potato dextrose agar (PDA) from pieces of infected subepidermal tissue in stem galls of witches' broom-affected branches previously surface-treated with flaming 95% alcohol. Inoculum consisted of 3-week-old PDA fungal cultures fragmented in a blender. Two-year-old plants about one meter tall of a white cultivar were selected for inoculation.

Inoculations consisted of painting a fungus slurry onto 10 lightly abraded stems more than 1 year old, 10 non-abraded stems, and one tall branch terminal, bearing new growth, not abraded, on each of 10 plants. The non-inoculated controls consisted of 10 branch terminals painted with sterile agar slurry. One-half of the inoculated plants in each of the above treatments were covered with polyethylene bags for 2 days. Plants were examined weekly for symptoms. Temperatures ranged from 25-32 C during the experiment.

Results and Discussion

Stem swelling and the beginning of witches' broom were detected after 4 months incubation on all branch terminals bearing new growth at the time of inoculation. Inoculations of abraded or non-abraded stems failed to produce disease symptoms regardless of the use of polyethylene bags. Non-inoculated controls remained healthy.

Symptoms on stems artificially inoculated were the same as those occurring on naturally infected plants. Infected stems showed a considerable increase in diameter (Fig. 1-B), protuberances 1-6 mm on the stem (Fig. 1-A), and numerous branches arising from a single node. Branches in the witches' broom usually remained less than 25 cm long and did not flower. Eventually these branches and the main stem above them died. (Fig. 1-C). Pycnidia were frequently formed on the surface of dead stems. Isolations from inoculated plants showing these symptoms resulted in the repeated recovery of *S. tumefaciens.*

The identity of the pathogen, *S. tumefaciens,* is the same as that described earlier (1). Measurements of 50 macroconidia gave a mean size of 31 x 4.6 μm which is slightly larger in length than the conidia reported for the isolates from *C. viminalis* (1).

Cross inoculation studies are presently being conducted to determine the specificity and host range of this fungus.

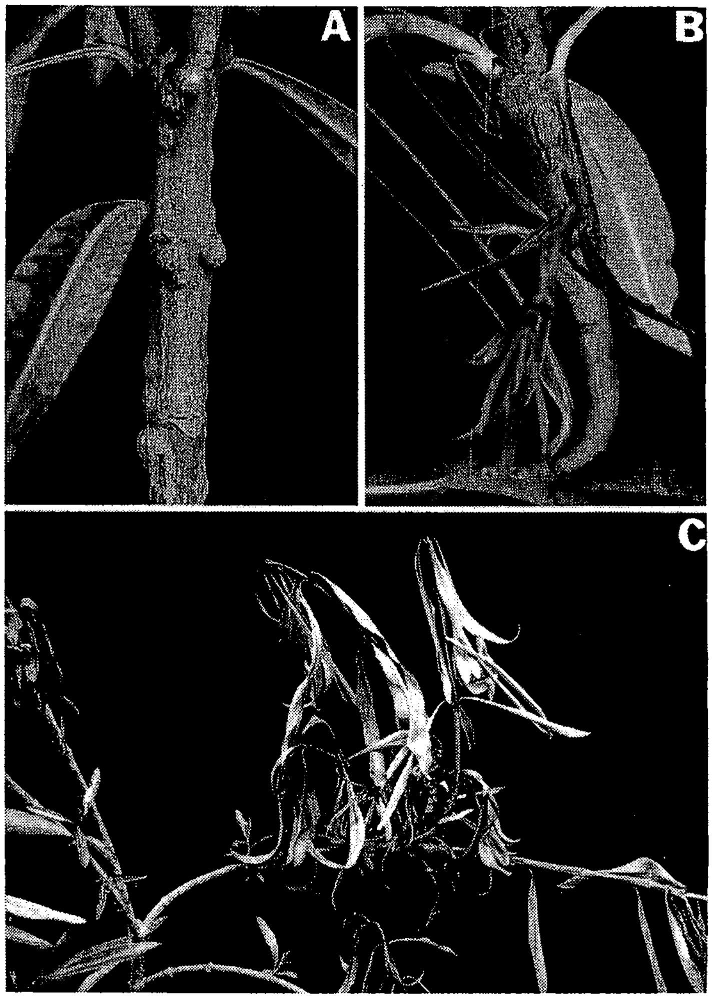

Fig. 1—(A to C). Oleander stems infected by *Sphaeropsis tumefaciens.* A) Protuberances on stem, B) increased stem diameter, and C) dead witches' broom.

