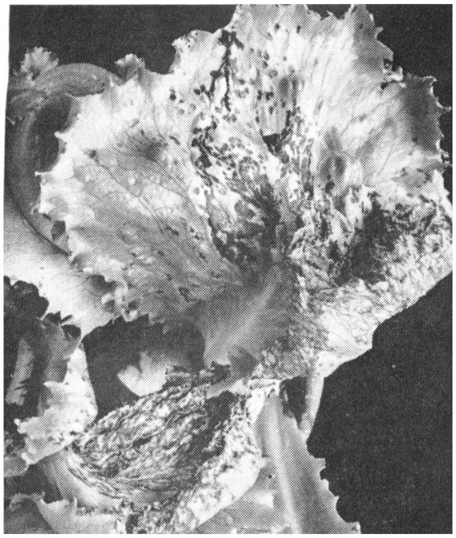

Lettuce leaves showing irregularly shaped lesions caused by bacterial spot Xanthomonas vitians (also cover photo). Elimination of nearby weed hosts of the bacterium and avoidance of overhead irrigation appear to be the most practical means of controlling the newly discovered disease of lettuce in the Salinas Valley.

A new disease in California . . .

BACTERIAL SPOT OF LETTUCE

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Bacterial spot of lettuce occurs in other parts of the world but had not been observed in California until 1963, when an outbreak was noted in several fields in the Salinas valley. The disease is characterized by circular or irregular translucent water-soaked leaf lesions which become dark brown with age. The disease seldom kills the plant but may render a crop unmarketable depending upon the severity of infection. The older leaves are more susceptible and may be killed, though defoliation is rare.

The disease is caused by *Xanthomonas vitians*, a bacterium which forms raised, pale-yellow colonies on nutrient dextrose agar. Infection is through stomata (natural leaf openings) and is favored by periods of high humidity, dew, and rain. The bacteria exude from lesions and are spread by overhead irrigation, rain or wind-blown water drops. Infection does not occur unless surface moisture is present on the leaf for a 6- to 8-hour period, and even then, the disease will usually remain limited, unless there is a recurrence of moist conditions.

An examination of the climatological records for April 1963—the period preceding the occurrence of the disease—showed that the amount of precipitation was nearly double the average for the preceding 10 years (2.9 versus 1.5 in.). Perhaps even more significant, however, was the finding that precipitation occurred on 17 of the 30 days of the month, compared to an average of 6.8 for the previous 10 years. The average temperature during April was 3°F below the average. Although the temperature was somewhat lower, the increased amount of moisture made conditions ideal for disease development.

Weed hosts

The two best possibilities on the origin of the disease outbreak were (1) that the seed source was contaminated, or (2) that the organism was present, having survived on weed hosts in other localities. To find the answer, a number of weeds commonly found in California and related to the lettuce plant were collected from lettuce fields and noncultivated areas. The weeds were inoculated by spraying with a water suspension of the bacterium to determine their susceptibility to the disease. Plants experimentally infected were prickly lettuce (*Lactuca scariola*), trumpet fireweed (*L. canadensis*), *L. ludoviciana*, and *L. pulchella*. These plants are in the same genus as the common commercial lettuce. Sow-thistle (*Sonchus oleraceus*), a closely related plant, also was highly susceptible and frequently was found in lettuce fields and nearby noncultivated areas. It therefore appears from these tests that weed hosts can afford the pathogen with a means of perpetuating itself and thus provide a continuous source of inoculum to infect a lettuce field. An outbreak of the disease then may occur if environmental conditions are favorable for infection and spread, as occurred in April, 1963. With the normal pattern of precipitation, however, it is doubtful whether the disease would occur, or be of any significance regardless of whether the organism was carried on seeds, or was present on an occasional weed host.

It is problematical whether this disease will recur often in Salinas Valley, and if so, whether the disease will be severe enough to warrant the cost of initiating control measures. The summer weather in the valley is semi-arid and does not favor foliar infection by bacterial pathogens.

Preventing infection

When the disease does occur, efforts should be directed towards preventing infection rather than eradicating the bacterium after it has invaded the leaves, since none of the available bactericides appear to be systemic. The application of a bactericide after plants have been infected, however, may reduce further spread of the organism.

Streptomycin and fixed coppers were tested for preventing infection of lettuce. Streptomycin was sprayed on plants at varying concentrations, allowed to dry, and the leaves inoculated by spraying with a bacterial suspension. Control was obtained with 50 and 100 ppm streptomycin with no apparent injury to the plants. However, this material cannot be used on lettuce at this time because it is not registered for use on this crop.

Greenhouse trials

In greenhouse trials, sprays of fixed copper were ineffective in preventing infection, since concentrations necessary to prevent infection were highly toxic to the lettuce. Injury first occurred with solutions containing 0.1% metallic copper by weight. There was, however, no control of infection unless concentrations of 0.2% of metallic copper or greater were used, and at this level the plants were severely injured. The experiments suggest that the most practical means of controlling the disease would be elimination of nearby weed hosts, and the avoidance of overhead irrigation, since moisture is the primary factor necessary for initiation of the disease.

