TABLE 1. RUSSET EVALUATION OF 1971 SULLIVAN PEAR FIREBLIGHT CONTROL TEST

Treatment	Spray* or spray/acre (gallons)		Material per acre per application	% lenticels russetted†
Check	———		0	9.4% a
Streptomycin 17%	conc.	50	4.8 oz.	10.6% b
Streptomycin 17%	conc.	50	9.6 oz.	10.9% b
Streptomycin 17%	dilute	200	9.6 oz.	11.3% c
Streptomycin 17%	conc.	50	19.2 oz.	13.8% c
Streptomycin 17% + COCS (2 times)	conc.	50	9.6 oz. 16.0 oz.	19.1% d
COCS (copper)	conc.	50	16.0 oz.	23.8% e
Kocide (copper)	conc.	50	16.0 oz.	24.7% e

* Concentrate at 50 gal. per acre or dilute at 200 gal. per acre.
† Values followed by different letters are significantly different at .05 level.

TABLE 2. RUSSET EVALUATION IN 1972 HERINGER PEAR FIREBLIGHT CONTROL TEST

Treatment	Spray per acre (gallons)	Material per acre per application	% Lenticels russetted*
Check	0	0	42.3% a
Terramycin 17%	50	8.0 oz.	46.7% b
Streptomycin 17%	200	28.8 oz.	46.7% b
COCS copper	50	2.0 lbs.	59.9% c
Tribasic copper	50	2.0 lbs.	60.4% c
COCS copper	50	1.0 lbs.	60.8% c
Kocide alternated with Streptomycin	50	2.0 lbs. 8.0 oz.	65.4% d
Kocide plus Streptomycin 17%	50	1.0 lbs. + 8.0 oz.	65.8% d
Kocide	50	1.0 lbs.	67.1% d
Kocide	200	1.0 lbs.	67.3% d
Kocide	50	2.0 lbs.	67.4% d
Kocide + Streptomycin 17%	50	2.0 lbs. + 8.0 oz.	79.4% e

* Values followed by different letters are significantly different at .01 level.

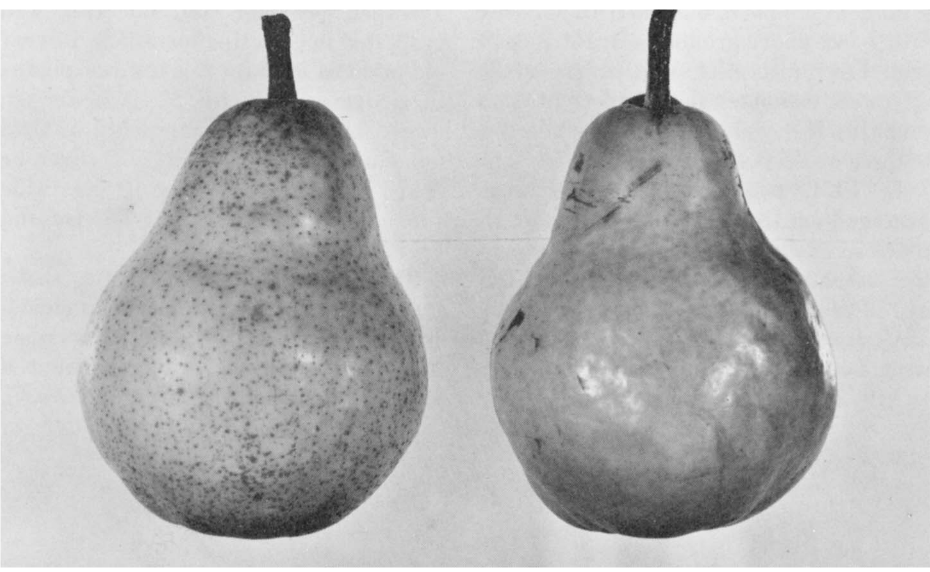
so did the amount of russet. The addition of only two copper sprays (COCS) to the 9.6 oz per acre rate of streptomycin during the season significantly increased the russet compared with using streptomycin alone. The checks, which received only normal insecticide sprays (no blight sprays), had significantly less russet than any of the plots sprayed for blight.

