5. Post, Kenneth. 1959. Florist Crop Production and Marketing. Orange Judd Publishing Co., Inc. New York.
6. Sax, K. 1955. The effect of ionizing radiation on plant growth. Amer. Jour. of Bot. 42:360-364.
7. Shear, C. D., H. L. Crane and A. T. Myers. 1946. Nutrient element balance: A fundamental concept in plant nutrition. Proc. Amer. Soc. Hort. Sci. 47:239-248.
8. Stapleton, G. E., D. Billen, and A. Hollaender. 1953. Recovery of X irradiated bacteria at suboptimal incubation temperatures. J. Cell Comp. Physiology 41:345-357.
9. Steffensen, Dale. 1958. Chromosome aberrations in calcium deficient **Tradescantia** produced by irradiation. Nature 182:1750-1751.
10. Storer, J. B. and L. H. Hempelmann. 1952. Hypothermia and increased survival rate of infant mice. Am. Jour. Physiol. 171:341-348.
11. Stubbe, H. and H. Doring. 1938. Untersuchungen uber experimentalle Auslosung von Mutationen bei **Antirrhinum majus.** Biol. Abs. 14:88.

GROWTH AND FLOWERING OF BOUGAINVILLEA GLABRA 'SANDER' AS AFFECTED BY PHOTOPERIOD AND LEVELS OF NITROGEN AND POTASSIUM

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Erratic flowering habits of bougainvilleas in Florida have been credited largely to their nitrogen sensitivity. Amateur and professional horticulturists for many years have recommended low nitrogen and generally high potassium fertilization for best flowering response. The general belief has been that high nitrogen applications produced luxuriant growth with sparse to no flowering. Many nurserymen have discontinued growing this tropical plant due to their inability to control flowering.

As early as 1935 Allard (1) found that *Bougainvillea glabra* was a short day plant, forming flower buds at 12 or fewer hours of light at temperatures from 70 to 75° F. Plants given 12 hour photoperiods in Washington, D. C., beginning in May flowered in 110 days. Those receiving 10 hour photoperiods produced more flowers and bloomed in 54 days. Post (3) found (in Ithaca, N. Y.) normal flower budding period for *B. glabra* 'Crimson Lake' under greenhouse conditions was from September 20 to October 1. Good Christmas bloom was obtained by shading from August 15. He credited the long blooming period of this plant in Florida to high temperatures and long periods of short days for flower bud formation.

The ability to control flowering of this plant and grow it in a compact vigorous condition would provide a potentially profitable flowering pot plant to the nursery trade. This experiment was established to investigate some cultural and environmental conditions that affect bougainvillea flowering.

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METHODS AND MATERIALS

A 3x3x2 factorial experiment using a split-plot design was initiated to test effects of three levels each of N and K_2O and two photoperiods on the growth and flowering of *Bougainvillea glabra* 'Sander.' Main plot treatments consisted of two photoperiods—9 and 18 hours. Subplot treatments included randomly placed factorial combinations of N and K. N was provided from ammonium nitrate at rates of 0 (N_1), 100 (N_2) and 300 (N_3) pounds of N per acre per year. K_2SO_4 was used to provide 0 (K_1), 50 (K_2) and 100 (K_3) pounds of K_2O equivalent per acre per year. Two 8-inch pots containing one plant each constituted the experimental unit and treatments were replicated 4 times.

Rooted cuttings were planted October 10, 1961, in a potting soil composed of two parts sand, one part peat and one part perlite. Three pounds of superphosphate per cubic yard was mixed to supply phosphorus. All plants were placed under long day conditions until variable photoperiod treatments were begun October 23. Plants receiving short day treatments were covered with black sateen cloth from 5 p.m. to 8 a.m. nightly, and long day plants received supplemental light from incandescent bulbs from 5 p.m. until 1 a.m. Terminal buds were pinched October 28, and all plots watered twice weekly. Fertilizer applications were started November 6 and repeated at one month intervals.

