SOME PHYSIOLOGICAL FACTORS AFFECTING GREENHOUSE FORCING OF GLADIOLUS

by

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INTRODUCTION

In less than 200 years the gladiolus has progressed from a native species in Africa to the fourth most valuable florist cut-flower crop in the United States. Gladiolus are grown principally out-of-doors during the warmer months of the year. Little research has been conducted to develop a method for greenhouse culture for out-of-season forcing.

The principal winter production of gladiolus occurs in the state of Florida. The flowers are cut in tight bud, packed, and shipped to all points of the United States. By the time the product reaches its destination and the flowers open for the florist, the quality is often poor. The retail customer, therefore, pays for and receives a product that never opens many blossoms and never can be at its attractive best. The florist has no choice but to sell poor quality gladiolus because there is no other flower source during the winter.

Greenhouse production of gladiolus is a logical step in the production of a local cut-flower crop, which might prove superior to shipped blossoms from Florida.

Florida growers are limited on the varieties which they are able to grow and ship successfully. Only a few selected varieties have the capability to open florets from spikes cut in tight bud and to withstand long-distance shipping.

The selection of varieties suitable for greenhouse culture and local cut-flower sales are numerous. New varieties of different colors could be added to those now in use by florists resulting in increased demand for the gladiolus by florist and consumer.

This study was undertaken to determine the feasibility of greenhouse gladiolus culture, and the response of modern day varieties forced under modern greenhouse facilities.

REVIEW OF LITERATURE

Crocker (2) stated that supplementing greenhouse light in the winter with intermittent artificial light at night hastened the growth and flowering of gladiolus. Several varieties of large flowering gladiolus could be brought to flower by late January from bulbs planted in early October when grown at low temperatures with intermittent light for an average of 3.4 hours each night.

Laurie (7) found that light is of much importance in the development of the flower shoot. He states that unless light of sufficient intensity and duration is available when the leaves are 8-10 inches high, flower development ceases and blasting occurs. Stimulation of growth through the use of additional light is satisfactory only if the intensity is high enough to simulate sunlight, which would mean the use of 500 or 1000 watt lamps and some 100 or more foot candles.

Laurie, Kiplinger, and Nelson (8) observed that the light factor is important in the development of the flowering shoot. Stimulation of growth through the use of additional light at the critical period is of value but the expense is too great to warrant commercial practice.

Post (10) concluded that the flower bud differentiates as the stem develops regardless of daylength. Pridham (11) found that all plant growth was responsible for differentiating flower spikes but flower spikes often abort a few inches from the bulb if the days are short or if the light intensity is low and the temperature is high.

Weinard and Decker (12) found that lengthening the day with artificial light during the winter months increased flower production. Laurie and Poesch (9) and Balch (1) showed that varieties responded differently, but that most varieties flowered better when given supplementary light.

Post (10) found that days are apparently long enough, and the light intensity great enough north of 35° N latitude to permit normal flowering of gladiolus in the greenhouse from corms planted on February 1 if grown at 50°F at night during cloudy weather and at 55° to 60°F when the light intensity becomes greater.

The result of investigation by Jones (6) on the time of formation of the embryo flower was his basis for employing artificial light to supplement the daylight of the fall and early winter. Jones found that it is desirable to use artificial light when winter blooming of gladiolus in the greenhouse is desired. A 63 percent increase in flower yield was secured with the cultivar 'Crimson Glow' when planted in January and grown under 100 watt lights.

White (13) worked with four cultivars, 'Halley', 'Mrs. F. King', 'America', and 'F. Pendleton', planted December 12 and used 50 watt lights. All cultivars benefited by artificial light as shown by increased numbers of flower stalks.

