

the limits of growth of bougainvillea in the state. The single occurrence of the disease in Gainesville was on a plant brought into the city from a south Florida nursery, and it is assumed from an area where the disease occurred. More than 75 percent of the disease specimens were received from eight east coast counties (Fig. 3), with Brevard and Volusia counties accounting for slightly more than 60 percent of all specimens, and representing approximately 33 percent of the communities in which the disease is now found. It is also observed that the disease was more prevalent in areas of greatest population, although disease incidence in Brevard and Volusia counties seems to be significantly higher.

Other than the known distribution in the United States, the disease has been identified on *B. glabra* in El Salvador, on *B. spectabilis* in Hyderabad State, India, and on leaves of *B. stipitata* in Tucumán, Argentina.

#### HOSTS

It was previously suggested (5) that bougainvillea varieties with glabrous leaves and relatively short, straight spines (*B. glabra* group) varied from nonsusceptible to resistant, that varieties with pubescent leaves and recurved spines (*B. spectabilis* group) were moderately

susceptible, and that forms in which leaf and spine characteristics were not distinctively of one or the other type (Crimson Lake group), were moderately to highly susceptible to attack by *C. bougainvilleae*.

Eight previously unreported bougainvillea hosts have been found. Afterglow, a variety much like Golden Glow, was highly susceptible to *C. bougainvilleae*; Panama Pink, a parent of the highly susceptible Hugh Evans variety, was moderately susceptible; Crimson Lake Jr., Mrs. Butt, and Orange King of the Crimson Lake group, were moderately susceptible; Rosa of Catalina, a *B. spectabilis* type and a parent of Marg Bacon, was moderately susceptible; and Paper Flower and Four-O'clock, both of unknown parentage, were moderately susceptible. This makes a total of 17 varieties of bougainvillea grown in Florida that are moderately to highly susceptible to *C. bougainvilleae*.

#### LITERATURE CITED

1. Ancalmo, O. 1961. Occurrence of *Cercospora bougainvilleae* in El Salvador. Plant Dis. Repr. 45: 666.
2. Deighton, F. C. 1967. Studies on *Cercospora* and allied genera. II. Commonwealth Mycol. Inst., Mycol. Papers, No. 112, 80 p.
3. Muntañola, M. 1957. Tres especies de "*Cercospora*" ("*Deuteromycetae*") de Tucumán. Rev. Agr. Agron. 24: 81-88.
4. Rao, P. N. 1962. Some *Cercospora* species of Hyderabad, India. Indian Phytopathol. 15: 114-122.
5. Sobers, E. K., and A. P. Martinez. 1966. A leaf spot of *Bougainvillea* caused by *Cercospora bougainvilleae*. Phytopathology 56: 128-130.

## FLOWERING OF GARDENIAS AS AFFECTED BY PHOTOPERIOD, CYCOCEL AND B-9

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#### ABSTRACT

Experiments were initiated during 1965 and 1966 to determine effect of photoperiod and levels

of Cycocel and B-9 on flowering of *Gardenia jasminoides* 'Veitchii' and 'Glazeri'. Data were taken on number of flowers and date of 50% bloom.

Short day photoperiods of 9 hours duration for 4 or 6 weeks were necessary to obtain highest flower counts. Increasing duration of short day treatments from 4 to 8 weeks linearly decreased time to date of 50% bloom with 'Veitchii'.

Flowering was increased 75 to 100% by application of Cycocel during both years' experiments, while B-9 increased flowering only during 1965. In the 1966 experiment, B-9 delayed flowering when compared with Cycocel by an average 5½ days.

## INTRODUCTION

*Gardenia jasminoides* is widely grown in Florida as a flowering pot plant for Christmas, Easter and Mother's Day. Under present cultural practices, some growers discard up to 50% of their crop because plants fail to flower on schedule. Any method devised to increase bud set on *Gardenia jasminoides* and to assure flowering at the proper time would be of value to Florida's growers. Information obtained on factors effecting flowering would be helpful in the establishment of gardenias as a commercial cut flower crop in Florida.

