Southern Forest Experiment Station

Research Note

SO-253

1979

Using Bayleton (Triadimefon) to Control Fusiform Rust in Pine Tree Nurseries

G. A. SNOW, S. J. ROWAN, J. P. JONES, W. D. KELLEY, AND J. G. MEXAL

SUMMARY

Bayleton® was field-tested for fusiform rust control at eight pine tree nurseries during the spring of 1978. Four to six foliar sprays of this systemic fungicide were as effective as ferbam sprayed 16 to 36 times. Seed treatment with Bayleton reduced infection levels but did not significantly improve rust control in plots sprayed with Bayleton. At high rates, Bayleton sprays inhibited seedling growth and mycorrhizal development. However, proper application rates should minimize this problem and result in no loss of seedling quality.

Additional keywords: *Cronartium quercuum* f. sp. *fusiforme,* loblolly pine, slash pine, fungicide.

INTRODUCTION

The systemic fungicide Bayleton[1] (triadimefon), (1-[4-Chlorophenoxy]-3, 3-dimethyl-1-1-[1H-1,2, 4-triazol-1-yl]-2-butanone) is effective against several plant diseases including rust fungi attacking a wide variety of hosts (Siebert 1976). The chemical is translocated in plants, and application methods have included foliar sprays, soil drenches, and seed treatment to achieve both protective and curative control (Kaspers 1977). In recent greenhouse trials, Bayleton showed considerable promise for control of fusiform rust on slash (*Pinus elliottii* var. *elliottii* Engelm.) and loblolly (*Pinus taeda* L.) pine seedlings. As a seed treatment, Bayleton protects pine seedlings at least until after the plants shed their seed coats (Mexal and Snow 1978). Foliar sprays have been effective applied both before and after inoculation with *Cronartium quercum* (Berk.) Miyabe ex Shirai f. sp. *fusiforme* (Kelley 1979, Snow 1978).

Since fusiform rust is a serious problem in southern pine tree nurseries (Rowan 1977a) and more effective controls are needed, we tested Bayleton at pine tree nurseries in six southern States in 1978. Our purpose was to evaluate Bay-

[1]Bayleton is a registered trademark of Farbenfabriken Bayer GmbH, Leverkusen.

The use of trade, firm or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the USDA of any product or service to the exclusion of others that may be suitable.

This publication reports research involving fungicides. All uses of fungicides must be registered by appropriate State and Federal agencies before they can be recommended. Use fungicides only when needed and handle them with care. If fungicides are handled, applied, or disposed of improperly they may injure humans, domestic animals, desirable plants, pollinating insects, fish, or other wildlife, and may contaminate water supplies. Follow the directions and heed all precautions on the container label.

Southern Forest Experiment Station/T-10210 U.S. Postal Services Bldg., 701 Loyola Avenue, New Orleans, La. 70113
Forest Service, U.S. Department of Agriculture.
Serving Alabama, Arkansas, Louisiana, Mississippi, Eastern Oklahoma, Tennessee, Eastern Texas.

leton under a wide range of environmental conditions, compare seed treatment with foliar sprays, establish a desirable rate for Bayleton sprays, and compare the material with ferbam, which has been commonly used for rust control in pine tree nurseries.

METHODS

We adopted a standard test procedure and followed it with minor variations at all the nurseries. The experimental design was a factorial of seed soak and spray treatment in a randomized complete block with three replications. Two seed treatments (untreated and Bayleton-treated) and five spray treatments were tested (table 1). A replication consisted of three adjacent nursery beds. In portions of these beds the combinations of seed soak and spraying were assigned at random. The beds were 1.22 m (4 ft) wide and spray plots were usually 15.25 m (50 ft) long. At the Ashe and Weyerhaeuser nurseries, the high dosage Bayleton-treated plots and the controls were reduced to 7.6 m (25 ft) long to avoid possible heavy losses from rust infection or phytotoxicity. Plots at the Beauregard nursery were 9.2 m (30 ft) long. The nursery beds were sown with slash pine seed at all nurseries listed in table 1, except at the Weyerhaeuser nursery where loblolly seed was sown. Similar experimental plots were also established in loblolly pine beds at the Hauss, Stauffer, and Miller nurseries in Alabama. Data from these tests are not presented because no trees were infected with fusiform rust.

