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and 0.3 meq/l of Cl; and C—9 meq/l of Na and 0.6 meq/l of Cl). The Na and Cl levels were low in comparison to those used in other experiments evaluating salt tolerances of woody nursery crops (1, 4). Tip and marginal leaf burn have been found to occur on woody nursery crops at sodium and chloride levels of 0.5 and 1.5 to 2.5 percent, respectively, on a dry weight basis (1, 5, 6). Leaf Na contents of honeysuckle and mockorange plants from this experiment were lower than 0.5 level at which leaf injury was reported.

Some leaf injury due to salt accumulation was observed on mockorange leaves which were sprinkler irrigated. Water quality C (Table 1) resulted in some foliar injury due to salt accumulation on the leaves and some foliar necrosis was observed with water quality B (Table 1). Harding *et al.* (10) reported that 2 to 3 meq/l of Na and Cl in irrigation water caused severe injury associated with salt accumulation on leaf surfaces. Both salt levels B and C contained greater than 3 meq/l of Na (Table 1). Foliar injury due to salt accumulation or foliar necrosis due to salt was not observed on honeysuckle plants during this experiment. Differences in leaf characteristics between mockorange and honeysuckle plants could be the cause for this.

### Significance to Nursery Industry

This experiment indicated that the spot-spitter type of mini-sprinkling increased the media moisture levels in comparison to sprinkler irrigation. Increasing the moisture levels also made possible the leaching of salts from the media. The spot-spitters also prevented possible accumulation of salt on the leaves by applying water below leaf surfaces. A third advantage of spot-spitters was a more efficient use of water by concentrating the water applied within the container and uniformly distributing it. Based on these results spot-spitters (mini-sprinkling) could be successfully implemented by nurserymen in their management program to reduce salt injury to nursery crops.

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# Container Production of Comptie, *Zamia furfuracea* Ait.[1]


**G.J. Keever and G.S. Cobb**[2]
*Department of Horticulture,*
*Alabama Agricultural Experiment Station,*
*Auburn University, AL 36849*



## Abstract

The effects of cultural factors on growth of comptie, *Zamia furfuracea* Ait., were evaluated. Plant growth was increased under 47% shade compared to 72% shade and when 1.2 kg $m^{-3}$ (2 lb $yd^{-3}$) dolomitic limestone was incorporated into the medium compared to 4.7 kg $m^{-3}$ (8 lb $yd^{-3}$). Nitrogen fertilization of 200 ppm and 300 ppm per week increased frond number compared to 100 ppm per week whereas container volume had no effect on plant growth.



**Index words:** nutrition, container size


### Introduction

Comptie (*Zamia furfuracea* Ait. [*Z. pumila* L.]), is one of about 40 species of palm-like, dioecious cycads in the Zamiaceae family native to tropical and subtropical America (Fig. 1). Comptie has a trunk up to 15 cm (6 in) high or wholly underground. Leaves are pinnately compound, 0.6 m (2 ft) to 1.2 m (4 ft) long with 2 to 13 pairs of thick, leathery pinnae, 5.1 cm (2 in) to 20.3 cm (8 in) long, oblong-obovate in shape (6). As a group, cycads are tolerant of drought and grow in full sun or partial shade. They make attractive landscape plants, however, because of difficulty in germinating seed and a long cropping period (3 to 5 years for saleable plants), few nurserymen grow cycads and they are


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[2]Assistant Professor and Former Superintendent, Ornamental Horticulture Substation, Mobile, Ala., resp. Current address of junior author: Cottage Hill Nursery, Rt. 2, Box 143, Irvington, AL 36544.


**Fig. 1. Comptie, *Zamia furfuracea* Ait.**

infrequently used in the landscape. Cycads are reported to fix nitrogen and have a supposedly unchangeable growth rate (5), but little research has been reported on the manipulation of early growth of comptie. Two studies were initiated to investigate the influence of several cultural practices, including light intensity, nitrogen fertilization, liming rate, and container volume, on the growth of comptie.

