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EFFECTS *of* LIGHTING *and* SHADING *on* FLOWERING *of* CERTAIN FLORIST CROPS UNDER SOUTHERN CONDITIONS

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EFFECTS *of* LIGHTING *and* SHADING *on* FLOWERING *of* CERTAIN FLORIST CROPS UNDER SOUTHERN CONDITIONS

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BASIC research of Garner and Allard *(3)* in 1920 established the fact that length of day affected the time of flowering and growth of plants. This fact has since been developed by Laurie, Poesch, Post, and others *(4, 5, 7, and 11)* into practical methods of regulating the time of flowering of florist crops under northern conditions by artificially controlling the length of day. Since very little has been done in this field in the South, work was started at the Alabama Agricultural Experiment Station, Auburn, in 1936, to study the response and determine the time and length of treatment required to induce certain florist crops to flower at given periods when grown under southern conditions.

This bulletin presents the results obtained from experiments with the China-aster, chrysanthemum, gardenia, calendula, feverfew, kalanchoe, primrose, Shastadaisy, and stock during the period 1936 to 1943, inclusive. It may be used as a guide for day-length treatments to control the time of flowering of the listed florist crops under southern conditions; to extend the blooming season of desirable crops and varieties; to insure a constant supply of fresh flowers, which at present are supplied by other sections; and to regulate the time of flowering of florist crops in order to avoid periods of oversupply.

REVIEW OF BASIC LITERATURE

Only the research of Garner and Allard *(3)*, reported in 1920, will be reviewed here, as the work of a large number of investigators since then has not materially changed the basic principles established by this early research.

Garner and Allard conclude from their work that the length of

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day is a factor of first importance in the growth and flowering of plants. Except under extreme conditions, differences in temperature, moisture supply, and light intensity appear to only hasten or retard sexual reproduction, while the length of day may cause a definite expression in initiating the reproductive process or inhibiting it, depending on whether the day length is favorable or unfavorable to sexual reproduction of the species or variety. An unfavorable day-length causes continued vegetative growth. The length of day required to induce flowering and fruiting varies with the species and variety. Many species and varieties flower and fruit only when the length of day falls within certain limits, while others flower under all lengths of day. Plants can be classified into three groups: those that respond to relatively long-day lengths, those that respond to relatively short-day lengths, and those that respond to all-day lengths. The seasonal range of day-length is a factor in the natural distribution of plants, since the interrelation of length of day and winter temperatures largely control the ability of many species of plants to reproduce and survive in a given region.

Later work by other investigators has been concerned primarily with studying the response of other plants to various length of day treatments, developing practical methods of artificially controlling length of day, determining length and time of treatment required to induce flowering at a specific time, and determining the influence of length of day on growth of various species and varieties of plants.

BASIS FOR DIFFERENCE IN RESPONSE IN NORTH AND SOUTH

Figure 1 shows that the day-length at Montgomery, Alabama, latitude 32° N. varies from 10 hours and 5 minutes on December 21 to 14 hours and 15 minutes on June 21, a difference of 4 hours and 10 minutes between the shortest and longest day. Day-length at Ithaca, New York, latitude 42° N, on the same dates is 9 hours and 10 minutes for the shortest day and 15 hours and 40 minutes for the longest day, a difference of 6 hours and 30 minutes. This difference of 2 hours and 20 minutes in the day-length of the shortest and longest days between Montgomery and Ithaca is important, since it has been shown *(1, 11)* that certain florist crops respond to a difference in day-length of 30 minutes. Day-length at Montgomery is shorter from March 21 to September 21

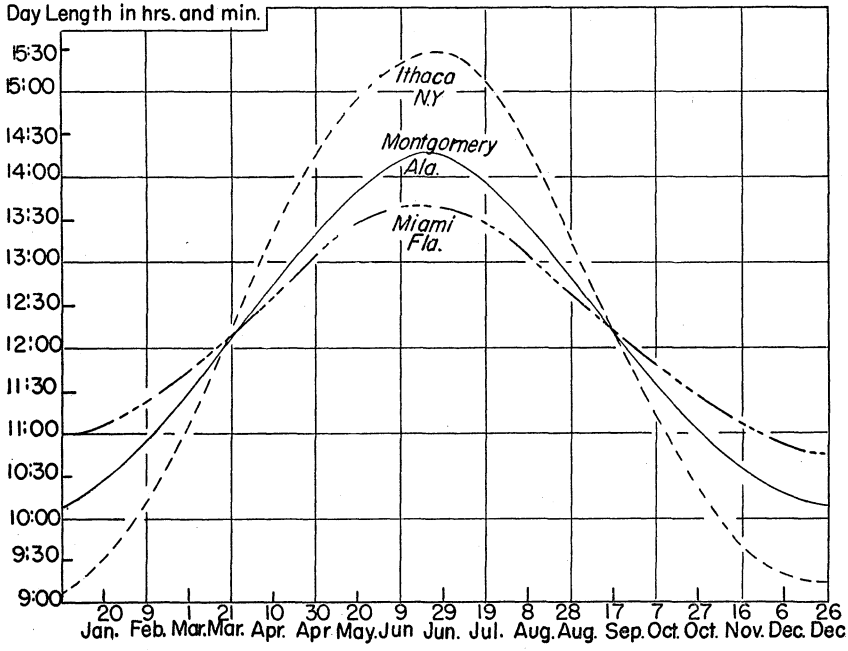

FIGURE 1. Day-length curves for Miami, Fla., Montgomery, Ala., and Ithaca, N. Y. Data for Ithaca are from Cornell Agricultural Experiment Station Bulletin No. 787; for Montgomery and Miami, from United States Weather Bureau records.

and longer from September 21 to March 21 than the day-length at Ithaca. Other things being equal, short-day plants that initiate bud before September 21 would be expected to bloom earlier at Montgomery than at Ithaca, and short-day plants that initiate bud after September 21 would be expected to bloom later at Montgomery than at Ithaca. Long-day plants would be expected to show a reverse response. Post *(11)* states that chrysanthemums initiate buds at Ithaca from August 15 to 25, or during a day-length period of 13 hours and 20 minutes to 13 hours and 50 minutes. This same day-length period at Montgomery would be reached between July 20 and August 10. Data presented in Table 4 show that varieties of chrysanthemums bloom from 26 days earlier to 9 days later at Auburn, Alabama, than the cataloged date for central Ohio.

CLASSIFICATION OF PLANTS AS TO RESPONSE TO DAY-LENGTH

LONG-DAY PLANTS. A long-day plant may be defined as one that begins to flower or in which flowering is hastened by a long-

day-length, or one that ceases to flower or in which flowering is retarded by a short day-length.

The following are some of the more important florist crops that have been shown *(1, 3, 4, 7, 10, 11)* to respond favorably to lighting:

Boston Yellow Daisy	Feverfew	Primrose
Calceolaria	Gardenia	Scabiosa
Calendula	Iris	Shastadaisy
China-aster	Larkspur	Snapdragon
Cornflower	Lily	Stock
Dahlia	Pansy	

Short-day Plants. A short-day plant may be defined as a plant that begins to flower or in which flowering is hastened by a short day-length, or one in which flowering ceases or is retarded by a long day-length.

The following are some of the more important florist crops that have been shown *(1, 3, 4, 7, 10, 11)* to respond favorably to shading:

Bouvardia	Melior Begonia
Chrysanthemum	Poinsettia
Eupatorium	Stevia
Kalanchoe	

Controlling Day-Length Artificially

Long-day Treatment. As a commercial practice, long-day treatment consists of lighting the plants from sundown to 10 p.m. each day during the treatment. Certain crops may respond to a shorter period of lighting, but it is more practical to turn the lights on and off either by hand or by a time clock at a set period than to vary the lighting period for each individual crop. Clear or frosted Mazda bulbs are used with a suitable reflector to direct the light downward and to prevent loss of light to the sides of the benches or beds. Lights are normally spaced 2 to 3 feet above the plants and 4 to 5 feet apart. The wattage should supply 2 to 5 foot-candles of light for most plants. Bulbs of 50 to 75 watts spaced 5 feet apart and 2 feet above will supply sufficient light for most plants. Chrysanthemums and gardenias should be given 10 to 15 foot-candles of light; 100- to 150-watt bulbs spaced 5 feet apart and 2 feet above the plants will provide sufficient light. Some commercial concerns use permanent installations of large reflectors and high wattage bulbs spaced

along the roof of the greenhouse. Such an installation should be made by a qualified person, and so installed as to give even distribution of the foot-candles of light required by the plants to be grown.

Long-day treatment may be used to delay the time of flowering of short-day plants. With these plants, the light is applied before the flower buds form and is continued approximately as long as desired to delay flowering. Long-day treatment may be used to hasten the flowering of long-day plants. With these the light is not applied until the plants have made the desired vegetative growth and is continued until the plants are in bud or bloom.

Since light treatment may affect time of bloom of adjacent crops, it is important to protect them from the lights. Black cloth shade or other screening is often necessary to separate the lighted areas from other areas.

SHORT-DAY TREATMENT. As a commercial practice, short-day treatment is provided by completely covering or darkening the plants with a light-tight material from 5 p.m. to 7 a.m. each day to provide a 10-hour day. Double use may be made of the cloth with satisfactory results by shading the area from 3 p.m. until dark, moving the cloth to another area after dark and leaving it until 8 a.m. Afternoon and morning shading may be alternated to equalize the light and temperature effects on the plants.