Previously stratified seeds were soaked in an aqueous solution of Bayleton (25 or 50 WP, 800 mg. a.i./liter [.1 oz/gal]) at room temperature for 24 hours. Before planting, treated seed were air-dried and coated with bird repellent. Sprays were applied with tractor-driven power sprayers. For all Bayleton sprays, Agrodex surfactant was used at the rate of 1.3 ml/liter (1 pt/100 gal) of water. The first Bayleton sprays were applied after about 50 percent of the seed germinated and then at 2-week intervals. When long rainy periods occurred during the second week after a spray, the Bayleton application followed within 2 days after the rain. This spray date became the base for a new 2-week schedule. Dates for the last Bayleton sprays varied from the first week in June to the first week in July in 1978. Ferbam (76 WP) applications in the test followed the same schedule used for the rest of the nursery, usually 2 or 3 times a week from seed germination until the first week of July.

After the growing season (November-January), we lifted seedlings from three or five randomly selected .3 m × 1.2 m (1 ft × 4 ft) areas within all 30 plots. These seedlings were examined for fusiform rust galls, and an equal number of them from each plot were measured for height growth and weighed. Mycorrhizal development was assessed from sample seedlings lifted from experimental plots at nurseries in Florida, Georgia, and Mississippi in late summer of 1978 and in January 1979. Assessments were based on visual estimates of the percentage of feeder roots with ectomycorrhizae.

RESULTS

Relative to previous years (Rowan 1977b), rust infection was low at nurseries in Louisiana, Mississippi, and Georgia and was very low at nurseries in Alabama and Florida (table 1). Despite this low infection rate, fungicide evaluation was usually possible. At the Ashe, Beauregard, Davisboro, and Weyerhaeuser nurseries, the Bayleton seed treatment significantly reduced the incidence of fusiform rust. The effect of the seed treatment was less evident in plots sprayed with the fungicides; in plots sprayed with Bayleton differences attributable to seed treatment were not significant at any nursery.

Bayleton spray treatments gave better control than ferbam at the Ashe and Weyerhaeuser nurseries and were as effective at all others. The medium and high dosages of Bayleton appeared to be more effective than the low dosage spray in beds planted with untreated seed but differences among the three rates of Bayleton were not significant. Ferbam sprays alone significantly reduced rust incidence at the Ashe, Beauregard, and Davisboro nurseries but not at the Weyerhaeuser nursery. Statistical comparisons were not made of data from the Buckeye Cellulose, Walker, and St. Regis nurseries because of the low rust infection. The reader is invited to observe that

G. A. Snow is Principal Plant Pathologist, Southern Forest Experiment Station, Forest Service—USDA, Gulfport, Mississippi; S. J. Rowan is Principal Plant Pathologist, Southeastern Forest Experiment Station, Athens, Georgia; J. P. Jones is Assistant Professor, Department of Plant Pathology and Crop Physiology, Louisiana State University; W. D. Kelley is Professor, Department of Botany and Plant Pathology, Auburn University; and J. G. Mexal is Regeneration Specialist, Weyerhaeuser Co., Hot Springs, Arkansas.

Table 1.—*The effect of fungicidal sprays and seed treatment on fusiform rust incidence at seven pine tree nurseries*[1]

Nursery	Foliar spray and rate (a.i.) per hectare[2]	Number of sprays	Percentage of galled plants: No seed treatment	Percentage of galled plants: Bayleton seed treatment
W. W. Ashe Nursery Brooklyn, Miss.	Control	0	3.5 a[3]	.2 c
	Ferbam 2.2 kg	31	2.1 b	.6 c
	Bayleton .28 kg	4	.5 c	.1 c
	Bayleton .56 kg	4	.0 c	.1 c
	Bayleton .84 kg	4	.0 c	.0 c
Beauregard Nursery Beauregard, La.	Control	0	2.5 a	1.1 bc
	Ferbam 2.6 kg	12	0.8 bc	0.4 bc
	Bayleton .28 kg	3	1.0 bc	0.3 bc
	Bayleton .56 kg	3	1.2 b	0.4 bc
	Bayleton 1.12 kg	3	0.6 bc	0.5 bc
Davisboro Nursery Davisboro, Georgia	Control	0	5.3 a	2.0 b
	Ferbam 2.6 kg	36	0.5 c	0.1 c
	Bayleton .28 kg	5	0.9 bc	0.1 c
	Bayleton .56 kg	5	0.0 c	0.0 c
	Bayleton 1.12 kg	5	0.0 c	0.0 c
Weyerhaeuser Nursery Aliceville, Ala.	Control	0	.9 a	.5 ab
	Ferbam 2.2 kg	16	1.3 a	.5 ab
	Bayleton .28 kg	4	.3 b	.2 b
	Bayleton .56 kg	4	.1 b	.1 b
	Bayleton .84 kg	4	.1 b	.0 b
Buckeye Cellulose Perry, Fla.	Control	0	0.2	0.0[4]
	Ferbam 2.6 kg	32	0.0	0.0
	Bayleton .28 kg	5	0.0	0.0
	Bayleton .56 kg	5	0.0	0.0
	Bayleton 1.12 kg	5	0.0	0.0
St. Regis Nursery Lee, Fla.	Control	0	0.3	0.2[4]
	Ferbam 2.6 kg	20	0.0	0.0
	Bayleton .28 kg	6	0.0	0.0
	Bayleton .56 kg	6	0.0	0.0
	Bayleton 1.12 kg	6	0.0	0.0
Walker Nursery Reidsville, Ga.	Control	0	0.2	0.2[4]
	Ferbam 2.6 kg	25	0.1	0.1
	Bayleton .28 kg	5	0.0	0.0
	Bayleton .56 kg	5	0.0	0.0
	Bayleton 1.12 kg	5	0.0	0.0

