washed, homogenized in sterile water and used as inoculum. Freshly harvested cuttings were injured with a sterile toothpick, then dipped into the homogenate, and placed into test tubes of sterile water, bagged, and incubated for 5 days at room temperature or placed in the propagation area. Cuttings not inoculated with the homogenate served as controls.

Leaf and stem inoculations with the bacterium isolated from geraniums were also made on 'Mountain Peak' chrysanthemum. Leaves were surface sterilized in 0.5% sodium hypochlorite, washed in sterile water, and blotted dry. The prepared leaves were placed in moist chambers consisting of sterile petri plates lined with moistened sterile towels and inoculated as previously described. After the leaves were removed, stems of 'Mountain Peak' were inoculated with a sterile toothpick covered with the bacteria, incubated in moist chambers for 48 hr at 22°C, and then examined for symptoms. Isolations from leaf spot affected chrysanthemums were made on King's medium B and the isolated bacterium was tested for pathogenicity on geranium as previously described.

Results

Isolations from 50 naturally diseased geraniums with basal rot symptoms consistently recovered a fluorescent bacterium on King's medium B. No fungi were recovered from diseased cuttings on any of the media tested.

Identification tests showed that the isolated bacterium was fluorescent on King's medium B and positive for oxidase reaction, arginine dihydrolase utilization, and hypersensitive response on tobacco. The bacterial growth on Crystal Violet Pectate, Miller-Scroth, and SV media were not characteristic of *Erwinia* sp. or *Xanthomonas* sp.

Reinoculations of healthy geranium cuttings with the fluorescent bacterium and with the infected plant material consistently produced basal rot symptoms on stems (Table 1) and spots on leaves. None of the controls showed any symptoms. Inoculations of chrysanthemum leaves and stems with the bacterium from geranium consistently produced typical leaf spot and stem rot respectively. Similarly, geranium cuttings inoculated with the mum isolates consistently showed basal rot symptoms.

Reisolations from symptomatic stem and leaf tissue of geranium and chrysanthemum yielded *P. cichorii*. No bacterium was recovered from the asymptomatic tissue.

Discussion

Numerous ornamental hosts of *P. cichorii* have been reported (5, 6, 7). This study reports a basal rot on geranium cuttings in propagation. A report of stem rot of geranium caused by bacterium isolated from a leaf spot was made in 1932 (2), however, the bacterium was not identified. A study in 1954 (8) showed that a *Xanthomonas* sp. was the causal agent of a leaf spot and stem rot. The isolation, identification and pathogenicity studies presented here indicate that the bacterium causing basal rot of geranium cuttings in propagation is *P. cichorii*. Further, with cross-inoculation studies, we have demonstrated that the chrysanthemum and geranium isolates of *P. cichorii* are pathologically similar.

Table 1. Inoculation of geranium and chrysanthemum with the bacterium isolated from naturally basal rot affected geranium cuttings.[z]

Treatment	Number of stems or leaves with symptoms			
	Geranium[y]		Chrysanthemum[x]	
	DRI	IM	Leaves	Stems
Untreated check	0	0	0	0
Injured check	0	0	0	0
Injured, inoculated with geranium bacterial isolates	15	15	15	15
Injured, inoculated with diseased tissue	15	15	15	15

[z]All inoculation tests were carried out 3 times with 5 replicates in each treatment.
[y]'Dark Red Irene' (DRI), 'Improved Minnetonka' (IM). Only stems were inoculated.
[x]'Mountain Peak' chrysanthemums were used.

Literature Cited

1. Cuppels, D., and A. Kelman. 1974. Evaluation of selective media for isolation of soft rot bacteria from soil and plant tissue. Phytopathology 64:468-475.
2. Dodge, B. O., and M. E. Swift. 1932. Black stem rots and leaf spot of *Pelargonium*. J. N.Y. Bot. Gardens 33:97-103.
3. Englehard, A. W., H. C. Mellinger, R. C. Ploetz, and J. W. Miller. 1982. A leaf spot of florists' geranium incited by *Pseudomonas cichorii*. Plant Dis. 67:541-544.
4. Galloway, B. T. 1890. Diseases of geraniums. J. Mycol. 6:114-115.
5. Jones, J. B., A. W. Englehard, and B. C. Raju. 1983. An outbreak of stem necrosis on chrysanthemum incited by *Pseudomonas cichorii* in Florida. Plant Dis. 67:431-433.
6. Mcfadden, L. A. 1961. A bacterial leaf spot of florists chrysanthemums, *Chrysanthemum morifolium*. Plant Dis. Rptr. 45:16-19.
7. Miller, J. W., and J. F. Knauss. 1973. Bacterial blight of *Gerbera jamesonii* incited by *Pseudomonas cichorii*. Plant Dis. Rptr. 56:504-505.
8. Munnecke, D. E. 1954. Bacterial stem rot and leaf spot of *Pelargonium*. Phytopathology 44:627-632.
9. Schaad, N.W. (ed.). 1980. Laboratory guide for plant pathogenic bacteria. Amer. Phytopathol. Soc., St. Paul, MN.

