put it into tissue culture, and named it Supreme. *Spathiphyllum* Sensation came from a cross between St. Mary and Supreme, made by Jim Georgusis. Lynise came from a cross from Bond Caldwell of Babylon Nursery. Robert DeNeve, now of Hawaii also introduced several varieties to the industry.

Strelitzia

The Bird of Paradise, *Strelitzia reginae* was grown as early as 1790 by Englishman D. Landreth. He produced Bird of Paradise commercially in Philadelphia at that time.

Syngoniums

White Nephthytis, as it was known then, was originally introduced in 1949. If is now known as White Butterfly. Pink Allusion came later, followed by Bob Allusion, which originated from Donaldson's in Zellwood, Florida. Lemon-Lime and Pixie were selected and named by Mark Poorbaugh of Prolific Plants in Apopka, Florida.

Yucca

Nurseryman Lex Ritter, originally from New Jersey, popularized *Yucca elephantipes* as a foliage plant in the U.S. He and his son collected Yucca cane from coffee plantations in Nicaragua and the Guanacaste region of Costa Rica in the mid 1970's.

References

Brown, B. F. 1996. Telephone interview. June.
Deneve, R. 1997. Telephone interview. July.
Donselman, H. 1997. Telephone interview, Nov.
Joiner, J. 1981. Foliage Plant Production. Prentice-Hall, Inc. Englewood Cliffs, N.J. 9-33.
Martin, T. 1988. Once Upon A Windowsill. Timber Press. Portland, Oregon 178-180; 185-189; 205-207; 214-239.
Oglesby, R. 1997. Telephone interview. Sept.
Vosters, J. R. 1996 Personal interview. Nov.

Proc. Fla. State Hort Soc. 110:107-110. 1997.

A LIGHT AND SCANNING ELECTRON MICROSCOPE STUDY OF BENT-TIP IN *AGLAONEMA* 'SILVER QUEEN'

M. S. ELLIOTT
Department of Plant Pathology
University of Florida
Gainesville, FL 32611

J. L. GRIFFIS, JR.
Department of Citrus and Environmental Horticulture
Florida Southern College
Lakeland, FL 33801

D. B. MCCONNELL
Department of Environmental Horticulture
University of Florida
Gainesville, FL 32611

F. W. ZETTLER
Department of Plant Pathology
University of Florida
Gainesville, FL 32611

Additional index words. Light microscopy, meristem, leaf primordium.

Abstract. **Aglaonema 'Silver Queen' is a popular foliage plant widely used in homes and commercial interiorscapes. During production, particularly periods of rapid growth, leaf tips may emerge bent, folded and deformed thereby reducing plant quality. The "bent-tip" can first be observed when the newest leaf emerges from the petiole sheath of the preceding leaf and appears to be limited to *Aglaonema* 'Silver Queen'. Leaf tips and apical meristems were excised from shoot apices and examined with a dissecting microscope, a compound light microscope and a scanning electron microscope. Crushed and distorted cells were observed in sections of bent leaf tips examined with a compound light microscope, and flattening, bending and folding were observed when leaf primordia were examined using a scanning electron microscope. Deformation of leaf tips occurs when growth rates of emerging primordia apparently exceed the rate of elongation of preceding petioles which results in the tips of leaf primordia coming into contact with the leaf bases of preceding leaves. Increased light, temperature and fertilization as well as fluctuations in light and temperature appear to be the cause of the "bent-tip" syndrome. Maintaining uniform light levels, reducing temperature fluctuations and following the cultural guidelines provided by Henny et al. (1992) is recommended to minimize the occurrence of "bent-tip" in Aglaonema 'Silver Queen'.**

Aglaonema 'Silver Queen' is a popular foliage plant widely used in homes and commercial interiorscapes (Fig. 1). It is free-branching, tolerates low light and humidity and has few pests. *Aglaonema* 'Silver Queen' contributes an estimated $4,000,000 to the State economy annually (Florida Department of Agriculture and Consumer Services Division of Marketing and Agricultural Facts Bureau of Education and Consumer Facts. 1996 Agricultural Statistics; McConnell et al., 1989). Of the nurseries listed in the Florida Foliage Locator, 34 specifically listed *Aglaonema* 'Silver Queen' as one of the crops produced. An additional 24 nurseries listed *Aglaone-*

Florida Agricultural Experiment Station Journal Series No. N-01514.