## Materials and Methods

In the first study, bare-root seedlings of comptie were potted November 2, 1981, in 10.2 cm (4 in) containers of milled pine bark-sandy loam soil (7:1, v/v) amended with 1.2 kg (2 lb) superphosphate, 1.2 kg (2 lb) gypsum, 2.4 kg (4 lb) Esmigran per $m^{-3}$ ($yd^{-3}$), and 2 rates of dolomitic limestone, 1.2 kg $m^{-3}$ (2 lb $yd^{-3}$), and 4.7 kg $m^{-3}$ (8 lb $yd^{-3}$). Plants were placed under 47% shade and misted until established. On December 28, 1981, plants were selected for uniformity and half of plants receiving each liming rate were placed under each of 2 light regimes, 47% and 72% shade. Beginning January 19, 1982, plants received weekly applications of 100, 200 or 300 ppm N with 50 ppm N from $KNO_3$ and the remainder from $NH_4NO_3$. Plants were arranged in a completely randomized design with 4 replicates of 4 plants each. Hence, with 2 liming rates, 2 light regimes, and 3 N rates factorialized, there was a total of 192 plants in the study. Growth medium soluble salts and pH were determined in April and September 1982; leaf number was counted in July and October 1982.

In a second study, the influence of container size on growth and leaf development of comptie was determined. On March 26, 1985, uniform 2-year-old seedlings were potted in 4 sizes of containers using an unamended milled pine bark-sandy loam soil (7:1, v/v) and placed in a 47% shaded greenhouse. Container volumes were 750 cc, 1250 cc, 2500 cc, and 5250 cc; (Lerio C-450 (1 qt.), RT-600 (azalea), Rt-750 (7.5 in round), and C-850 (#2); Lerio Corp., P.O. Box 2084, Mobile, Ala., 36652). To lessen the influence of fertilization on growth medium volume, surface application of 3.7 g (0.13 oz) dolomitic limestone, 2.0 g (0.072 oz) gypsum, 1.3 g (0.05 oz) Micromax, and 3.2 g (0.11 oz) Osmocote 13N-5.6P-10.8K (13-13-13) per container plus weekly application of 150 ppm N from $NH_4No_3$ was made. There were 6 replicates of 3 plants each arranged in a completely randomized design. Leaf number was determined at potting and again on November 15, 1985; growth index was measured January 9, 1986.

## Results and Discussion

By October 1982, more leaves were produced by plants grown under 47% shade compared to 72% shade (Table 1). A similar response to less shading has been reported with other cycads (2). Comptie responded to N fertilization up to 200 ppm N per week with an increase in leaf number. No additional benefit was obtained from weekly applications of 300 ppm N. These results concur with those of Smith (5) who investigated the fertilization of *Zamia integrifolia*. Plants continued to form new leaves throughout the study, and by October 1982 plants were considered marketable in the 10.2 cm (4 in) containers or of sufficient size to transplant into 3.8 l (#1) containers.

Dolomitic limestone applied at the 4.7 kg $m^{-3}$ (8 lb $yd^{-3}$) rate resulted in fewer leaves than the 1.2 kg $m^{-3}$ (2 lb $yd^{-3}$) rate at both sampling dates. In November 1982, plants were placed under 47% shade and fertilized weekly with 200 ppm