Black sateen cloth with a thread count of 64x104 is most generally used for shading. Any one of several other materials may also be used, including rubberized cloth (Appendix Table 2), canvas, and plain and reinforced papers. It is difficult to completely darken plants with papers. This accounts in part for the popularity of black sateen cloth. It is not advisable to use a cheap grade or thin cloth. To be effective the cloth must not admit more than 2 foot-candles of light. Thickness of the cloth is particularly important for early shading. Strong sunlight during the summer and early fall is difficult to exclude by shading, and failure to secure desired results is often due to not excluding enough light.

Rubberized cloth has the advantage of providing better rain protection for chrysanthemums or other flowers grown in the cloth house or in the open. However, it is heavy and is difficult to handle and repair.

In the South it is not advisable to make a stationary enclos-

ure of building papers along the sides and ends of plant beds to reduce the amount of black cloth required for shading. Particularly is this true with chrysanthemums. The use of such a structure provides conditions favorable to diseases, which may cause severe damage.

RESPONSE OF SOME MAJOR FLORIST CROPS TO LIGHTING AND SHADING

The work reported herein covers the period of 1936 to 1943, inclusive. Not all crops, however, were tested during each year.

CHINA-ASTER

The southern market is now supplied quite largely with China-asters, *Callistephus chinensis,* shipped from California, even though this plant is well adapted to production under cloth in the South. Production has been limited in the South because of the prevalence of aster wilt, a lack of varieties resistant to southern strains of aster wilt, and the lack of facilities for sterilizing the soil. Except where grown on a new soil area or where the soil has been sterilized, it is difficult to mature a crop of China-aster because of this disease.

Prior to 1936 China-asters were brought into bloom 1 to 3 weeks earlier by shading the plants after planting at Columbus, Ohio *(10).* Post *(11)* reports that China-asters normally formed buds between July 25 and August 5, that they formed buds between September 1 and May 1 when lighted, and that shading to a day-length of less than 14 hours hastened bud development.

PRELIMINARY STUDY. Results of a preliminary study made in 1936 at Auburn, Alabama, are given in Table 1. In this study various day-length treatments were used on several varieties of China-asters grown under cloth. The seedlings were lighted with 100-watt Mazda bulbs spaced 5 feet apart and 2 feet above the plants. The light was applied from 5 p.m. to 10 p.m. daily. Results indicated that lighting in the seedling stage was more effective in producing early flowering in the China-aster than was shading during later stages of growth. The Royal varieties of China-asters came into bloom on an average of 13 days earlier when shaded than untreated plants, and 27 days earlier when lighted. The Queen of the Market varieties when lighted bloomed an average of 49 days earlier than untreated plants. Laurie

and Link (*8*) in 1938 reported similar results at Columbus, Ohio. They found that lighted seedlings on an average bloomed 13 days earlier than untreated plants, and that plants shaded during the later stages of growth bloomed an average of 6 days earlier than those in the check treatment.

STUDIES WITH EARLY, MIDSEASON, AND LATE VARIETIES. An additional study was made with China-asters in 1937 to determine the effect of various times and lengths of light treatment on earliness and yield. Early, midseason, and late varieties were used.

TABLE 1. INFLUENCE OF LIGHTING AND SHADING ON EARLINESS, DIAMETER OF FLOWER AND STEM LENGTH OF SEVERAL VARIETIES OF CHINA-ASTER, AUBURN, ALABAMA, 1936

Variety	Treatment	Number of plants	Date of flower	Flowering advanced	Diameter flower	Stem length
				Days	*Inches*	*Inches*
Royal White	Check	40	7/1	0	2.3	19
	Lighted 3/3 to 4/16	32	6/2	29	2.2	11
	Shaded from 5/27	103	6/22	9	2.1	14
Royal Shell Pink	Check	14	7/6	0	2.5	18
	Lighted 3/3 to 4/16	30	6/12	24	2.5	15
	Shaded from 5/27	46	6/19	17	2.0	12
Queen of Market White	Check	22	7/13	0	2.3	13
	Lighted 3/3 to 4/16	22	5/29	45	2.2	11
Queen of Market Flesh Pink	Check	33	7/20	0	1.3	13
	Lighted 3/3 to 4/16	35	5/29	52	2.0	9

TABLE 2. INFLUENCE OF LIGHTING IN SEEDLING STAGE ON EARLINESS IN THE CHINA-ASTER, AUBURN, ALABAMA, 1937

Planting date	Light treatment		Early varieties		Midseason varieties		Late varieties	
	Length	Date	Av. flowering date	Flowering advanced	Av. flowering date	Flowering advanced	Av. flowering date	Flowering advanced
				Days		*Days*		*Days*
Feb. 3	None	Check	6/24	0	7/7	0	8/13	0
	4 weeks	2/10-3/10	5/7	48	5/11	57	5/16	89
	6 weeks	2/10-3/24	5/8	47	5/13	55	5/19	86
	7 weeks	2/10-3/31	5/13	42	5/15	53	5/21	84
	7 weeks	2/24-4/14	5/22	33	5/24	44	5/26	79
Feb. 17	None	Check	7/6	0	7/17	0	8/22	0
	4 weeks	3/17-4/14	6/6	30	6/6	41	6/9	74
	6 weeks	3/3 -4/14	5/30	37	5/28	50	6/7	76
	7 weeks	2/24-4/14	5/30	37	5/28	50	6/5	78
	8 weeks	2/17-4/14	5/28	39	5/27	51	5/28	88

The early varieties were American Beauty Rose, American Beauty White, Ball Deep Purple, and Crego Deep Rose; the midseason varieties were American Beauty Purple, Ball Deep Rose, California Giant Purple, and Royal White; and the late varieties were Crego Azure Blue and Ball White Late. Seed of all varieties were sown on February 3 and 17. Treatments given the plants are listed in Tables 2 and 3.

The treated plants were lighted with 100-watt Mazda lamps spaced 5 feet apart and 2 feet above the plants on a 3½ foot bench. The lights were applied from 5 p.m. to 10 p.m. daily. All plants were transplanted to a cloth house April 14.

The results presented in Table 2 show that early, midseason, and late varieties responded progressively in earliness to lighting in the seedling stage; *i.e.*, late varieties that normally bloom on an average of 43 days later than the early varieties bloomed only ½ to 1½ weeks later than early varieties when lighted in the seedling stage. The same varieties bloomed on an average of 9 days earlier when seeded February 3 than when seeded February 17.

Lighting for 4 weeks, from February 10 to March 10, was the most effective treatment in inducing early flowering in plants seeded February 3; lighting for 6 weeks beginning on the same date was slightly less effective. The most effective treatment for plants seeded February 17 consisted of lighting for 8 weeks from date of seeding to April 14. For early and midseason varieties, lighting for 6 weeks, from March 3 to April 14, was almost as effective in inducing earliness as lighting for 8 weeks.

Results, presented in Table 3, show that lighting for 4 weeks in the seedling stage induced an average reduction in yield from that of unlighted plants of about 44 per cent for plants seeded February 3 and about 18 per cent for plants seeded February 17. On the other hand, lighting for 6, 7, and 8 weeks caused an average reduction in yield of about 31 per cent from plants seeded February 3, and about 12 per cent from plants seeded on February 17. To summarize, lighting the two February seedings of China-asters caused a reduction in yield of 31 per cent when lighted for 4 weeks and 21 per cent when lighted 6, 7, and 8 weeks. Lighting for 4 weeks caused a decrease of about 35 per cent in salable flowers, the reduction being greatest for early varieties sown February 3 and least for late varieties sown February 17.

TABLE 3. INFLUENCE OF LIGHTING IN THE SEEDLING STAGE ON THE YIELD, PERCENTAGE OF SALABLE FLOWERS, AND STEM LENGTH OF THE CHINA-ASTER, AUBURN, ALABAMA, 1937

Variety group	Date of light treatment	Length of light treatment									
		Planted February 3					Planted February 17				
		Check	4 weeks	6 weeks	7 weeks	7 weeks	Check	4 weeks	6 weeks	7 weeks	8 weeks
		None	2/10-3/10	2/10-3/24	2/10-3/31	2/24-4/14	None	3/17-4-14	3/3-4/14	2/24-4/14	2/17-4/14
Early (4 varieties)	Av. no. plants per variety	7	13	12	24	71	10	17	18	23	26
	Av. no. flowers per plant	13.2	6.4	8.5	7.7	6.8	9.2	9.2	8.6	7.8	9.3
	Av. per cent salable	72	17	13	12	52	90	79	69	55	69
	Av. stem length, inches	14.5	8.6	8.3	8.2	10.9	17.9	14.9	13.0	12.4	12.6
Midseason (4 varieties)	Av. no. plants per variety	10	14	14	34	88	8	15	18	35	30
	Av. no. flowers per plant	9.7	6.7	8.7	8.0	7.7	9.8	8.2	10.0	7.9	8.2
	Av. per cent salable	86	46	36	40	40	82	75	70	50	68
	Av. stem length, inches	16.6	11.7	11.0	11.6	10.4	15.3	14.7	13.8	11.3	14.2
Late (2 varieties)	Av. no. plants per variety	8	13	13	29	127	10	17	16	37	38
	Av. no. flowers per plant	13.2	6.7	9.0	8.6	7.3	12.2	7.5	9.8	8.6	9.7
	Av. per cent salable	49[1]	69	56	55	62	53[1]	90	93	60	74
	Av. stem length, inches	11.8	13.1	11.6	11.6	12.0	12.0	18.9	17.0	12.4	14.1

[1]Flowers damaged by aster rust.

In 1939, seed of seven midseason varieties were sown March 27; light treatment was from March 27 to May 18, or 7½ weeks. The average date of bloom was July 12, or 19 days earlier than untreated plants, average blooming date of which was July 31. In 1942, seed of eight midseason varieties were sown February 18; the 8-week light treatment was from March 2 to April 28. Average date of bloom was June 17, or 31 days earlier than untreated plants, average blooming date of which was July 18.

