Fungicides for late blight in tomato

Albert O. Paulus □ Jerry Nelson □ Harold W. Otto □ Roy Kobayashi

Late blight has become of increasing economic importance on tomatoes in California during the last few years. Previously, the disease, caused by the fungus *Phytophthora infestans*, occurred mainly in coastal areas of California where environmental conditions favored its development. The disease may attack plants at any time during the growing season and, when it is severe, all plants in a field may be killed in a week or two. Late blight also results in great losses of tomatoes in transit, storage, and market.

The late blight fungus causes irregular, rapidly enlarging, water-soaked areas to blackish gray lesions on the stems, branches, and leaves. Severely affected plants appear damaged by frost. Rotted areas of the fruit are dark green, brown, or brownish black and "greasy" with a rather firm but slightly wrinkled surface. In moist weather, the fungus sporulates on lesions as a whitish gray, downy growth and is usually most abundant on the lower surface of the leaves.

Two-year study

We evaluated several new and old fungicides for control of late blight in the fall of 1981 and 1982. In both trials, we used the cultivar 'Sunny', grown in the greenhouse at the University of California, Riverside, and transplanted at the four-leaf stage to the field at the UC South Coast Field Station near Santa Ana.

Each plot, consisting of eight plants 18 inches apart in the row, was sprinkler-irrigated for five-minute periods six times daily throughout the experiment to provide an environment for development of late blight. Each treatment was replicated five times. The first fungicide spray was applied when the plants were approximately 18 inches tall.

Disease symptoms were rated on a scale of 0 to 10, with a 1 rating indicating excellent control and leaf blight hard to find, while a 10 rating indicated brown leaves and stems and complete collapse of the plant.

In the 1981 trial, plants were transplanted on August 12, the first fungicide was applied on September 14, and disease symptoms were rated on November 2. Late blight was absent before application of the first spray. Dithane M-45 (mancozeb) and Daconil 2787 (chlorothalonil) provided excellent control of late blight in comparison with untreated plots. Dithane M-45 combined with Difolatan (captafol) and Difolatan alone gave very good control, but neither treatment was as effective as Dithane M-45 or Daconil 2787 alone.

In 1982, tomatoes were transplanted on August 27, and first sprays were on September 24. Foliage disease ratings on November 2 showed Ridomil MZ (metalaxyl plus mancozeb) to be significantly better than all other materials for disease control. Dithane M-45, Difolatan Sprills, and Bravo 500 (chlorothalonil) gave intermediate control. Yield of healthy fruit measured on December 2 showed no significant difference among Ridomil MZ, chlorothalonil, or Dyrene (anilazine) treatments. Phytophthora fruit rot (*P. infestans*) was severe at the conclusion of the experiment, and no yield of fruit was obtained from untreated plots.

Some *Botrytis* fruit rot was present in 1982. Anilazine is known to be effective against this fungus and might possibly be responsible for the satisfactory yield with this fungicide, but further work is needed to clarify this point.

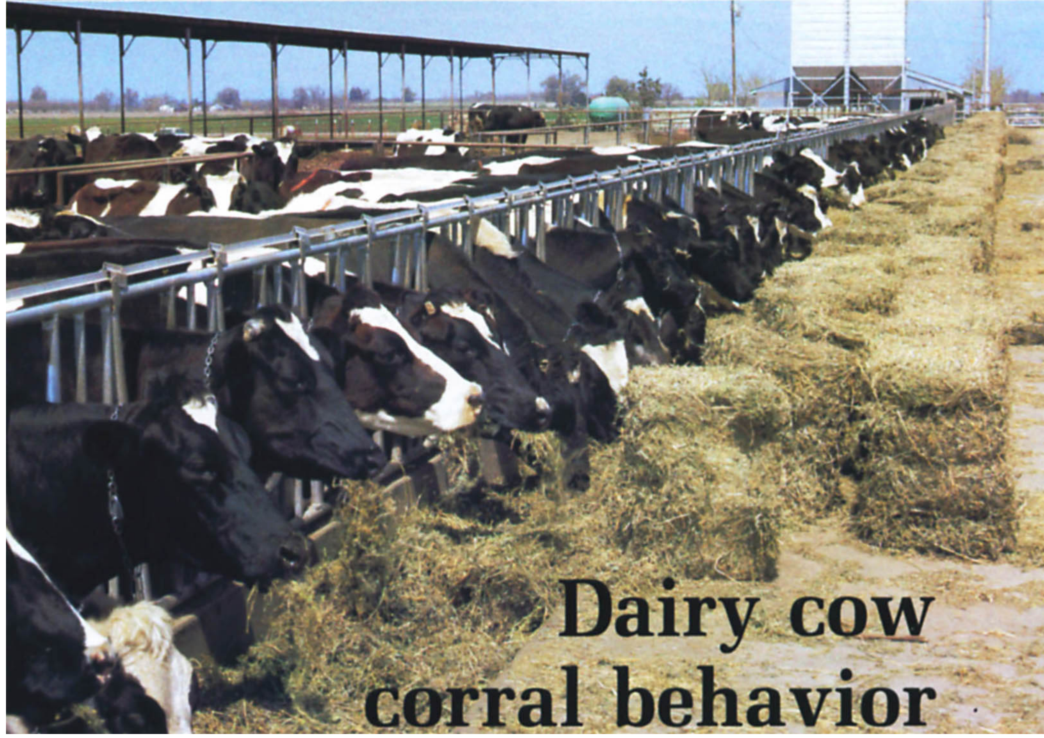
In summary, mancozeb, chlorothalonil, captafol, and metalaxyl combined with mancozeb provide effective control of late blight of tomato.

