Salvia madrens (Forsythia Sage):

Planted July 1993. Tall (4.5 to 5 feet), coarse, shrubby perennial with somewhat triangular leaves, deep green and large, to 3 inches long. Bears large curving racemes of light yellow flowers. Flowering occurs only in spring and fall, but provides spectacular color at that time. Cut flowers last well, but the flower spikes bear sticky sap very attractive to ants and other insects. Plant is fast-growing and large, with thick square stems hidden beneath abundant foliage. Spread by rhizomes. Propagation by cuttings has been successful in the summer months.

Salvia emininta (Belize Sage):

Planted January 1994. Three foot compact plants with deep green stiff leaves. Deep carmine flowers to 1 inch are held erectly above foliage on a 6 inch raceme, becoming less attractive when the flowers fall. The calyx is inconspicuous. Flowers are not abundant but are consistent throughout the year.

Salvia pratensis (Meadow Clary):

Planted April 1994. Large coarse leaves, 3 to 5 inches, stems arising from basal, pubescent, leaves. Flowers violet-blue, with green bracts. Corolla about 1 inch, and curved. Flowering stems about 6 to 8 inches and somewhat curved. Plants were typically rather unattractive and suffered from root rots, probably due to very wet weather.

Salvia splendens ‘Purple Fountain’:

Planted July 1993. Plants nearly 2 feet tall with deep green leaves and trailing habit. Flowers are a deep pink, covering a short 3 to 5 inch raceme. Few flowers appear in the summer months, but are more abundant in the spring and fall. Plants make a good groundcover, and are easily propagated by cuttings.

Salvia uliginosa (Bog Sage):

Planted January 1994. Light green small leaves are born on herbaceous plants to 4 feet tall. Flowers occur in racemes with green bracts; flowers are light blue and small with white markings. Insect, bees especially, are very attracted to the flowers. The plant is very vigorous, with an open, wild appearance. Spreads easily by rhizomatous roots. Needs large amounts of water, and wilts quickly when transplanted.

Salvia vanouttii (Van Houtts’ Sage):


Results

Most of the Salviae observed were very resistant to insect and disease problems. Minor leaf spots appeared on S. coccinea during hot, wet weather, and S. pratensis suffered root rot due to wet weather. Insect damage was not observed. Although all these sages can be grown in South Florida, several seem to possess outstanding qualities in our location in West Palm Beach, Florida. S. madrens ‘Forsythia Sage’ contributes exceptional color and texture in the landscape, S. leucantha ‘Mexican Bush Sage’ provides striking flower and foliage color, S. splendens ‘Purple Fountain’ displays an interesting trailing habit and pleasant flowers, and S. coccinea is a very easily grown, highly reliable, flowering bedding plant.

CULTURE OF WATER SNOWFLAKE

Water snowflake makes an attractive addition to aquatic gardens. The plants are easy to propagate as each leaf produces a plantlet. Little is known of the fertilization requirements for culture of the plantlets. Water snowflake plantlets were planted in sand filled circular, plastic containers placed in outdoor cement tanks. Sierra fertilizer (17-6-10 plus minors) formulated for an 8-9 month release rate was placed in amounts of 0, 2.5, 10, and 20 g per container as a layer 7 cm below the surface of the sand. Growth, as measured by number of leaves, leaf width, and total plant dry weight, was poor for plants in containers with sand only. Growth at the 10-g rate, equivalent to 565 g per square meter, was consistently high. Growth for plants at the 20-g rate per container was mixed because some of the plants appeared to be killed by this high level of fertilizer. Water snowflake takes up few nutrients from the water and proper fertilization of the rooting medium is required to produce large healthy plants with many large leaves.

Members of the Nymphoides genus are perennial aquatic herbs with rhizomes in submerged soil substrates. Their leaves float on the water surface and are attached to rhizomes by long, slender, petiolelike stems. Each stem may produce one

Additional index words. Nymphoides indica, ornamental aquatic plants, aquatic gardens, aquascaping, fertilization practices.

Abstract. Water snowflake (Nymphoides indica (L.) O. Kuntze), a member of the floating-hearts group of aquatic plants, is used as an aquatic ornamental. This plant, which is a native of Australia, produces numerous small, white flowers with fringed petals attached to floating, dark green, cordate leaves.
to several leaves. Flowers form from a node near the surface. Roots, and in some species a bananalike cluster of fleshy, tuberlike roots, form from the same stem node. The plants can be easily propagated from these nodes.