This phase of the experiment was terminated January 10, 1962. Growth index measurements (height + width $\div$ 2) were taken October 27, 1961, and subtracted from the growth index at termination of the experiment. Quality was graded to standards scaled from 1 to 5 (1—poor and 5—superior). At weekly intervals counts were made of bracts which had reached ½ inch or longer since the preceding count. Weekly counts were tallied to give a final total number of flowers per treatment.

Results

Vegetative growth of the plants was unaffected by photoperiods, but there was an interaction effect between N and K (Table 1). At the low K level the high level of N increased growth significantly as compared with the other two levels. N_3 produced more growth than N_1 at the medium K level; but when high potassium was provided, each increment of N resulted in a highly significant increase in growth.

Only plants receiving short day treatments flowered during this experiment, and on these plants nitrogen produced a significant flowering effect. Mean bract count per plant receiving N_1, N_2 and N_3 was 29.1, 35.2 and 61.6, respectively. LSD required for significance was 19.3 at the .05 level of probability and 26.2 at the .01 level. Figure 1 shows the weekly bract counts.

Plant quality was affected by N levels only. Average grade for plants getting low, medium and high N levels was 2.1, 2.5 and 3.5, respectively. LSD required for significance was 0.5 at the 1% level of probability.

TABLE I. EFFECTS OF N AND K ON TOTAL GROWTH IN CENTIMETER OF POTTED BOUGAINVILLEA GLABRA 'SANDER'. JANUARY 10, 1962

K Levels ppa Per Year	N Levels - ppa Per Year N_1 0	N_2 100	N_3 300	K Level Means
K_1 - 0	7.5	9.6	14.4	10.5
K_2 - 50	8.1	10.3	13.5	10.6
K_3 - 100	4.9	10.9	23.3	13.0
N Level Means	6.8	10.3	17.1	
LSD		.05	.01	
Between Means within Table		3.9	5.3	

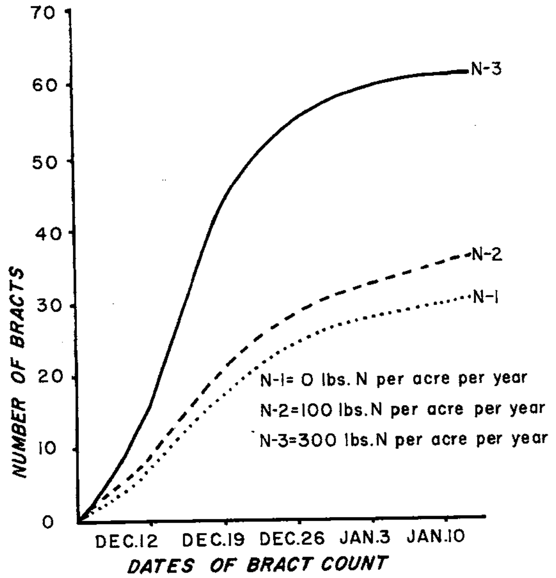

FIGURE I. Effects of nitrogen levels on average weekly bract count on Bougainvillea glabra, 'Sander', from December 12, 1961, to January 10, 1962.

Discussion

Photoperiod had no effect on growth, due probably to the indeterminate flowering habit of bougainvillea. Flowering bracts are borne singly or in panicles on peduncles which arise at the axil of leaf petioles and stem. Apparently there is no separation of growth and flowering response due to photoperiod, which is in general agreement with responses of tuberous-rooted begonias (3).

When nitrogen was raised from N_1 to N_3 at all levels of K more growth occurred, with the most significant increases and largest total growth occuring at K_3. This generally agrees with work by Joiner and Smith (2) on chrysanthemums indicating that as N supply is increased demand for K by plants is increased.

This work confirms the work of Allard (1) and Post (4) that *B. glabra* is photoperiodically sensitive and within restrictions of temperature interactions can be flowered at any time during the year.

The fact that increased nitrogen very significantly increased flowering on this plant—which refutes most of the previous literature on this subject—is logical when the flowering characteristics of this plant is considered. *B. glabra* blooms from leaf axils of new growth only; therefore, higher nitrogen levels which promote more vegetative growth would provide more potential flowering surface.

