A CHLOROSIS PRODUCED BY FLUORINE ON CITRUS IN FLORIDA


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In April, 1950, a chlorotic condition of citrus trees in the Bartow area of Polk County, Florida, was called to the attention of the senior author. This chlorosis appeared shortly after a plant for the manufacture of triple-superphosphate was put into operation. At that time, only a small area of citrus showed the chlorotic leaf pattern and the condition was alleviated when additional scrubbing facilities were installed at the plant.

No further reports of this type of chlorosis were received at the Citrus Experiment Station until the early part of 1954. At that time several inquiries were made as to the cause of a chlorosis appearing in groves in the southern part of the Lakeland-Highlands area. Investigation showed that a much larger area was affected. In the interval between 1950 and 1954, several more triple-superphosphate manufacturing plants were constructed in the Bartow-Mulberry area. Apparently the chlorosis was connected with the manufacturing process. The leaf pattern, shown in Fig. 1, was found on citrus as far as six miles away from a triple-superphosphate manufacturing plant. Several different soil types and different varieties of citrus were involved. Because of the occurrence and extent of the symptoms, it appeared likely that an air-borne agent was the cause.

From a consideration of the manufacturing process, it appeared that three types of materials should be considered as possible causes: (1) phosphoric acid, (2) sulfur dioxide and/or sulfur trioxide (as sulfuric acid) and (3) volatile materials containing fluorine such as hydrofluoric acid and silicon tetra-

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million fluorine was found in certain leaf samples, no clear correlation between fluorine content and degree of chlorosis was apparent. Normal leaves taken outside the affected area showed from 12 to 30 p.p.m. fluorine. It has been reported by Kaudy, et al. (3) that citrus leaves in California, obtained near an industrial plant, showed up to 211 p.p.m. fluorine. However, no chlorosis was reported in that area.

Since analysis of citrus leaves were erratic, samples of an air plant, Spanish Moss (Tillandsia Usneoides), were collected at varying distances from one of the triple-superphosphate plants and analyzed for fluorine. The results, shown in Table 1, indicate that fluorine was being released in the manufacturing operation, since the amount in the Spanish Moss decreased as the distance from the plant site increased. The deviation from the general trend noted for the 3.5 mile sample can be ascribed to the topography of the area. The chlorosis tends to be more pronounced in low spots.

In the spring of 1955, sprays of aqueous hydrofluoric acid, fluosilicic acid, and phosphoric acid were applied at a concentration of 0.1 Normal to the foliage of four year old Ruby Red grapefruit trees. These trees were located north of Lake Alfred, nineteen air miles from the nearest triple-superphosphate plant. Approximately one liter of solution was applied per tree per spray application. After seven applications over a period of two months, a chlorotic pattern—identical to that found in the Lakeland-Highlands area — appeared on the foliage. This pattern occurred on the trees which had received the hydrofluoric and fluosilicic acid sprays, but not on those which had received the phosphoric acid sprays. The pattern was confined to the growth produced during the period of spraying and was most pronounced on leaves which were about three-fourths matured. In addition to the chlorotic pattern, a marked reduction in leaf size was also frequently observed.

Although, in some cases, the application of nutritional sprays and chelated iron to affected groves has resulted in an improvement in general appearance, the chlorotic leaves have not re-greened and the pattern persists. Observations to date indicate that once the pattern appears on the leaf, it remains until the leaf drops.

**LITERATURE CITED**


**WATER TABLE FLUCTUATION AND DEPTH OF ROOTING OF CITRUS TREES IN THE INDIAN RIVER AREA**

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There is a divergence in opinion as to the adequacy of the drainage system now in use in the Indian River Area. Some feel that the citrus areas are inadequately drained, pointing to the following facts: (1) Nearly all groves contain areas of slightly lower eleva-