Laurie et al (4) stated that gardenias are short day plants and if shaded July 21 to August 13 in central Ohio some flowers would be obtained for Christmas and early January. Two weeks of shading was insufficient to initiate flower buds. Longer periods of shade will induce floral initiation on all terminals but flower

buds fail to develop until advent of long days the following spring. Joiner and Poole (1) found that shading plants for six weeks produced more flowers than other shade treatments used. Rose and Dickey (6) obtained more flowers when *Gardenia* plants were grown in full sun.

Effects of growth retarding chemicals on flowering of *Gardenia jasminoides* were studied by Joiner and Poole (1) and Poole (5). In both experiments, plants treated with 2-Chloroethyl Trimethylammonium Chloride (Cycocel) produced more flowers. Cycocel treatments also affected date of flowering and growth of plants. Kiplinger et al (2) reported that pot gardenias treated with 0.5% spray of N-dimethylamino-succinic acid (B-9) could be kept more compact than non-treated plants, but gave no indication of effect on flowering.

The following experiments were designed to further evaluate effects of long photoperiod du-

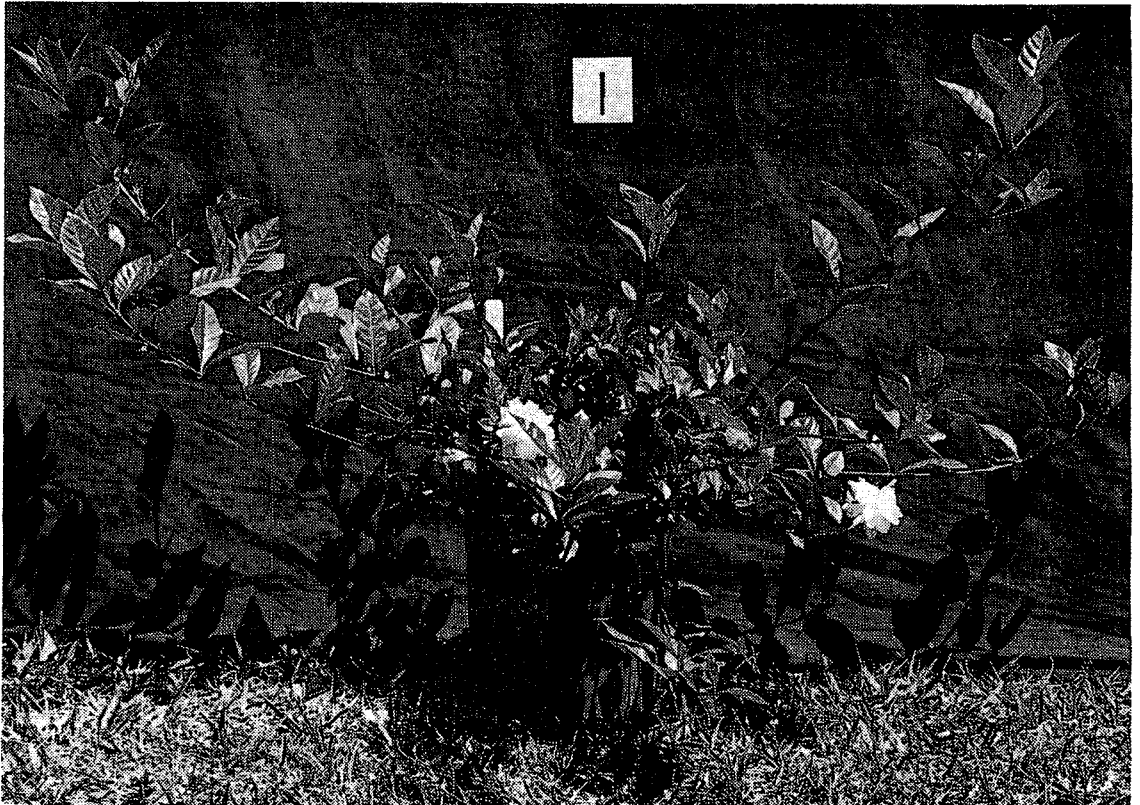


Figure 1.—A typical *Gardenia* plant from the check treatment showing normal elongated growth.

ration and chemical treatment on the flowering of two varieties of *Gardenia jasminoides*.