Proc. Fla. State Hort. Soc. 97:274-278. 1984.

CONTROLLING ALGAE IN FOLIAGE PLANT PRODUCTION[1]

A. R. Chase and L. S. Osborne[2]
University of Florida, IFAS,
Agricultural Research and Education Center,
2807 Binion Rd., Apopka, FL 32703

Additional index words. soil treatment, dodine, mancozeb, zineb, quaternary ammonium, sodium hypochlorite, phytotoxicity, foliage plants.

Abstract. **Fungicides and disinfectants were tested in the greenhouse for algae control on potting medium surfaces and toxicity to foliage plants. Although sodium hypochlorite (10% commercial bleach) provided good short-term control of algae, regrowth occurred within 3 days. Dodine (Cyprex 65 WP), mancozeb 2 (Dithane M45), and zineb 2 (Dithane Z78) provided the best control for 5 weeks following a single application. Other formulations of carbamate fungicides provided equal control to mancozeb 2 and zineb 2. Sodium hypochlorite was very toxic when applied directly to leaves of 8 species of foliage plants causing severe necrosis, chlorosis and leaf abscission following a single ap-**

[1]Florida Agricultural Experiment Stations Journal Series No. 5994.
[2]Associate Professor of Plant Pathology and Assistant Professor of Entomology, respectively.

plication. Minor phytotoxicity occurred after a single application of either a quaternary ammonium compound (QA #2) or dodine on some species tested. Both zineb and mancozeb were safe on each of the 8 species tested.

Algae can cause serious problems during the production of foliage plants. They grow on pots, potting media, bench and walkway surfaces, and even on the plant leaves. Products such as sodium hypochlorite (commercial bleach), copper compounds, and quaternary ammonium compounds are available for algae control on nonliving surfaces such as benches and walkways (1, 2, 4). Most of these products are not recommended for use on plants since they can be toxic. Other research has identified several fungicides which are effective in controlling algae growth on capillary mats during crop production (3). The purpose of the research reported in this paper was to evaluate some of the same fungicides and disinfestants as well as others for use on potting medium surfaces as an algicide.

Materials and Methods

Algae control tests were performed using a potting medium consisting of Canadian peat (50%) and perlite (50%) by volume. The medium was irrigated weekly with a 400 ppm nitrogen solution of fertilizer (9-3-6, N-P-K) to provide water and nutrients for algae growth. Genera of algae present after 2 weeks were determined to be *Chlorella, Ulothrix,* and several similar to *Nostoc.* Some tests were performed using freshly prepared media (without algae growth) while others were performed after algae growth had occurred. Algae growth on the perlite component of the medium was rated qualitatively on a weekly basis according to the following scale: 1 = white (no visible growth), 2 = very slight green growth on 25% or less of the medium surface, 3 = slight green growth on 26-75% of the medium surface, 4 = moderate green growth over the entire medium surface, and 5 = dense green growth over the entire medium surface. Ten 10-cm square plastic pots were used for each treatment in each trial and arranged in a randomized complete block design with a single pot serving as the experimental unit. All treatment solutions were applied as drenches to soak the top 2.5 cm of potting medium using a pump action hand sprayer.