Gilbert and Pember (3) working at the Rhode Island experiment station in 1931 found significant increases in the number of flowers produced when supplemental lighting was used. The light intensity from

100 watt lamps was sufficient to bring about the desired results and, in some cases, the light from a 50 watt lamp brought about decided increases in numbers of blooms. Supplemental lighting during the later portion of the growth period did not bring about flowering in any case. It was found necessary to begin supplemental lighting soon after the first leaves appeared above the ground. There were indications to show that once flowering began, supplemental lighting could be discontinued.

Further investigation by Gilbert and Pember (3) showed that when cultivars that normally have a short growing period were grown without supplemental lighting, they gave good flower yields if the early forcing period contained a large number of cloudless days. This led to the use of supplemental lighting to hasten the date of flowering by varying light intensities. They showed, however, that little or no shortening of the period between planting and flowering can be ascribed to increased illumination.

Post (10) quotes work by McCalla, Weir, and Neatby who found that temperature was the controlling factor for stem elongation in gladiolus. The minimum temperature at which elongation occurred was 40°F and at no high point did temperature depress growth.

Laurie (7) and Howell (5) found that gladiolus do well when corms are forced at a temperature of 50°F.

Hottes (4) quotes work by Cowee, Taft, and Bebbington, all of whom have recommended maintaining a night temperature of 50°F until roots are well established, followed by 55°F night and 65°F during the day.

MATERIALS AND METHODS

Four gladiolus cultivars were selected for use in this study. Three cultivars, 'Friendship', 'White Friendship', and 'Repartee' were chosen because of their early-blooming characteristic. 'Spic and Span', a late-blooming cultivar, was also selected.

Response to temperature, photoperiod, and corm de-eyeing were studied during the winter and spring in the greenhouses. Standard greenhouse flats with a depth of 4-inches were used initially for forcing corms. Later this was modified to a flat of 6-inches in depth to provide additional stability and support for the plants.

Sixteen corms were planted at equal spacing and at a depth of 3-inches. Seven flats of each of the four cultivars were used in the greenhouse study. Initial plantings were made on February 11. Three additional plantings were made until April using each of the four cultivars.

The soil media for all plantings consisted of 1/5 organic matter (peat), 1/5 perlite, and 3/5 sterilized loam soil.

After planting, all flats were stacked in the greenhouse and maintained at a temperature of 65°F until shoots emerged from the soil and active growth had begun. This permitted greater utilization of greenhouse space and shortened the cropping time (Fig. 1). After active growth had begun and shoots had attained a height of approximately 2-inches above the soil, all flats were transferred to the greenhouse bench. Fig. 2 shows the typical growth habit after six weeks in the greenhouse.

Nylon netting was suspended over the plants during the advanced stages of growth to aid in the support of foliage and the flowering spikes (Fig. 3).

Temperature Study. Two forcing regimes were selected to study the most desirable range for growth. One greenhouse was maintained at 55°F at night and 65°F during the day. Another greenhouse was maintained at 65°F at night and 75°F during the day. These temperatures were maintained as nearly as possible through the use of thermostatically controlled heating units, ventilation, and cooling, when necessary.

Three flats of 'Friendship', 'White Friendship', 'Repartee', and 'Spic and Span' were grown at each of these designated temperatures. The flats remained at the respective temperatures until 48 plants had flowered and data were recorded. The experiment was repeated with additional plantings on February 28, March 14, and April 3.

Photoperiod Study. From corms planted on February 11, one flat of 'Friendship', 'White Friendship', 'Repartee', and 'Spic and Span' was grown each under photoperiods of 8, 11, 14, and 17 hours. Greenhouse temperatures were maintained at approximately 60°F at night, and 70°F during the day. Sixty watt incandescent lamps were spaced two feet apart and three feet above the plants. To separate the photoperiods black muslin curtains were drawn at 5:00 p.m. daily and removed at 8:00 a.m. each morning. Periods of supplemental night lighting were regulated by using time clocks.

Daylength tests were conducted during the months of February, March, and April, 1968, and again during October, November, and December of the same year. These months were thought to be those in which gladiolus would show a beneficial response to supplemental lighting.

