	-	1	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
6	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

Table 3 - Treatment With Formalin, Commercial (continued)

Seeds planted April 3, 1934

Date	Amount of Treatment Per Square Foot															
	4/5 oz. to 1 pint H_2O				3/5 oz. to 1 pint H_2O				2/5 oz. to 1 pint H_2O				1/5 oz. to 1 pint H_2O			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2	P1.1	P1.2
May 15	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
17	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	4	-	-	3	-	-	-	1	2	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
20	-	-	3	-	-	-	-	1	-	-	-	4	-	-	-	1
21	-	-	-	-	-	-	4	-	-	-	11	5	-	-	-	2
22	-	-	2	1	-	-	5	2	-	-	11	1	-	-	5	6
23	-	-	-	3	-	-	7	3	-	-	7	3	-	-	-	-
24	-	-	-	-	-	-	17	7	-	-	4	5	-	-	5	4
25	-	-	2	2	-	-	7	2	-	-	2	3	-	-	2	2
Totals	79	85	9	10	88	80	43	15	79	87	39	34	92	91	12	15

Table 4 - Treatment With Semesan

Seeds planted April 23, 1934.

Date	Amount of Treatment Per Square Foot											
	2.362 gr. to 1 pint H_2O				1.181 gr. to 1 pint H_2O				.591 gr. to 1 pint H_2O			
	Number Emerged		Number Damped Off		Number Emerged		Number Damped Off		Number Emerged		Number Damped Off	
	Pl.1	Pl.2*	Pl.1	Pl.2*	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2	Pl.1	Pl.2
May 4	4	4	-	-	3	4	-	-	5	5	-	-
5	10	2	-	-	9	14	-	-	12	8	-	-
6	23	3	-	-	9	19	-	-	15	11	-	-
7	9	16	-	-	16	14	-	-	14	12	-	-
8	12	18	-	-	12	8	-	-	12	12	-	-
9	9	14	-	-	11	10	-	-	8	10	-	-
10	9	6	-	-	2	2	-	-	10	10	-	-
11	7	10	-	-	6	11	-	-	8	4	-	-
12	-	1	-	-	-	1	-	-	-	2	-	-
13	3	-	-	-	-	2	-	-	5	1	-	-
14	2	5	-	-	-	1	-	-	2	1	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	2	-	-	-	-	-	2	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	1	-	-	-	-
19	-	-	-	-	-	-	-	4	-	-	-	4
20	-	-	-	-	-	-	-	-	-	-	1	6
21	-	2	-	8	-	-	-	-	-	-	3	5
22	-	-	2	5	1	1	9	9	-	-	2	3
23	-	-	-	1	-	1	2	3	-	-	2	-
24	-	-	-	-	1	-	6	4	-	-	2	3
25	-	-	-	3	-	-	-	-	-	-	3	8
Totals	88	83	2	17	72	88	17	23	91	76	13	29

* Watered every day.

received water every third day the percentage of damping off dropped to 30.6, or 25.5 trees out of 83.5.

Damping Off Results on Untreated Plats

Amount of Treatment	Average No. Emerged	Average No. Damped Off	Per Cent Damped Off
Watered every day	82.5	70.5	85.5
Watered every second day	86.0	55.0	64.1
Watered every third day	83.5	25.5	30.6

Sulphuric Acid Treatment

The use of acid caused a change in the physical characteristics of the top soil. This was more pronounced in the plats which received the most acid. The top soil became crusty and was marked with small fissures which caused it to dry rapidly. There was also a slight reaction with the soil and the forming of insoluble calcium sulphate.

The plats treated with the highest concentration (1/4 oz. to 1 pt. of H_2O) suffered from acid injury and some were undoubtedly unable to push their way through the crusted surface. An average of only 16.5 plants emerged with 9.1 per cent, or 1.5 plants damping off. The treatment with 1/8 oz. to 1 pt. of H_2O proved a little more successful in the number of plants emerging, but there was a larger percentage that damped off. In this case the average emergence was 59.5 seedlings, of which 11.7 per cent, or 7, damped off. The weakest solution (1/16 oz. to 1 pt. H_2O) had an average emergence of 72.5 seedlings and 26.2 per cent of these, or 19, damped off.

The acid treatment proved very effective in the control of weeds, for not a single weed appeared in any of the plats.

