Relationship of Potassium to a Leaf Spot of *Ficus elastica* 'Decora'

Robert B. Marlatt and Paul G. Orth

Associate Plant Pathologist and Assistant Soils Chemist, respectively, University of Florida, Subtropical Experiment Station, Homestead 33030.

Florida Journal Series Paper No. 3277 of the Institute of Food and Agricultural Sciences. The technical assistance of Eva Pryor is gratefully acknowledged.

Accepted for publication 3 September 1969.

ABSTRACT

Ficus elastica 'Decora', an important commercial crop in southeastern Florida, has a severe spotting of the undersides of leaves with which no pathogenic organism has been associated. Low K and high Mg increased the disease, but an imbalance of B, Ca, Cu, Fe, Mn, Mo, or Zn did not produce these symptoms. Disease was greatly diminished by a hydroponic solution containing a high concentration of K. Phytopathology 60:255-257.

The severity and incidence of a leaf spot of the ornamental rubber plant, *Ficus elastica* 'Decora' Roxb., has increased in southern Florida for at least a decade. The plants are propagated by removing a 1.9-cm strip of bark, completely girdling a branch, wrapping the girdle with moist sphagnum moss, and covering the moss with aluminum foil. After roots readily grow into the moss, the branch is cut off just below the roots, and the air layer is planted. The disease is especially severe on leaves of spring and fall air layers shortly before the layers are harvested. Early symptoms consist of red, angular, interveinal areas of 1-2 mm diam on the abaxial surface. Lesions enlarge, coalesce to roughly rectangular shapes, and assume a tan coloration as the lower epidermis and mesophyll die (Fig. 1). Eventually some lesions are visible on the upper leaf surface.

Attempts to isolate pathogenic organisms were unsuccessful. A mineral deficiency was hypothesized because leaves on air layers showed severe disease while leaves on the rest of the plant often remained healthy. Also, symptoms were more severe on leaves exposed to direct sunlight than on shaded foliage. Mineral contents of leaves in various plants have been reported to be reduced, and associated necrotic spotting increased in bright sunlight (1) or high temperature (4).