Experiment 1. This test was performed as a broad spectrum screen for several fungicides and disinfestants. Pots were treated prior to algae growth with one of the following treatments: 1) water control, 2) dodine—10.0 g a.i./liter (Cyprex 65 WP), 3) copper hydroxide—11.8 g a.i./liter (Kocide 101 77 WP), 4) soap product #1—13.0 ml a.i./liter (Safer's Insecticidal Soap), 5) soap product #2—6.6 ml a.i./liter (Safer's Algicidal Soap), 6) sodium hypochlorite—5.2 ml a.i./liter (Clorox 5.25%), 7) mancozeb—12.2 g a.i./liter (Dithane M45 80 WP), 8) zineb—11.5 g a.i./liter (Dithane Z78 75 WP) and 9) isopropyl alcohol, 100 ml/liter. Treatments were applied on March 23, 1984 and pots were rated weekly until 30 days post-treatment.

Experiment 2. This test was performed to evaluate some of the best compounds from the first test and to compare them to a quaternary ammonium product. Lower rates of several compounds were tested to determine their efficacy. The following treatments were included: 1) water control, 2) dodine (4.6 g a.i./liter), 3) soap product #2 (13.0 ml a.i./liter), 4) sodium hypochlorite (5.2 ml a.i./liter), 5) mancozeb 2 (11.2 g a.i./liter), 6) zineb 2 (10.5 g a.i./liter), and 7) a quaternary ammonium compound 0.4 ml a.i./liter—QA #1 (Physan). This test was performed once by applying the compounds March 28, 1984 prior to algae growth and again on April 11, 1984 following algae growth. The test was performed a second time with treatments applied once only on April 11, 1984 after algae growth. Pots were rated weekly for 30 days post-treatment.

Experiment 3. Carbamate fungicides other than those previously evaluated were tested at a 3.0 g/liter (formulated) rate to compare their efficacies. The treatments were: 1) water control, 2) maneb (Manzate D 80 WP), 3) mancozeb 1 (Manzate 200 80 WP), 4) mancozeb 2 (Dithane M45 80 WP), 5) mancozeb and thiophanate methyl (Zyban 75 WP), 6) zineb 1 (Zineb 75 WP), 7) zineb 2 (Dithane Z78 75 WP), and 8) ferbam (Carbamate 76 WP). Treatments were applied on April 20, 1984 prior to algae growth and they were rated twice at weekly intervals.

Experiment 4. Lower rates of dodine were tested for efficacy: 1) 0 g a.i./liter (water control), 2) 0.6 g a.i./liter, 3) 1.2 g a.i./liter, 4) 2.3 g a.i./liter, 5) 4.6 g a.i./liter and 6) 9.1 g a.i./liter. Treatments were applied prior to algae growth on May 18, 1984 and ratings were made on May 25, June 8 and June 18, 1984.

Experiment 5. A broad scale screening of fungicides was performed in experiment 5 to identify other useful algicides. The fungicides included were: 1) water control, 2) triadimefon—0.3 g a.i./liter (Bayleton 50 WP), 3) benomyl—0.3 g a.i./liter (Benlate 50 WP), 4) captan—1.2 g a.i./liter (Captan 50 WP), 5) chloroneb—0.8 g a.i./liter (Demosan 65 WP), 6) iprodione—0.3 g a.i./liter (Chipco 26019 50 WP), 7) chlorothalonil—1.0 ml a.i./liter (Daconil 4.17 F), 8) vinclozolin—0.3 g a.i./liter (Ornalin 50 WP), 9) benodanil—0.3 g a.i./liter (MF-654 50 WP), and 10) dicloran—0.3 g a.i./liter (Botran 50 WP). Treatments were applied on April 20, 1984 and pots were rated on April 27 and May 3, 1984.

Experiment 6. Several disinfestants were compared for efficacy of algae control in this experiment. They were applied either once before algae growth on April 6, 1984 or once after algae growth on April 20, 1984. The following were included: 1) water control, 2) quaternary ammonium compound #1—0.2 ml a.i./liter (QA1, Physan), 3) quaternary ammonium compound #2—0.3 ml a.i./liter (QA2, Prevent), 4) QA2—0.6 ml a.i./liter, 5) QA2—0.8 ml a.i./liter, and 6) sodium hypochlorite—5.2 ml a.i./liter. Ratings were made on April 17 and April 24, 1984.