Figure 1. *Aglaonema* 'Silver Queen' specimen plant.

Figure 2. *Aglaonema* 'Silver Queen' leaves with bent-tip and normal tips.

ma species and varieties which may well include *Aglaonema* 'Silver Queen'. While other varieties are gaining in popularity, *Aglaonema* 'Silver Queen' remains an important component of the Florida foliage industry.

During production, particularly during periods of rapid growth, leaf tips emerge bent, folded and deformed (Fig. 2). The bent tip can first be observed when the newest leaf emerges from the petiole sheath of the preceding leaf. This "bent-tip" syndrome appears to be limited to *Aglaonema* 'Silver Queen' and differs from "cripple-leaf" of *Aglaonema* 'Francher', which is characterized by strapped chlorotic leaves (Poole and Pate, 1980). Research has shown that the incidence or severity is not related to soil nutrient levels or pH (Henny et al., 1992). This morphological abnormality may become frequent and severe enough to reduce plant quality. This study was undertaken to determine the cause of this abnormality.

Materials and Methods

Six nurseries in central Florida were surveyed for the incidence of "bent-tip" in *Aglaonema* 'Silver Queen', and observations of growing environments were made.

Leaves were excised from shoot apices and immediately examined with a dissecting microscope.

Leaf tips and apical meristems were killed and fixed in formaldehyde, ethyl alcohol, and acetic acid (FAA), dehydrated in an ethyl alcohol/t-butyl alcohol series, embedded in paraffin, sectioned on a rotary microtome at 10 microns, stained with 0.05% toluidine blue and examined with a light microscope.

Leaves and leaf primordia were excised from apical meristems until one to three primordia remained. Meristems were then killed and fixed in FAA, dehydrated in an ethyl alcohol/acetone series, critical-point dried, coated with 400 Å of gold and examined with a Hitachi S450 scanning electron microscope.

Results and Discussion

Aglaonema 'Silver Queen' plants with "bent-tip" symptoms were observed in five of six nurseries surveyed. The nursery in which "bent-tip" was not observed provided very uniform shading and bottom heat to the plants.

Examination of live shoot apices revealed various degrees of flattening, bending and folding of young leaf tips (Fig. 3).

Microscopic examination of apical meristems showed no deformation of meristematic cells or the earliest one of two leaf primordia. However, deformed areas of bent leaf tips showed crushed and distorted cells (Fig. 4).

Scanning electron microscopy revealed both normal (Fig. 5) and flattened, bent or folded leaf tips (Fig. 6).

Each developing leaf primordium emerges from the petiole sheath of the preceding leaf (Fig. 7). This pattern of growth keeps the primordium in close proximity and often in

