



Fungicidal control of tomato blackmold under rainy conditions

Eugene M. Miyao □ Dennis H. Hall □ Prudence Somerville □ Nancy Blaker

Fungicides as preventive sprays significantly reduced incidence of blackmold

Blackmold, a common ripe-fruit rot of processing tomatoes, is most severe in California after late-summer rains but can also develop significantly after long dew periods. In years with late-summer or early-fall rains, entire fields can remain unharvested because of high incidence of blackmold. California state inspection standards allow a maximum of 8 percent for all rots of tomato fruit, including blackmold, but tomato processors often impose more stringent standards.

Blackmold is caused by the fungus *Alternaria alternata* (Fr.) Keissl. Only ripe fruit are infected, and disease symptoms vary from small, superficial, brown flecks to large, sunken, black lesions. In advanced stages, the fungus may produce a black, velvety layer of spores on the surface of the lesions.

We conducted a study to investigate the possibility of reducing the incidence of blackmold under summer rainfall conditions by using various fungicides as preventive sprays. The study also evaluated the effects of various application frequencies. The three currently registered fungicides tested reduced the disease when used in multiple applications as preventive treatments.

Field study

The field trials for control of blackmold took place at the University of California, Davis campus, during a three-year period. Tomatoes were planted in single rows on beds with 5-foot centers. The trial design was a randomized complete block with four replicates, each 10 feet in length, for each treatment. Fungicides,

applied with a hand-held sprayer pressurized at 30 pounds per square inch in 75 gallons of water per acre, were sprayed over the plant canopy along the length of the plot first in one direction and then in the opposite direction for better coverage. In the last year of trials, single guard rows separated adjacent treatment rows to reduce possible contamination from fungicide spray drift.

The trials included seven fungicides in various formulations applied two or four times before tomato harvest (table 1). Ronilan (vinclozolin) was also tested in three applications in 1983. The four-application treatments began at early fruit set eight to ten weeks before harvest and continued at two-week intervals. The two-application treatments began four to six weeks before harvest at the early fruit-ripening stage and were completed two weeks later.

Because there was limited timely natural rainfall, we used a solid-set overhead sprinkler system to simulate rainfall and enhance blackmold development in all trials. Water was applied at a rate of 0.17 inch per hour, initially totaling more than 0.5 inch of water. Thereafter, applications were made intermittently during the day and often occurred during the early evening to maintain continuous high humidity in the canopy. In all tests, over 90 percent of the fruit were mature and susceptible to rot at the beginning of the sprinkling period, approximately two weeks before harvest.

In 1983, we applied 2.1 inches of water, and an additional 0.5 inch of natural rainfall occurred five days before harvest. In

Blackmold can cause processors to reject whole loads of tomatoes.

1984, applications totaled 3.8 inches, with no natural rainfall occurring. In 1985, sprinklers applied 3.5 inches, with an additional 0.3 inch of natural rainfall occurring 14 days before harvest. To further enhance disease incidence in the last year of the test, we sprayed mycelial fragments and spores of *A. alternata* in a dilute solution of V-8 juice on untreated guard rows before initial fungicide applications.

At harvest, fruit from the center 5 feet of the plots were inspected and sorted according to presence and type of fruit rot. Incidence of blackmold was determined by the presence of visible symptoms, regardless of extent, and was expressed as a percentage of the number of ripe fruit harvested.

Results and conclusions

The incidence of blackmold of tomato was effectively reduced with multiple applications of fungicides applied as preventive treatments. All three currently registered fungicides — Difolatan (captan), Bravo (chlorothalonil), and Dithane (mancozeb) — were equally effective in controlling the disease (table 1). In 1983 and 1984, disease incidence was only 2 to 6 percent in plots treated with any of these three fungicides, compared with 12 to 13 percent in untreated control plots. In 1985, disease incidence in untreated plots was significantly higher at 22 percent, probably resulting from timely natural rainfall and guard row inoculations. Even with the higher disease incidence in 1985, Difolatan, Bravo, and Dithane still provided good control, with less than 10 per-



Progression of black mold disease on processing tomatoes (above). Severe black mold (below) that often occurs after late-summer rains can result in entire fields of tomatoes not being harvested.

