cin and copper spray, (3) evaluate day vs night applications, (4) evaluate dilute vs concentrate applications, (5) compare alternate-row applications with every-row applications, and (6) compare travel speeds of 1 and 2 miles per hour.

The sprayer used was a Hart Carter 432G 500-gallon machine calibrated to spray either concentrate at 100 gallons per acre or dilute at 400 gallons per acre (every-row basis).

Rain, relative humidity and temperature were monitored in the orchard during the test to relate them to time of blight infections. Rain occurred March 25, 26, 27, April 6, 9, 13, 17, 20 (including some hail), May 1, 2, 4, 5, 6 and 8. Table 1 shows the hours per week of temperatures over 65° F (critical temperature for blight infection) and hours over 90% relative humidity. Five percent bloom was recorded March 28 and full bloom on April 3. The first blight infections were observed on April 26.

The orchard was first irrigated during early bloom, March 20, which precluded use of ground spray treatments at that time. Due to the earliness of bloom, a streptomycin 3,000 ppm dust application was made by air at the rate of 20 lbs per acre to the entire block on March 24. Following this initial aerial treatment, ground applications began with the treatments described. A total of 10 applications were made, starting on March 29, and followed on April 2, 7, 12, 16, 21, 26, 30, May 5 and 10.

TABLE 1. SULLIVAN RANCH 1971 WEATHER DATA

Week endinng	Hours per week over 65° F	Hours per week over 90% RH
March 29	10	42
April 5	50	48
April 12	24	52
April 19	42	43
April 26	21	24
May 3	44	44
May 10	38	66
May 17	72	24
May 24	82	28

TABLE 2. C. E. SULLIVAN BLIGHT EXPERIMENT—CHEMICAL APPLICATIONS, TIMING, INFECTIONS

Treatment	Amount applied/acre	Night or day	Spray per acre (gallons)	Mean infections per plot‡	
Check	–	–	–	173	
Streptomycin	2.4 oz.	N	50	25	b
COCS 50% Cu	16	D	50	24	b
Streptomycin 17%	4.8	D	50	20	bc
Streptomycin 17%	4.8	N	50	19	bc
Streptomycin 17%	9.6	N	50	11.25	cd
Streptomycin 17%	9.6	N	100*	11.25	cd
Streptomycin 17% + oil 1%	9.6 64 oz.	N	50	9.25	cd
Streptomycin 17%	9.6	N	200	8	cd
Streptomycin 17%	9.6	D	200	6.25	d
Streptomycin 17%	9.6	D	50	5.5	d
Streptomycin 17% + 2 copper sprays	9.6	D	50	5.25	d
Streptomycin 17%	9.6	D	100†	4	d
Kocide 53% Cu	16	D	50	3.25	d
Streptomycin 17%	19.2	N	50	1.75	d

* 1 mph.
† every row.
‡ means followed by different letters differ significantly (P = .05).

The number of blight infections was counted on the interior four rows and center six trees within each plot, providing a one-tree-wide buffer around each plot. Despite some missing trees due to blight in 1970, all plots contained 20 to 24 trees. The average number of blight infections per plot is summarized in table 2.

The more streptomycin used, the better the control achieved. Results with 2.4 and 4.8 oz of 17% streptomycin were nearly equal, but significantly better control was obtained with 9.6 oz and 19.2 oz. There was no significant difference between 9.6 and 19.2 oz, but there was a trend favoring 19.2 oz applications.

Copper materials gave different results. Kocide at 1 lb per acre gave statistically better control than COCS at 1 lb per acre. The best copper spray (Kocide) gave control equal to the best (streptomycin, 19.2 oz) and the lower rates of streptomycin sprays gave control similar to COCS. The addition of 1% oil to 9.6 oz of streptomycin had no effect on blight control.

Concentrate (50 gal per acre) and dilute sprays (200 gal per acre) of streptomycin gave equally good control of blight. Spray patterns were checked for uniform distribution with spray target cards at the beginning and midpoint of the test so no real differences in coverage existed.