#### METHODS AND MATERIALS

*Experiments I and II* — Two 3 x 6 factorial experiments in randomized block design with 5 replications were established to test effects of photoperiod and growth chemicals on flower production of gardenia. The experiments were similar except *Gardenia jasminoides* 'Veitchii' on its own root was used in experiment I and *Gardenia jasminoides* 'Glazeri' grafted on *Gardenia thunbergia* understock was used in experiment II. Photoperiod treatments consisted of 6 ( $L_1$ ), 4 ( $L_2$ ) and 2 ( $L_3$ ) weeks of short days and growth retardant treatments were

Check ( $C_1$ ), Cycocel drench-5 ml/6" pot ( $C_2$ ), 0.25% Cycocel spray ( $C_3$ ), 0.50% Cycocel spray ( $C_4$ ), 0.50% B-9 spray ( $C_5$ ) and 1.00% B-9 spray ( $C_6$ ).

One liner sized plant was planted per 6" Lerio metal container during May 1965 and constituted an experimental unit. Plants were fertilized monthly with 60 lbs. N, 10 lbs.  $P_2O_5$  and 20 lbs.  $K_2O$  per acre applied in solution and plants grown at a minimum night temperature of 65°F in a clear glass greenhouse at Gainesville, Florida.

Long day photoperiods were maintained until short day treatments were started as follows:  $L_1$  — September 1,  $L_2$  — September 15 and  $L_3$  — September 29, 1965; at the initiation of short days (plants shaded from 5 p.m. to 8 a.m.



Figure 2.—An average more compact Gardenia plant having been treated with Cycocel.