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SULFUR CONTENT Of Fruit Tree Leaves

E. L. PROEBSTING · R. TATE

TABLE 1.—SULFUR CONTENT OF WALNUT LEAVES IN A BUTTE COUNTY ORCHARD IN PER CENT DRY WEIGHT

Date	Per cent sultur											
6/6/47	.18	.20	.20	.19	.17	.19	.17	.17	.20	.26	.26	.23
6/14/48	.21	.17	.18	.23	.23	.24	.27	.21	.19	.23	.25	.28
8/30/48		.22	.26	.24	.29	.28	.28	.28	.30	.32	.29	.31
8/25/49	.25	.26	.26	.27	.27	.29	.26	.27	.26	.27	.29	.31

TABLE 2.—SULFUR CONTENT OF WALNUT LEAVES IN A SAN JOAQUIN COUNTY ORCHARD IN PER CENT DRY WEIGHT

Date	Per cent sulfur											
7/18/49	.27	.31	.30	.30	.32	.31	.35	.32	.30	.33	.25	.27
9/2/49	.34	.33	.32	.29		.31	.47	.39	.48	.40	.34	
5/5/50	.21	.23	.23	.23	.23	25	.17	.23	.28	.25	.22	.22
5/31/50	.27	.25	.25	.23	.23	.23	.25	.25	.21	.25	.27	.23
7/27/50	.20	.28	.25	.34	.26	.24	.21	.21	.23	.24	.25	.24
8/23/50	.21	.24	.22	.25	.20	.22	.25	.23	.23	.23	.25	.24
5/25/51	.22	.22	.23	.19	.21	.20	.21	.21	.18	.21	.21	.22
6/27/51	.23	.25	.24	.26	.22	.22	.24	.25	.25	.25	.24	.23
8/21/51	.20	.17	.20	.19	.19	.21	.21	.22	.30	.22	.23	.23

TABLE 3.—SULFUR CONTENT OF LEAVES OF PRUNE, PEACH, APRICOT AND PEAR TREES AT DAVIS IN PER CENT DRY WEIGHT, 1961

	Plot no.	April 17	July 17	Sept. 27
Prune	1	.31	.28	.42
	2	.55	.28	.51
	3	.58	.24	.34
Peach	1	.24	.23	.33
	2	.28	.22	.27
	3	.28	.25	.29
	4	.29	.18	.33
	5	.32	.17	.28
	6	.32	.17	.18
Apricot	1	.20	.20	.27
	2	.23	.24	.23
	3	.40	.16	.28
	4	.34	.14	.26
Pears	1	.27	.26	.28
	2	.33	.16	.27
	3	.27	.17	.29

ALTHOUGH THERE is extensive literature on sulfur requirements and some tissue analyses of annuals, little information is available on the sulfur requirements of deciduous fruits. The only two reports concern the Japanese plum in Australia, and more recently, several species in Washington. Both reports suggest deficiency levels of less than 0.1%.

According to tests reported here, no sulfur deficiency has been found in any deciduous fruit tree in California. With the knowledge that a number of annuals have responded to sulfur applications, these analyses were made to represent a cross section of the common fruit species from major areas sampled at different times in the year. It was anticipated that these values would represent commonly occurring levels which might serve as a point of reference. Samples of suspected deficiency could be compared to those of known adequacy.

Most of the samples of almond, apricot, fig, peach, pear, prune and walnut were taken from trees at the University of California, Davis. Others came from the middle Sacramento Valley, the middle and lower San Joaquin Valley and the Napa Valley. In some instances, samples were taken in three successive years from the same plots. In others, the effects of seasonal changes were observed by taking samples on several dates of the same year. None of these plots was designed to test sulfur deficiency.

The average sulfur content in "Texas" almond leaves was made on four 10-tree plots on seven dates during a four-year period: May 25, 1949, 0.27%; May 26, 1950, 0.19%; August 30, 1950, 0.19%; June 1, 1951, 0.23%; June 14, 1951, 0.23%; July 6, 1951, 0.23%; April 9, 1952, 0.21%. These figures indicate that time of year has little bearing on sulfur content.

Fig leaves sampled on August 26, 1950, and September 27, 1951, showed averages for six plots of 0.24% and 0.22% respectively.

Walnut leaf samples were taken from plots in these districts between 1947 and 1961. Four sets of samples of twelve each are shown from an orchard in Butte county in table 1. Table 2 shows results of tests in San Joaquin County where nine sets of twelve plots each were observed. Each sample in these two orchards is a composite of ten trees each.

Samples from Napa Valley, taken on May 18, 1961, gave percentage values of: 0.39, 0.36, 0.32, 0.41, 0.31, 0.36, 0.40, 0.30, 0.24, 0.19 and 0.27. These figures are generally somewhat higher than those from trees in the interior, but are in the range between nearly 0.2% to 0.4%.

Samples taken on three dates in 1961 at Davis illustrate values for prune, peach, apricot and pear in a Yolo soil in the Sacramento Valley. Each value reported (table 3) is the mean of seven plots of six trees each. Except for the peaches, they had not been fertilized.

The sulfur content of leaves of the species reported is within the range to be expected in trees showing no evidence of deficiency. These values may be used in comparing samples suspected of deficiency. All of these analyses show leaf sulfur content well above the 0.1% (or less) found in trees showing deficiency.

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