One species included in the floating-heart group of aquatic plants is commonly called water snowflake (*Nymphoides indica* (L.) O. Kuntze). A native of Australia, this plant is used as an aquatic ornamental because its flowers, which form a cluster on a leaf, are composed of five white, fringed petals (Figs. 1 and 2). Water snowflake is heterostylous, and seed is produced only when long-styled and short-styled flowers cross-pollinate (Aston 1977). Although the plant produces numerous flowers, generally only one to three are open at a time. The dark green, cordate leaves float on the surface. The dark green leaves combined with the fringed, white petals make an attractive addition to aquatic gardens.

In Australia the plant grows in water up to a depth of 2 meters in a variety of habitats, including static and flowing conditions (Sainty and Jacobs 1981). It may be found growing on substrates ranging from sand to those high in organic material. It will survive for a short period of time on substrates low in moisture.

The plants are easy to propagate as each floating leaf has a bud that produces a plantlet. Little is known of the fertilization requirements of the plantlet. The objective of this study was to evaluate the influence of fertilizer on growth of water snowflake plantlets cultured in outdoor tanks.

**Materials and Methods**

Plantlets collected from water snowflake maintained in culture at the Fort Lauderdale Research and Education Center (FLREC) were used in two growth experiments. For each experiment, plantlets were cultured in an outdoor concrete tank as previously described by Sutton (1993). Water depth in the tank was maintained at 42 cm. Plantlets were planted in round, plastic containers without drainage holes that were 16.5 cm in height and had diameters of 13 cm at the bottom and 15 cm at the top. Containers were filled with coarse builders sand to within 2 cm of the top. The surface area of the container was 0.018 m².

Sierra fertilizer (17-6-10 plus minors) formulated for an 8-9 month release rate at 21°C was placed as a layer 7.0 cm below the surface of the sand. For each experiment, four containers with one plantlet each were used for each fertilizer rate. The rates were 2.5, 5, 10, and 20 g of Sierra fertilizer per container. Four containers filled with sand only served as a control.

A plantlet consisted of a mature leaf that was beginning to form roots and leaves, and which also had one floating leaf. The plantlet was held in position in the culture container by placing sufficient sand over the mature leaf to prevent the plantlet from floating to the surface.

Containers were placed in four rows in the tank with fertilizer rates randomized within each row. Water temperatures for each experiment were recorded as described by Sutton (1986).

Growth was determined by counting the number of leaves produced, leaf width (Fig. 2), and plant dry weight. Dry weight was determined by washing the plants with pond water to remove sand, remaining fertilizer, and other debris. The
plants were then cut into a leaf portion that included floating leaves, flowers and plantlets when present, and stem petioles cut close to the rhizome, and a root portion that included the rhizome and roots. The leaf and root portions were then dried in a forced-air oven at 60°C.

The first experiment consisted of plantlets of water snowflake planted April 14, 1993 and allowed to grow until August 26, 1993. Every 2 weeks the number of leaves on each plant was counted and leaf width measurements were determined for each leaf. For the second experiment, plantlets were planted June 15, 1994 and allowed to grow until July 27, 1994. During the second culture period, the leaves of each plant were measured and counted every week.

Number of leaves, leaf width, and plant dry weights were statistically analyzed using General Linear Models (GLM) procedures of the Statistical Analyses System (SAS Institute Inc., Cary, NC 27511) developed for use on personal computers. Results are shown as bar graphs (Figs. 3 to 10). Each value is the mean of four plants with its associated standard deviation. Values within weekly or biweekly counts of number of leaves or measurements for leaf width and width of largest leaf, and mean plant dry weight values followed by the same letter are not significantly different at the 5% level according to the Duncan-Waller Empirical Bayes LSD procedure (Peterson, 1985).

Results and Discussion

The mean number of leaves was comparable for all fertilizer rates and the control after 2 weeks of growth for water snowflake cultured April 14 to August 26, 1993 (Fig. 3). The mean number of leaves for the control, plants in containers with sand only, was five after 2 weeks of growth and then remained close to this number during the remainder of the 12-week culture period. After 4 weeks of growth, the number of leaves for plants in the containers with 5 and 10 g of fertilizer per container were higher than for the controls. By the end of the 12-week period, water snowflake at the 10-g rate produced an average of 77 leaves which was 18 times the number of leaves of the control, and was the highest number recorded for this culture period. The number of leaves was quite variable for plants treated with 20 g of fertilizer per container.