With all factors considered, the best results were obtained from seed sown February 17 and lighted for 6 weeks beginning 2 weeks after seeding. In this treatment early flowering varieties bloomed an average of 37 days, midseason varieties 50 days, and late varieties 76 days earlier than untreated plants. In this treatment there were less reductions in number of flowers per plant, stem length, and percentage of salable flowers.

It is possible to more than double the length of the blooming season of the China-aster by varying the seeding date and by lighting the plants in the seedling stage. A combination of these treatments extended a 7-week blooming season, July 6 to August 22, to a 15-week blooming season, May 8 to August 22. China-asters blooming May 8 to 19 have a ready sale on the northern markets for use on Memorial Day, May 30.

CHRYSANTHEMUMS

The variety of types, forms and colors, and the excellent keeping quality of *Chrysanthemum morifolium* give this flower an almost universal appeal to the customer, retail florist, wholesale florist, and grower alike. For these reasons, there probably has been more experimental work done with lighting and shading the chrysanthemum than any other florist crop. It responds readily to lighting and shading, shading to advance blooming season, lighting to delay blooming season, and a combination of lighting and shading to bring this crop into bloom during the spring and summer months.

Varieties of chrysanthemums that bloom before November 1 can be grown throughout most of the South under cloth. Usually it is not profitable to grow them in the open, since the blooms need some protection from strong sunlight and rain in order to prevent damage and lowering of quality. Plants grown in full sunlight usually have poor foliage, flower color, and stems as compared to plants grown under protecting structures. It is easier

to control humidity and insect pests under a cloth house having both top and side walls. Overhead cloth only, which reduces sunlight about 40 per cent, will improve color and quality of both foliage and flower. Various materials are used in cloth house construction including onion sacking, tobacco cloth, nylon cloth netting, and camouflage cloth. However, camouflage cloth is difficult to handle and most grades give too much shade for best results.

Some type of overhead protection should be given open blooms to prevent damage by rain. Some of the materials used for protecting blooms are overhead sash, waterproof canvas, and glass substitutes on a permanent or temporary frame. If canvas is used it should be placed high enough above the beds to allow effective light to reach the plants in the inside rows. Beds in units of two protected by raised canvas, which permits light to come in from the sides, produce chrysanthemums of satisfactory quality.

Because of more vigorous growth and difficulty in controlling diseases outdoors and under cloth in the South, a wider space between plants should be used for chrysanthemums when grown under cloth. The reduction in yield per square foot due to disease, loss of foliage, and weak stems may be greater than the reduction in yield when the spacing is increased from 8 to 12 inches.

Except those that are to be shaded, varieties selected for the cloth house should be those that will bloom at least 15 days before the average date of the first killing frost. The plants and blooms can be protected from light frost injury by covering with the black cloth used for shading.

TIME OF BLOOM IN THE SOUTH. As listed in Table 4, early varieties of chrysanthemums were considered to be those blooming before October 31, midseason were those blooming November 1 to 20, and late, were those blooming after November 20. The average planting date of these varieties was June 25, with a spacing of 9x9 inches. All plantings of pompon varieties were grown under cloth. The standard and disbud varieties were grown under cloth from 1936 to '41, inclusive, and under lath from 1942 to '43. The late varieties under lath were covered with glass after October 15 and were grown at a temperature of 50° F. or above.

The data presented in Table 4 show that the 40 varieties tested

TABLE 4. DATE OF BLOOM OF CHRYSANTHEMUMS AT AUBURN, ALABAMA, 1936-43

Varieties	Yearly replications	Blooming date: Av. at Auburn	Blooming date: Central Ohio[1]	Days difference[2]
	No.			*No.*
Early				
Arcadia	2	10/25	10/28	−3
Captain Cook	3	10/26	10/20	+6
Chattanooga	1	10/30	11/25	−26
Cora Peck Buhl	4	10/27	10/25	+2
Dainty Maid	2	10/29	11/1	−3
Detroit News	3	10/27	11/1	−5
Firebird	3	10/29	10/25	+4
Gold Mine	3	10/30	11/1	−2
Golden Spray	2	10/20	10/23	−3
Good News	1	10/21	11/1	−11
Irene	3	10/23	10/18	+5
Jewell	4	10/17	10/15	+2
Lilac	1	10/14	10/15	−1
Mefo	1	10/25	11/20	−26
New York	2	10/31	11/13	−13
Norma	1	10/27	11/18	−22
Nubian	4	10/25	10/23	+2
Pink Doty	3	10/23	11/1	−9
Rodell Improved	4	10/18	10/20	−2
Roman Bronze	2	10/22	10/20	+2
Rose Glory	2	10/27	10/20	+7
Sea Gull	1	10/19	11/1	−13
Silver Sheen	2	10/27	10/18	+9
Uvalda	5	10/19	10/10	+9
Yellow Blanche	1	10/28	11/1	−4
Yellow Mefo	2	10/30	11/20	−21
Midseason				
Bronze Masterpiece	1	11/3	11/15	−12
Chicago Pearl	1	11/3	11/15	−12
Gladys Pearson	3	11/7	11/25	−18
Gold Coin	1	11/11	12/1	−20
Honey Dew	3	11/5	11/15	−10
Indianapolis Pink	1	11/3	11/8	−5
Marketeer	1	11/7	11/18	−11
Orchid Beauty	3	11/14	11/15	−1
Rolinda	3	11/10	11/23	−13
Susanne Miller	2	11/11	11/18	−7
Varsity	2	11/5	11/10	−5
White Chieftain	3	11/1	11/1	0
Late				
Cordova	1	11/21	11/30	−9
Tonquin	2	11/29	12/10	−11

[1]Varietal blooming dates listed in commercial catalogues.

[2]Minus (−) = earlier than central Ohio; plus (+) = later than Central Ohio.

during the 8-year period, 1936 to 1943, on an average flowered earlier at Auburn than in central Ohio. Twenty-six early varieties flowered from 26 days earlier to 9 days later, an average of 4 days earlier; 12 midseason varieties flowered from 0 to 20 days earlier, an average of 10 days; and 2 late varieties flowered 9 to 11 days earlier, an average of 10 days earlier.

In general, these findings are in agreement with those of Post *(11, 12)*, who found that chrysanthemums formed flower buds at Ithaca, New York, between August 15 and 25. Figure 1 shows that the day length at Ithaca during the August 15-25

period occurred at Montgomery, Alabama, July 23 to August 6, or 20 days earlier. Post also found that rapidity of flower bud development in chrysanthemum varieties varies greatly with variety because early varieties develop buds faster than late varieties, and that flower bud formation and development is prevented or retarded by a temperature averaging 50° F. Higher southern temperatures during the fall and shorter day length may account, in part, for the fact that chrysanthemums bloom earlier in the South than in the North.

SHADING OR SHORT-DAY TREATMENT. Average planting date of the varieties used in the shading tests was June 25; the plants were spaced 9x9 inches. All plantings were grown in a cloth house from 1936 to '41, inclusive. In 1942 and 1943, the standard and disbud types were grown under lath shade during the summer and fall, and were covered with glass sash October 15 and grown at a temperature of 50° F. or above.

The shading treatment consisted of darkening or shading the plants from 5 p.m. to 7 a.m. each day; black sateen cloth having a thread count of 64x104 per inch was used.

Summarized in Table 5 are the results of an 8-year test, 1936 to '43, conducted at Auburn to determine the response of 43 varieties to various periods of shading. The experiment included 28 early, 13 midseason, and 2 late varieties. The response by varieties to various periods of shading is given in Appendix Table 1.

TABLE 5. RESPONSE OF CHRYSANTHEMUMS TO SHADING AT AUBURN, ALABAMA, 1936-43[1]

Date when shading was started	Days flowering advanced						
	28 early varieties		13 midseason varieties		2 late varieties		Average, all groups
	Range	Average	Range	Average	Range	Average	
July 15	25-50	37	23-63	40	30	30	36
August 1	14-33	25	15-41	28	23-25	24	26
August 15	8-25	16	13-39	21	16-22	19	19
September 1	[2]-16	7	0-17	10	[3]- 8	4	7
September 10	1- 8	4	12-26	19	[4]- 3	1	8
Blooming Range of Untreated Plants	10/17 to 10/30		11/1 to 11/11		11/21 to 11/29		

[1]See Appendix Table 1 for variety response.
[2]Bloomed 3 days later than untreated plants.
[3]Bloomed 2 days later than untreated plants.
[4]Bloomed 1 day later than untreated plants.