Slowing travel speed of sprayer from 2 mph to 1 mph gave no improvement in control. Spraying every row each time, compared with alternate-row spraying, resulted in slightly, but not significantly better, blight control with streptomycin.

Alternate-row treatment consisted of spray application from odd-numbered row middles, followed by a subsequent application from even-numbered row middles, then odd-numbered middles the third time, and so on throughout the test. During the first month following bloom, foliage density is low enough to permit good coverage across two rows of trees, hence the alternate-row treatments commonly used by growers are effective.

Based on this test and other observations it appears that streptomycin at 9.6 or 19.2 oz per acre, or Kocide at 1 lb per acre, gives satisfactory control of fireblight in pears if spray applications are made every five days during bloom, and for at least 30 days after bloom.

FIREBLIGHT

W. J. MOLLER · J. A. BEUTEL

A SEVERE OUTBREAK of fireblight occurred in Bartlett pear orchards in the northern Sacramento Valley during 1971. It developed in orchards where growers had followed a thorough blight control program using streptomycin sprays (12 to 18 applications per season) exclusively during 1970 and 1971. Blight samples from these orchards were collected and checked for streptomycin resistance in May 1971. The pathogen in many of these samples was shown to be highly resistant to streptomycin. This newly developed resistance to streptomycin in the Sacramento Valley apparently accounted for the failure to control blight in 1971 with streptomycin programs that had performed successfully in 1970.

To test which materials might be effective against this streptomycin-resistant strain of fireblight, an experiment was set up in an orchard near Gridley owned by Heringer Enterprises. Spray treatments were applied to the orchard in September 1971 but no fall blight developed. In the spring of 1972, the same 20-acre pear orchard was again used to determine the efficacy of several materials for the control of fireblight.

The orchard had been badly affected by the streptomycin-resistant strain in the spring of 1971. It was 14 years old and planted in hedgerows with 11 by 22 ft spacing. The 20-acre orchard was divided into 78 plots of 40 trees each (4 rows wide by 10 trees long). Each plot was sprayed on an alternate-row basis with a Hart-Carter 432G air-blast sprayer calibrated to apply either concentrate at 100 gallons per acre or dilute material at 400 gallons per acre on an every-row basis. Thirteen treatments with six replications were applied every 5 to 6 days starting March 13 (at 20% bloom) and ending April 28 for a total of ten applications. Materials tested were three copper compounds (Kocide, COCS and tribasic copper) and two antibiotics (terramycin and streptomycin) and combinations of these materials.

Weather during the test was recorded in the orchard with a recording hydrothermograph. Conditions favoring blight (temperature over 65° F or relative hu-

STREPTOMYCIN-RESISTANT CONTROL STUDIES, 1972

· W. O. REIL · F. J. PERRY

TABLE 1. WEATHER DATA—HERINGER EXPERIMENT 1972

Week ending	Hours per week over 65°F	Hours per week with rel. hum. over 90%
March 19	66	32
March 26	14	36
April 2	17	51
April 9	16	51
April 16	20	32
April 23	38	19
April 30	53	21

TABLE 2. PEAR FIREBLIGHT INFECTIONS—1972—HERINGER RANCH

Treatment	Concentrate or dilute spray	Amount material per acre per application	Blight strikes per plot (16 trees)*
Kocide	Conc.	1 lb.	0.3 d
Kocide	Dilute	2 lb.	1.0 d
Kocide	Conc.	2 lb.	1.2 d
Terramycin 17% + Streptomycin 17%	Conc.	8 oz.	1.2 d
Terramycin 17%	Conc.	8 oz.	1.3 d
Kocide + Streptomycin 17%	Conc.	2 lb. 8 oz.	1.8 cd
COCS	Conc.	2 lb.	1.8 cd
COCS	Conc.	1 lb.	2.2 cd
Kocide or Streptomycin 17% (alternated)	Conc.	2 lb. 8 oz.	2.7 cd
Kocide + Streptomycin 17%	Conc.	1 lb.	
Streptomycin 17%	Conc.	8 oz.	3.3 cd
Streptomycin 17%	Dilute	28.8 oz.	5.3 c
Tri Basic Copper	Conc.	2 lb.	10.0 b
Check	–	–	15.3 a

* Values followed by different letters are significantly different at the 0.05 level.

midity over 90%) are summarized in table 1. Rain occurred March 20, 21, 22, and April 5, 8, 9, 11, 12 and 22. Irrigation was applied March 31 and April 1.