Leaf width of the control water snowflake averaged less than 5 cm for the period of April 14 to August 26, 1993 (Fig. 4). Leaf width was the same after 2 weeks of growth for the control and fertilizer treatments. After 4 weeks of growth however, plants at the 2.5, 5, and 10-g rates were higher than either the control or 20-g rate. Mean leaf width was slightly under 12 cm after 8 weeks of growth for plants cultured at the 10-g rate, but was the largest for this measurement period. For plants at the 10 and 20-g rate, leaf width averaged 8.8 and 10.4 cm per leaf, respectively, but were not significantly different by the end of the 12-week culture period.

Results in Fig. 5 show width of the largest leaf of each water snowflake cultured for the period of April 14 to August 26, 1993. The control and the four fertilizer rates had similar leaf widths after 2 weeks of growth. However, after 4 weeks of growth, mean leaf width values for plants at the 2.5, 5, and 10-g rates were more than twice the control. Leaf width for plants at the 10-g rate was the highest of all treatments and averaged 23 cm for 6, 8, and 12 weeks of growth. A maximum value of 26 cm measured for both the 8 and 12 week period for plants cultured at the 10-g rate.

Dry weight of water snowflake for the period of April 14 to August 26, 1993 is presented in Fig. 6. Total plant weight was highest for the 10-g rate with the plants averaging 185 g each and was 54 times that of the control. Of the 185 g of total weight for the 10-g rate, the shoot portion, floating leaves and petioles, comprised 161 g or 87% of the total plant weight. For the 2.5 and 5.0-g rate, the shoot comprised 72% and 65%,
respectively, of the total weight. For the control, the shoots comprised only 27% of the total plant weight.

The number of leaves for water snowflake cultured June 15 to July 27, 1994 are presented in Fig. 7. For the first 3 weeks of growth, no significant differences existed between the control and the four fertilizer rates. By the 4th week of growth however, plants in the 5, 10, and 20-g rates were higher than either the control or the 2.5-g fertilizer rate. At the end of the

6-week culture period the highest number of leaves were recorded for the 5, 10, and 20-g rate. The number of leaves for the 2.5-g rate were similar to the 5-g rate. And the number of leaves for the control and 2.5-g rate were not significantly different.

Leaf width for control water snowflakes planted June 15 and grown until July 27, 1994 averaged about 5 cm during the 6-week culture period (Fig. 8). After 4 weeks of growth leaf

![Graphs and figures](Image URL)

Figure 5. Leaf width of the largest leaf for water snowflake cultured April 14 to August 26, 1993.

Figure 6. Dry weight of water snowflake April 14 to August 26, 1993.

Figure 7. Number of leaves of water snowflake cultured June 15 to July 27, 1994.

Figure 8. Leaf width of water snowflake cultured June 15 to July 27, 1994.
width for plants in all four fertilizer rates was higher than the control. At the end of the 6-week culture period, leaf width averaged 10, 11, 12, and 12 cm for the 2.5, 5, 10, and 20-g rate, respectively.

Leaf width of the largest leaf for each individual water snowflake during June 15 to July 27, 1994 was the same until after 3 weeks of growth (Fig. 9). Leaf width of the largest leaf for plants cultured with 2.5 g of fertilizer were not significantly different from the control until after 6-weeks of growth. No significant differences were observed for leaf width between the 2.5 and 5-g rates. Leaf widths for the 5, 10, and 20-g rates were not significantly different. A maximum leaf width of 28 cm was measured for one plant grown at the 20-g rate.

The highest dry weight was recorded for water snowflake harvested from the 20-g fertilizer rate for plants cultured June 15 to July 27, 1994 (Fig. 10). As in the previous culture period, a higher percentage of shoot weight was associated with a higher total plant dry weight. For example, shoots of plants cultured at the 20-g rate comprised 84% of the total weight as compared to 56% for the control.

Plantlets readily adapted to being planted in containers with sand and fertilizer. New floating leaves were produced within 1 week after planting, but differences between fertilizer treatments did not occur until after 4 weeks of growth for both culture periods. These data show that the plantlet requires about a month to become established before it shows a response to nutrients available in the root zone.

Water snowflake is a perennial. Casual observations of stock cultures at the FLREC indicate little, if any, production of new leaves during the winter period. These studies, however, show that production of leaves may be quite high during the summer months.

The ease with which water snowflake plantlets can cultured in sand amended with controlled-release fertilizer is shown in this study. Additional studies will be helpful in evaluating year-round production of water snowflake for the ornamental aquatic plant industry.

Literature Cited