TABLE 6. EFFECT OF DATE OF SHADING ON STEM LENGTH, DIAMETER OF FLOWERS, AND YIELD OF REPRESENTATIVE VARIETIES OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Replications	Plants	Check			Shaded from 7/15			Shaded from 8/1			Shaded from 8/15			Shaded from 9/1		
			Flowers			Flowers			Flowers			Flowers			Flowers		
			Per plant[1]	Dia.	Stem length	Per plant[1]	Dia.	Stem length	Per plant[1]	Dia.	Stem length	Per plant[1]	Dia.	Stem length	Per plant[1]	Dia.	Stem length
	No.	*No.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*
STANDARDS																	
Columbus Dispatch	2	17	2.4	3.9	25.0	3.1	3.5	19.8	3.4	3.4	21.5	2.3	3.5	20.1	3.2	3.4	22.2
Gladys Pearson	3	26	2.9	4.6	25.7	2.2	4.0	29.9	2.6	4.0	28.2	2.9	3.5	25.0	2.9	4.5	28.0
Indianapolis Pink	1	23	3.2	3.8	21.0	3.5	3.4	16.7	2.5	3.8	25.2	3.3	2.8	16.5	3.4	3.4	21.2
Marketeer	1	25	3.6	4.0	20.0	3.2	2.9	19.3	2.9	3.1	25.6	3.0	3.0	19.0	3.3	3.6	26.6
Average	1.8	23	3.0	4.1	22.9	3.0	3.5	21.4	2.9	3.6	25.1	2.9	3.2	20.2	3.2	3.7	24.5
DISBUDS																	
Pink Doty	2	32	3.7		27.9	2.4		24.5	2.0		28.3	4.3		16.7	3.4		21.8
Rolinda	3	15	2.8		23.1	2.5		18.9	3.2		20.0	2.6		19.1	2.6		25.5
Yellow Blanche	1	21	5.3		21.2	3.1		20.9	2.2		25.0	3.1		18.3	2.4		20.5
Average	2.0	23	3.9		24.1	2.7		21.4	2.5		24.4	3.3		18.0	2.8		22.6
POMPONS																	
Arcadia	2	18	.43		25.4	.26		20.3	.41		19.2	.47		23.5	.49		27.5
Golden Spray	2	18	.19		17.0	.64		15.7	.25		17.5	.50		24.4	.27		17.0
Jewell	3	20	.23		18.0	.19		14.7	.22		13.3	.49		19.9	.66		16.9
Rodell Improved	2	23	.24		15.0	.28		13.6	.30		18.6	.53		21.6	.31		13.9
Roman Bronze	2	21	.15		24.2	.10		21.5	.10		15.0	.32		29.5	.25		31.6
Average	2.2	20	.25		19.9	.29		17.2	.26		16.7	.46		23.8	.40		21.4

[1]For standards and Disbuds flowers per plant; for pompons 9 ounce bunches per plant.

It will be noted in Table 5 that (1) midseason varieties showed the greatest response and late varieties showed the least average response to shading of all varieties tested; (2) varieties within the three flowering groups varied as much as 40 days in their individual response to shading; (3) normal flowering period of 5 weeks for the varieties tested was increased 7 weeks by shading, the same varieties flowering over a 12-week period; and (4) shading begun July 15, August 1, August 15 advanced the average flowering date approximately 5 weeks, 4 weeks, and 3 weeks, respectively. The flowering period was advanced 1 week in each case when shading was begun September 1 and September 10.

By shading, not only can inferior varieties be eliminated from the planting schedule and be replaced by better varieties but the superior varieties can be brought into flower earlier than the earliest varieties available at the present time. The flowering season can be extended by shading to include late summer. The White Chieftain variety, which normally flowers November 1, bloomed August 30 when shading was begun July 15, Appendix Table 1.

Shading at various dates on representative varieties, Table 6 and Appendix Tables 3 and 4, produced no appreciable difference in yield and quality of standard chysanthemums as measured by number of flowers per plant, diameter of bloom, and stem length. Shading of disbud varieties, however, resulted in an average decrease of 1.1 flowers per plant, and an average decrease of 2.5 inches in stem length. Shading of pompon varieties resulted in an average decrease of .09 bunches per plant, but it did not materially affect stem length.

LIGHTING OR LONG-DAY TREATMENT. The average planting date for the varieties used in the lighting tests was June 25. The plants were spaced 9x9 inches and grown at temperatures ranging from 50° to 55° F.

The light treatment consisted of lighting with 100-watt Mazda bulbs spaced 5 feet apart and 2 to 2½ feet above the plants. The lighting period was from 5 p.m. to 10 p.m. daily during the periods listed in Table 7.

Laurie and Kiplinger *(6)* state that lighting should be started August 10 to prevent flower bud formation. Post *(11)* states that

TABLE 7. RESPONSE OF CHRYSANTHEMUMS TO LIGHTING AT AUBURN, ALABAMA, 1936-43

Variety groups	Light treatment	Length of light period	Varieties in av.	Date of flower		Blooming delayed	
				Av.	Range	Av.	Range
		Days	*No.*			*Days*	*Days*
Early varieties	None	0	20	10/27	10/17-11/8	0	-
	8/30 to 10/8	39	8	12/6	11/30-12/15	36	30-45
	9/1 to 10/15	44	4	11/30	11/27-12/10	37	32-44
	8/16 to 10/20	65	8	12/6	11/29-12/20	41	32-48
	8/30 to 10/20	51	8	12/6	11/24-12/20	40	32-48
	9/10 to 11/1	52	6	12/13	12/2 - 1/4	49	46-69
	9/10 to 11/15	66	3	1/9	12/19- 1/24	74	58-88
Midseason and late varieties	None	0	13	11/10	10/23-11/21	0	-
	8/30 to 10/8	39	3	12/17	12/2 - 1/4	36	27-44
	9/1 to 10/15	44	4	12/10	11/27-12/20	33	21-41
	9/10 to 10/15	35	3	12/27	12/27-	42	36-48
	8/16 to 10/20	65	3	12/18	12/10-12/24	38	35-41
	8/30 to 10/20	51	3	12/16	12/10-12/24	36	35-39
	9/10 to 11/1	52	6	1/1	12/18- 1/9	55	42-61
	9/15 to 11/10	56	4	1/27	1/20- 2/4	75	70-79
	9/15 to 11/20	66	4	2/3	1/26- 2/17	81	76-88

lighting should begin August 15 and be continued for as many days as it is desired to delay flowering.

The data presented in Table 7 and Appendix Tables 5 and 6 show less effect of length of light treatment on delaying flowering than time of treatment with reference to age of plant. In other words, lighting during the later stages of growth delayed flowering more than lighting during early stages. Lighting for 65 days (August 16 to October 20) delayed flowering of early varieties for an average of 41 days, while lighting early varieties for 66 days (September 10 to November 15) delayed flowering 74 days. Lighting midseason and late varieties for 66 days (September 15 to November 20) delayed flowering 81 days. A like comparison of plants lighted for 51 days (August 30 to October 20) delayed flowering of early varieties 40 days, and midseason and late varieties 36 days. Lighting for 52 days (September 10 to November 1) delayed flowering of early varieties an average of 49 days, and midseason and late varieties an average of 55 days. The various light treatments, started between August 16 and September 1 and were continued to a date between October 8 and October 20 (periods of 39 to 65 days), delayed flowering of early, midseason, and late varieties 33 to 42 days. Lighting beginning September 10 and 15 and continuing to a date between

November 1 and November 20 (periods of 52 to 66 days) delayed flowering of the same groups from 49 to 81 days. In the early stages of growth, lighting between August 16 and September 20, delayed flowering an average of 0.9 of a day for each day lighted, regardless of the length of the light treatment. Lighting during the later stages of growth, September 10 to November 20, delayed flowering an average of 1.1 days for each day the plants were lighted.

By lighting, it is possible to delay flowering and to extend the normal blooming period of the varieties of chrysanthemums tested from 5 weeks to 17 weeks. It was previously noted that it was possible to advance the normal blooming season of the same varieties 7 weeks by shading. Since lighting may be used to delay flowering for as much as 12 weeks, the normal blooming season of 5 weeks may be extended to 24 weeks by combining shading and lighting with normal bloom of the same varieties. Therefore, the best varieties as to color, type, and form, may be used over a greater period than is now possible with even the earliest and latest varieties, many of which are of inferior quality.

Results in Table 8 and Appendix Tables 7 and 8 show that, in general, lighting caused a reduction in yield and a slight increase in stem length. The response of individual varieties, however, was inconsistent.

TABLE 8. EFFECT OF LIGHTING ON YIELD AND LENGTH OF STEM OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Type (Varieties)	Light treatment	Varieties	Plants per treatment	Flowers per plant	Stem length
		Number	*Number*	*Number*	*Inches*
Standards	None — Check	2	24	2.9	24
(Gladys Pearson)	9/15 to 11/1	2	23	3.6	36
(Yellow Mefo)	9/10 to 11/15	2	22	2.2	41
Disbuds	None — Check	2	15	3.5	18
(Pink Doty)	9/10 to 10/15	1	23	3.6	16
(White Doty)	9/15 to 11/1	2	13	3.0	18
	9/10 to 11/15	1	23	1.4	20
Pompons	None — Check	4	26	.37[1]	16
(Catherine)	9/15 to 11/10	4	19	.20[1]	14
(Penquin)	9/10 to 11/20	4	23	.07[1]	13
(Tonquin)					
(Yuvawn)					

[1]Nine-ounce bunches.

In the various shading treatments, the following varieties failed to respond satisfactorily to shading, as measured by the color and quality of flowers produced under shading treatments:

COLUMBUS DISPATCH	JEWELL	RODELL
DAINTY MAID	MARKETEER	ROMAN BRONZE
INDIANAPOLIS PINK	PENQUIN	YELLOW BLANCHE
JOSEPHINE LAWLER	PINK DOTY	YELLOW MEFO

The following varieties in the lighting treatment showed poor response as measured by yield and quality of flower:

CHRISTMAS GOLD	TONQUIN
CORDOVA	WHITE DOTY
PENQUIN	YUVAWN
PINK DOTY	

GARDENIA

The Veitch Gardenia, *Gardenia jasminoides,* is in demand as a corsage flower during holiday seasons and winter months. Thus, any treatment that will advance the blooming date will increase the value of this plant as a forcing crop, particularly if brought into flower for the Christmas season. The gardenia normally blooms during the late winter and spring under southern forcing conditions.