Comparison of fungicides for tomato late blight control, cultivar 'Sunny', Santa Ana, California

Fungicide and rate*	Disease rating†‡	Healthy fruit
1981 trial (applied Sept 14, 21,28; Oct 5,12,19,26)	**Nov. 2**	
Dithane M-45 80W, 2.5 lb	1.0 a	—
Daconil 2787 75W, 2.75 lb	1.7 ab	—
Dithane M-45, 80W, 1 lb + Difolatan F, 1 qt	2.2 bc	—
Difolatan F, 1.5 qt	3.0 cd	—
Difolatan F, 3 qt	3.0 cd	—
Dyrene 50W, 4 lb	3.2 d	—
Untreated control	8.9 e	—
1982 trial (applied Sep 24, Oct 4,15,25; Nov 4,15,24)	**Nov 22**	**Dec 2** *lb*
Ridomil MZ, 58W, 1.5 lb	0.5 a	18.3 a
Dithane M-45 80W, 2.5 lb	2.7 b	15.8 b
Difolatan Sprills 80%, 2 lb	2.8 b	17.9 b
Bravo 500, 2.25 pt	2.8 b	26.9 a
Dyrene 50W, 4 lb	4.2 c	20.4 a
Untreated control	9.1 d	0.0 c

*Rates of materials per 100 gallons of water; 4 fluid ounces of Rohm and Haas Triton B-1956 spreader-sticker per 100 gallons of water added to all fungicide suspensions. Sprays applied to complete coverage with a 2-gallon CO_2 pressurized Hudson sprayer at 30 psi.
†Significant at 5 percent level. Within each trial year, treatments with same letter are not significantly different.
‡Rated on a scale of 0 to 10; 0 equals no disease; 10 equals severe disease with plants dead.

Albert O. Paulus is Plant Pathologist, and Jerry Nelson is Staff Research Associate, Cooperative Extension, University of California, Riverside; Harold W. Otto is Farm Advisor, and Roy Kobayashi is Extension Field Assistant, Orange County.



An example of solid strip shade in the corral and uncovered feed mangers — the most common shade arrangement in the study area.

Dairy cow corral behavior

Thomas A. Shultz

Rotted areas of tomatoes are dark green, brown, or brownish black and "greasy" with a firm, wrinkled surface.

In moist weather, the fungus sporulates on lesions as a whitish gray downy growth, mostly on lower leaf surface.

The corral confinement system used for intensive dairying in the Central Valley and southern California subjects the cow to various types of stress, particularly following parturition and during peak lactation. The effect of weather on these animals is of primary concern, especially in the hot, dry summer, when temperatures average highs of 95° F, with numerous days over 100° F, and relative humidity averaging 33 percent. Winters in the area are usually cool and mild; spring and fall are moderately warm.

Several types of shade have been constructed in the corrals to alleviate weather stress on the cow. The most common is a solid strip roof, 12 feet wide and 12 feet above the ground, with no walls. Increasing numbers of dairies are installing completely roofed free-stall barns without walls for the combined resting and feeding area. Some dairies have variations of these shade types, and others have no shades.

Behavior of individual cows visually monitored in small groups reflects adaptation responses to stressful conditions. Also, time-lapse photography of small numbers of cows in comparatively good environmental conditions has shown that the high-producing dairy cow voluntarily consumes feed a dozen times in 24 hours; each feeding lasts 10 to 12 minutes with an average of 90 minutes between feedings.

Relatively little information exists on cow behavior in large commercial dairy units where each corral may have 100 cows moving about freely. The objectives of this study were to develop an observation method suitable for recording activity under such circumstances and to evaluate the effects of weather and shade type on behavior at different times of the year.

Cows were studied on eight dairies milking twice a day with production averages of 18,500 pounds of milk per cow yearly at 3.5 percent butterfat test. Observations were in the high-production corrals, which averaged 88 cows with a daily milk yield of nearly 90 pounds per cow. Each of the following shade types was represented by two dairies: no shade; solid strip roof, 12 feet wide and 12 feet high with no walls; similar strip roof plus a separate shaded manger feeding area; and completely shaded free-stall combined resting and feeding area. All dairies fed quality alfalfa hay, cereal silage, and concentrates in similar feeding routines offering fresh feed four times daily. Observations were grouped by weather type (see table 1).

One person visually scanned the corral at 15-minute intervals from 6:00 a.m. until 6:00 p.m. Five minutes per scan

TABLE 1. Average temperatures during dairy observations

Condition	Weather type*		
	Cool	Warm	Hot
		°F	
Unshaded, 7 a.m.	46	61	71
Shaded, 7 a.m.	46	59	67
Unshaded, 3 p.m.	64	88	104
Shaded, 3 p.m.	61	83	95

*Averages of 24 days.