Damping Off Results on Plats Treated With Sulphuric Acid

Amount of Treatment	Average No. Emerged	Average No. Damped Off	Per Cent Damped Off
1/4 oz. H_2SO_4 to 1 pt. H_2O	16.5	1.5	9.1
1/8 oz. H_2SO_4 to 1 pt. H_2O	59.5	7.0	11.7
1/16 oz. H_2SO_4 to 1 pt. H_2O	72.5	19.0	26.2

Formalin Treatment

Formalin has been used in the past by the School of Forestry and Conservation and has given fair results. It was therefore decided to do a little more work with this treatment than with the others.

Plats treated with the strongest solution (4/5 oz. to 1 pt. of H_2O) showed an average emergence of 82 seedlings. Of this number, 9.5 plants, or 11.6 per cent, damped off. Those treated with 3/5 oz. to 1 pt. had an average emergence of 84, but 29, or 34.6 per cent, damped off. Those treated with 2/5 oz. to 1 pt. suffered the most, with an average of 36.5 out of 83, or 43.9 per cent, damping off. The weakest solution (1/5 oz. to 1 pt.) showed very good results, only 13.5 out of 91.5, or 14.7 per cent, damping off.

Damping Off Results on Plats Treated With Formalin

Amount of Treatment	Average No. Emerged	Average No. Damped Off	Per Cent Damped Off
4/5 oz.Formalin to 1 pt. H_2O	82.0	9.5	11.6
3/5 oz.Formalin to 1 pt. H_2O	84.0	29.0	34.6
2/5 oz.Formalin to 1 pt. H_2O	83.0	36.5	43.9
1/5 oz.Formalin to 1 pt. H_2O	91.5	13.5	14.7

Semesan Treatment

Semesan, which is a compound of mercury, proved quite effective when used at double strength. It was decided to water one of the plats treated with the double strength daily as a check on the check plats. One plat is not sufficient to state anything definite but merely gives a general idea of what is likely to happen.

The plat treated with double strength semesan and watered every second day showed an emergence of 88, of which only 2 plants, or 2.3 per cent, damped off, while the one which received water every day had an emergence of 83, with 17 plants, or 20.5 per cent, damping off. The plats treated with normal strength semesan had an emergence of 80 plants, 20 of which damped off, or 25 per cent. Those plats which received half normal semesan damped off 25.2 per cent, 21 plants out of 83.5 succumbing.

Damping Off Results on Plats Treated With Semesan

Amount of Treatment	Average No. Emerged	Average No. Damped Off	Per Cent Damped Off
Double strength Watered daily	88.0	2.0	2.3
Double strength	83.0	17.0	20.5
Normal strength	80.0	20.0	25.0
Half normal strength	83.5	21.0	25.2

Conclusions

There is no doubt that damping off becomes more serious as the supply of moisture is increased. This is well shown by the results of the check plats as well as by the plat which was treated with double strength semesan and watered daily.

The use of sulphuric acid in lighter concentration (1/16 oz. to 1 pt. of H_2O) proved fairly effective while heavier acid treatment resulted in acid injury,a reaction with the soil,and a caking of the top soil. Further study should be made before drawing any definite conclusions.

Formalin proved very effective both in the high concentration (4/5 oz. to 1 pt. of H_2O) and the low concentration (1/5 oz. to 1 pt. of H_2O).I In the intermediate concentrations there was a decided discrepancy which the author can not account for unless reinfection of the beds took place. In view of the fact that the lower concentration proved nearly as effective as the higher one the additional cost outlay would not be warranted in commercial practice.

Semesan proved the most effective of all treatments when used in double strength. The cost of such treatment is,however, prohibitive to its use. To disinfect a 4'x 12' seed bed would cost in the neighborhood of $3.00.

Recommendations

(1). Further study should be made to determine the relative merits of (a).the use of water in small quantities,(b) the use of sulphuric acid in low concentration,and (c) the use of formalin in low concentration.

(2).Although the effect of continued application of poisonous material to the soil has not yet been determined it seems probable that there might be an ill effect if continued over a long period of time. It would be best,therefore,until further study indicates otherwise,to forego chemical treatment and merely regulate the amount of water. Regulation should aim toward supplying only that amount of moisture sufficient for germination and growth.

(3). If on the basis of the foregoing study it is felt necessary to use a chemical treatment it is recommended that formalin be used. It should be used in the strength of 1 gal. of formalin (commercial) to 80 gals. of H_2O and applied at the rate of 1 qt. per square foot.

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