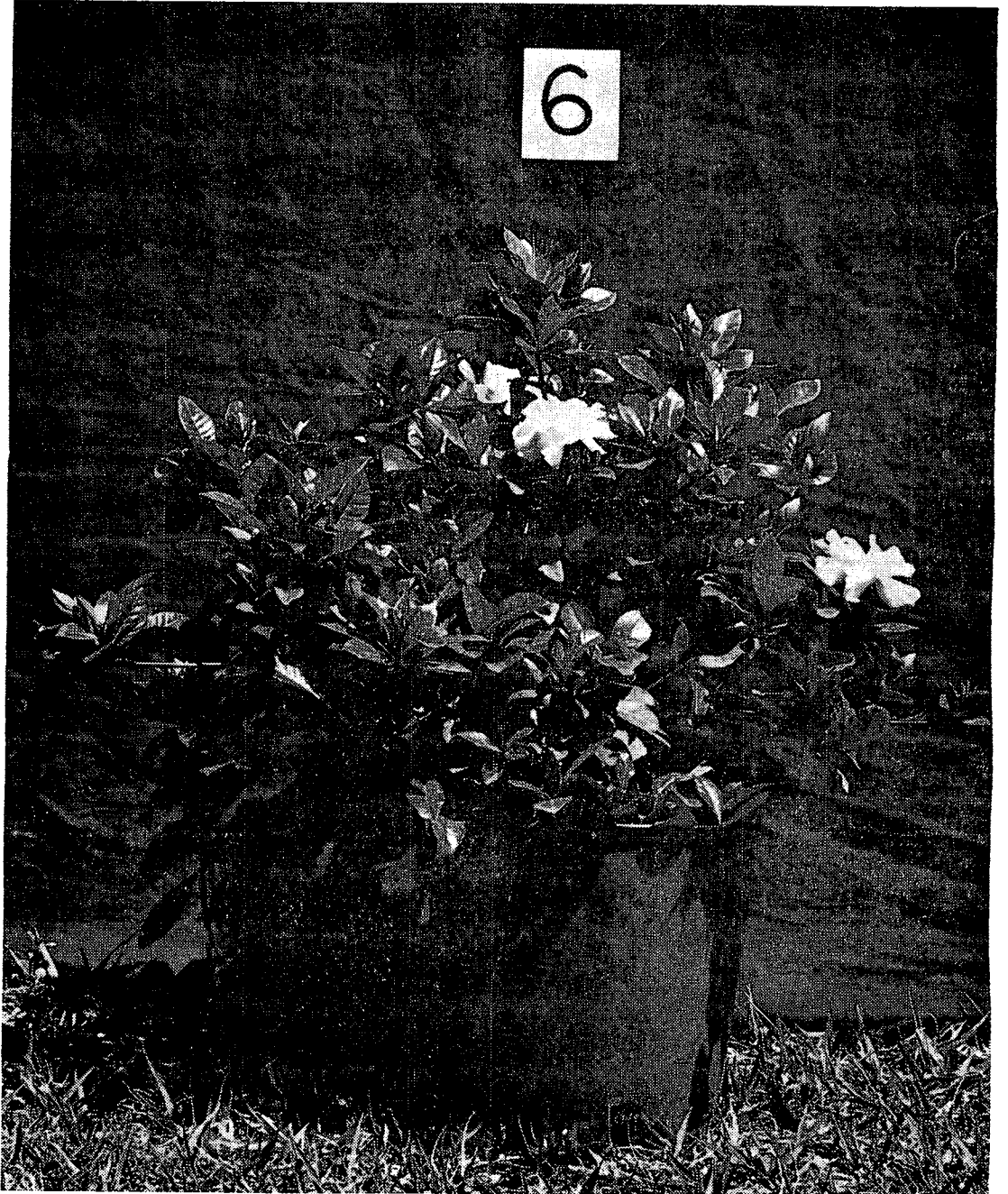


Figure 3.—The most compact Gardenia plants were those treated with B-9.

daily) each treatment also received a single application of growth retardant. Short days were terminated October 13 and long days provided (plants lighted from 10 p.m. to 2 a.m. daily) until plants bloomed.

Flowers that opened and bloom dates were recorded and data statistically analyzed by the analysis of variance method and treatment comparisons made by single degrees of freedom.

*Experiment III* — A 3 x 6 factorial experiment in randomized block design with 5 replications was established to test effects of photoperiod and growth retardants on own root *Gardenia jasminoides* 'Veitchii'. Photoperiod treatments consisted of 8 (L<sub>1</sub>), 6 (L<sub>2</sub>) and 4 (L<sub>3</sub>) weeks of short days and growth retardant treat-

ments were check (C<sub>1</sub>), 0.125%, 0.25% and 0.50% Cycocel sprays (C<sub>2</sub>, C<sub>3</sub> and C<sub>4</sub>), and 0.50% and 1.00% B-9 sprays (C<sub>5</sub> and C<sub>6</sub>).

One plant per 8" Lerio metal container constituted an experimental unit — plants were the same used in the previous years' work. Plants were fertilized monthly with 50 lbs. N, 10 lbs. P<sub>2</sub>O<sub>5</sub>, and 30 lbs. K<sub>2</sub>O per acre applied in solution monthly as a liquid and provided long day photoperiods until initiation of short days. Plants were grown at a minimum night temperature of 65°F in a clear glass greenhouse at Gainesville, Florida.

Short day photoperiods (plants shaded from 5 p.m. to 8 a.m. daily) were started as follows: L<sub>1</sub> — November 23, L<sub>2</sub> — December 7 and L<sub>3</sub> —

Table 1. Simple effects of chemical growth retardants and photoperiod on flower production of gardenia.