In the 1972 test, russet was three to four times worse than in the 1971 test. This variation in russet from year-to-year and area-to-area is quite common and is generally considered to be due to variation in such climatic factors as low temperature, dew, rate of fruit growth, amount of natural wax on the surface of fruit plus other conditions. In 1972, a light frost occurred shortly after petal fall and could have been a major cause of increased russetting.

Russet data measured in the Heringer blight control test are summarized in table 2. Despite a high level of russet in this orchard in 1972, the pears on the check trees which received insecticides, but no blight control sprays, had significantly less russet than fruit from all other treatments. The antibiotics, streptomycin and terramycin, caused significantly less russet than did the copper sprays. The various copper materials produced different amounts of russetting with Kocide producing significantly more than COCS or tribasic copper. The amount of copper applied per acre as Kocide or COCS did not cause a difference in russet in this test. When copper as Kocide was mixed with streptomycin sprays or when sprays of Kocide and streptomycin were alternated, the amount of russet on pear fruit was similar to that obtained from Kocide spray alone; this indicates that copper is the primary cause of increased fruit russet, especially since it is applied when fruits are small and most susceptible to russet.

After two years of evaluation on the effect of blight sprays on russetting of pear fruit in the Sacramento Valley, these results clearly demonstrate that copper sprays increase russet more than antibiotics such as streptomycin and terramycin. Even where the number of copper sprays was reduced by alternating with streptomycin, the amount of russet was significantly higher than where streptomycin was used alone. The fact that blight is resistant to control with streptomycin in several Sacramento Valley orchards precludes its use in these orchards. Russet is primarily a problem of pears shipped fresh and does not affect the sales of pears used for canning.

Pear fruits showing russetted lenticels compared with smooth finish of normal fruit.



FIREBLIGHT

THIS REPORT evaluates a method used to determine the uniformity of spray coverage in a pear fireblight control experiment in 1972. Trees used for the experiment were mature 14-year-olds in a hedgerow planting at 11 by 22 ft spacing. The trees were uniform in size, vigorous in growth (many 5-ft shoots per season) and completely grown together in the hedge. Standard vase-shaped pruning was practiced, giving a diameter of approximately 14 ft, with a height of 15 ft after dormant pruning.

The sprayer used was a Hart-Carter Spray Master 432G. The sprayer had one manifold with shut-off valves for concentrate and dilute nozzles. The dilute nozzles were calibrated to apply 400 gallons per acre on a 22-ft spacing and the concentrate nozzles were calibrated to apply 100 gallons per acre at the same spacing. Pressure was maintained at 125 psi, with an engine speed of 2900 rpm. Speed was maintained at 2 mph for all plots. Rhodamine B concentrate 500% powder was used at 8 oz per 100 gallons of water in all target-card tests.

Eight white target cards measuring 2½ by 4½ inches were attached to a pole at 2-ft increments to a height of 16 ft. Three sets of cards were placed in each tree with one set approximately 1 to 2 ft within the canopy of the tree closest to sprayer. The second set of cards was placed near the center of the tree, with the third set located on the side of the tree farthest from the sprayer. The sprayer was then driven by at 2 mph, cards allowed to dry, and nozzles readjusted where necessary to give complete pattern coverage. Target cards were used for both the concentrate and dilute patterns and cards were resprayed until the desired pattern was achieved.

The experiment was of a randomized complete block design with 5 replications of 11 treatments, plus an unsprayed

USE OF SPRAY TARGET CARDS AND LEAF ANALYSIS TO MEASURE SPRAY COVERAGE

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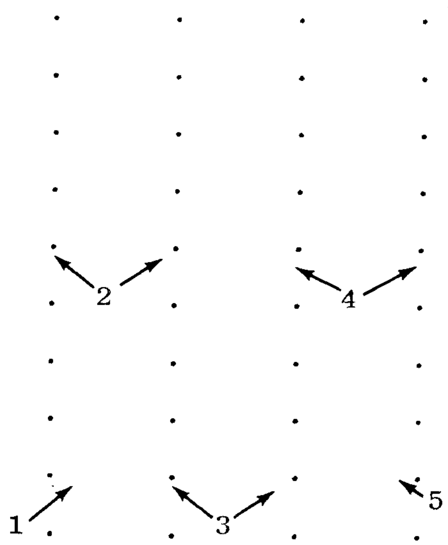
check. Some of the treatments contained no copper material, so it was necessary to delete these and only evaluate the other treatments.