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SALT TOLERANCE OF LIVISTONA CHINENSIS[1]

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Abstract. **Year-old seedling container grown Chinese Fan Palms were transferred to a half-strength Hoagland's solution in August 1974 and grown for 18 months after which 0, 125, 250, 500, 1000, 2000, 3000, 4000, 5000, 7500, 10,000 and 15,000 ppm of a 10:1 ratio of $NaCl$:$MgCl_2$ was added to the Hoagland's solution. Height measurements and tissue analysis showed increased amounts of Na and Mg in plant tissue but decreased plant growth with increased levels of the 10:1 $NaCl$:$MgCl_2$.**

Chinese Fan Palm (*Livistona chinensis* Jacq.) is a single stem fan palm attaining a mature height of 30 to 50 feet (10). Native to cool areas of China, Chinese Fan Palm is grown in South, Central and warmer regions of North Florida as a landscape palm. This palm may become more widely used throughout the state since it is not subject to lethal yellowing (7).

Several species of palms are used as ornamentals in Florida's densely populated coastal areas to create tropical and subtropical settings. Chinese Fan Palm has not been planted commonly in the state and its salt tolerance is not known. One reference classified Chinese Fan Palm as not salt tol-

[1]Florida Agricultural Experiment Stations Journal Series No. 244.

erant (13) while another classified it as tolerant with some protection from heavy salt drift (8).

Increasing substrate salt concentrations reduced plant growth rate and when salt concentrations were high enough, complete growth inhibition occurred (4). Research has shown that specific ions in sea water change the nutritional status of plants. Increasing Mg levels have decreased Ca and Mn absorption (8), and increasing Na levels have decreased absorption of Ca and Mg (1, 12). Moisture stress induced by a decrease in substrate osmotic potential has reduced P uptake (3).

This study was initiated to determine the effects of selected salt concentrations on growth and elemental composition of Chinese Fan Palm.

Materials and Methods

Year old container grown Chinese Fan Palms were transferred to 4 liter plastic containers having 2 liters of half-strength Hoagland's solution in August 1974. Nutrient solutions were maintained at 2 liters by additions of de-ionized water as needed and changed weekly. Solutions were adjusted weekly beginning January 29, 1976 to contain an additional 0, 125, 250, 500, 1000, 2000, 3000, 4000, 5000, 7500, 10,000 and 15,000 ppm 10:1 ratio of $NaCl:MgCl_2$ (Table 1). Treatments were replicated six times with one palm per container constituting the experimental unit. Plant height was determined at experiment initiation. The experiment was terminated April 15, 1976.

Table 1. Concentration of selected elements in 0.5 strength Hoagland's nutrient solution.

ppm of 10:1 $NaCl:MgCl_2$	N	P	K	Ca	Mg	Na	Cl
	PPM (parts per million)						
0	105	15	117	100	24	0	.8
125	105	15	117	100	28.3	42.4	79.6
250	105	15	117	100	32.8	85.0	158.4
500	105	15	117	100	41.6	170.1	316.0
1000	105	15	117	100	59.4	340.5	631.7
2000	105	15	117	100	95.0	681.2	1262.6
3000	105	15	117	100	130.5	1022.0	1893.9
4000	105	15	117	100	166.1	1362.6	2525.0
5000	105	15	117	100	201.6	1703.5	3156.2
7500	105	15	117	100	290.6	2555.5	4734.1
10,000	105	15	117	100	379.7	3407.3	6311.6
15,000	105	15	117	100	557.2	5111.0	9467.4

Plants were measured and recently expanded fronds were selected for tissue analysis of nutrient elements at experiment termination.