A review of previous work with the Veitch Gardenia shows a varied response of this plant to photoperiodic treatment. Baird and Laurie *(2)* reported that short-day treatment during the summer was effective in inducing flower bud differentiation, and that lighting in the late stages of bud development caused buds to open more rapidly. Laurie and Kiplinger *(6)* at Columbus, Ohio, found that shading Veitch Gardenia July 21 to August 13 initiated buds that bloomed Christmas when lighted in late November and early December with 150-watt Mazda bulbs to hasten development. Keyes *(5)* reports that supplementary light increased the number of buds formed and increased production when a 70° F. temperature was maintained during the long-day period, followed by a 60° F. temperature during the subsequent short-day period. Post *(11)* states that photoperiodic treatments are probably of little value in forcing early flowering in the gardenia and that lighting should not be used unless needed to stimulate growth of well-developed buds.

Results of a preliminary test made at Auburn in 1939 with 1-

year plants, grown at approximately 50° F., indicate that lighting significantly advanced the flowering date of the Veitch Gardenia without adversely affecting the quality and total production of blooms. Lighting from October 1 to February 5 advanced the flowering date 40 days, or from May 22 to April 12. The plants used in this test did not show marked vegetative growth and did not respond to long-day treatment until the warm days of late winter and early spring. This indicates that older or more mature plants grown at a higher temperature might show a greater response to long-day treatment.

Two additional series of tests were conducted, one in 1940 and one in 1941. In these tests, the plants were spaced 12x12 inches. They were lighted from 5 p.m. to 10 p.m. daily with 100-watt Mazda bulbs spaced 5 feet apart over the center of a 3½ foot growing area and 2 feet above the plants.

In the 1940 series, 2-year cut-back plants were transplanted August 15 from the lath house to ground beds and later were grown at approximately 60° F. Each treatment consisted of 20 plants. Three light treatments were used, the period of lighting extending from September 15 to February 5, from October 1 to March 1, and from November 15 to March 1.

In the 1941 series, plants from 4-inch pots were transplanted to a raised bench on June 15 and later were grown at approximately 60° F. Each treatment consisted of 25 plants. Four light treatments were used, the period of lighting extending from September 1, September 15, and October 1, to April 1.

Results from these two series of treatments, given in Table 9, show that plants lighted from September 15 and October 1 consistently produced significantly more blooms per plant than untreated plants of corresponding age or those lighted from September 1, or from November 1. They produced an average of 39 per cent more blooms than untreated plants and over 100 per cent more than plants lighted from November 1. The September 1, September 15, and October 1 treatments induced maximum flowering of 1-year plants during December. Two-year plants lighted from September 15 reached effective flowering by December 16 but did not produce maximum flowering until January 15-30.

Lighting beginning September 1, September 15, October 1, and November 1 advanced the average effective blooming date

90, 87, 60, and 44 days, respectively, while the same treatments advanced the average maximum flowering period approximately 90 days.

TABLE 9. RESPONSE OF VEITCH GARDENIA TO LIGHTING, AUBURN, ALABAMA, 1940-41

Start of additional lighting	Age of plants	Plants per treatment	Flowering period						Flowers per plant	Diam. of flowers
			Effective			Maximum				
			Date		Flowering advanced	Date		Flowering advanced		
		No.			*Days*			*Days*	*No.*	*In.*
Check	1-year	25	Feb.	28	0	Mar.	15-30	0	7.8	1.9
	2-year	19	Feb.	20	0	Apr.	15-30	0	9.8	1.8
Average		22	Feb.	24	0	Apr.	1-15	0	8.8	1.9
September 1	1-year	25	Nov.	28	90	Dec.	15-30	90	8.8	2.2
September 15	1-year	25	Nov.	10	108	Dec.	1-15	105	11.2	2.1
	2-year	20	Dec.	16	65	Jan.	15-30	89	13.0	1.7
Average		22.5	Nov.	29	87	Dec.-Jan.	23-7	97	12.1	1.9
October 1	1-year	25	Dec.	12	76	Dec.	15-30	90	11.6	2.1
	2-year	20	Jan.	6	44	Jan.	15-30	89	13.1	1.6
Average		22.5	Dec.	26	60	Jan.	1-15	90	12.4	1.9
November 1	2-year	20	Jan.	6	44	Jan.	15-30	89	5.6	1.5

RESPONSE OF SOME MINOR FLORIST CROPS TO LIGHTING AND SHADING

CALENDULA

The calendula, *Calendula officinalis,* is not widely grown in the South but it may be profitably handled in two ways by the retail grower. It may be used as a short-term cool crop, from November to March, to fill in between chrysanthemums and a late spring crop to produce a low priced flower for home decoration during the winter. Seed sown in August or September may also be planted in the cloth house in October or November for early spring flowering. The plants will come through mild winters. Even when the tops are killed by cold, the plants will usually come through to produce better flowers in the spring than spring seedlings.

Calendula has shown a varied response to lighting. Laurie and Poesch *(7)* secured no response from lighting a September plant-

ing in December at Columbus, Ohio. Post *(11)* states that lighting reduced production and did not hasten flowering when the crop was grown at 55° to 60° F. at Ithaca, New York.

Presented in Table 10 are the results obtained with two varieties of calendulas, Lemon Queen and Orange Supreme, grown at Auburn in 1939 from seed sown August 8, plants transplanted to benches October 18, and later grown at 50° F. The plants were lighted from sundown until 10 p.m. each night from October 18 until January 1 or for 73 days.

The data in Table 10 show that the Ball Orange Supreme variety was more responsive to lighting than the Ball Lemon Queen variety. Lighting advanced the flowering of the Ball Orange Supreme 38 days and induced a 17 per cent increase in number of flowers per plant, whereas lighting advanced the flowering of the Ball Lemon Queen variety only 19 days and reduced the number of flowers per plant 53 per cent. Lighting had little effect on the diameter of bloom of either variety, but it did increase the stem length approximately 39 per cent.

TABLE 10. RESPONSE OF CALENDULA TO LIGHTING, AUBURN, ALABAMA, 1939

Variety	Treatment	Plants	Date of flower	Flowering advanced	Flowers per plant	Stem length	Diameter flower
		No.		*Days*	*No.*	*In.*	*In.*
Ball Lemon Queen	Check	5	1/3	0	9.8	16	3.2
	Lighted 10/18-1/1	45	12/15	19	4.6	23	3.3
Ball Orange Supreme	Check	5	2/3	0	3.2	17	4.3
	Lighted 10/18-1/1	15	12/27	38	3.8	23	4.0

FEVERFEW

Feverfew, *Chrysanthemum parthenium,* is a useful spring filler flower, available in white and yellow. By varying the planting date and by growing part of the crop under lights and part without lights, this crop can be brought into bloom from April to July.

Laurie and Kiplinger *(6)* at Columbus, Ohio, found that feverfew lighted beginning December 15 flowered April 1, or 2 months earlier than untreated plants.

One year's results from lighting feverfew are given in Table 11. The seed were sown on September 1, plants were transplanted to benches March 5 and spaced 12x12 inches, and were later grown

TABLE 11. RESPONSE OF FEVERFEW TO LIGHTING, AUBURN, ALABAMA, 1940

Treatment	Plants	Date of flowering	Flowering advanced	Yield per plant	Stem length
	No.		*Days*	*Ounces*	*In.*
Check	35	6/21	0	2.9	25
Lighted 3/12 to 5/2	355	5/2	50	3.2	20

at approximately 50° F. Light treatments were started on March 12 and continued to May 2, using 75-watt Mazda bulbs spaced 5 feet apart and 2 feet above the plants.

The data presented in Table 11 show that lighting advanced the flowering of feverfew 50 days, increased production 11 per cent, and decreased the stem length approximately 20 per cent.

KALANCHOE

Kalanchoe, *Kalanchoe blossfeldiana,* is valuable throughout the winter months for its orange-red flowers. It finds a ready sale as a medium-priced pot plant for Christmas. Plants of the Tom Thumb variety from a spring propagation will normally come into flower for Christmas if grown at 60° F., or for January if grown at 60° F. from November to January. If plants from the same propagation are grown at 50° F., they will flower in February and March. Plants from a summer propagation will flower in March and April if grown at 50° F. Plants to be shipped as pot plants for Christmas should be shaded from late September until buds set.

Laurie and Kiplinger *(6)* and Poesch *(9)* state that kalanchoe shaded August 15 to October 1 flowered December 1 to 15, and that kalanchoe shaded September 1 to October 20 flowered December 25. Post *(11)* reports that kalanchoe set bud between September 25 and October 5 and that shading from August 10 to October 10 was necessary to flower plants for Christmas; shading after October 10 was not necessary.

In Table 12 are summarized 4 years' results of shading Tom Thumb and Hybrid varieties of kalanchoe. Plants in 4-inch pots were grown under lath during the summer, were transferred to the greenhouse in September, and were grown at approximately 60° F. The plants were shaded from the dates shown in Table 12 to October 15 or until the buds showed color.

Results show that untreated plants of the Tom Thumb variety came into flower for Christmas when grown at approximately 60° F.

Shading the Hybrid varieties of kalanchoe from September 1 to October 15 in 1941, and to December 20 in 1942 advanced the flowering date 27 days in each case; 90 per cent of the plants were in flower by December 25. Shading started September 15, September 25, and September 27 was less effective, bringing 63 per cent or more of the plants into flower for Christmas. The average flowering date of untreated plants was January 20.