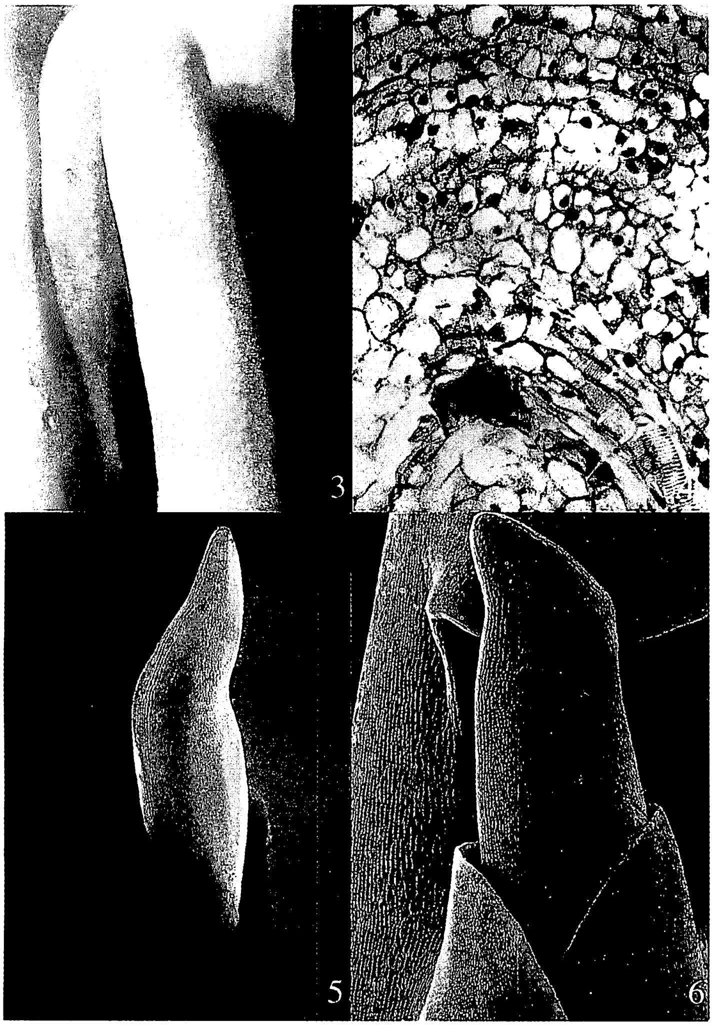

Figure 3. Furled leaf with a portion removed to reveal a folded leaf tip.
Figure 4. Light micrograph showing distorted cells in a leaf section with a bent-tip.
Figure 5. Normal leaf primordium.
Figure 6. Leaf primordium flattened against preceding furled leaf.

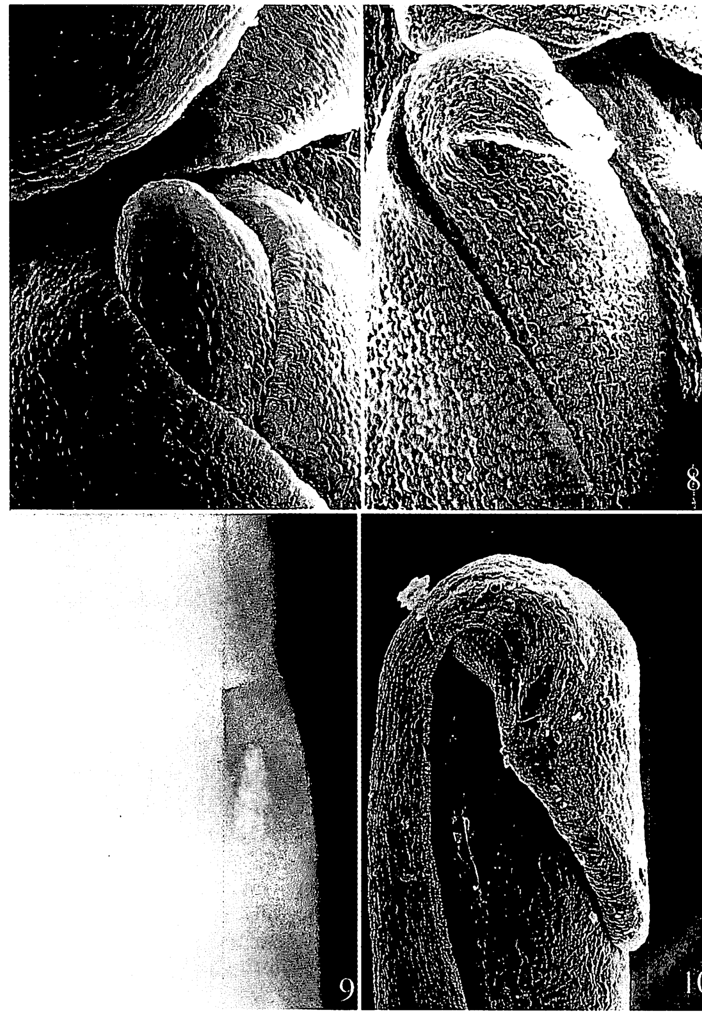

Figure 7. Leaf primordium emerging from a petiole sheath prior to contacting furl of preceding leaf.
Figure 8. Leaf primordium distorted by contact with the furled preceding leaf.
Figure 9. Leaf primordium growing into the furl of the preceding leaf.
Figure 10. Leaf primordium folded after having grown into the preceding furled leaf.