Experiment 7. Phytotoxicity of several of the most promising fungicides and disinfestants was tested with a single application on August 30, 1984. The test was performed to evaluate effects of accidental application to plants which could occur during treatment of walkways. The following compounds and rates were used: 1) water control, 2) QA #2—0.3 ml a.i./liter 3) dodine—2.0 g a.i./liter, 4) mancozeb 2—2.4 g a.i./liter, 5) zineb 2—2.2 g a.i./liter 6) QA #1—0.2 ml a.i./liter, and 7) sodium hypochlorite—5.2 ml a.i./liter. Five of each of the following plants were sprayed with one of the treatments: *Aglaonema commutatum* Schott cv. Silver Queen, *Brassaia actinophylla* Endl. (schefflera or umbrella tree), *Chamaedorea elegans* Mart. (parlor palm), *Cissus rhombifolia* Vahl (grape ivy), *Dieffenbachia maculata* (Lodd.) G. Don 'Rudolph Roehrs', *Hedera helix* L. (English ivy), *Philodendron scandens* C. Koch. & H. Sello subsp. *oxycardium* (heartleaf philodendron), and *Philodendron selloum* Koch. (selloum). All plants were obtained from commercial producers and used as received. Visual assessment of damage was made on September 10, 1984.

Experiment 8. Since one of the uses of an algicide is to spray the surface of pots or beds containing seeds, the products and rates listed above were tested for effects on germination of foliage plant seeds. Ten pots of each of the following were treated after sowing seeds for each of the 6 treatments listed in experiment 7: schefflera (25 seeds/pot), *Schefflera arboricola* Hayata ex Kanehira (dwarf schefflera, 25 seeds/pot), *Asparagus* sp. L. (asparagus fern 20 seeds/

pot) and selloum (25 seeds/pot). Germination was recorded weekly starting 1 week after sowing and treatment application (both on August 30, 1984).

Results and Discussion

Experiment 1. Although several products gave good short-term control of algae only dodine gave good control after 4 weeks. Both mancozeb 2 and zineb 2 also gave moderate control of algae in this experiment. Isopropyl alcohol and sodium hypochlorite gave very poor control over the 4-wk period with copper hydroxide and the soap products providing some control (Table 1).

Table 1. Effect of various fungicides and disinfestants on algae growth over a 4-week period. Treatments were applied on March 23, 1984 (Expt. 1).

Treatment (rate a.i./liter)	Degree of algae growth[z] (rating date)		
	March 26, 1984	April 9, 1984	April 23, 1984
Control	4.9e[y]	4.9f	4.7d
Dodine (10.0 g)	1.2a	1.4a	1.3a
Copper hydroxide (11.8 g)	3.8d	2.8cd	2.9b
Soap product #1 (13.0 ml)	3.1c	3.8e	3.6bc
Soap product #2 (6.6 ml)	2.2b	4.1e	3.8c
Sodium hypochlorite (5.2 ml)	2.1b	3.2d	4.8d
Mancozeb 2 (12.2 g)	2.4b	2.2b	3.5bc
Zineb 2 (11.5 g)	2.2b	2.5bc	3.4bc
Isopropyl alcohol (100 ml)	4.2d	4.0e	3.9c

[z]Degree of algae growth was rated on a scale from 1 (no visible color) to 5 (dark green growth covering the potting medium surface).
[y]Mean separation in columns by Duncan's new multiple range test, 5% level.

Experiment 2. Dodine again provided very good control of algae whether applied once or twice (Table 2). In this experiment, however, the two carbamate products, mancozeb 2 and zineb 2, gave excellent control even at the reduced rate. At this point the soap products appeared to give poor control and their testing was discontinued. Although QA #2 and sodium hypochlorite gave some control after 1 week, the benefit rapidly disappeared during the second and third weeks.

Experiment 3. The seven carbamate fungicides were equally effective. As in the previous 2 tests, the degree of control achieved was high for a 4-week period following the fungicide applications (data not shown).

Experiment 4. The higher rate of dodine the better the algae control with excellent control achieved at all rates at the 1-week rating. After 2 weeks, however, the only rate which provided excellent control was the highest rate and after 4 weeks, none of the treatments provided good control (data not shown). The difference between this test and previous tests in the ability of the dodine to control algae growth may be due to the increase in air temperatures since this test was performed later in the season. Algae control during the summer may therefore require higher rates of algicide to achieve the same degree of control as during the winter.

Experiment 5. Several compounds tested showed promise as algicides including triadimefon, benodanil, didoran, captan, and chlorothalonil. This is especially encouraging since these compounds were tested at relatively low rates (Table 3). Since the final rating was made only 2 weeks after fungicide application, these compounds may not be as good as those previously found effective for 4 weeks.