This paper reports the results of a study made to

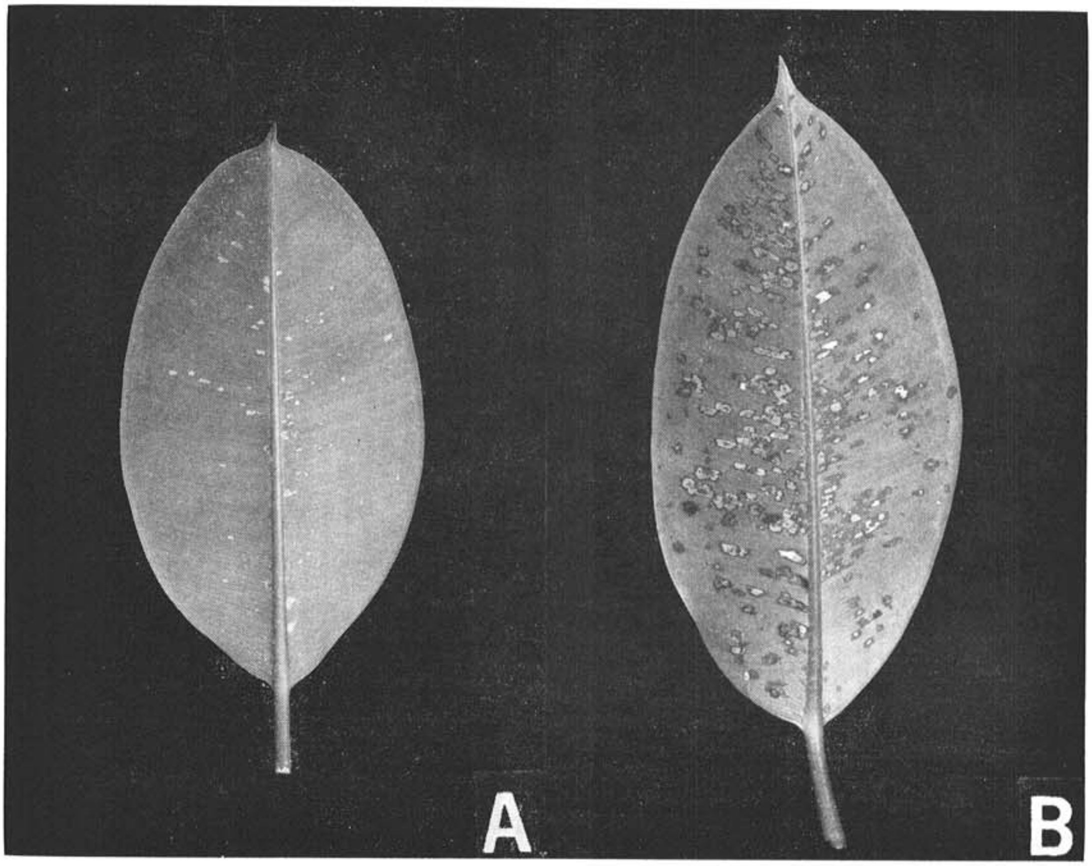

Fig. 1. Leaves of *Ficus elastica* 'Decora', with mild **A)** and severe **B)** spotting.

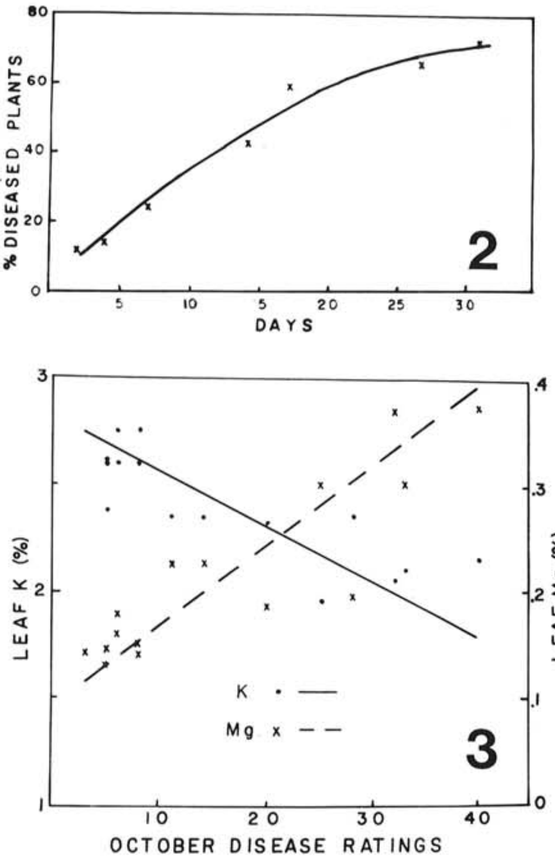

Fig. 2-3. **2)** Incidence of leaf spotting on *Ficus elastica* 'Decora' increased with time in an outdoor nursery. **3)** Relationship between potassium or magnesium concentration in leaves of *Ficus elastica* 'Decora' (May sampling) and disease ratings made after 12 and 17 months in solution culture.

TABLE 1. Relationship of nutrient solution to leaf spotting of *Ficus elastica* 'Decora'

	Disease ratings[a]		
		Avg	
Treatment	Most diseased single leaf at 12 months	Three worst leaves at 16 months	All leaves at 17 months
High magnesium	3.5 bc[b]	15.3 a	32.5 a
Low potassium	5.5 ab	14.5 ab	18.3 b
Low molybdenum	5.0 ab	11.0 abc	17.8 bc
Low iron	5.5 ab	11.5 abc	14.0 bcd
High copper	4.0 b	11.0 abc	11.0 bcd
Control	4.5 ab	1.8 f	10.8 bcd
Low manganese	6.0 a	10.5 abcd	10.5 bcd
High calcium	4.3 ab	8.8 bcd	10.5 bcd
High molybdenum	5.5 ab	8.0 cd	10.0 bcd
High zinc	4.0 b	5.8 cdef	9.3 bcd
Low copper	5.0 ab	7.8 cde	9.3 bcd
Low zinc	5.5 ab	8.0 cd	8.0 d
High manganese	5.0 ab	5.3 def	7.8 d
High iron		9.3 bcd	6.0 d
Low magnesium	4.0 b	4.0 ef	5.8 d
High potassium	1.8 c	4.0 ef	5.8 d

[a] 0 = No spots on leaves; 10 = leaves completely covered with spots.

[b] Ratings followed by the same letter are not significantly different at the 5% level (May) and 1% level (September and October), as determined by Duncan's multiple range test.

determine if the spotting disease of *F. elastica* 'Decora' was related to the nutrition of the plant.

