RABBIT REPELLENTS IN NORTH MISSISSIPPI

Russell M. Burns
Southern Forest Experiment Station, U. S. Forest Service
Oxford, Miss.[1]

Rabbits that browse pine seedlings during the winter threaten the success of plantation establishment in the eroded uplands of north-central Mississippi. In some areas they have nipped the tops from more than 90 percent of newly planted seedlings, and pruned the lateral branches from older ones. This paper summarizes a test in which several formulations successfully repelled rabbits.

Methods

Nicotine sulfate, zinc dithiocarbamate, thiram, endrin, copper, carbonate, calcium polysulfide, and water were mixed with each of five adjuvants: water, and emulsions of wax, asphalt, plastic, and latex. The resulting 35 formulations were applied by highpressure spray to randomly selected strips of loblolly pine (Pinus taeda L.) seedlings in the nursery bed. The seedlings, which were of uniform size and color, were lifted, graded, and packed in standard Forest Service bales within 48 hours after spraying. In December 1958, after a week's storage in bales, they were bar-planted in two widely separated fields that had been fenced to exclude livestock.

A randomized block design, with four replications of 35 plots, each containing 25 seedlings, was employed in each field. All seedlings were examined during each of the first 4 months after planting, and again at the end of the year.

To test phytotoxicity of the formulations, unsprayed seedlings were potted and placed in a greenhouse. In early spring sunflower seeds were planted in the pots. Sunflower seedlings were thinned to five per pot and allowed to grow until all had four secondary leaves. The pots were then divided into 35 groups of 3 each and the pines and sunflowers sprayed with one of the 35 formulations. Phytotoxicity of the formulations was indicated by damage to the plants one month after treatment.

Results

When seedlings are nipped above the seed leaves, few of the resulting sprouts survive.[2] When nipped below the seed leaves, seedlings fail to sprout (4).

Of the 7,000 seedlings planted, 1,910 were nipped by rabbits. More than 1,500 test seedlings died during the first year. Most dead seedlings bore marks of rabbit damage, but frost heaving, drought, tip moth, chemical burn, and improper planting also contributed to total mortality. As the principal cause of death could not be ascertained for each seedling, table 1 shows the proportions dead from all causes combined. The column on total rabbit damage includes all seedlings nipped by rabbits regardless of whether they survived.

With the exception of copper carbonate in wax, the formulations containing endrin, zinc, water, and copper were nonphytotoxic to potted plants even though they had been applied during a period of active growth. Thiram, calcium, and nicotine burned both sunflowers and pines; the pines recovered but many sunflowers died.

[1] Oxford Research Center. maintained in cooperation with the University of Mississippi.
[2] Thames. John L. 1959. Sprouting ability of loblolly pine. Unpublished report on file at Southern Forest Experiment Station.

Table 1.--Summary of first-year mortality and rabbit damage

Formulation		Proportion of seedlings damaged by rabbits	Proportion dead from all causes
		Percent	*Percent*
Endrin:	asphalt*.....	15	13
	latex*.....	14	8
	plastic.....	28	10
	water.....	28	14
	wax*.....	16	12
Zinc dithiocarbamate:	asphalt*.....	22	10
	latex*.....	24	16
	plastic.....	42	24
	water.....	28	33
	wax*.....	14	16
Calcium polysulfide:	asphalt*.....	25	20
	latex.....	28	26
	plastic.....	38	17
	water.....	28	12
	wax.....	32	6
Nicotine sulfate:	asphalt.....	28	36
	latex*.....	22	20
	plastic.....	32	22
	water.....	42	20
	wax.....	27	20
Thiram:	asphalt.....	40	45
	latex.....	18	34
	plastic.....	34	18
	water.....	26	6
	wax.....	34	18
Copper carbonate:	asphalt.....	15	26
	latex.....	13	43
	plastic.....	24	30
	water.....	19	33
	wax.....	26	60
Water:	asphalt.....	30	18
	latex.....	31	10
	plastic.....	28	16
	water.....	50	25
	wax.....	36	18

*Formulations that reduced rabbit damage 50 percent or more below the control (water-water) while maintaining at least 80 percent survival.

Seedling mortality and damage by rabbits were considered in appraising the repellent formulations. In an analysis of variance the treatments were found to differ significantly, but a comparison of arrayed treatment means using Duncan's test (2) failed to indicate the superiority of one chemical over any other. Accordingly, the practicability of individual formulations was evaluated by arbitrary standards. Year-end survival had to exceed 80 percent and damage by rabbits had to be at least 50 percent below the control before the formulations were considered acceptable. The eight that met standards are, in order of effectiveness: endrin-latex, endrin-wax, endrin-asphalt, zinc wax, zincasphalt, zinc-latex, nicotine-latex, and calcium-asphalt. Recommended mixtures are shown in table 2.

Discussion

Endrin and nicotine are extremely poisonous and may be absorbed through the skin or inhaled. Plastic or rubber gloves should be worn when handling seedlings treated with these chemicals.

The repellents containing zinc and calcium are effective yet nontoxic. They are recommended where endrin and nicotine are banned because of their toxicity. Although calcium caused some foliage burn in the pot study, it probably would not be harmful if applied during the dormant season.

Table 2.--Effective nontoxic rabbit repellents[1]

Chemical	Volume	Weight
	Gallons	*Pounds*
Zinc dithiocarbamate (4.5 percent metallic zinc)	5.0	42.6
Wax emulsion	23.8	197.6
Water	71.2	593.5
Total	100.0	833.7
Zinc dithiocarbamate	5.0	42.6
Asphalt emulsion	(2)	120.0
Water	85.5	712.7
Total	100±	875.3
Zinc dithiocarbamate	5.0	42.6
Latex emulsion	6.3	52.1
Water	88.7	739.4
Total	100.0	834.1
Calcium polysulfide (30 percent)	11.1	116.9
Asphalt emulsion	(2)	120.0
Water	74.5	621.1
Total	100±	858.0

[1] The chemical should be added to the emulsion-water mixture, and the formulation agitated during application.
[2] Paste.

None of the thiram formulations met minimum standards of acceptance. With emulsified adjuvants the phytotoxicity of thiram increased while its repellency declined.

In other studies copper carbonate (55 percent basic copper) was an effective rabbit repellent (5), but caused serious injury to seedlings stored in shipping bales (1, 3•). When pine seedlings were treated shortly before planting virtually no injury was reported. Unbaled seedlings were not used in this experiment, but it appears that copper carbonate may be a suitable repellent if it can be applied in the field.

Although the adjuvants did not differ in effectiveness, latex seemed to have the advantage of being clean, readily miscible, quick-drying, and compatible with most chemicals. Seedling beds should be well watered before latex emulsion is applied; otherwise, it seals the surface of the soil and makes it impervious to irrigation.

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