TABLE 12. RESPONSE OF KALANCHOE TO SHADING, AUBURN, ALABAMA, 1939-42

Variety	Start of shading	Treatments	Plants	Date of flowering			Flowering advanced	Plants flowering by Dec. 25
				First	Last	Average[1]		
		No.	*No.*				*Days*	*Pct.*
Tom Thumb (Dwarf)	None	2	8	12/11	12/24	12/18	0	100
	9/1	2	11	12/3	12/16	12/2	16	100
	9/15	1	11	12/8	12/26	12/11	7	100
	9/25	1	7	12/3	12/18	12/18	0	100
	10/1	1	13	12/8	12/16	12/16	2	100
	10/10	1	7	12/18	12/28	12/28	10[2]	14
	11/1	1	7	12/8	12/28	12/28	10[2]	7
Hybrid	None	4	29	1/11	2/1	1/20	0	0
	9/1	2	31	12/5	1/5	12/24	27	90
	9/15	2	19	12/20	12/31	12/22	29	75
	9/25	1	52	12/22	12/28	12/24	27	63
	9/27	1	35	12/20	12/30	12/25	7[2]	74
	10/1	2	19	12/30	1/17	1/2	18	9
	10/10	1	43	12/28	1/10	1/4	16	0
	10/15	1	21	1/5	2/1	1/9	11	24
	11/1	1	44	12/28	1/19	1/19	1	0

[1]When 50 per cent of variety was in flower.
[2]Retarded.

PRIMROSE

One year's results with lighting primrose, *Primula obconica,* are given in Table 13. Four-inch plants grown at 55° to 60° F. were lighted from 5 p.m. to 10 p.m. daily between the dates shown in Table 13. These results show that lighting primrose from October 1 to December 15 was more effective in inducing early flowering than lighting from October 15 to December 15 and from November 1 to December 15. Lighting from October 1 to December 15 advanced the flowering date 24 days, and brought 50 per cent of the plants into flower by December 26.

TABLE 13. RESPONSE OF PRIMROSE TO LIGHTING, AUBURN, ALABAMA, 1941

Treatment	Plants	Date of flowering			Flowering advanced
		First	Last	Average[1]	
	No.				*Days*
Check	20	12/31	2/2	1/19	0
Lighted 10/1 -12/15	22	12/16	1/29	12/26	24
Lighted 10/15-12/15	22	12/26	2/3	1/8	11
Lighted 11/1 -12/15	21	12/26	2/3	1/8	11

[1]Date when 50 per cent or more of the plants were in flower.

SHASTADAISY

The excellent keeping quality of the Shastadaisy, *Chrysanthemum maximum*, and the many forms available in present-day varieties make it a very desirable cut flower during any season, especially during late winter and spring months. Field-grown or greenhouse-grown plants may be profitably forced under lights as a follow-up crop for chrysanthemums and other fall crops or for flowering from late February until the late spring outdoor crop comes into bloom.

Laurie and Poesch (7) found that Shastadaisy planted and lighted from December 15 flowered at Columbus, Ohio, on March 30 or 56 days earlier than untreated plants. Plants lighted from January 6 flowered 26 days earlier than untreated plants. In both cases lights increased the number of flowers per plant.

The response of second year clumps of Shastadaisy at Auburn is shown in Table 14. The plants were transplanted to a sash greenhouse on August 15 and lighted daily from 5 p.m. to 10 p.m. with 100-watt Mazda bulbs from October 15 to February 5 and grown at approximately 50° F.

Data in Table 14 show that lighting from October 15 to February 5 brought the plants into flower 83 days earlier than untreated plants, advanced the flowering date from May 17 to February 25, and induced a 75 per cent increase in number of flowers per plant and a 14 per cent increase in stem length.

TABLE 14. RESPONSE OF SHASTADAISY TO LIGHTING, AUBURN, ALABAMA, 1939

Treatment	Plants	Date of flowering	Flowering advanced	Flowers per plant	Stem length	Diameter flowers
	No.		*Days*	*No.*	*In.*	*In.*
Check	23	5/17	0	3.0	28	3.6
Lighted 10/15-2/5	48	2/25	83	5.2	32	4.0

STOCK

Laurie and Poesch *(7)* and others *(6), (10),* found that stock seeded in August, transplanted to benches in October, and lighted at various stages flowered from 19 to 26 days or an average of 24 days earlier than untreated plants. Post *(11)* states that lighting of stock is of little value in inducing flowering under high temperatures.

The average response of six varieties of stock, *Mathiola incana,* planted at various times and lighted at various stages of development is given in Table 15. The seed were sown during September, October, and November. The plants were grown in a greenhouse at approximately 50° F.

The data in Table 15 show that lighting advanced the flowering date of stock 7 to 16 days or an average of 11 days. The plants seeded in September showed slightly greater response to lighting than later plantings. Lighting in various stages of development was approximately of equal value in causing earliness of flower.

There was little varietal difference in response to lighting in the six varieties tested.

TABLE 15. INFLUENCE OF LIGHTING ON EARLINESS AND STEM LENGTH OF COMMON STOCK, AUBURN, ALABAMA, 1939-42

Planting date	Date of light treatment	Varieties	Plants	Date of flowering	Flowering advanced	Stem length
		No.	*No.*		*Days*	*In.*
	None	3	29	2/26	0	29
	10/19-2/5	3	148	2/10	16	28
September	None	4	46	2/28	0	23
	12/24-2/19	4	168	2/17	11	24
	None	5	13	3/17	0	31
	1/5 -3/1	5	10	3/5	12	29
October	None	5	81	3/17	0	32
	1/5 -3/1	5	258	3/10	7	29
November	None	4	21	3/17	0	21
	1/11-3/14	4	131	3/7	10	25

SUMMARY

CHINA-ASTER. Lighting seedlings planted February 17 for 6 weeks beginning March 3 advanced the average flowering dates of early varieties from July 6 to May 30, midseason varieties from July 17 to May 28, and late varieties from August 28 to June 7.

CHRYSANTHEMUM. Early varieties on an average flower 4 days earlier, midseason varieties an average of 10 days earlier, and late varieties on an average of 10 days earlier in the South than under more northern conditions.

Shading from 5 p.m. to 7 a.m. daily from July 15, August 1, August 15, and September 1 until the flowers showed color advanced the flowering date an average of 5, 4, 3, and 1 week, respectively. The greatest response was from the White Chieftain variety, which when shaded July 15 flowered August 30 or 63 days earlier than plants not shaded.

Lighting for 52 to 66 days beginning September 10 or 15 was more effective in delaying flowering than lighting earlier. Lighting during this period delayed flowering 49 to 81 days, delayed the average flowering date of early varieties from October 27 to December 13 and January 9, or approximately 1.1 days for each day the plants were lighted.

GARDENIA. Lighting Veitch Gardenia beginning September 15 brought 1-year plants into maximum bloom and 2-year plants into effective bloom by Christmas, advanced the maximum bloom period approximately 90 days, from April 1 to 15 to December 23 to January 7, and increased yield 39 per cent.

CALENDULA. Lighting from October 18 to January 1 advanced flowering an average of 29 days, from January 19 to December 21.

FEVERFEW. Lighting September 1-seeded plants from March 12 to May 2 advanced flowering 50 days, or from June 21 to May 2.

KALANCHOE. The Tom Thumb variety came into flower for Christmas without shading when grown at 60° F. Shading the Hybrid variety from September 1 advanced the average flowering date 27 days, from January 20 to December 24, and brought 90 per cent of the plants into flower for Christmas.

PRIMROSE. Lighting of Primrose plants from October 1 to December 15 advanced the average flowering date 24 days, from January 19 to December 26, and brought 50 per cent of the plants into flower for Christmas.

SHASTADAISY. Lighting 2-year plants from October 15 to February 5 advanced the flowering date 83 days, from May 17 to February 25, and increased the number of blooms per plant 75 per cent.

STOCK. Lighting advanced the flowering of stock from 7 to 16 days, an average of 11 days.

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APPENDIX TABLE 1. EFFECT OF DATE OF SHADING ON THE TIME OF BLOOM OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1936-43

Variety	Yearly replications	Check, not shaded	Response to shading beginning: July 15		August 1		August 15		September 1		September 10	
			Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced
	No.			*Days*		*Days*		*Days*		*Days*		*Days*
Early												
Arcadia	2	10/25	9/29	26	10/2	23	10/12	13	10/22	3		
Captain Cook	3	10/26			9/27	29	10/3	23	10/16	10	10/22	4
Chattanooga	1	10/30			10/15	15	10/20	10				
Cora Peck Buhl	4	10/27	9/19	38	9/27	30	10/6	21	10/18	9	10/27	5
Dainty Maid	2	10/29			10/5	24	10/12	17	10/20	9	10/26	3
Detroit News	3	10/27	9/16	42	9/29	28	10/7	20	10/23	4		
Firebird	3	10/29	9/20	39	10/2	27	10/19	10	10/19	10		
Gold Mine	3	10/30	9/23	37	10/9	21	10/15	15	11/2	[1]		
Golden Spray	2	10/20	10/4	16	9/27	23	10/6	14	10/18	2		
Good News	1	10/21	9/10	41	10/1	20	10/8	13				
Irene	3	10/23	9/10	43	9/29	24	10/4	19	10/16	7		
Jewell	4	10/17	9/15	32	9/25	22	10/2	15	10/11	6		
Josephine Lawler	2	10/24	9/4	50	9/25	29	10/3	21	10/18	5	10/16	8
Lilac	1	10/14			9/17	27			10/10	4		
Mefo	1	10/25	9/16	39	10/6	19	10/12	13				
Nellie T. Ross	1	10/31	9/24	37	10/3	28	10/11	20				
New York	3	10/31	9/23	38	10/12	19	10/23	8	10/31	0		
Norma	1	10/27	9/27	30	10/3	24	10/10	17				
Nubian	3	10/23	9/12	41	9/26	27	10/7	16	10/16	7	10/16	7
Pink Doty	4	10/21	9/5	46	9/18	33	10/6	14	10/12	9	10/19	2
Rodell Improved	4	10/18	9/10	38	9/23	25	10/3	15	10/12	6		
Roman Bronze	2	10/22	9/27	25	9/27	25	10/6	16	10/14	8		
Rose Glory	2	10/27			9/24	33	10/5	21	10/11	16		
Sea Gull	1	10/19	9/24	25	9/30	19	10/4	15				
Silver Sheen	2	10/27			9/28	29	10/2	25	10/12	15		
Uvalda	5	10/19	9/10	39	9/24	25	10/4	15	10/14	5	10/16	3