[1]Tests were on slash pine at all nurseries except Weyerhaeuser where loblolly pine was used.
[2]English equivalent of application rates are: .28 kg/hectare = 4 oz/acre; .56 kg/ha = 8 oz/acre; .84 kg/ha = 12 oz/acre; 1.12 kg/ha = 16 oz/acre; 2.2 kg/ha = 2 lb/acre and 2.6 kg/ha = 2.3 lb/acre.
[3]Values for the 10 means for each nursery followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.
[4]Infection levels were too low to meet requirements of the Analysis of Variance so statistical comparisons among treatments are not presented.

Table 2.—*The effect of fungicidal sprays on seedling growth and ectomycorrhizal development at six pine tree nurseries*[1]

Nursery	Foliar spray and rate (a.i.) per hectare[2]	Average plant height (mm)		Average percentage of mycorrhizae development	
		8/78	1/79	8/78	1/79
Beauregard Nursery Beauregard, La.	Control	....	210.2 a[3]	....	48.0 a
	Ferbam 2.6 kg	....	239.5 a	....	50.5 a
	Bayleton .28 kg	....	208.0 a	....	47.5 a
	Bayleton .56 kg	....	206.1 a	....	44.5 a
	Bayleton 1.12 kg	....	216.2 a	....	44.0 a
Buckeye Cellulose Perry, Fla.	Control	235.0 a	242.4 a	15.8 a	33.2 a
	Ferbam 2.6 kg	241.5 a	235.1 a	14.4 ab	34.8 a
	Bayleton .28 kg	212.7 a	210.5 b	10.6 c	29.7 a
	Bayleton .56 kg	196.6 b	207.1 bc	11.3 bc	31.2 a
	Bayleton 1.12 kg	176.9 b	186.5 c	7.1 c	30.0 a
Davisboro Nursery Davisboro, Ga.	Control	210.6 a	232.1 a	13.3 a	27.7 a
	Ferbam 2.6 kg	196.5 ab	236.6 a	16.8 a	27.5 a
	Bayleton .28 kg	201.5 a	220.3 ab	8.5 c	[illegible] a
	Bayleton .56 kg	196.2 ab	212.6 b	4.5 c	27.3 a
	Bayleton 1.12 kg	191.5 b	205.0 b	11.4 b	31.4 a
St. Regis Nursery Lee, Fla.	Control	138.9 a	172.9 ab	15.0 a	43.0 b
	Ferbam 2.6 kg	141.6 a	182.5 a	18.0 a	46.4 ab
	Bayleton .28 kg	138.7 a	181.5 a	6.3 b	44.5 ab
	Bayleton .56 kg	111.9 b	163.2 b	7.6 b	51.6 a
	Bayleton 1.12 kg	78.2 c	149.4 c	5.2 b	46.4 ab
Walker Nursery Reidsville, Ga.	Control	218.0 a	231.1 a	14.0 ab	49.9 a
	Ferbam 2.6 kg	201.3 a	234.6 a	20.0 a	49.4 ab
	Bayleton .28 kg	205.3 a	207.7 b	16.2 a	49.6 a
	Bayleton .56 kg	174.5 b	205.7 b	11.3 b	47.2 ab
	Bayleton 1.12 kg	183.8 b	211.6 b	11.7 b	43.2 b
Weyerhaeuser Nursery Aliceville, Ala.	Control	....	211.5 a	....	....
	Ferbam 2.2 kg	....	203.6 a	....	....
	Bayleton .28 kg	....	207.3 a	....	....
	Bayleton .56 kg	....	203.6 a	....	....
	Bayleton .84 kg	....	199.7 a	....	....