Each experimental plot consisted of 40 trees—4 trees wide (22 feet apart) by 10 trees long (11 feet apart)—see sketch. Alternate rows were sprayed each time on a four to five day schedule.



Middle 2 and 4 were sprayed one date. Middle 1, 3 and 5 were sprayed on alternate dates with nozzles nearest the plot turned on when Middle 1 and 5 were sprayed. Both sides of the sprayer were turned on when Middle 3 or Middles 2 and 4 were sprayed.

TABLE 1. FIREBLIGHT PEAR SPRAY COVERAGE DATA—CONCENTRATE VS. DILUTE SPRAYING

Material	Concentrate or Dilute spray	Amount material/acre per application	% Copper	Copper Residue*
				ppm
COCS	Concentrate	2 lbs	50	378 b
Kocide	Concentrate	1 lb	53	404 b
Kocide	Concentrate	2 lbs	53	702 c
Kocide	Dilute	2 lbs	53	751 c
Tribasic Cu	Concentrate	2 lbs	53	476 b
Check	......	0	0	40 a

* Values followed by different letters are significantly different at the 0.01 level.

TABLE 2. OUTSIDE VS. INSIDE TREE SPRAY COVERAGE PEAR FIREBLIGHT CONTROL TRIALS

	Top		Bottom		
	Outside	Inside	Outside	Inside	Total
Dilute	751b*	504a	1424c	1482c	4161
Concentrate	702b	440a	1693d	1293c	4128
Conc/dil %	93	87	119	87	99

* Values followed by different letters are significantly different at the 0.01 level.

Part of the evaluation studies was concerned with alternate row spraying and the possibility of inadequate coverage on the sides of the tree furthest from the sprayer. The target cards showed an adequate pattern throughout the tree, although spray coverage was less on the side farthest from the sprayer.

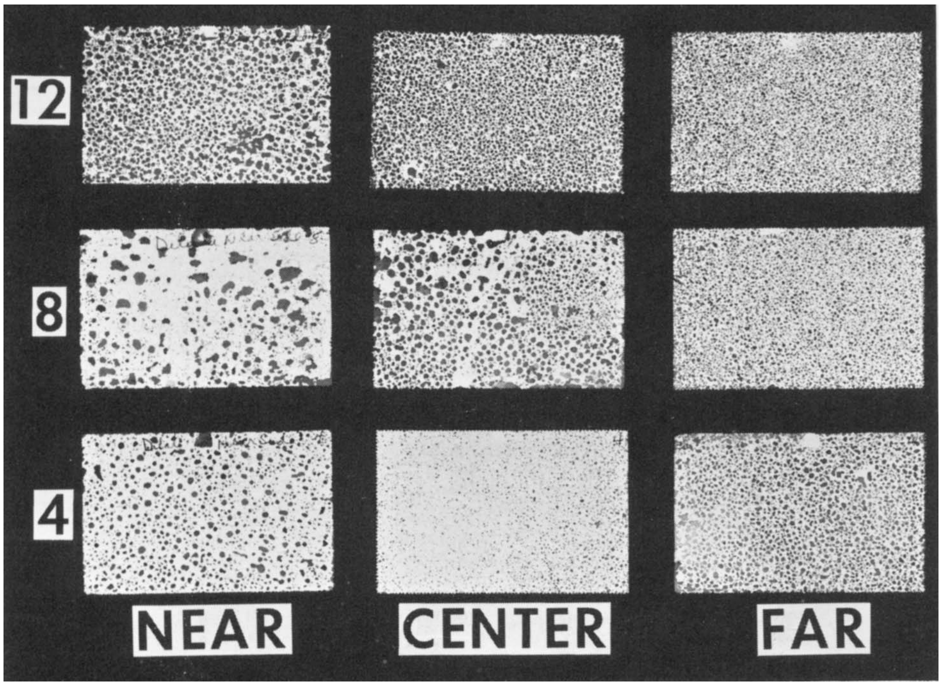
Where growers are applying multiple sprays on a fixed schedule as a preventative treatment the spraying of alternate rows can be used effectively in some situations. The sprayer used must be calibrated for the orchard to provide coverage to the entire tree.