Treatment	Experiment I 'Veitchii' # flowers/pot	Experiment II 'Glazeri' # flowers/pot
C <sub>1</sub> - Check	3.8	7.3
C <sub>2</sub> - Cycocel drench	7.4	10.4
C <sub>3</sub> - .25% Cycocel spray	10.2	9.9
C <sub>4</sub> - .50% Cycocel spray	7.6	10.0
C <sub>5</sub> - .50% B-9 spray	7.8	9.1
C <sub>6</sub> - 1.00% B-9 spray	7.7	8.5
C <sub>1</sub> Vs means of all others	*	**
C <sub>2</sub> Vs means C <sub>3</sub> , C <sub>4</sub> , C <sub>5</sub> , & C <sub>6</sub>	N.S.	N.S.
C <sub>3</sub> & C <sub>4</sub> means Vs means of C <sub>5</sub> & C <sub>6</sub>	N.S.	N.S.
C <sub>3</sub> Vs C <sub>4</sub>	N.S.	N.S.
C <sub>5</sub> Vs C <sub>6</sub>	N.S.	N.S.
L <sub>1</sub> - 6 wks short days	10.5	9.3
L <sub>2</sub> - 4 wks short days	5.8	10.3
L <sub>3</sub> - 2 wks short days	6.0	8.0
L <sub>1</sub> Vs L <sub>3</sub> (Linear)	*	N.S.
L <sub>2</sub> Vs means of L <sub>1</sub> and L <sub>3</sub> (Quadratic)	N.S.	**

\* Significant at .05 level of probability

\*\* Significant at .01 level of probability

N.S. - Non significant

December 29, 1966 at which times plants also received a single application of growth retardant. Short days were terminated January 18 and plants grown under long days (plants lighted from 10 p.m. to 2 a.m. daily) until they bloomed.

As plants flowered, both number of flowers and blooming date were recorded and data statistically analyzed by the analysis of variance method and treatment comparisons made by single degrees of freedom.

#### RESULTS AND DISCUSSION

Certain of the chemical treatments caused notable differences in plants during both years' experiments. Cycocel spray treatments, par-

ticularly higher rates, caused a chlorosis of foliage within a day after treatments. In each instance, newer foliage developed a mottled appearance with yellowish irregular spots appearing within green areas. In a few cases some of the affected leaves turned almost completely yellow with only a few irregular green areas remaining. However, within a few weeks after treatment, green pigmentation reappeared in yellowish areas and the mottled appearance disappeared. Final salability was not affected in any way.

Both B-9 treatments produced plants with darker foliage than the check and Cycocel treatments which were similar. At the highest rate of B-9 (1.00%) some foliage distortion occurred

Table 2. Simple effects of chemical growth retardants and photoperiod on number of days required for 50% of flowers to bloom after termination of short day treatments on Gardenia jasminoides 'Veitchii'.