Experiment 6. Comparisons of 3 disinfestants showed that QA #2 used at the highest rate provided the best control of algae (Table 4). QA #2 gave better control when used before algae growth occurred than after algae growth occurred. In unreported trials comparing this product to dodine or the carbamate products, the fungicides provided better control than QA #2.

Experiment 7. Several of the compounds tested for safety on foliage plants proved to be toxic when applied once to their foliage. Sodium hypochlorite was very toxic to all of the plants tested causing contact burns, chlorosis and severe leaf abscission (Table 5). QA #2 caused similar symptoms although they were minor compared to those caused by the sodium hypochlorite. QA #2 was safe when used on aglaonema, grape ivy, English ivy and heartleaf philodendron, but caused some marginal necrosis on the

Table 2. Effect of various fungicides or disinfestants on algae growth for pots treated before or after infestation of the potting medium (Expt. 2).

Treatment (rate a.i./liter)	Degree of algae growth[z] (rating date, 1984)							
	April 6[y]	April 17[y]	April 25[y]	May 2[y]	April 17[x]	April 25[x]	May 2[x]	May 8[x]
Control	3.0d[w]	3.8e	4.1d	4.6f	3.9f	4.6d	4.8cd	5.0d
Dodine (4.6 g)	1.0a	1.0a	1.2a	3.3b	1.2a	1.4a	2.4a	3.6b
Soap product #2 (13.0 ml)	1.2ab	3.2d	4.0d	4.7d	3.6e	4.2d	5.0d	5.0d
Sodium hypochlorite (5.2 ml)	1.6bc	1.8b	3.6cd	4.4cd	1.6b	3.7c	4.1b	4.2c
Mancozeb 2 (11.2 g)	1.3abc	1.8b	2.4b	2.8ab	1.9bc	2.7b	2.8a	2.4a
Zineb 2 (10.5 g)	1.4abc	1.9b	2.5bc	2.6a	2.2c	2.7b	2.8a	2.7a
QA #1 (0.2 ml)	1.6c	2.6c	3.0c	4.1c	2.8d	3.8cd	4.6c	4.6cd

[z]Degree of algae growth was rated on a scale from 1 (no visible color) to 5 (dark green growth covering the potting medium surface).
[y]Treatments applied on March 28 and April 11, 1984.
[x]Treatments applied on April 11, 1984.
[w]Mean separation in columns by Duncan's new multiple range test, 5% level.

Table 3. Effect of various fungicides on algae growth on the potting medium surface (Expt. 3).

Treatment (rate a.i./liter)	Degree of algae growth[z] (rating date)	
	April 27, 1984	May 3, 1984
Control	3.2d[y]	3.4c
Triadimefon (0.3 g)	1.2a	2.0ab
Benomyl (0.3 g)	3.0d	3.6c
Captan (1.2 g)	1.4ab	1.6a
Chloroneb (0.8 g)	2.6c	3.1c
Iprodione (0.3 g)	2.0b	3.4c
Chlorothalonil (1.0 ml)	1.3a	2.0ab
Vinclozolin (0.3 g)	2.4b	4.2d
Benodanil (0.3 g)	1.6ab	2.2b
Dicloran (0.3 g)	1.2a	2.2b

[z]Degree of algae growth was rated on a scale from 1 (no visible color) to 5 (dark green growth covering the potting medium surface).
[y]Mean separation in columns by Duncan's new multiple range test, 5% level.

other 4 plants tested. Dodine caused mottling, chlorosis and some distortion on schefflera, grape ivy and dieffenbachia, but was safe on the other five plants. QA #1 Mancozeb 2 and zineb 2 were safely used on all 8 of the plant species tested. Since the products were applied only once, the effect of repeated applications on plant growth was not determined.

Experiment 8. Seed germination was recorded for 39 days following potting medium treatment. Although mean numbers of seeds germinated per pot differed considerably for some plants tested, they were not statistically different at the final rating for 3 of the 4 seed types (Table 6). Only selloum seeds were affected by the treatments with the highest germination for seeds treated with mancozeb 2 or sodium hypochlorite. None of the other treatments significantly reduced germination, although it was very low for the dodine treatment.

