

Efficacy of 18 Adjuvants in Combination With Bayleton for Control of Fusiform Rust on Pine Seedlings

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Eighteen adjuvants tested in formulations with Bayleton were essentially equal in enhancing the effectiveness of the fungicide for control of fusiform rust on southern pine seedlings.

The protective and systemic fungicide Bayleton¹ (triadimefon; 1-(4-chlorophenoxy)-3,3-dimethyl-1 (1 H-1,2,4-triazol-1-yl)-2-butanone) will effectively control fusiform rust caused by *Cronartium quercuum* (Berk.) Miyabe ex Shirai f. sp. *fusiforme* in pine nurseries with as few as three or four foliar sprays (1, 3). The fungicide has 24-C registration in several Southern States for use in pine tree nurseries as foliar sprays for control of fusiform rust. Mobay Chemical Corp. (Kansas City, Mo.) distributes this fungicide in the United States and has suggested sprays be formulated with Agri-Dex (Helena Chemical Co., Memphis, Tenn.) adjuvant. Their reason for suggesting this adjuvant was based on chemical compatibility tests made in the laboratory rather than biological tests comparing a number of adjuvants.

The efficacy of a pesticide formulation is measured by its ability to eradicate or prevent crop losses to the target pest. An adjuvant is used in formulations to improve the efficacy of the pesticide. Formulations may be improved by increased wetting of foliage,

greater tenacity of spray residues, improved solubility or suspendibility of the pesticide, less drift, less foam, less phytotoxicity, and less inactivation of the active pesticide ingredient. Reported here are results of testing 18 spray adjuvants in formulations with Bayleton for control of fusiform rust on loblolly pine (*Pinus taeda* L.) seedlings.

Methods

Efficacy tests of adjuvants.

Twenty 2 to 4-day-old loblolly pine seedlings were transplanted into each of 200 flats (33 by 13 by 11 centimeters) containing a sandy loam, sand, and vermiculite soil mix (2:1:1 ratio by volume). All seedlings were fertilized 2 weeks, 4 weeks, 2 months, 4 months, and 6 months after transplanting with Miracle-Gro, a commercially available liquid fertilizer. Bayleton sprays were formulated to contain 600 milligrams of active ingredient and the adjuvant at the distributor's recommended rate per liter (table 1).

Each Bayleton formulation was vigorously agitated and applied at the rate of 1.87 kiloliters per hectare to 10 replicate flats of each treatment. After 48 hours, five flats of each treatment were placed in a rain chamber and exposed to 5 centimeters of rain. The rain chamber was equipped with a cone Raindrop nozzle that delivered 2.5 centimeters of rain each 63 minutes. The other five

replicate flats of each spray treatment were not put in the rain chamber. Two hours after seedlings were removed from the rain chamber and when their foliage was dry, all test seedlings were artificially inoculated with basidiospores (75,000 spores/ml) of *C. quercuum* f. sp. *fusiforme*. Controls were nonsprayed seedlings and seedlings sprayed with Bayleton alone.

The experimental design was a randomized complete block with five replications. Seedlings were sprayed and inoculated 6 weeks after emergence when their growth rate was near maximum. Inoculum derived from aeciospores collected from loblolly pine galls in Clarke County, Ga. (source 2-74), was used to produce basidiospores on northern red oak (*Quercus rubra* L. seedlings). The percentage of seedlings infected (galled) was determined 9 months after inoculation.

Compatibility tests of selected adjuvants. All Bayleton-adjuvant formulations rated by the distributor of Bayleton as inferior for control of fusiform rust were tested for incompatibility reactions between adjuvant and pesticide. Replicate water agar plates were seeded with basidiospores of *C. quercuum* f. sp. *fusiforme* and then atomized with nonagitated, 24-hour-old suspensions of Bayleton (600 mg/l) alone and Bayleton in formulations with Agri-Dex (the recommended adjuvant), Agway Target NL (because of suspected incompatibility), and all adjuvants judged

¹Bayleton is a registered trademark of Farbenfabriken Bayer GmbH, Leverkusen, West Germany.