contact with the preceding leaf. Deformation of leaf tips occurs when growth rates of emerging primordia apparently exceed the rate of elongation of preceding petioles which results in the tips of leaf primordia coming into contact with the leaf bases of preceding leaves (Fig. 8). These tips then either become tightly appressed to the exterior or grow into the center of the furled leaf (Fig. 9). Leaf tips entering the preceding furl are frequently deflected and folded back against themselves and remain this way until released when the older leaf blade unfurls (Fig. 10).

Poole and Pate (1980) discounted pH and nutritional deficiencies and toxicities as the cause of the "bent-tip" syndrome but reported the percentage of bent tips increased with increasing fertilization and decreased with increasing shade levels. Henny et al. (1992) suggested water and light stress played a role in causing this syndrome, and C. A. Conover (personal communication) implicated heat stress. During surveys of several nurseries the senior author observed an increase in the frequency of "bent-tip" on *Aglaonemas* growing on the ends of benches which received higher light than the plants growing in interior portions of the benches. These plants, growing under conditions of higher light levels and therefore higher temperatures, apparently were growing faster than those in the interiors. These plants also experienced greater light and temperature fluctuations than those growing in the interior and received even illumination throughout the day. These light and temperature fluctuations are likely to contribute to the "bent-tip" syndrome. Though infrequent, similar observations have been made in nurseries producing *Dieffenbachia* spp. (D. B. McConnell, personal communication).

Increased light, temperature and fertilization as well as fluctuations in light and temperature appear to be the cause of the "bent-tip" syndrome. Therefore, maintaining even light levels and reducing temperature fluctuations is recommended. Henny et al. (1992) recommend growing *Aglaonemas* in 73% to 90% shade (1000-2400 foot-candles) and fertilizing with 3N-0.44P-1.66K (3-1-2) liquid or slow-release fertilizer at a rate of 28-33 lb N/1000 ft^2/year. Micronutrients must also be supplied. Supplemental copper must be added to avoid "crinkle-leaf" copper deficiency. These recommendations will enable growers to produce *Aglaonema* 'Silver Queen' with a minimal degree of "bent-tip".

Literature Cited

Henny, R. J., A. R. Chase and L. S. Osborne. 1992. Aglaonema production guide. Institute of Food and Agricultural Sciences, Central Florida Research and Education Center. Apopka Foliage Plant Research Note RH-91-2.

Poole, R. T. and A. J. Pate. 1980. Bent-Tip of *Aglaonema commutatum* 'Silver Queen'. Foliage Digest. September:15-16.

McConnell, D. B., R. W. Henley and K. B. Kelly. 1989. Commercial foliage plants: twenty years of change. Proc. Fla. State Hort. Soc. 102:297-303.

Proc. Fla. State Hort. Soc. 110:110-112. 1997.

DIRECT TISSUE BLOT ADAPTED FOR USE IN DETECTING CMV IN GLADIOLUS

M. S. ELLIOTT AND F. W. ZETTLER
Department of Plant Pathology
University of Florida
Gainesville, FL 32611

Additional index words. Cucumber mosaic virus, anti-rabbit alkaline phosphatase conjugate, cross-absorption, NBT, BCIP.