Table 4. Effect of disinfestants on algae growth on potting medium in the greenhouse (preventive and eradicative effects) (Expt. 6).

Treatment (rate a.i./liter)	Degree of algae growth[z] (rating date)		
	April 17, 1984[y]	April 23, 1984[y]	April 23, 1984[x]
Control	3.8 c[w]	4.9b	3.9d
QA #2 (0.3 ml)	3.2bc	4.8b	3.6c
QA #2 (0.6 ml)	1.8a	4.1a	2.7b
QA #2 (0.8 ml)	1.9a	4.0a	2.3a
QA #1 (0.2 ml)	3.2bc	4.7b	3.6c
Sodium hypochlorite (5.2 ml)	3.0b	4.8b	3.6c

[z]Degree of algae growth was rated on a scale from 1 (no visible color) to 5 (dark green growth covering the potting medium surface).
[y]Pots treated on April 6, 1984 prior to any algae growth.
[x]Pots treated on April 20, 1984 after all pots were rated 4 or 5 for algae growth.
[w]Mean separation in columns by Duncan's new multiple range test, 5% level.

The most effective and safe compounds which were tested in these experiments appear to be the carbamate products. They provided excellent control of algae growth on the potting medium surface comparable to that achieved with dodine in many tests. In addition, these products are safe on most foliage plants, they are readily available and relatively inexpensive. The best compound for algae control alone was dodine. Use of this compound by the foliage producer has a few drawbacks, primarily relating to availability of the product in Florida and safety margin on a wide range of foliage plants. Although sodium hypochlorite products are very inexpensive and readily available, their use as a safe, long-term algicide is extremely limited. Quaternary ammonium compounds are safer when applied

Table 5. Effect of pesticides applied as a foliar spray to several genera of foliage plants (Expt. 7).

Plant	Treatments					
	QA #2 (0.3 ml)[z]	Dodine (2.0 g)	Mancozeb 2 (2.4 g)	Zineb 2 (2.2 g)	QA #1 (0.2 ml)	Sodium hypochlorite (5.2 ml)
Aglaonema commutatum	safe	safe	safe	safe	safe	severe
Brassaia actinophylla	marginal burn	mottling chlorosis	safe	safe	safe	severe burn
Chamaedorea elegans	marginal	safe	safe	safe	safe	severe burn
Cissus rhombifolia	safe	moderate distortion	safe	safe	safe	severe burn
Dieffenbachia maculata	moderate burn	contact burn	safe	safe	safe	severe burn
Hedera helix	safe	safe	safe	safe	safe	severe burn
Philodendron scandens oxycardium	safe	safe	safe	safe	safe	severe burn
Philodendron selloum	moderate burn	NT[y]	NT	NT	safe	severe burn

[z]Rate of active ingredient per liter of water. Sprays applied a single time to runoff.
[y]NT = not tested.

Table 6. Germination of foliage plant seeds in potting medium treated with various algicides and fungicides (Expt. 8).

Treatment (rate a.i./liter)	*Asparagus*[z] sp.	*Brassaia*[y] *actinophylla*	*Philodendron*[y] *selloum*	*Schefflera*[y] *arboricola*
Control	7.8a[x]	12.4a	2.8ab	4.4a
QA #2 (0.3 ml)	6.8a	12.8a	6.4abc	3.2a
Dodine (2.0 ml)	8.2a	12.6a	1.8a	1.6a
Mancozeb 2 (2.4 g)	7.4a	12.2a	7.8c	2.0a
Zineb 2 (2.2 g)	9.6a	15.4a	3.8abc	2.6a
QA #1 (0.2 ml)	13.2a	13.2a	1.8a	2.2a
Sodium hypochlorite (5.2 ml)	7.8a	11.4a	7.2bc	3.2a

[z]Twenty seeds per each of 5 pots were rated for germination 39 days after planting. Number given is the mean for 5 pots.
[y]Twenty-five seeds per each of 5 pots were rated for germination 39 days after planting. Number given is the mean for 5 pots.
[x]Mean separation in columns by Duncan's new multiple range test, 5% level.

to plant foliage, but do not provide algae control for as long a period as the fungicides. Our phytotoxicity trials with foliage plants and seeds do not establish the long-term safety of the products should they be used routinely to control algae on the plants themselves. However, similar use of the carbamate products for disease control is safe and many foliage plants are found on their labels. Since each producer has different conditions and requirements for algae control, each must determine the best product for their nursery.