(continued)

APPENDIX TABLE 1. (Continued) EFFECT OF DATE OF SHADING ON THE TIME OF BLOOM OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1936-43

Variety	Yearly replications	Check, not shaded	Response to shading beginning: July 15		August 1		August 15		September 1		September 10	
			Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced	Date of flowering	Flowering advanced
	No.			*Days*		*Days*		*Days*		*Days*		*Days*
Yellow Blanche	1	10/28	9/23	35	10/14	14	10/18	10	10/24	4		
Yellow Mefo	2	10/30	9/13	47	9/30	30			10/23	7	10/29	1
Average				37		25		16		7		4
Midseason												
Bronze Masterpiece	1	11/3	10/5	29	10/15	19	10/21	13				
Chicago Pearl	1	11/3	9/28	37	10/6	28	10/16	18				
Columbus Dispatch	2	11/10	10/1	40	10/9	32	10/17	24	10/22	19		
Gladys Pearson	3	11/7	9/28	40	10/4	34	10/20	18	10/27	11		
Gold Coin	1	11/11	10/19	23	10/21	21	10/25	17				
Honey Dew	3	11/5	9/20	46	10/5	31	10/6	30	10/28	8		
Indianapolis Pink	1	11/3	9/5	59	10/1	33	10/14	20	10/18	16		
Marketeer	1	11/7	10/6	32	10/14	24	10/22	16	11/3	4		
Orchid Beauty	3	11/14	9/26	49	10/12	33	10/5	39	11/4	10	10/19	26
Rolinda	3	11/10	10/10	31	10/18	23	10/27	14	11/3	6		
Susanne Miller	2	11/11	10/15	27	10/20	22	10/27	15				
Varsity	2	11/5			10/14	22			11/4	1		
White Chieftain	3	11/1	8/30	63	9/21	41	10/4	28	10/19	13	10/20	12
Average				40		28		21		10		19
Late												
Cordova	1	11/21	10/22	30	10/29	23	10/30	22	11/13	8	11/18	3
Tonquin	2	11/29			11/4	25	11/13	16	12/1	[2]	11/30	[3]
Average				30		24		19		4		1

[1]Bloomed 3 days later than untreated plants; [2]Bloomed 2 days later than untreated plants; [3]Bloomed 1 day later than untreated plants.

APPENDIX TABLE 2. COMPARISON OF RUBBERIZED AND SATEEN CLOTH[1] FOR SHADING CHRYSANTHEMUMS, AUBURN, ALABAMA, 1937

Variety	Check, not shaded	Shading beginning: August 1		August 15		September 1	
		Rubberized	Sateen	Rubberized	Sateen	Rubberized	Sateen
Gold Mine, date of bloom	11/1	10/14	10/14	10/14	10/20	10/29	11/1
Days flowering advanced	0	18	18	18	12	3	0
Nubian, date of bloom	10/27	9/28	9/28	10/5	10/8	10/16	10/20
Days flowering advanced	0	29	29	22	19	11	7
Irene, date of bloom	10/20	10/5	10/5	10/8	10/8	10/13	10/13
Days flowering advanced	0	15	15	12	12	7	7
Rodell, date of bloom	10/20	10/5	9/28	10/8	10/7	10/11	10/16
Days flowering advanced	0	15	22	12	13	9	4
Rose Glory, date of bloom	10/20	9/22	9/24	10/5	10/5	10/11	10/11
Days flowering advanced	0	28	26	15	15	9	9
Silver Sheen, date of bloom	10/20	9/28	9/28	10/5	10/2	10/8	10/8
Days flowering advanced	0	22	22	15	18	12	12
Uvalda, date of bloom	10/20	10/5	10/5	10/8	10/8	10/13	10/13
Days flowering advanced	0	15	15	12	12	7	7
Average							
Days flowering advanced	0	20.3	21.0	15.1	14.4	8.3	6.6

[1]Windsor No. 375 cloth with a thread count of 64 x 104 per square inch.

APPENDIX TABLE 3. EFFECT OF DATE OF SHADING ON STEM LENGTH, DIAMETER OF FLOWER, YIELD OF STANDARD AND DISBUD CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Replications	Plants	Check			Shaded from 7/15			Shaded from 8/1			Shaded from 8/15			Shaded from 9/1		
			Flowers			Flowers			Flowers			Flowers			Flowers		
			Per plant	Diam.	Stem length	Per plant	Diam.	Stem length	Per plant	Diam.	Stem length	Per plant	Diam.	Stem length	Per plant	Diam.	Stem length
	No.	*No.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*	*No.*	*In.*	*In.*
Standards																	
Chattanooga	1	8	1.7	5.0	23.0				2.3	4.0	17.2	2.9	4.0	18.4			
Columbus Dispatch	2	17	2.4	3.9	25.0	3.1	3.5	19.8	3.4	3.4	21.5	2.3	3.5	20.1	3.2	3.4	22.2
Detroit News	1	12	1.5	2.3	24.3	1.3	2.7	22.0	1.6	2.5	18.7	1.4	2.8	28.3			
Gladys Pearson	3	26	2.9	4.6	25.7	2.2	4.0	29.9	2.6	4.0	28.2	2.9	3.5	25.0	2.9	4.5	28.0
Good News	1	19	1.7	2.5	26.6	1.6	2.5	19.9	1.1	2.5	26.1	1.0	2.9	29.5			
Indianapolis Pink	1	23	3.2	3.8	21.0	3.5	3.4	16.7	2.5	3.8	25.2	3.3	2.8	16.5	3.4	3.4	21.2
Josephine Lawler	2	31	2.5	3.5	17.0	4.1		34.0	2.7	3.0	22.5				2.2	4.0	18.0
Marketeer	1	25	3.6	4.0	20.0	3.2	2.9	19.3	2.9	3.1	25.6	3.0	3.0	19.0	3.3	3.6	26.6
Mefo	1	27	1.7	2.9	37.6	1.4	2.6	26.5	1.9	2.6	32.7	2.1	2.7	36.9			
White Chieftain	2	29	2.6	3.3	20.1	2.3		29.0	4.5		23.0				2.6	4.3	22.0
Yellow Mefo	2	29	2.0	4.9	28.0				2.2	3.1	33.1				3.2	5.0	36.0
Average	1.5	22	2.3	3.7	24.4	2.5	3.1	24.1	2.5	3.2	24.9	2.4	3.2	24.2	3.0	4.2	24.9
Disbuds																	
Pink Doty	2	32	3.7		27.9	2.4		24.5	2.0		28.3	4.3		16.7	3.4		21.8
Rolinda	3	15	2.8		23.1	2.5		18.9	3.2		20.2	2.6		19.1	2.6		25.5
Susanne Miller	2	9	4.2		26.2	2.6		18.4	3.2		18.4	3.5		21.7			
White Doty	2	32	3.0		24.0				3.0		24.9				4.5		19.9
Yellow Blanche	1	21	5.3		21.2	3.1		20.9	2.2		25.0	3.1		18.3	2.4		20.5
Average	2	22	3.8		24.3	2.7		20.7	2.7		23.3	3.4		19.0	3.2		21.8

APPENDIX TABLE 4. EFFECT OF DATE OF SHADING ON STEM LENGTH AND YIELD OF POMPON CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Replications	Plants	Check		Shaded from 7/15		Shaded from 8/1		Shaded from 8/15		Shaded from 9/1	
			Bunches per plant	Stem length	Bunches per plant	Stem length	Bunches per plant	Stem length	Bunches per plant	Stem length	Bunches per plant	Stem length
	No.	*No.*	*No.*	*In.*	*No.*	*In.*	*No.*	*In.*	*No.*	*In.*	*No.*	*In.*
Arcadia	2	18	.43	25.4	.26	20.3	.42	19.2	.47	23.5	.49	27.5
Captain Cook	2	27	.31	21.8			.30	24.3			.21	18.8
Cora Peck Buhl	2	28	.23	15.5			.26	18.0			.31	14.7
Cordova	2	17	.30	22.3	.13	19.0	.27	20.0			.23	19.0
Dainty Maid	2	15	.31	20.0			.34	21.0			.55	15.5
Golden Spray	2	19	.19	17.0	.64	15.7	.25	17.5	.50	24.4	.27	17.0
Jewell	3	20	.23	18.0	.19	14.7	.22	13.3	.49	19.9	.66	16.9
Lilac	1	28	.41	20.0			.40	39.0			.21	13.0
Penquin	1	15	.35	19.1	.63	20.0	.17	16.4			.15	16.8
Rodell Improved	2	23	.24	15.0	.28	13.6	.30	18.6	.53	21.6	.31	13.9
Roman Bronze	2	21	.15	24.2	.10	21.5	.10	15.0	.32	29.5	.25	31.6
Tonquin	2	24	.60	20.1			.36	17.3	.48	20.0	.48	20.0
Uvalda	2	27	.44	15.0			.33	15.7			.19	11.4
Average	1.9	22	.32	19.5	.32	17.8	.29	19.6	.47	23.2	.33	18.2

APPENDIX TABLE 5. EFFECT OF LIGHTING ON THE DATE OF FLOWERING OF EARLY VARIETIES OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1936-43