One group of plants receiving the various fertilizer treatments were placed under natural daylengths for observation. Since this photoperiod treatment was not replicated, statistical comparisons could not be made with the experimental results. However, those under natural daylengths did not begin to flower until about four months after treatment initiation or approximately four weeks after beginning of peak flowering of the short day plants, and maximum flowering occurred during late March and early April. As with plants in the other photoperiod treatments, those receiving the highest rates of nitrogen flowered the most profusely.

For this report terminal data were taken January 10, 1962. At time of this writing the experiment is continuing with higher levels of nitrogen, and final data will not be taken for several weeks. During summer months, however, those plants receiving short day treatments continued to flower profusely (high N treatments), whereas those under long and natural days did not produce more than an occasional flowering bract.

Summary

A 3x3x2 factorial experiment with a split-plot design and four replications was established with photoperiods of 9 and 18 hours as main plots and combinations of three N and K_2O levels as subplots. N was applied at 0, 100 and 300 and K_2O at 0, 50 and 100 pounds per acre per year.

Photoperiod did not affect vegetative growth, but growth increases occurred at *all* levels of K as N was increased to N_3—the most significant increase occurring at K_3.

Flowering buds on plants receiving long day treatments abscissed, while plants under short days flowered abundantly. More flowering bracts developed at the high N level than at the lower levels, and K had no effect. Increasing N improved quality grade.

Literature Cited

1. Allard, H. A. 1935. Response of the wood plants **Hibiscus syriacus, Malvaviscus** conzatti, and Bougainvillea glabra to length of day. Jour. Agr. Res. 51:27-34.

2. Joiner, J. N. and T. C. Smith. 1962. Effects of nitrogen and potassium levels on the growth, flowering responses, and foliar composition of **Chrysanthemum morifolium** 'Bluechip.' Proc. Amer. Soc. Hort. Sci. 80:571-580.

3. Lewis, Charles A. 1953. Further studies on the effects of photoperiod and temperature on growth, flowering and tuberization of tuberous-rooted begonias. Proc. Amer. Soc. Hort. Sci. 61:559-568.

4. Post, K. 1942. Effects of daylength and temperature on growth and flowering of some florist crops. N. Y. Cornell Agr. Exp. Sta. Bul. 787.

VARIABLE PHOTOPERIOD AND CCC EFFECTS ON GROWTH AND FLOWERING OF GARDENIA JASMINOIDES 'VEITCHII'

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Introduction

One and two year old *Gardenia jasmoinoides* plants are in demand as pot plants for certain holidays, especially Easter and Mother's Day. Several commercial growers in Florida are producing gardenias for pot plant use, but have difficulty flowering them on schedule.

Gardenias flower in greenhouses in colder northern climates the entire year, but bloom only in late winter and early spring in the south. Any treatment that will increase the number of flowers per plant and advance its blooming date so it can be sold during the winter holiday season will increase the value of this crop to the south.

This experiment was designed to test effects of combinations of long nights and (2-chloroethyl) trimethylammonium chloride, CCC, on flowering and growth of *Gardenia jasminoides*, 'Veitchii.'

Review of Literature

Baird and Laurie (1) produced flowers by December 15 in Columbus, Ohio, by using short days from July to the middle of September (ten weeks) and using supplemental light beginning December 7. A minimum night temperature of 58 degrees F. was maintained from September 15 to October 10. McElwee (2) advanced the flowering date of one year old gardenias by use of lights and 50 degree night temperature. The quality and total production of blooms were not affected. Young plants did not respond to long day treatments until warm days of late winter and spring. He reported that two year old plants given additional light beginning September 15 bloomed December 16. Plants lighted from September 15 and October 1 consistently produced more blooms than untreated ones and those lighted from September 1 or November 1. Lighting beginning September 1, September 15, October 1 and November 1, advanced the blooming date 90, 87, 60 and 44 days, respectively.

Witter and Tolbert (4) reported that 10^{-3}M solution of CCC applied to the roots of tomato plants promoted earlier flowering. Earlier tillering was produced on wheat by the use of CCC (3).

Materials and Methods

A 3x3 factorial experiment in split plot design was initiated June 1, 1962, involving long nights and time of CCC application. Treatments were

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