Results and Discussion

Increasing salt levels generally reduced plant height and effected tissue content (Table 2). Palm growth rate was erratically affected but generally decreased as salt concentrations increased. Additions of 500 ppm salt to the Hoagland's solution resulted in detectable reduction in amount of new growth compared to controls. However, even at the highest level (15,000 ppm salt) growth was not completely inhibited. The growth rate of *Phoenix dactylifera*, a salt tolerant palm, was reduced when salinity of irrigation water was increased above 3000 ppm, with a linear decrease in growth to 24,000 ppm (2). However, the growth rate of Date Palm, *(P. dactylifera)* at 3000 ppm was 90% of the control, while the growth rate of Chinese Fan Palm at 3000 ppm was 65% of the control.

Chinese Fan Palms treated with 15,000 ppm salts showed frond tip necrosis within 6 weeks; those treated with 10,000 ppm exhibited tip necrosis within 7 weeks. Necrosis occurred on recent fully expanded leaves and progressed from the apical portion of the frond tips toward the hastula. Necrotic area never exceeded more than 10% of the leaf surface. Lower, mature aging leaves did not show tip burn. Other plants have exhibited similar reactions (6). No necrosis of *P. dactylifera* was reported by Furr and Ream when irrigation water contained 24,000 ppm soluble salts (2).

Increasing salt levels and decreasing osmotic potential of the substrate had no effects on N, P, Ca or microelement levels (Table 2, 3). K level was increased at the 15,000 ppm treatment and Mg and Na tissue levels increased as concentrations of these elements increased in the solution. Increases in tissue content of Mg and Na did not correspond directly with concentrations of these elements in the nutrient solutions. Mg solutions levels were increased almost 20 times, but tissue levels increased only 1.5 times, Na nutrient levels increased 120 times, while tissue levels increased by a factor of 2.8. Apparently as salinity of the substrate increased, Chinese Fan Palm effectively depressed frond accumulation of Na and Mg.

Surprisingly, the large increments of Na and Mg in the nutrient substrates did not antagonize absorption of Ca and K as would have been expected under the concepts of Shear *et al.* (11), Hewitt (5) and others (1, 12). Conversely, a slight increase in K absorption occurred as evidenced in K tissue levels (Table 2). However, the K/Na ratio in the tissue changed from 8.5 to 4.2.

Elemental composition data suggest the reduced growth rate of Chinese Fan Palm resulted from decreasing osmotic potential of the substrate, Cl ion toxicity or both rather than a nutritional inbalance.

Table 2. Influence of increasing concentrations of a 10:1 $NaCl:MgCl_2$ on growth rate and tissue content of *Livistona chinensis* grown in 0.5 Hoagland's solution.

ppm of[z] 10:1 $NaCl:MgCl_2$	N	P	K	Ca	Mg	Na	Amount of new growth (cm)
				Percent			
0	2.31 a	.27 a	1.46 a	.07 a	.128 ab	.17 a	12.91 a
125	2.15 a	.31 a	1.73 ab	.07 a	.125 a	.17 a	8.75 ab
250	2.21 a	.21 a	1.54 a	.08 a	.139 abc	.20 ab	8.91 ab
500	2.21 a	.27 a	1.46 a	.08 a	.140 abc	.17 a	7.08 bc
1000	2.48 a	.26 a	1.58 a	.11 a	.180 abc	.24 abcd	9.00 ab
2000	2.23 a	.31 a	1.76 ab	.07 a	.147 abc	.32 bcdef	5.16 bcd
3000	2.25 a	.27 a	1.53 a	.09 a	.200 c	.24 abcd	8.50 ab
4000	2.23 a	.21 a	1.54 a	.06 a	.174 abc	.33 cdef	4.33 bcd
5000	2.36 a	.28 a	1.59 a	.08 a	.200 c	.35 def	7.41 bc
7500	2.43 a	.22 a	1.68 ab	.07 a	.180 abc	.43 fg	4.83 bcd
10,000	2.31 a	.29 a	1.78 ab	.09 a	.190 bc	.39 efg	2.58 d
15,000	2.30 a	.33 a	2.04 b	.07 a	.200 c	.49 g	3.25 cd

[z]Each figure is the mean of 6 replicates. Means within a column followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test.