[1]Seed treatments did not affect growth or mycorrhizae and data represent a combination of both seed treatments.
[2]English equivalent of application rates are: .28 kg/ha = 4 oz/acre; .56 kg/ha = 8 oz/acre; .84 kg/ha = 12 oz/acre; 1.12 kg/ha = 16 oz/acre; 2.2 kg/ha = 2 lb/acre and 2.6 kg/ha = 2.3 lb/acre.
[3]Separately for each nursery and for each response variable the 5 means for each nursery followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.

the most infection occurred at these nurseries in control plots and no infected trees were found in plots sprayed with Bayleton.

Bayleton sprays inhibited seedling growth and mycorrhizal development at nurseries in Florida and Georgia (table 2). By January, however, the differences in mycorrhizal development were no longer evident at the Beauregard, Davisboro, and St. Regis nurseries. A similar pattern of mycorrhizal development occurred at the Ashe nursery, but no differences in growth or color of the trees were observed that could be related to the spray treatments at the Ashe, Beauregard, Hauss, Miller, Stauffer, and Weyerhaeuser nurseries. The lower phytotoxicity at these six nurseries was probably due to the fewer sprays and, consequently, lower dosage applied.

Fresh weight of slash seedlings from beds with treated seed averaged 1.9 grams less than seedlings from untreated seed beds at the Ashe nursery while at the Weyerhaeuser nursery, loblolly seedlings grown from treated seed were 3.2 grams heavier than those produced from untreated seed. These differences in seedling size did not affect number of plantable seedlings at either nursery and were probably unrelated to

treatment. Seedling growth was not affected by the seed treatment at the other nurseries. Treatments did not affect seedling stand density at any of the nurseries.

DISCUSSION

Bayleton promises to be an excellent fungicide for fusiform rust control in pine tree nurseries. One might conclude from these tests, particularly those at the Ashe and Weyerhaeuser nurseries, that the seed treatment alone would provide adequate control of fusiform rust throughout the 2- to 3-month infection season. We do not wish to convey this idea. Weather favorable for pine infection only occurred at the above nurseries during and soon after seed germination. If infection had occurred later, as was likely the case at the Beauregard and Davisboro nurseries, additional benefit would likely have been realized from the foliar sprays. Experiments are currently underway to determine the length of time that pine seedlings are protected by Bayleton seed treatment.

Although rate and method of application appear to be important to avoid reduction in the size of pine seedlings, Bayleton holds many advantages over ferbam:

1. When used as a seed treatment, Bayleton protects during germination while ferbam must be applied daily to provide equal protection.
2. Fewer sprays are required and this should reduce tractor pad compaction, manpower requirements, and nursery bed deterioration during wet weather.
3. Since Bayleton is a systemic fungicide, timing of sprays is less critical.

Bayleton is not currently available for commercial use in pine tree nurseries. It was recently registered in the United States for control of Azalea blight, and Mobay Chemical Corporation is seeking approval from appropriate federal and state agencies to label the compound for forestry uses.

LITERATURE CITED

Kaspers, H.
1977. Practical importance of the systemic properties of Triadimefon Provisional results. *In* Internal Therapy of Plants, Proc. Int. Symp. (August 1976) p. 361–364. A. Fuchs, ed. Wageningen, The Netherlands.

Kelley, W. D.
1979. Control of fusiform rust on loblolly pine seedlings with the systemic fungicide, Bayleton. Phytopathology 69(1):1-A5–1-A6.

Mexal, J. G., and G. A. Snow.
1978. Seed treatment with systemic fungicides for the control of fusiform rust in loblolly pine. U.S. Dept. Agric. For. Serv. Res. Note SO–238, 4 p. South. For. Exp. Stn., New Orleans, La.

Rowan, S. J.
1977a. Fusiform rust management strategies in concept: nursery management. *In* Management of fusiform rust in southern pines, Symp. Proc. p. 116–121. R. J. Dinus and R. A. Schmidt, eds. Univ. Fla., Gainesville.

Rowan, S. J.
1977b. Incidence of fusiform rust in Georgia forest tree nurseries, 1959–1973. Tree Planters' Notes 28(2):17–18, 29.

Siebert, R.
1976. New approach to the control of rust diseases of cereals with Bayleton. Pflanzenschutz-Nachr. 29:303–309.

Snow, G. A.
1978. Reduction of fusiform rust on slash pine seedlings with foliar sprays of Bayleton. Phytopath. News 12(9):197.

☆U.S. GOVERNMENT PRINTING OFFICE: 1980- 671-123/1004