MATERIALS AND METHODS.—Seventy-six uniform air layers were planted in 2-gal plastic pots containing a mixture of equal volumes of perlite and vermiculite. Plants received only distilled water for the first 3 months in order to deplete their mineral reserves. Treatments consisted of 19 modified Hoagland's and Arnon's (3) nutrient solutions made with reagent grade compounds and distilled water. High and low concentrations of boron, calcium, copper, iron, magnesium, manganese, molybdenum, potassium, and zinc were prepared by using 10 times the recommended amount of an element or omitting it entirely. A balanced nutrient control was included. Precipitates in the high-calcium and high-iron solutions were suspended before use. Treatments were randomized in four blocks.

At weekly intervals, beginning in mid-May 1967, 2 quarts of fresh solution were applied to thoroughly flush the solution remaining from the previous week. Plants were air layered 5 February 1968. All plants with their attached air layers were moved outdoors into a sunny location 25 March 1968. Plants were examined and records taken on the progress of the disease for 3 months. Disease incidence was rated three times from May through October. Figure 1 shows leaves rated 4 and 7 by a scale of 0 for no spots to 10 for spotting of the entire leaf surface. Two mature leaves above the air-layer girdle were taken from each plant 9 May 1968, and the oven-dried, ground tissue was analyzed for N, P, K, Ca, Cu, Fe, Mg, Mn, and Zn.

RESULTS AND DISCUSSION.—No symptoms developed during the 10 months when plants were in the greenhouse. The disease appeared on nine plants in six treatments only 2 days after they were moved outdoors.

Leaf spotting increased from 12% at 2 days to 72% after 31 days (Fig. 2). Differences in disease severity also increased with time. All plants received direct sunlight for most of the day; however, those which first became shaded in late afternoon were the last to show symptoms. Later, disease incidence and severity were not related to a plant's position in the outdoor nursery.

Disease ratings were first made 2 May 1968 for statistical analysis, 15 months after the experiment was begun. The high- and low-B, low-Ca, and high-Fe treatments had already stopped producing new leaves and were therefore omitted from this analysis.

Four months after cutting back the plants, 4 September 1968, new shoots were rated a second time for disease; the three most severely diseased leaves per plant were rated and totals were analysed statistically. High-B, low-B, and low-Ca treatments had produced no new leaves and were omitted. At the last disease rating, 8 October 1968, plants had been cut back again and 1

TABLE 2. The relationship of nutrient solutions to concentrations of potassium and magnesium in leaves of *Ficus elastica* 'Decora' after 12 months

Treatment	K[a]	Mg[a]	Ratio K:Mg
	%	%	
High magnesium	2.06 a	.336 f	6.19
Low iron	2.08 a	.182 bcd	11.48
Low manganese	2.24 ab	.202 cd	11.20
Control	2.30 bc	.192 bcd	11.94
Low potassium	2.34 bcd	.208 d	11.37
High copper	2.37 bcd	.175 abcd	13.57
High molybdenum	2.38 bcd	.169 abc	14.23
Low molybdenum	2.40 bcd	.171 abc	14.05
Low zinc	2.45 bcd	.172 abcd	14.26
High iron	2.54 cde	.240 e	10.67
Low magnesium	2.55 cde	.140 a	18.27
Low copper	2.58 cdef	.180 bcd	14.40
High potassium	2.71 def	.156 ab	17.51
Low calcium	2.73 def	.260 e	10.56
High zinc	2.79 ef	.178 bcd	15.96
High calcium	2.80 f	.193 bcd	12.40
High manganese	2.89 f	.171 abc	13.42

[a] Values followed by the same letter are not significantly different at the 5% level.

month's new growth was rated for disease. By this time, plants had grown in the same pots for 20 months.

Disease was influenced by only K and Mg (Table 1). The high-K treatment was associated with significantly less disease than the low-K treatment, and the low-Mg treatment was associated with significantly less disease than the high-Mg treatment. Von Hentig & Pawlowski (2) recommended a high-K fertilizer for *Ficus elastica* 'Decora', although they did not mention any disease.

The relationship between K or Mg concentration in the leaves and disease are shown in Fig. 3 for the four treatments involving K and Mg. Correlations between disease and K or Mg concentration in the leaves are highly significant. The regression equations and correlations are: disease = 110-39(% K); r = −0.89 and disease = −12.4 + 133(% Mg); r = 0.90. There was little disease in treatments producing leaves containing more than 2.5% K and less than 0.17% Mg 12 months after treatments began. Leaves from control plants analyzed 2.30 ± .16% K and .192 ± .009% Mg. A high rate of either Mg or K significantly increased the concentration of that same element in leaves and decreased the amount of the other element (Table 2), illustrating the inverse relationship often found between these two nutrients (5).

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