All flats remained under the respective photoperiod treatments until 16 plants in the flat had flowered and data were taken.

EXPLANATION OF PLATE I

Fig. 1. Method of stacking flats in the greenhouse after planting to permit corm sprouting and initial growth.

PLATE I

EXPLANATION OF PLATE II

Fig. 2. Typical growth habit after 6 weeks on the greenhouse bench.

Fig. 3. Nylon netting used for support of foliage and flower spikes.

PLATE II

Corm De-eyeing. In an effort to induce earlier flowering and improve bloom quality, 32 uniform corms of 'Repartee' were selected and de-eyed. All growing points except one were removed from the corms. An additional 32 uniform corms were selected as a check.

All corms were planted on May 8 in flats 6-inches in depth, 16 corms per flat. The plants were forced at a temperature of 65°F at night and 75°F during the day.

Data Taken. Data were taken on every plant flowering as follows: Date of flowering (when first floret opens); flowerhead length (the distance from the base of the bottom floret to the tip of the spike); and the total number of buds on the spike.

RESULTS

Temperature

The temperature and cultivar interactions were subjected to an analysis of variance. There were significant differences observed between the temperature treatments, as well as the cultivars within a treatment.

Table 1 shows that there are significant differences in the average number of days to flower for the cultivars between the 55°F night-65°F day, and 65°F night-75°F day temperature regimes. Each of the cultivars required fewer days to flower at 55°F night-65°F day. Analysis of variance of the average number of days required from planting to flowering of the four cultivars at the two temperature regimes is shown in Table 8.

'White Friendship' and 'Repartee' were markedly earlier at the 55°F night-65°F day temperature. 'Spic and Span' required the greatest number of days to flower at both temperature levels.

Table 1. The effect of two temperature regimes on the time required to flower of four gladiolus cultivars, shown in number of days from planting to blossom.

Temperature Regime	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	Days	Days	Days	Days	Days
55° night-65° day	73.2	77.0	68.0	92.8	77.8
65° night-75° day	86.1	94.3	85.0	102.7	95.4
Mean	79.7	85.7	83.2	97.8	

L.S.D. at .05 Cultivar = 5.7 Temperature = 4.0
Cultivar x Temperature = 8.1

Comparison of the effect of temperature on flowerhead length shows notable variations (Table 2). 'Friendship' and 'Spic and Span' produced significantly longer flowerheads at 55°F night-65°F day than at 65°F night-75°F day, but the differences in 'White Friendship' and 'Repartee' at these temperatures were not significant. Analysis of variance of the average flowerhead length of the four cultivars at the two temperature regimes is shown in Table 9.

'Friendship' produced significantly longer flowerheads at both temperatures than all other cultivars.

Figures 4 and 5 show typical flower spikes of 'Friendship' grown at 55°F night-65°F day from corms planted February 11.

Table 2. The effect of two temperature regimes on the length of flowerhead produced by four gladiolus cultivars.

Temperature Regime	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	In.	In.	In.	In.	In.
55° night-65° day	19.4	14.2	12.1	13.6	14.8
65° night-75° day	16.2	13.6	11.8	11.4	13.3
Mean	17.8	13.9	11.9	12.4	

L.S.D. at .05 Cultivar = 0.9 Temperature = 0.6
Cultivar x Temperature = 1.3

When considering number of buds per spike, Table 3 shows that only 'White Friendship' was significantly influenced by temperature. This cultivar responded with higher bud count at 65°F night-75°F day. The effect of temperature did not significantly alter the bud count of 'Friendship', 'Repartee', or 'Spic and Span'. Analysis of variance of the average number of buds produced per spike of the four cultivars at the two temperature regimes is shown in Table 10.

EXPLANATION OF PLATE III

Fig. 4. Typical flower spikes of 'Friendship' gr[illegible] °F night-65°F day from corms planted February 11.