Blight infections were first noticed on April 10 and the total infections in each plot were counted on May 4 and 5. Counts were made on the inside 16 trees (2 rows by 8 trees) in each plot and the average number of infections per treatment are reported in table 2.

As the data indicate, less than one strike per tree was obtained in the unsprayed trees. All treatments gave better control than this, but to evaluate materials effectively, the amount of blight received was much less than desirable; however, some generalizations can be made.

From the data obtained, Kocide and COCS were statistically better than either 28.8 oz of 17% streptomycin or 2 lb of tri-basic copper. No statistical differences were obtained between the Kocide or COCS treatments. The number of strikes per plot showed that Kocide averaged slightly better than COCS. Terramycin was also as good as the two copper materials. When streptomycin was combined with copper, the controls were poorer than when Kocide was used by itself. In some further tests in the laboratory, it was obvious that the combination of materials caused over-wetting of the foliage, resulting in excessive runoff of the material. This may have accounted for poorer control when Kocide and streptomycin were combined. Tri-basic copper gave statistically poorer control than COCS or Kocide at equivalent rates of copper per 100 gallons of spray. Equivalent blight control was obtained with one and two pounds of COCS per acre and between one and two pounds of Kocide per acre. Since both materials contain approximately 50% copper, it appears that ½ lb actual copper gave good blight control under the conditions of this test.

Blight infections found in the plots were primarily of the streptomycin-resistant strain, indicating that the resistant strain first detected in the previous season was stable and had persisted through the winter.

In summary, it is evident that copper materials (COCS or Kocide) gave better blight control than the highest registered rate (28.8 oz per acre) of streptomycin. Combinations of Kocide and streptomycin gave better control than streptomycin alone but inferior to Kocide alone. Streptomycin-resistant fireblight can be controlled by copper materials (COCS and Kocide) at one or two lbs per acre of formulated material, if sprays are applied every five days.

EFFECTS OF CONTROL SPRAYS ON RUSSETTING OF BARTLETT PEARS

W. O. REIL · J. A. BEUTEL · W. J. MOLLER

RUSSET (small, corky, brown spots on the surface of fruit) makes pears less attractive to buyers and so reduces prices paid for fresh fruit even though it does not affect the eating or keeping quality. Several studies have shown that sprays, dew or rain on the surface of young fruit increase russet. For this reason, fireblight control sprays applied to pear trees with young russet-susceptible fruit were evaluated for their effect on fruit russet in 1971 and 1972.

Russet evaluation consisted of estimating the percentage of lenticels russetted on a random sample of outside fruit hanging 5 to 7 feet above ground on trees in each plot. For uniformity, one person made all russet estimates for all plots in each orchard. The evaluations were made two to three weeks before harvest.

In 1971, two russet estimates were averaged per tree and 40 trees were evaluated in each treatment. This blight control test was in the C.E. Sullivan orchard of 12-year-old trees planted 15½ by 15½ ft near Yuba City, and was conducted in a year of minimum russetting. In 1972, five russet evaluations were averaged per tree and 60 trees were evaluated in each treatment. The 14-year-old orchard used for this test was planted in hedgerows 11 by 22 ft apart and owned by Heringer Enterprises of Gridley. Russet was severe in 1972. Each orchard received a total of 10 sprays between bloom and the first 40 days following fruit set.

The results of the 1971 test, shown in table 1, indicate that streptomycin sprays caused significantly less russet than copper sprays. As the amount of streptomycin applied per acre increased,