

EFFECTIVE APPLICATION RATES OF TMTD RABBIT REPELLENT TO DOUGLAS-FIR SEEDLINGS IN THE NURSERY¹

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Introduction

Formulations containing 10-percent TMTD were effective in protecting Douglas-fir seedlings from damage by hares and rabbits (Besser and Welch 1959). Effectiveness of the repellent

¹ Active ingredient, tetramethylthiuram disulfide.

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was evaluated in pen and field tests; the formulation was applied by dipping the tops of lifted seedlings or by hand spraying the seedlings before lifting. Such methods usually require approximately one-half gallon of the TMTD formulation for 1,000 2-0 seedlings, and the treated trees are usually coated with protective amounts of the repellent.⁴

In adopting this technique, nurserymen in western Washington needed power spraying equipment to apply the repellent to planting stock (Duffield and Eide 1962). This method has been very convenient and economical.

⁴ Unpublished data on file at Pacific NW. Forest & Range Expt. Sta., U.S. Forest Serv., Portland, Oreg.

Rates of application of the repellent, however, have not always been satisfactory.

Recently, minimum protective amounts of TMTD for 2-0 Douglas-fir planting stock in western Washington were found to range from 11 to 22 mg. per seedling (Radwan 1965). This information was used in the present investigation to determine the minimum effective rate of spraying 2-0 Douglas-fir seedlings with 10 percent TMTD repellent. Seedlings were sprayed with the repellent at different rates, and chemical analyses of TMTD on the treated seedlings were made. The rate of application which resulted in seedlings retaining the minimum effective amounts of TMTD was considered the minimum effective rate.

Another approach to the problem involves spraying the seedlings with TMTD at different rates and then subjecting them to field and pen tests for repellency to hares and rabbits. This work is now in progress.

Materials and Methods

Two-year-old Douglas-fir seedlings (Pseudotsuga menziesii (Mirb.) Franco) from the same low-elevation seed source were selected in December 1963. Five adjacent 4 by 280-foot nursery beds at the L. T. "Mike" Webster Forest Nursery were used. Treatments were limited to three beds which were each divided into seven 4- by 40-foot units. Stocking within all beds was as uniform as possible, with an average of about 60,000 trees per bed (45 seedlings per square foot). The remaining two beds alternated with the treatment beds and served as buffer strips insuring against drift.

The TMTD formulation used was freshly prepared by mixing 22.5 gallons of Arasan 42-S,⁵ 22 gallons of Rhoplex AC-33, ⁶ 2 ounces of normal octyl alcohol, and water to make 100 gallons of spray.

⁵Sources of TMTD. Manufactured by E. I. Du Pont de Nemours & Co., Wilmington, Del.

⁶An acrylic resin used as adhesive. Manufactured by Rohm & Haas Co., Philadelphia, Pa.

Spray applications were made with an agricultural power sprayer mounted on a tractor. A constant pressure of 250 p.s.i. was maintained at the pump; therefore, the spray could be applied at different rates by changing the speed of the tractor. The treatments, with 3 replications each and assigned to the 21 bed units at random, were 0, 4, 5, 7, 9, 11, and 13 gallons of repellent per 1,000 square feet.

Two days following treatment 2 samples of 25 seedlings each were taken at random from each replication of each treatment by severing the plants just above the root collar. In the laboratory a subsample of five seedlings, selected for uniform size, was taken from each sample.

All subsamples were placed in glass containers and dried to constant weight at 105°C. Dried tissues were weighed, ground to 40 mesh in a Wiley mill, and analyzed for TMTD in duplicate according to Keppel's method (1959). In each case, TMTD was extracted with chloroform, and aliquots of extracts were treated with cuprous iodide. Absorbance of resulting solutions was then measured in a Beckman DU spectrophotometer at 440 mμ, and the amount of TMTD was read from a previously constructed calibration curve.

Results

A range in tractor speed of 1.1 to 3.6 m.p.h. resulted in applications of 13.0 to 4.0 gallons of 10-percent formulation of TMTD per 1,000 square feet of seedbed area (table 1). The amount of repellent retained was not strictly proportional to the rate of application.

Table 1 also shows that seedlings sprayed at rates below 9.0 gallons of 10-percent TMTD per 1,000 square feet (tractor speeds above 1.5 m.p.h.) retained 1 to 9 mg. TMTD per seedling, whereas the required minimum is 11 to 22 mg. TMTD per seedling (Radwan 1965). Therefore, a tractor speed of about 1.5 m.p.h. would be optimum. Such speed would result in an application rate of 9.0 gallons of the repellent spray per 1,000 square feet of seedbed

TABLE 1.--Effect of tractor speed and spray rate on retention of TMTD by 2-0 Douglas-fir seedlings¹

Tractor speed (m.p.h.) ²	Spray rate ² <i>Gal./M sq. ft.</i>	TMTD per seedling			
		Replication 1	Replication 2	Replication 3	Range
		<i>Mg.</i>	<i>Mg.</i>	<i>Mg.</i>	<i>Mg.</i>
1.1.....	13.0	21.6	15.4	23.2	15-23
1.3.....	11.0	18.4	13.7	13.4	13-18
1.5.....	9.0	18.8	12.5	11.6	12-19
2.0.....	7.0	6.9	4.6	9.0	5-9
2.9.....	5.0	3.1	2.6	6.2	3-6
3.6.....	4.0	1.5	1.6	2.2	1-2

¹ Average oven-dry weight per seedling was 2 to 3 grams. All TMTD values were adjusted to a 3.0-gram seedling to eliminate weight variations. Replication TMTD values are averages of two determinations, and figures for TMTD ranges are rounded to the nearest milligram.

² Average of five replications.

area, and the sprayed seedlings would be coated with protective amounts of TMTD.

more efficient spray equipment so the TMTD will be more effective and economical.

Discussion and Conclusions

Results show that the application of about 7.0 gallons of 10-percent TMTD spray per 1,000 square feet of seedbed area is inadequate. Seedlings sprayed at this rate retain only 5 to 9 mg. TMTD per seedling; when they are outplanted, they are probably protected only for a very short period. Therefore, application should be about 9.0 gallons of the repellent formulation per 1,000 square feet of seedbed area. Such a rate would provide TMTD coatings of 12 to 19 mg. per seedling and should afford field protection throughout the dormant season. The additional cost, less than 10 cents per 1,000 seedlings, is certainly justified, and use of the higher rate should be encouraged.

The large volumes of repellent required for spray operations in the nursery are largely due to the adhesive in the formulation and to the power equipment used for spray applications. Rhoplex AC-33, the adhesive now used in TMTD formulations, does not seem to bind TMTD to the seedlings adequately. Consequently, significant amounts of the repellent are lost, both through handling in the nursery and weathering after outplanting (Radwan 1965).

Present spray equipment applies about 70 percent of the formulation to the seedbed instead of to the trees. Thus, two critical problems remain: (1) To find an adhesive with better binding properties than Rhoplex AC-33 and (2) to develop

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