Streptomycin for Plant Diseases

tests indicate streptomycin or dehydrostreptomycin to be effective against plant pathogenic bacteria

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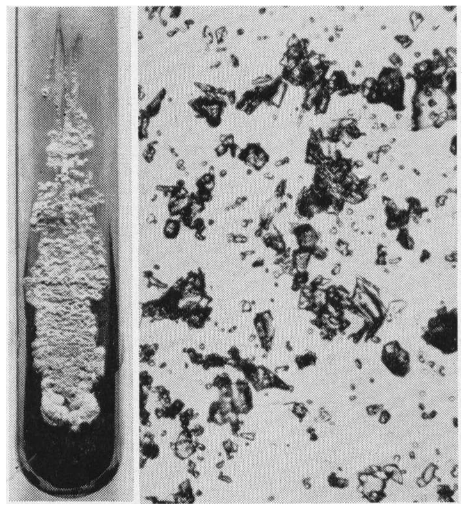
Streptomycin—an antibiotic produced by a soil microorganism, *Streptomyces griseus*—is under study by plant pathologists as a possible substitute for conventional agricultural bactericides.

Streptomycin is a relatively stable compound and remains active either in acid or alkaline media. On reduction it gives dehydrostreptomycin which is just as active but causes little or no skin irritation.

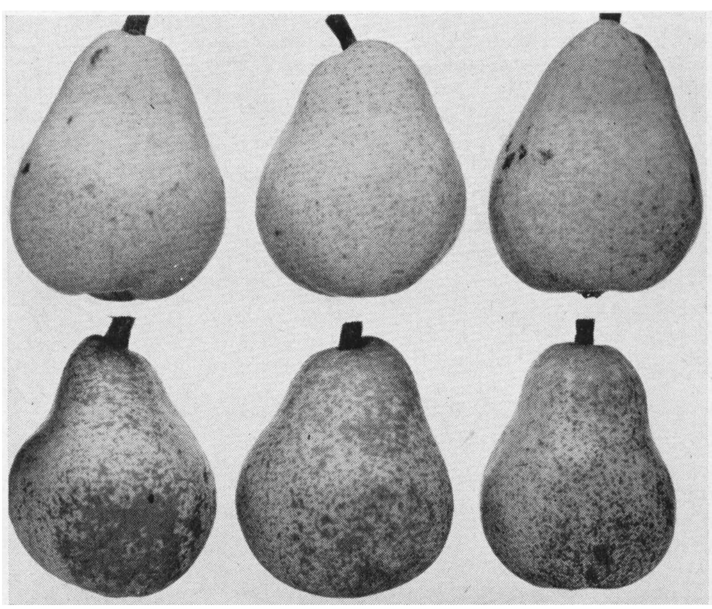
The activity of streptomycin was tested in the laboratory against many important bacterial plant pathogens occurring in California, including the causative agents of fire blight of pear—*Erwinia amylovora*—walnut blight—*Xanthomonas juglandis*—tomato canker—*Corynebacterium michiganese*—bacterial canker of stone fruits—*Pseudomonas syringae*—angular leaf spot of cotton—*Xanthomonas malvacearum*—bacterial spot of begonia—*Xanthomonas begoniae*—olive knot—*Bacterium savastanoi*—and crown gall—*Agrobacterium tumefaciens*.

Streptomycin gave a good performance against all bacteria listed. However, Gram-positive species—those retaining the color with which they were stained—such as the tomato canker organism—were definitely more susceptible to streptomycin than some Gram-negative—decolorized—bacteria, such as the fire blight bacteria.

Because crops have to be protected from one or more fungus diseases and insect pests, and this protection may involve the use of combined sprays or dusts, the reaction of streptomycin with some standard fungicides was studied in the laboratory. Tests were performed with copper sulfate, lime sulfur, arasan, fermate, and captan as commonly used fungicides, and ovotran, sulphenone, malathion, dimite, aramite, parathion and DDT, as acaricides in common use in orchards against mites.



Left—A culture of *Streptomyces griseus*. Right—Crystals of streptomycin sulfate derived from *Streptomyces griseus*.



Upper row—Clean fruit from the streptomycin plot. Lower row—Russeting produced by copper in the copper-lime experimental plot.

The tests demonstrated a relationship between the activity of fermate and fermate plus streptomycin on the bacteria causing fire blight and those causing walnut blight. The action of streptomycin on fire blight bacteria seems to be heightened in the presence of fermate, but there was slight inhibition against the walnut blight bacteria. Otherwise, there was no inhibition of the activity of streptomycin in the presence of any of the fungicides and pesticides used.

Because some bacterial pathogens are carried on the seed a study was made of the effects of steeping field seed and artificially contaminated seed in streptomycin. Freedom from disease-producing bacteria was ascertained by culturing on a potato-dextrose peptone agar medium.

In the tests were cucumber seed contaminated with angular leaf spot—*Pseudomonas lachrymans*—cotton seed with angular leaf spot and tomato seed carrying tomato canker. The concentrations of the streptomycin in the tests were: one part streptomycin to 1,000 parts of distilled water 1-to-5,000, and 1-to-10,000. The seeds—100 in each test—were exposed from 20 minutes to one hour. Treated seeds were washed in sterile distilled water and dried before culturing. The results showed that all treated seeds were free of pathogenic bacteria. Greenhouse tests revealed no injury on plants produced from the treated seeds.

