

# Sulfur Dioxide Injury on Citrus

Riverside tests show orange trees to be resistant to plant-damaging air pollutant at known atmospheric concentrations

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**Concentrations** of sulfur dioxide—an important plant-damaging constituent of the atmosphere—vary from 0.01 part per million—ppm—to 0.24 ppm, and average about 0.06 ppm in the south coastal plain of California.

Although no damage to citrus leaves in the field has been reported—which could be attributed to air pollution in general or to sulfur dioxide in particular—it is known that leaf markings on alfalfa first appear when plants are exposed to sulfur dioxide at 1.25 ppm for one hour, and severe damage occurs in one hour at 5 ppm. To determine the concentrations of sulfur dioxide required to cause acute injury to leaves of citrus and to note the symptoms, a series of studies was conducted.

Seedlings of sweet and sour orange bearing either new, fully expanded leaves or old mature leaves were fumigated with sulfur dioxide under controlled conditions in fumigation chambers. Concentrations of 2.5 ppm and 6.5 ppm were used, and plants were exposed for periods of two to six hours at 72F and 84% relative humidity.

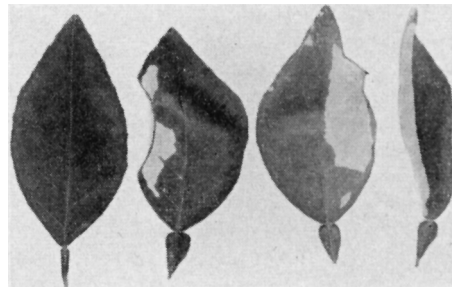
Damage occurred at both concentrations but only on young leaves and then only if those leaves had developed in the relatively warm conditions of a greenhouse. Leaves of new flushes which had developed out-of-doors in the winter months were not damaged even at the higher concentration.

Injury on sweet orange leaves consisted primarily of bleaching and distortion of varying proportions of the leaf. Bleached areas extended across veins, and veins did not remain green as is characteristic of sulfur dioxide damage on herbaceous plants such as alfalfa. At the lower concentration, it was not unusual for the damage to be limited to a portion or all of one half of a leaf. In the latter case, the injured half of the leaf usually became tightly rolled. A slight silverying also sometimes occurred on the lower leaf surface. Leaf fall was very common. Approximately 13% of the leaves fell within a few days following fumigation for two to six hours at 2.5 ppm, and plants became completely defoliated following fumigation for six hours at 6.5 ppm. Abscission occurred between the leaf blade and the petiole wing.

The symptom pattern on sour orange was somewhat different. Silverying of the lower leaf surface was the predominant symptom on leaves fumigated for two to four hours at 2.5 ppm. Six months after fumigation, the silverying was still evident but the damage had not extended through the leaf to the upper surface. Longer exposures at the low concentration or exposure at the high concentration caused bleaching of the leaves in addition to silverying. However, veins were not affected but remained green as is usual on herbaceous plants. Petiole wings were also affected, but defoliation was rare. Slight rolling of injured leaves occurred occasionally.

Sweet orange was more sensitive to sulfur dioxide than was sour orange. In addition to the defoliation occurring on sweet, the extent of the more severe bleaching symptom was about two times greater on sweet than on sour. The extent of silverying on the lower leaf surface was greater on sour than on sweet, but this silverying appeared to be a less injurious manifestation of the effect of sulfur dioxide.

From these experiments it is apparent that sulfur dioxide damage would not



Leaves from sweet orange seedling fumigated with sulfur dioxide at 2.5 ppm. Left to right: Exposure for 0, 2, 4, and 6 hours. Note bleaching, extending across veins and tight rolling of affected half of leaf exposed for six hours.

be expected to occur in the field because the concentrations required for injury are far in excess of the concentrations that are known to occur in the atmosphere in the south coastal plain of southern California.

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**Leaves from sour orange seedlings fumigated with sulfur dioxide at 2.5 ppm. Left to right: Nonfumigated; upper surface exposed two hours; lower surface exposed two hours, showing silver symptom; exposure four; and exposure six hours. Note veins remaining green on leaves bleached at four and six-hour exposure.**