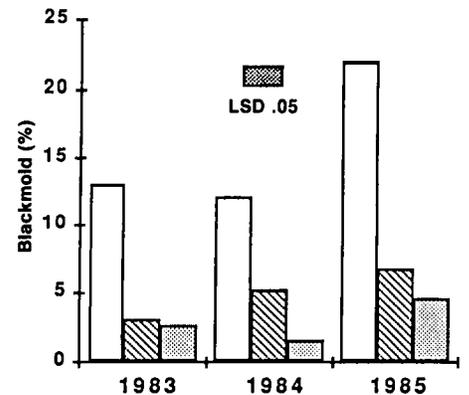
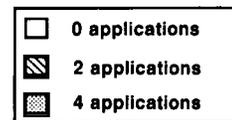


Fig. 1. Combined data indicated slightly better control with four applications of fungicides than with two late applications.

cent of fruit showing blackmold symptoms.

The combined data from the three years of trials indicate a trend for better control with four applications rather than two late applications (fig. 1). While differences between two and four applications of fungicides were relatively small, application frequency for effective disease control may depend on environmental conditions, cultural practices, and cultivars. In observational plots in which Bravo was applied within 24 hours after rainfall only, there appeared to be no reduction in blackmold incidence relative to the untreated control.

In limited testing of unregistered fungicides, Rovral (iprodione) and Bravo plus oxadixyl appeared promising. Ridomil MZ58 (10 percent metalaxyl plus 48 percent mancozeb), presently registered on tomatoes in California for late blight control only, also appeared promising in the 1985 trial. This result may be due to the presence of mancozeb in the formulation. The unregistered fungicides Fungafloor (imazalil) and Ronilan did not provide control.

Eugene M. Miyao is Farm Advisor, Yolo County; the late Dennis H. Hall was Extension Plant Pathologist; Prudence Somerville is Postdoctoral Researcher, Department of Plant Pathology, and Nancy Blaker is Postdoctoral Researcher, Department of Vegetable Crops, both at the University of California, Davis. The authors dedicate this article to the memory of Dennis H. Hall. This research was supported in part by a grant from the California Tomato Research Institute. The authors thank SDS Biotech, Rohm and Haas, Rhône Poulenc, Ortho, Ciba-Geigy, BASF, FMC, and Mycogen, and also thank Sid Lucero, John Hewitt, Woodrow Ishisaka, Peggy Smith, and Charles Langston for their assistance.

TABLE 1. Effect of fungicides and spray frequency on control of blackmold under simulated rainfall

Fungicide and rate*	Number of sprays†	Blackmold incidence‡		
		1983	1984	1985
		-----%		
Difolatan 80% (2 lb.)	2	2	5	6
	4	2	1	6
Bravo 75W (3 lb.)	2	4	4	9
	4	2	1	4
Dithane M-45 80% (3 lb.)	2	3	6	4
	4	3	2	4
Dithane 68% sprills (3 lb.)	4	2	3	-
Ronilan 50% (2 lb.)	3	9	-	-
Rovral 50% (2 lb.)	2	-	4	11
	4	-	3	6
Imazalil (1 lb.)	4	-	4	18
Ridomil MZ58 (2 lb.)	4	-	-	9
Bravo + oxidixyl 80% (2.25 lb.)	4	-	-	6
Untreated control	-	13	12	22
Least significant difference, .01		5.0	3.3	7.3
Least significant difference, .05		3.7	2.4	5.4
Coefficient of variation, %		65	41	43

*Pounds of product per acre in 75 gallons of water.

†Applications at 2-week intervals starting 8 weeks (4 sprays) or 4 weeks (2 sprays) before anticipated harvest. Values are an average of 4 replicates.

‡Blackmold incidence determined by visual inspection and expressed as a percent of total number of fruit.