Table 1.—Efficacy of 18 adjuvants in Bayleton sprays for control of fusiform rust of loblolly pine seedlings when applied 2 days before seedlings were exposed to 0 and 5 centimeters of artificial rain

Treatment	Application rate	Galled seedlings ¹	
		0 cm	5 cm
	MI/l	----- % -----	
Agri-Dex	2.5	0.0a ²	0.0a
Agway Target NL	.63	.0a	.0a
Atlas Sur-Fac	5.0	.0a	.0a
Bio-88	.63	.0a	.0a
Bio-film	.47	.0a	.0a
Bond Spreader-Sticker	2.5	.0a	1.2b
Dupont Spreader-Sticker	.31	.0a	.0a
Exhalt-800	1.25	.0a	.0a
Nu-film-17	1.25	.0a	.0a
Olds Worlde	1.25	.0a	.0a
Ortho-Chevron Spray -Sticker	.63	.0a	.0a
Ortho X-77	.47	.0a	1.1 b
Plantgard	200.0	.0a	.0a
Plyac	1.25	.0a	.0a
Security Spreader-Sticker	.63	.0a	.0a
Triton x-45	1.25	.0a	.0a
Triton x-100	1.25	.0a	.0a
Wex	.78	.0a	.0a
No adjuvant	— ³	1.2b	1.2b
No Bayleton	—	56.0c	69.8c

¹Infection percentages are the average of five 20-tree replicates determined 9 months after inoculation. Sprays contained 600 miligrams active Bayleton ingredient per liter.

² Means in a column followed by the same letter do not differ significantly at the 95-percent probability level. Duncan's new multiple range test was used to compare column means, and Student's t-test was used to compare rainfall effects. Zero percentages were excluded from these analyses.

³— = not applicable.

inferior for control of the disease. Germination percentages were determined after 24 hours' incubation at 20° C by counting a minimum of 200 spores per plate. Spores were counted as germinants only when the germ tube exceeded spore diameter by three-fold.

Results and Discussion

Without simulated rain, all Bayleton-adjuvant spray formulations controlled the disease, but Bayleton alone did not, indicating the need for adjuvants (table 1). After 5 centimeters of simulated rain, only 16 formulations contain-

ing adjuvants were superior to Bayleton alone; Ortho X-77 and Bond Spreader-Sticker failed to improve the efficacy of Bayleton.

In compatibility tests, germination percentages after 24 hours' incubation at 20° C indicated that Bayleton precipitated from suspension when formulated alone or with Ortho X-77, Bond Spreader-Sticker, and Agway Target NL adjuvants (table 2). Basidiospore germination percentages were not significantly different among the untreated, Bayleton, and Ortho X-77 plates. Formulations with Bond Spreader-Sticker and Agway Target NL adjuvants, however, significantly reduced germination, but Agri-Dex-treated plates reduced

Table 2.—Efficacy of selected adjuvants in nonagitated formulations with Bayleton to inhibit *Cronartium quercuum* f. sp. *fusiforme* basidiospore germination on seeded water agar plates

Adjuvant	Application rate	Spore germination
	MI/l	%
No Bayleton (control)	— ¹	83.2a ²
No adjuvant	—	82.6a
Ortho X-77	0.47	82.0a
Bond Spreader-Sticker	2.5	40.0b
Agway Target NL	.63	35.9b
Agri-Dex	2.5	.0c

¹— = not applicable.

² Means followed by the same letter do not differ significantly at the 95-percent probability level according to Duncan's new multiple range test.

spore germination to zero. Thus, Bayleton formulated without adjuvant results in a precipitated product with poor wetting and residue tenacity features. Control obtained after treatment with Bayleton formulations depends upon the ability of the fungicide to act systemically. Bond Spreader-Sticker and Agway Target NL adjuvants keep Bayleton in suspension better than does Ortho X-77, but not as well as does Agri-Dex. Bond Spreader-Sticker and Ortho X-77 adjuvants, although inferior in these tests, are nearly as effective as any adjuvant tested in formulations with Bayleton for control of fusiform rust. The rapidity with

which Bayleton formulations are absorbed by pine seedling tissues (2) probably explains why the adjuvants tested varied so little. These test results appear to confirm the Mobay Chemical Corp.'s results that Bayleton and Agri-Dex are compatible. However, proper agitation of the spray mix in spray tanks should make most, if not all, adjuvants tested of equal value when used with Bayleton. Economics, therefore, should be an important factor in choosing adjuvants to be used in Bayleton formulations. No phytotoxicity was noted in any of the formulations tested in this study.

Literature Cited

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