Abstract. **The gladiolus cut flower industry was valued at approximately $16,900,000 in Florida in 1996. "White break", caused by cucumber mosaic virus (CMV), can render flowers unsalable. Symptoms include whitish checkering on leaves, poorly developed inflorescences and color break on flowers. A direct tissue blotting technique was adapted for use by growers to detect this virus at different times in the gladiolus production cycle. Symptomatic and non-symptomatic gladiolus leaves, corms and roots were selected and blotted on a nitrocellulose membrane using a modification of the procedure described by Lin et al. (1993). Non-viral antibodies were absorbed by incubating CMV antiserum with healthy gladiolus sap extracted in Tris-buffered saline + Tween 20 (TBST) and blocking solution (10% powdered skim milk and TBST). Positive antibody-virus reactions were observed in all CMV-infected tissue, however no reactions were observed in blots of healthy tissue. Corm tissue appears to be the most reliable and useful tissue to index for CMV. This procedure is rapid, reliable and requires a minimum of equipment and reagents. A simplified protocol which can be easily modified to fit specific indexing requirements was prepared for use by non-scientifically trained personnel.**

The gladiolus cut flower industry was valued at approximately $16,900,000 in Florida in 1996 (Florida Department of Agriculture and Consumer Services Division of Marketing and Agricultural Facts Bureau of Education and Consumer Facts. 1996 Agricultural Statistics). Cucumber mosaic virus (CMV), the virus of greatest concern in gladiolus, reduces flower quality and renders them commercially unsalable. This virus disease is referred to by growers as "white break" and is characterized by whitish mosaic and checkering on leaves, poorly developed inflorescences and color break on flowers.

Florida Agricultural Experiment Station Journal Series No. N-01513. This project was supported by Manatee Fruit Company and the American Floral Endowment. Use of trade names or companies does not represent an endorsement of any specific product or company.

This study was undertaken to provide a rapid, simple and reliable test for screening plants and bulbs for CMV. The direct tissue blotting procedure was adapted so that it could be utilized by non-scientifically trained staff in existing facilities on site.

Materials and Methods

Symptomatic gladiolus leaves, corms and roots were selected to determine which tissue is best suited for direct tissue blotting. Small pie-shaped pieces of mature and immature corms were blotted using all possible orientations to determine the most reliable age and orientation. When present, healthy roots were cut diagonally to maximize surface area for blotting.

The blotting procedure is a modification of that described by Lin et al. (1993), and it has been used successfully by Yang et al. (1996) and Elliott and Zettler (1996) to detect viruses in lilies and bamboo, respectively. Healthy sap was extracted from gladiolus tissue in Tris-buffered saline plus Tween 20 (TBST) pH 7.2 in a ratio of 1:5 (weight:volume). Non-viral antibodies were absorbed by adding CMV antiserum produced in a rabbit to a solution consisting of equal volumes of healthy sap extracted in TBST and blocking solution (10% powdered skim milk in TBST). A ratio of 1:1000 (v:v) antiserum:solution was prepared, and it was stirred at room temperature for 1-2 hours. Long periods of incubation, freezing, thawing, and centrifugation of cross-absorbed antiserum was determined to be unnecessary. Tissue was blotted directly onto a 8.0 × 8.0 cm piece of nitrocellulose membrane. The membrane was placed in a 9.0 × 9.0 cm square petri dish and incubated on a shaker in 20.0 ml of the cross-absorbed antiserum for 1 hour at room temperature. The membrane was then washed in TBST 3 times, 5 minutes per wash. The membrane was then incubated, while shaking, for 1 hour at room temperature in 20.0 ml anti-rabbit alkaline phosphatase conjugate diluted 1:30,000 in blocking solution followed by 2, 5-minute washes in TBST, and 1, 5-minute wash in substrate buffer. The membrane was then incubated in the dark, without shaking, in 20 ul nitro blue tetrazolium (NBT), 20 µl bromo-chloro-indolyl phosphate (BCIP), 20 µl 0.1 M $MgCl_2$ and 20.0 ml substrate buffer (0.1 M NaCl, 0.1 M Tris) pH 9.5 for 15-30 minutes or until reactions developed to satisfactory intensity. The reactions were stopped by washing the membrane in distilled water. When necessary, chlorophyll and other plant pigments which may obscure the color reaction