In the fire blight disease of pear the chief avenue of entry is through the nectaries—the glands that secrete the nectar—of the open blossoms. Prevention of blight infection at this stage is now the principal method of control of fire blight in California. To test the ability of streptomycin to accomplish disinfection in the nectaries, the flowers of *Pyracantha angustifolia* were collected, in the cluster stage, and set in water in the laboratory. In one experiment unopened flowers were sprayed with a virulent culture of fire blight bacteria and allowed to dry at room temperature. After drying the blossoms were sprayed with 1-to-10,000 streptomycin sulfate plus 1% triton

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B-1956, as a spreader. In each set 100 blossoms were used. Appropriate checks were set up and all sets were placed in moist chamber at temperatures varying from 65° F to 80° F. After six days results showed no blight in the streptomycin-treated sets and those where no organism was applied as compared to a check sprayed with the culture alone which developed 96% of blight.

In another experiment, opened Pyracantha blossoms were dusted with streptomycin sulfate, 200 ppm plus bentonite, 200 mesh, and 24 hours later sprayed with a virulent culture of fire blight bacteria. As checks, undusted blossoms were sprayed with the same culture. Incubation was for six days in a moist chamber in a warm greenhouse. No blight developed in the streptomycin-treated lot but there was 100% blight in the checks. The experiments revealed that streptomycin can prevent fire blight disease in Pyracantha even when the bacteria were introduced a short time before the streptomycin.

The systemic action of streptomycin was protection against fire blight in the Pyracantha when shoots were sprayed with streptomycin sulfate—1-to-10,000—and when inoculated through wounds. Young shoots were inoculated through needle wounds at points protected from the spray by 1″ strips of waterproof tape removed at the time of inoculation.

To evaluate the protective properties of streptomycin under field conditions, crude streptomycin base was applied as a bentonite dust containing 240 ppm of the streptomycin. The dust was applied at the rate of 30 pounds per acre on 25 year old Bartlett pear trees. The streptomycin plot had 300 trees between two checks, one of 290 and one of 264 trees.

Another check was provided in which a comparable number of trees was dusted with 20–80 copper-lime dust, the standard control of fire blight. Due to circumstances beyond control, the streptomycin was not applied to the trees at exactly the same time as the copper-lime dust and the number of applications was smaller than in the copper schedule. Moreover, the streptomycin plot could not be dusted at the most critical time. In spite of this disadvantage, the streptomycin plot showed a remarkable protection from fire blight up to May 1 when comparison of the treatments was made. Both the streptomycin and the copper-lime plots had only a trace of fire blight, but the checks were heavily damaged by the disease. Observations throughout the season showed no visible injury on the pear foliage. Fruit from the copper-lime dusted plot was heavily russeted, but from the streptomycin plot it was clean.

Effect of Streptomycin Sulfate on a Gram-positive Bacterium, *Corynebacterium michiganese*, and a Gram-negative Bacterium, *Erwinia amylovora*.

Tested by a 13 mm. dia. disc, using potato-dextrose-peptone agar medium.

Organism	Disease produced	Concentration of streptomycin sulfate 1 : 10,000	1 : 20,000	1 : 40,000	1 : 80,000
		Diameter of inhibition zone in mm.			
Corynebacterium michiganese	Tomato canker	33	32	27	25
Erwinia amylovora	Fire blight	26	22	20	15

Systemic Effect of Streptomycin Sulfate on Movement of Fire Blight in Young Shoots of *Pyracantha angustifolia*.

Treatment	No. applications at 24 hr. intervals	Number of shoots inoculated	Time of inoculation after last spray (hrs.)	Average length of blighted shoots, ins.
Triton B-1956, 0.01%	1	13	24	5.9
Streptomycin sulfate, 1 : 10,000, plus spreader......	1	10	24	5.5
" " "	2	19	24	4.6
" " "	3	10	24	3.5
" " "	4	10	24	3.8
" " "	4	15	48	2.8
" " "	4	12	72	2.5
" " "	4	10	96	4.4
" " "	5	11	24	2.3
" " "	5	13	48	2.6
" " "	5	13	72	2.9
" " "	5	19	96	3.0
" " "	7	10	24	3.4
" " "	7	13	96	1.9
" " "	7	15	120	2.7

Results of Copper and Streptomycin Dust Treatments for Control of Pear Fire Blight.

Treatment	Dusting dates	Number of trees	Total blight cuts to May 1
Crude streptomycin sulfate bentonite dust	March 23[a], March 31[b], April 9[c], April 20	302	2
20–80 copper-lime dust...	March 5[1], March 16[1], March 27[d], April 1, April 4[2], April 7, April 21, April 24[2]	300	2
Check 1. No treatment.....	......	290	93
Check 2. No treatment.....	......	264	42

[a] 50% bloom; [b] 4 days past full bloom; [c] calyx stage; [d] full bloom.
[1] Copper in the form of Bordeaux for scab; [2] Copper in codling moth spray.

Spraying Experiments to Control Walnut Blight. Spring, 1953.

Pre-bloom spray, April 11; post-bloom spray, May 16. Walnut Creek, California.

Treatment	Total nuts counted	Diseased nuts	Per cent blight	% in relation to check
Check. No treatment...........	4847	1968	40.6	100
Copper A, 4 pounds @ 100 gallons	6182	1404	22.7	56
Check. No treatment...........	4947	2008	40.6	100
Streptomycin sulfate, 10 p.p.m. plus spreader........	5262	1105	21.0	52

For the past several years, experimental control of walnut blight by the use of streptomycin has been encouraging. In the spring of 1953, 21 Payne walnut trees were sprayed with 10 ppm streptomycin sulfate plus spreader. The first—pre-bloom—spray was made on April 11, followed by a post-bloom spray on May 16. Streptomycin gave a control of walnut blight comparable to that with Copper A. No injury from streptomycin was noted during the growing season.

Experimental evidence indicates that streptomycin is an excellent bactericide against plant pathogenic bacteria. Because of its stability, it can be used with common fungicidal and insecticidal sprays.

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