Table 3. Influence of increasing concentrations of a 10:1 NaCl:$MgCl_2$ on microelemental composition of *Livistona chinensis* grown in 0.5 Hoagland's solution.

ppm of[a] 10:1 NaCl:$MgCl_2$	PPM (parts per million) Cu	Fe	Mn	Zn
0	7.5 a	53 a	41 a	160 a
125	10.0 a	103 a	51 a	161 a
250	9.1 a	56 a	43 a	187 a
500	10.0 a	93 a	43 a	156 a
1000	9.1 a	105 a	53 a	180 a
2000	8.3 a	80 a	66 a	150 a
3000	7.5 a	64 a	56 a	165 a
4000	9.1 a	75 1	48 a	190 a
5000	8.3 a	120 a	60 a	157 a
7500	8.3 a	73 a	63 a	165 a
10,000	10.0 a	63 a	68 a	165 a
15,000	10.0 a	83 a	71 a	165 a

[a]Each figure is the mean of 6 replicates. Means within a column followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test.

Because the growth rate of Chinese Fan Palm is reduced by relatively low substrate salt concentrations, this palm can only be classified as having slight salt tolerance.

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INFLUENCE OF NUTRITION ON YIELD AND CHILLING INJURY OF SANSEVIERIA[1]

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Abstract. **Yield of** Sansevieria trifasciata **Prain grown under 50% shade increased when K levels were raised from 30 to 60 lb/A/month[2], but increasing N from 20 to 80 lb had no effect. A small increase in fresh weight occurred as N and K levels were increased. A N linear x K linear interaction occurred on value of plants harvested. Chilling was more severe at higher N levels, but not at the higher K level. Increased tissue levels of N and decreased levels of Ca were most closely associated with increased chilling injury.**

Sansevieria has been an important foliage plant of the Florida foliage industry since the late 1930's, and as late as 1967, accounted for 5.6% of sales (1). Major production areas are outdoors in south Florida and in heated shade houses in central Florida. The main plant types produced are *Sansevieria trifasciata* and *Sansevieria trifasciata* cv. Laurentii. Wilson et al. (6) discussed types of sansevieria produced in Florida, but little information was available on commercial culture until McConnell and Marlatt (3) evaluated the influence of fertilizer on field production in south Florida. They found that highest yield was obtained when 45 lbs N/A was applied each month. Their research indicated that yield of 3-leaf rooted divisions weighing about 0.29 lb was equal to 6.8 plants/ft^2/year. Chilling injury has presented problems to sansevieria growers for years. Chilling injury was discussed by Marlatt (2) and appeared as whitish water-soaked areas in the foliage 1 to 4 weeks after exposure to temperatures of 36 to 46°F. He suggested that increasing both N and K fertilization increased chilling injury.

Because no information was available on sansevieria culture under shadehouses in central Florida, this work was initiated.

Materials and Methods

A 3x2 factorial experiment in randomized block design was initiated with *Sansevieria trifasciata* on November 1, 1972. Nitrogen levels were 20, 50 and 80 lb/A/month and K levels were 30 and 60 lbs. There were 3 replications, and each experimental unit consisted of 4 rows 6 inches apart and 36 inches long with 20 cut leaf sections 4 inches long placed side-by-side in each row (240 leaf cuttings/treatment). A 1 1/2 ft buffer was maintained between treatments. Cuttings were placed in Lakeland fine sand amended with 2.5 lb dolomite, 1.5 lb single superphosphate and 1 lb Perk[3]/ 100 ft^2 and under slat shade excluding approx 50% light. No peat moss was used to amend Lakeland fine sand because sansevieria is considered to be a low value crop by growers. Fertilizer was applied overhead in liquid form with a sprinkling can using required levels of ammonium nitrate and potassium chloride.

After application, fertilizer was washed off foliage by ap-

[1]Florida Agricultural Experiment Stations Journal Series No. 222.
[2]One pound/acre = 1.1208 Kg/hectare.

[3]Perk is a microelement supplement manufactured by Kerr McGee Chemical Co., Jacksonville, FL.