The fourth and sixth tree in the middle two rows were used for sampling. Leaf samples of the second and third oldest mature leaves from vigorous-growing shoots were collected with 15 leaves picked from each tree. The same side of tree was used for the six samples in a given replication and another side was used for the next replication. Sampling location did not result in any significant differences. Samples for each treatment were picked approximately 10 to 13 ft high and 2 ft within the canopy after a total of *ten chemical applications* had been made. A cumulative total of two inches of rain had fallen in intermittent storms before the final two sprays were applied. The last spray was applied May 28 and samples were taken on June 1. Results for each plot are summarized in table 1.

In this experiment, Kocide-sprayed leaves showed approximately twice the copper residue when compared with COCS or Tribasic Copper. It was not possible to determine whether this was due to greater weathering ability or better initial deposition. The check treatment showed 40 ppm copper present. Part of this amount was due to natural copper present in the leaf tissues. A slight amount might also be due to copper contamination in the spray tank when the first codling moth spray was applied separately over the entire block. The remaining copper present on the check trees must have been due to drift from the other plots. Applications were made during the season with wind velocities as high as 10 mph, although most applications occurred in calm conditions.

To check the efficacy of concentrate as compared with dilute applications, four different locations per tree were sampled in the six replications of the 2-lb Kocide concentrate plot and the 2-lb Kocide dilute plot. Equal amounts of material had been applied in both treatments. The locations sampled were *top-outside*, which

Dilute spray pattern showing the 4, 8, 12 foot cards placed in tree near sprayer, in the center of the tree, and in the tree on the far side of the sprayer.



was comparable with samples in the previous test; *top-inside*, taken near center of tree from 10 to 13 ft from ground; *bottom-outside*, taken approximately 5 ft from ground and 2 ft within canopy; and *bottom-inside*, taken about 5 ft from ground near center of tree (table 2).

Comparisons between concentrate spraying and dilute spraying showed no significant difference at the same location except on the *bottom-outside* location, where the concentrate application was significantly higher than the dilute application. This could either be due to excess runoff of the dilute spray, to less inertia present in the smaller droplet size of the concentrate spray causing the drop to adhere to the first leaves contacted, or possibly a combination of both. Both inside locations showed about 87% of the amount of copper on the concentrate spray plot compared with the dilute spray, whereas the *top-outside* showed 93%, and the *bottom-outside* showed 119%—which means that a higher percentage of material adhered to the outside of the tree on concentrate spray than to the inside locations, when compared with dilute spray. The total amount of copper adhering to the leaves was the same for both concentrate and dilute sprays.

Coverage was considered excellent (by use of the target cards), although in all sprays, more material was generally applied to the bottom of the tree than the top. From the results, approximately three times the amount of copper adhered to *bottom-inside* leaves than to *top-inside* leaves. Part of the difference was due to rains washing some of the copper from upper leaves to lower leaves. Some difference also could be due to thin weak leaves collected in the *bottom-inside* leaf samples. Due to the dense canopy and shading factors, only these weaker leaves were present for sampling.

Part of the difference in copper present was due to nozzle adjustment on the sprayer, and lack of uniform coverage. This occurred even after use of target cards and visual evaluation of sprayer adjustment. Large trees with dense foliage are very hard to spray uniformly. In our tests, the least amount of material was applied to the top center of the trees. Evaluation for fireblight, insects and mites over the past few years has shown that the tree tops are most frequently affected and in fact this can often be further isolated to the top centers of trees. Many sprayers are not adjusted by precision methods, but merely by visual assessment at the beginning of each season. These sprayers are then used to apply chemicals to trees of differing variety, shape, size and planting configuration.

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