Literature Cited

1. Anonymous. 1982. Evaluation of a new algicide. Annu. Rpt. New Zealand Nursery Res. Centre, p. 16-17.
2. McCain, A. H. and R. H. Sciaroni. 1965. Alga control in the greenhouse. Florists' Rev. 137(3545):28, 79-81.
3. Powell, C. C. and K. J. Shumard. 1984. The chemical control of algae on subirrigation mats in greenhouses. Ohio Florists' Assoc. Bul. No. 652:5-7.
4. Vandiver, V. V., Jr. and T. R. Batterson. 1982. Algae—biology and control. Fla. Coop. Ext. Serv. Weeds in the Sunshine, A-82-9, p. 1-23.

Proc. Fla. State Hort. Soc. 97:278-279. 1984.

EFFECT OF SIMULATED SHIPPING TEMPERATURE AND DURATION ON PREFINISHED FLOWERING HIBISCUS

TERRIL A. NELL AND JAMES E. BARRETT[1]
IFAS, Ornamental Horticulture Department, University of Florida, Gainesville, FL 32611

Additional index words. abscission, chlorosis, *Hibiscus Rosa-sinensis.*

Abstract. **Budded hibiscus, (Hibiscus Rosa-sinensis L.), 'Seniorita' and 'Red American Beauty' were paper sleeved, boxed, and placed into simulated shipping temperatures of 40, 60, or 80°F for 2, 4, or 7 days then placed in the greenhouse until flowering. Plants held at 40 and 80°F abscissed a large number of buds when held for 4 days or longer. Bud abscission occurred for all buds, regardless of size at time of treatment initiation. Severe bud abscission was not related to water stress during shipping since water potential of all plants was similar at time of unboxing.**

The importance of flowering potted plants is increasing in Florida and the United States. Production of poinsettias, chrysanthemums, gloxinia, bedding plants, and numerous other flowering plants has increased in Florida in recent years (9). There also has been increased consumer interest and rapid production expansion in crops such as gerberas, hibiscus, and exacum. Many of these plants are sold outside Florida and may require 2-7 days shipping to reach the consumer.

Shipping temperature and duration are important factors in maintaining the post-production quality of flowering and foliage plants (2, 4, 5, 6, 7, 8). Shipping requirements differ with each plant species. Increased shipping time (10-15 days) resulted in greater leaf drop in *Ficus benjamina* L. plants at temperatures of 60-65°F (6). But, shipping studies with 4 foliage plants showed a wide range of acceptable temperatures and durations with plants being stored for 21 days without a significant loss of quality (5). 'Glory' poinsettia exhibited best quality when shipped at 55°F while less epinasty and highest quality plants were observed on 'Annette Hegg Dark Red' and 'Annette Hegg Supreme' at 60°F (7, 8). Shipping temperatures of 60°F caused excessive leaf loss in 'Amy' (3). Shipping at low temperatures (40°F) has been best with chrysanthemums (4), geraniums (2), and azaleas (Nell and Hackman, unpublished data).

Budded hibiscus are being produced in Florida as prefinished flowering potted plants and numerous growers have reported severe bud and leaf abscission following shipping to commercial forcers. These studies were established to identify the role of shipping on bud abscission.

Materials and Methods

Budded hibiscus, 'Red American Beauty' and 'Seniorita', were obtained from a commercial source and placed in a double polyethylene covered greenhouse in Gainesville, FL for 1-5 days prior to initiation of treatments. In all experiments, plants were placed into paper sleeves and wax-lined cardboard boxes before placement in environmentally controlled chambers. At the termination of treatments, plants were unboxed, unsleeved, watered, and placed at 70-75°F and 70 ft-c of light for approximately 12 hr before being moved to the greenhouse. The greenhouse provided a maximum light intensity of 6000-7000 ft-c. Minimum night temperatures were 65-68°F and maximum day temperatures were 90-95°F. Plants were maintained well watered without fertilizer prior to and following treatments.

[1]Florida Agricultural Experiment Stations Journal Series No. 6147. The authors are grateful to Yoder Brothers for donation of plant materials and American Florists Endowment for support of this project. The technical assistance of Deborah Gaw and Carolyn Bartuska is greatly appreciated.