Variety	Light treatment	Date of flowering	Flowering delayed	Variety	Light treatment	Date of flowering	Flowering delayed
			Days				*Days*
Captain Cook	None	10/31	0	New York	None	11/8	0
	8/30 to 10/8	12/2	32		8/30 to 10/8	12/9	31
	8/16 to 10/20	12/10	40		8/16 to 12/20	12/10	32
	8/30 to 10/20	12/10	40		8/30 to 10/20	12/10	32
	9/15 to 11/1	12/25	55				
	9/25 to 11/15	1/12	73	Nubian	None	10/31	0
					8/30 to 10/8	12/2	32
Chattanooga	None	10/27	0				
	9/1 to 10/15	12/10	44	Pink Doty	None	10/22	0
	9/10 to 11/1	1/4	69		9/10 to 10/15	11/22	31
	9/10 to 11/15	1/23	88		9/10 to 11/1	12/10	49
					9/15 to 11/1	11/15	24
Cora Peck Buhl	None	10/21	0		9/10 to 11/15	12/19	58
	8/30 to 10/8	12/5	45		9/25 to 11/15	11/3	12
Gold Mine	None	11/2	0	Rodell	None	11/2	0
	8/30 to 10/8	12/15	43		8/30 to 10/8	12/2	30
	8/16 to 10/20	12/20	48				
	8/30 to 10/20	12/20	48	Rose Glory	None	10/20	0
					8/16 to 10/20	11/29	40
Golden Queen	None	11/8	0		8/30 to 10/20	11/26	37
	8/30 to 10/8	12/15	37				
				Silver Sheen	None	10/20	0
Irene	None	10/27	0		8/16 to 10/20	11/29	40
	8/30 to 10/8	11/30	34		8/30 to 10/20	11/24	35
	8/16 to 10/20	12/7	41				
	8/30 to 10/20	12/6	40	Sun Gold	None	10/26	0
					9/1 to 10/15	11/27	32
Josephine Lawler	None	10/25	0		9/10 to 11/1	12/14	49
	9/10 to 11/1	12/27	65				
				Uvalda	None	10/20	0
Lilac	None	10/20	0		8/16 to 10/20	12/4	45
	8/16 to 10/20	12/2	43		8/30 to 10/20	12/4	45
	8/30 to 10/20	12/4	45				
				White Doty	None	10/24	0
Mefo	None	10/17	0		9/15 to 11/1	11/15	22
	9/1 to 10/15	11/27	41		9/25 to 11/15	11/3	10
	9/10 to 11/1	12/2	46				
				Yellow Mefo	None	11/2	0
Nellie T. Ross	None	10/26	0		9/15 to 11/1	12/5	33
	9/1 to 10/15	11/27	32		9/10 to 11/15	1/16	75
	9/10 to 11/1	12/12	47		9/25 to 11/15	11/20	18

APPENDIX TABLE 6. EFFECT OF LIGHTING ON THE DATE OF FLOWERING OF MIDSEASON AND LATE VARIETIES OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Light treatment	Date of flowering	Flowering delayed	Variety	Light treatment	Date of flowering	Flowering delayed
			Days				*Days*
Catherine	None	11/11	0	Orchid Beauty	None	11/15	0
	9/1 to 10/25	11/17	6		8/16 to 10/20	12/24	39
	9/15 to 11/10	1/20	70		8/30 to 10/20	12/24	39
	9/15 to 11/20	1/26	76				
				Penquin	None	11/10	0
Chicago Pearl	None	11/9	0		9/1 to 10/25	11/10	0
	8/30 to 10/8	12/15	36		9/15 to 11/10	1/25	76
	8/16 to 10/20	12/20	41		9/15 to 11/20	1/28	79
	8/30 to 10/20	12/14	35				
				Susanne Miller	None	10/23	0
Christmas Gold	None	11/9	0		9/1 to 10/15	12/2	40
	9/1 to 10/15	12/20	41		9/10 to 11/1	12/18	56
	9/10 to 10/15	12/27	48				
	9/10 to 11/2	1/9	61[1]	Tonquin	None	11/21	0
	9/10 to 11/15	[2]			8/30 to 10/8	1/4	44
					9/1 to 10/15	12/20	29
Cordova	None	11/15	0		9/10 to 10/15	12/27	36
	9/10 to 10/15	12/27	42		9/1 to 10/25	11/30	9
	9/10 to 11/1	[2]			9/10 to 11/1	1/13	53
	9/15 to 11/1	1/19	65		9/15 to 11/1	1/25	65
	9/10 to 11/15	[2]			9/15 to 11/10	2/4	75
					9/10 to 11/15	1/29	69
Gladys Pearson	None	11/10	0		9/25 to 11/15	2/13	84
	9/10 to 11/1	1/2	53		9/15 to 11/20	2/17	88
	9/15 to 11/1	12/11	31				
	9/10 to 11/15	1/19	70	Varsity	None	11/5	0
	9/25 to 11/15	11/30	20		8/30 to 10/8	12/2	27
					8/16 to 10/20	12/10	35
Gold Tips	None	11/19	0		8/30 to 10/20	12/10	35
	9/15 to 11/1	1/20	62				
	9/25 to 11/15	1/30	72	Yuvawn	None	11/10	0
					9/1 to 10/25	11/17	7
Marie DePetris	None	11/6	0		9/15 to 11/10	1/28	79
	9/1 to 10/15	11/27	21		9/15 to 11/20	2/4	86
	9/10 to 11/1	12/18	42				

[1]Average of 2.
[2]Treatment remained vegetative.

APPENDIX TABLE 7. EFFECT OF LIGHTING ON STEM LENGTH AND YIELD OF STANDARD AND DISBUD VARIETIES OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Light treatment	Plants	Date of flowering	Flowers per plant	Stem length
		No.		*No.*	*In.*
Chattanooga	None	23	10/30	2.6	20.5
	9/10 to 11/1	41	1/4	2.6	36.2
	9/10 to 11/15	38	1/23	2.3	51.5
Gladys Pearson	None	25	11/10	3.2	27.2
	9/10 to 11/1	21	1/2	2.7	32.5
	9/15 to 11/1	25	12/11	3.0	38.3
	9/10 to 11/15	25	1/19	2.6	45.1
	9/25 to 11/15	28	11/30	2.5	22.0
Josephine Lawler	None	17	10/25	0.8	12.0
	9/10 to 11/1	19	12/27	1.6	16.2
Pink Doty	None	19	10/22	3.7	16.9
	9/10 to 10/15	23	11/22	3.6	15.8
	9/10 to 11/1	41	12/10	2.7	19.3
	9/15 to 11/1	15	11/15	0.3	15.0
	9/10 to 11/15	23	12/19	1.4	19.9
	9/25 to 11/15	17	11/3	0.9	15.0
Yellow Mefo	None	23	11/2	2.6	21.2
	9/15 to 11/1	20	12/5	4.2	32.8
	9/10 to 11/15	19	1/16	1.8	36.6
	9/25 to 11/15	30	11/20	3.6	26.9
White Doty	None	10	10/24	3.2	18.0
	9/15 to 11/1	10	11/15	5.7	20.0
	9/25 to 11/15	10	11/3	1.4	14.0

APPENDIX TABLE 8. EFFECT OF LIGHTING ON STEM LENGTH AND YIELD OF POMPON VARIETIES OF CHRYSANTHEMUMS, AUBURN, ALABAMA, 1939-43

Variety	Light treatment	Plants	Date of flowering	9-ounce bunches per plant	Stem length
		No.		*No.*	*In.*
Captain Cook	None	15	10/31	0.32	16.9
	9/15 to 11/1	15	12/25	0.60	21.5
	9/25 to 11/15	19	1/12	0.20	20.1
Catherine	None	30	11/11	0.22	19.3
	9/1 to 10/25	30	11/17	0.32	16.9
	9/15 to 11/10	29	1/20	0.21	17.1
	9/15 to 11/20	25	1/26	0.11	16.0
Cordova	None	20	11/15	0.21	15.2
	9/10 to 10/15	20	12/27	0.13	17.0
	9/10 to 11/1	22	[1]		
	9/15 to 11/1	25	1/19	0.07	14.0
	9/10 to 11/15	24	[1]		
Christmas Gold	None	24	11/10	0.13	13.2
	9/10 to 10/15	24	12/27	0.13	18.8
	9/10 to 11/1	18	1/13	[1]	
	9/10 to 11/15	18	[1]		
Gold Tips	None	15	11/19	0.32	15.0
	9/15 to 11/1	15	1/20	0.81	18.0
	9/25 to 11/15	20	1/30	0.05	
Penquin	None	25	11/10	0.35	14.8
	9/1 to 10/25	25	11/10	0.36	14.3
	9/15 to 11/10	19	1/25	0.44	16.7
	9/15 to 11/20	16	1/28	0.07	10.6
Tonquin	None	20	11/21	0.60	15.5
	9/10 to 10/15	46	12/27	0.60	15.0
	9/1 to 10/25	25	11/30	0.25	14.2
	9/10 to 11/1	63	1/13	0.41	16.7
	9/15 to 11/1	10	1/25	0.68	24.0
	9/15 to 11/10	9	2/4	0.11	11.0
	9/10 to 11/15	90	1/29	0.27	17.9
	9/25 to 11/15	10	2/13	0.05	
	9/15 to 11/20	20	2/17	0.05	13.0
Yuvawn	None	30	11/10	0.31	16.1
	9/1 to 10/25	29	11/17	0.38	13.8
	9/15 to 11/10	18	1/28	0.05	11.1
	9/15 to 11/20	31	2/4	0.06	10.3

[1]Treatment remained vegetative.