Experiment I		Experiment III	
Treatment	1965-1966 No. Days	Treatment	1966-1967 No. Days
C <sub>1</sub> - Check	99.5	C <sub>1</sub> - Check	89.3
C <sub>2</sub> - Cycocel drench	100.7	C <sub>2</sub> - 0.125% Cycocel spray	85.6
C <sub>3</sub> - 0.25% Cycocel spray	96.2	C <sub>3</sub> - 0.25% Cycocel spray	89.9
C <sub>4</sub> - 0.50% Cycocel spray	96.5	C <sub>4</sub> - 0.50% Cycocel spray	85.4
C <sub>5</sub> - 0.50% B-9 spray	98.1	C <sub>5</sub> - 0.50% B-9 spray	92.9
C <sub>6</sub> - 1.00% B-9 spray	98.7	C <sub>6</sub> - 1.00% B-9 spray	92.4
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C <sub>1</sub> Vs means of all others	N.S.	C <sub>1</sub> Vs means of C <sub>2</sub> , C <sub>3</sub> & C <sub>4</sub>	N.S.
C <sub>2</sub> Vs means of C <sub>3</sub> , C <sub>4</sub> , C <sub>5</sub> , & C <sub>6</sub>	N.S.	C <sub>2</sub> , C <sub>3</sub> & C <sub>4</sub> means Vs means of C <sub>5</sub> & C <sub>6</sub>	**
C <sub>3</sub> Vs C <sub>4</sub> means Vs means of C <sub>5</sub> & C <sub>6</sub>	N.S.	C <sub>3</sub> Vs means of C <sub>2</sub> & C <sub>4</sub>	N.S.
C <sub>3</sub> Vs C <sub>4</sub>	N.S.	C <sub>5</sub> Vs C <sub>6</sub>	N.S.
C <sub>5</sub> Vs C <sub>6</sub>	N.S.	C <sub>3</sub> Vs C <sub>4</sub>	N.S.
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L <sub>1</sub> - 6 wks short days	90.1	L <sub>1</sub> - 8 wks short days	82.6
L <sub>2</sub> - 4 wks short days	101.7	L <sub>2</sub> - 6 wks short days	87.8
L <sub>3</sub> - 2 wks short days	103.1	L <sub>3</sub> - 4 wks short days	97.3
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L <sub>1</sub> Vs L <sub>3</sub> (Linear)	**	L <sub>1</sub> Vs L <sub>3</sub> (Linear)	**
L <sub>2</sub> Vs means of L <sub>1</sub> & L <sub>3</sub> (Quadratic)	**	L <sub>2</sub> Vs means of L <sub>1</sub> & L <sub>3</sub> (Quadratic)	N.S.

\*\* Significant at .01 level of probability

N.S. - Non significant

on 'Veitchii' and flower buds appeared doubled but were normal when open with new foliage somewhat crinkled.

No significant interactions were found between light and chemicals in the 3 experiments.

*Experiment I* — Plants treated with Cycocel and B-9 sprays produced more flowers than check plants (Table 1). Although C<sub>3</sub> had the highest number of flowers per pot it was not better than other chemical treatments; probably due to the high plant to plant variation within the clone. The drench treatment of Cycocel was similar to the 0.25 and 0.50% Cycocel sprays in its effect on flower production (Table

1), indicating no advantage to this method of treatment which had been used in previous experiments (1, 5).

Plants exposed to 6 weeks of short days produced more flowers than those receiving 2 weeks (Table 1), indicating a linear response to duration of short day treatments. These data are in agreement with earlier work (1, 4) on photoperiod effects on *Gardenia jasminoides* 'Veitchii'.

Application of growth retardant chemicals did not affect the date when 50% of the flowers in each treatment had bloomed, but this was affected by photoperiod (Table 2). Response to

Table 3. Simple effects of growth retardants and photoperiod on flower production of *Gardenia jasminoides* 'Veitchii'.

Treatment	Experiment III # flowers/pot
C <sub>1</sub> - Check	16.0
C <sub>2</sub> - 0.125% Cycocel spray	25.1
C <sub>3</sub> - 0.25% Cycocel spray	31.1
C <sub>4</sub> - 0.50% Cycocel spray	25.5
C <sub>5</sub> - 0.50% B-9 spray	16.9
C <sub>6</sub> - 1.00% B-9 spray	18.5
C <sub>1</sub> Vs means of C <sub>2</sub> , C <sub>3</sub> & C <sub>4</sub>	*
C <sub>2</sub> , C <sub>3</sub> , C <sub>4</sub> means Vs means of C <sub>5</sub> & C <sub>6</sub>	*
C <sub>3</sub> Vs means of C <sub>2</sub> and C <sub>4</sub>	N.S.
C <sub>5</sub> Vs C <sub>6</sub>	N.S.
C <sub>3</sub> Vs C <sub>4</sub>	N.S.
L <sub>1</sub> - 8 wks short days	23.7
L <sub>2</sub> - 6 wks short days	19.6
L <sub>3</sub> - 4 wks short days	23.3
L <sub>1</sub> Vs L <sub>3</sub> (Linear)	N.S.
L <sub>2</sub> Vs means of L <sub>1</sub> and L <sub>3</sub> (Quadratic)	N.S.