**Table 1. Effects of cultural practices on medium pH, soluble salts, and leaf number of comptie.**

| | pH | | Soluble salts (mmhos $cm^{-1}$) | | Leaf number | |
|---|---|---|---|---|---|---|
| **Treatments** | **April 30** | **Sept. 20** | **April 30** | **Sept. 20** | **July 13** | **Oct. 13** |
| *Light exclusion* | | | | | | |
| 47% | 5.1 | 4.6 | 0.71 | 0.76 | 5.3 | 7.6 a |
| 72% | 5.1 ns | 4.5 ns | 0.51 ns | 0.54 ns | 4.7 ns | 6.4 b |
| *Nitrogen fertilization (ppm/week)* | | | | | | |
| 100 | 5.4 a[z] | 5.4 a | 0.25 c | 0.16 c | 4.7 b | 6.3 b |
| 200 | 5.0 b | 4.3 b | 0.64 b | 0.74 b | 5.3 a | 7.3 a |
| 300 | 4.8 c | 4.0 c | 0.95 a | 1.05 a | 5.1 a | 7.5 a |
| *Liming rate (kg $m^{-3}$)* | | | | | | |
| 1.2 | 4.5 b | 4.2 b | 0.58 | 0.56 | 5.3 a | 7.3 a |
| 4.7 | 5.6 a | 4.9 a | 0.65 ns | 0.74 ns | 4.7 b | 6.8 b |

[z]Means within columns followed by the same letter are not significant at the 5% level using Duncan's multiple range test. Interactions between main effects were not significant.

N. By September 1983 plants given the lower rate of dolomitic limestone had developed interveinal chlorosis of the mature leaves. These symptoms are characteristic of magnesium deficiency, and this suggests that although comptie benefited from a very acidic growth medium (pH 4.2), magnesium should be added when the medium is amended with low rates of dolomitic limestone.

Increasing rates of $NH_4NO_3$ decreased growth medium pH and increased soluble salts at both sampling dates. Higher liming rates increased growth medium pH, but did not affect soluble salts levels in the medium at either sampling date.

Container volume had no effect on either leaf number or growth index of comptie (data not shown). These results differ from those reported in other studies in which an increase in container volume produced more growth (1,3,7); however, in several of these studies, fertilizer was applied on a volume basis. Consequently, response to a greater growth medium volume may have actually been a response to increased fertilizer. Goodale and Whitcomb (4) reported that in a study in which both fertility and container size were varied, plant response to container size was species-dependent, whereas increased fertility generally produced more growth.

## Significance to the Nursery Industry

Comptie responded to both reduced levels of shading and to nitrogen applications up to 200 ppm N per week, by forming more leaves, thus showing that production time can be shortened by manipulating cultural practices. Low levels of dolomitic limestone were beneficial, whereas container size was not critical, provided that 200 ppm N per week was supplied. Because of the positive response to management of certain cultural practices, nurserymen should be encouraged to grow this versatile, attractive cycad.

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# Automated Fertilizer Applicator for Potting Machines[1]


**Richard L. Parish**[2]
*Department of Agricultural Engineering*

**Roysell J. Constantin, William L. Brown and D. Wayne Wells**[3]
*Hammond Research Station*

*Louisiana Agricultural Experiment Station*
*Louisiana State University Agricultural Center*
*Baton Rouge, LA 70803*



## Abstract

An automatic fertilizer metering device was designed, built, and mounted on a nursery potting machine. The device senses the presence of a container under the fertilizer spout, and automatically deposits a metered charge of fertilizer into the planting hole in the medium in the container. Fertilizer rate is readily adjustable. Operation is fully automatic.



**Index words:** Dibble, fertilizer application, metering


## Introduction

Research on placement of fertilizers in containers has given highly variable results. Better plant performance was obtained with the placement of Osmocote in the planting hole than with incorporation over a range of 0.44 to 1.78 kg $N/m^3$ (0.75 to 3.00 lb $N/yd^3$) with 4 cultivars of azaleas (*Rhododendron* sp. cvs. 'Formosa,' 'G. G. Gerbing,' 'Judge Solomon,' and 'Fashion') and 2 holly species (*Ilex crenata* Thunb. 'Compacta' and *Ilex vomitoria* Ait. 'Nana') and equal results with 3 other species (2). In later work, dibble application was best for 3 species of plants, but surface application was better for 3 cultivars of azaleas ('Fielder's


[1]Received for publication April 14, 1986; in revised form May 27, 1986.


[2]Associate Professor

[3]Professor and Resident Director, Associate Professor, and Instructor; Hammond Research Station, Hammond, LA