\* Significant at .05 level of probability

N.S. - Non significant

photoperiod was linear between  $L_1$  and  $L_3$  indicating a reduction in time to bloom from additional short day treatment. However, the major benefit occurred between  $L_1$  and  $L_3$  since a quadratic relationship also existed.

*Experiment II*—Plant to plant variation within the 'Glazeri' clone of *Gardenia jasminoides* was considerably less than with 'Veitchii'. Plants treated with growth retardants produced more flowers per plant than the check, but there was no difference between growth retardant treatments (Table 1).

Plants exposed to 4 weeks of short days produced more flowers than those exposed for 2 or 6 weeks. An increase in number of flowers produced under 4 weeks versus 2 weeks of short day treatment has been previously reported for *Gardenia jasminoides* 'Veitchii' (4). However, the quadratic relationship existing in this experiment seems unexplainable from the data. Possibly this variety requires a short day treatment even greater than 6 weeks since it is considered a late blooming variety.

Application of growth retardant chemicals and short day treatments had no effect on the date when 50% of flowers had opened.

*Experiment III*—In this the second years' experiment Cycocel drench was dropped because it was no more effective than spray treatments in the previous year and was more difficult to apply. A 0.125% Cycocel spray was substituted for it.

Plants treated with Cycocel produced more flowers than check plants (Table 3). The difference in number of flowers was great, but considerable difference was expressed within the clone due to biological variation. Cycocel treatments were also better than B-9 treatments in-

dicating B-9 treatments were no better than the check in this case.

Application of Cycocel had no effect on the date when 50% of the flowers in each pot had bloomed, while B-9 delayed time to bloom by approximately 6 days (Table 2). Larson (3) reported delay in flowering date for B-9 treatments on poinsettias and Shanks and Link (7) reported the same for azaleas.

A linear decrease in time required for 50% bloom occurred when short day treatments were increased from 4 to 8 weeks (Table 2). The additional 4 weeks of short days decreased time to bloom from termination to short days by approximately 15 days. These data indicate that growers might closely control bloom date by manipulating length of short day treatment.

Considerable visible differences in plant size were noticeable between treatments. The check treatments averaged 43 inches in width by 19 inches high, Cycocel treatment 28 inches wide by 13 inches high and B-9 treatments 23 inches wide by 13 inches high (Fig. 1, 2 and 3).

#### LITERATURE CITED

1. Joiner, J. N. and R. T. Poole. 1962. Variable photoperiod and CCC effects on growth and flowering of *Gardenia jasminoides* 'Veitchii'. Proc. Fla. State Hort. Soc. 75: 449-451.
2. Kiplinger, D. C., R. O. Miller and H. K. Tayama. 1966. Growth regulators. Florists' Review. 139(3597): 52, 107-113.
3. Larson, R. A. 1967. Chemical growth regulators and their effects on poinsettia height control. North Carolina Agri. Exp. Sta. Tech. Bul. 180.
4. Laurie, A., D. S. Kiplinger and K. S. Nelson. 1958. Commercial flower forcing. pp. 509, McGraw-Hill, New York.
5. Poole, R. T. 1963. Effects of gibberellic acid and 2-chloroethyl trimethylammonium chloride on growth and flowering of *Gardenia jasminoides* 'Veitchii'. Proc. Fla. State Hort. Soc. 76: 474-477.
6. Rose, S. A. and R. D. Dickey. 1960. The effects of light plunging medium and fertilization on bud set of *Gardenia jasminoides* 'Veitchii'. Proc. Fla. State Hort. Soc. 73: 362-363.
7. Shanks, J. B. and C. B. Link. 1968. Some factors affecting growth and flower initiation of greenhouse azaleas. Proc. Amer. Soc. Hort. Sci. 92: 603-614.