Fig. 5. Typical flower spikes of 'Friendship' grow[illegible] °F night-65°F day from corms planted February 11.

PLATE III

Table 3. The effect of two temperature regimes on the number of buds produced per spike of four gladiolus cultivars.

Temperature Regime	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	Buds	Buds	Buds	Buds	Buds
55° night-65° day	12.7	10.0	8.6	9.7	10.2
65° night-75° day	12.3	12.2	7.8	9.5	10.4
Mean	12.5	11.1	8.2	9.6	

L.S.D. at .05 Cultivar = 0.6 Temperature = N.S.
Cultivar x Temperature = 0.9

Photoperiod

Supplemental lighting resulted in little, if any, added benefit to the growing plants and resulting spikes and blossoms.

Table 4 shows that only the 8 hour photoperiod required significantly fewer number of days to flower than an 11 hour photoperiod. Eleven, 14, and 17 hour photoperiods were not significantly different.

Table 4. The effect of four photoperiods on the time required to flower of four gladiolus cultivars, shown in number of days from planting to blossom.

Photoperiod (Hours light/day)	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	Days	Days	Days	Days	Days
8	77.0	83.1	83.1	94.9	84.5
11	84.6	84.6	86.0	95.5	87.7
14	80.4	85.5	81.9	95.4	85.5
17	83.0	81.5	85.4	94.9	86.2
Mean	81.3	83.7	84.1	95.2	

L.S.D. at .05 Cultivar = 2.1 Photoperiod = 2.1
Cultivar x Photoperiod = 3.7

Analysis of variance of the average number of days required from planting to flowering at the four photoperiod levels is shown in Table 11.

As shown in Tables 5 and 6, photoperiod produced no systematic effect on the flowerhead length or the number of buds per spike within the cultivars tested. The tables reveal that certain cultivars responded more favorably with increased amounts of supplemental lighting, while others did not.

Table 5. The effect of four photoperiods on the length of flowerhead produced by four gladiolus cultivars.

Photoperiod (Hours light/day)	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	In.	In.	In.	In.	In.
8	10.1	10.9	12.1	11.3	11.1
11	12.2	8.8	12.6	11.0	11.1
14	11.3	11.1	11.7	11.8	11.5
17	9.4	11.2	11.3	12.3	11.0
Mean	10.7	10.5	11.9	11.6	

L.S.D. at .05 Cultivar = 0.9 Photoperiod = N.S.
Cultivar x Photoperiod = 0.8

Table 6. The effect of four photoperiods on the number of buds produced per spike of four gladiolus cultivars.

Photoperiod (Hours light/day)	Cultivar				
	Friendship	White Friendship	Repartee	Spic & Span	Mean
	Buds	Buds	Buds	Buds	Buds
8	7.3	6.3	9.5	7.4	7.7
11	8.8	6.0	8.6	7.5	7.7
14	8.0	8.0	8.0	8.5	8.0
17	5.9	8.0	8.0	8.9	7.7
Mean	7.5	7.0	8.5	8.1	

L.S.D. at .05 Cultivar = 1.0 Photoperiod = N.S.
Cultivar x Photoperiod = 1.8

Analysis of variance of the average flowerhead length of the four cultivars at four photoperiod levels is shown in Table 12. Analysis of variance of the average number of buds produced per spike of the four cultivars at four photoperiod levels is shown in Table 13.

Corm De-eyeing

Table 7 shows the result of flower spikes produced from 32 de-eyed corms of 'Repartee' as compared to 32 check corms. Corm de-eyeing resulted in earlier flower production and improved spike quality when compared to the check. Flowerhead length and the average number of buds produced per spike are substantially increased when corms are de-eyed.

Figures 6 and 7 show the characteristic plant growth habit from de-eyed corms as compared to check (non-de-eyed) corms.

Table 7. The effect of corm de-eyeing on the flowering of gladiolus cultivar 'Repartee'.

Treatment	*Days to bloom from planting	*Flowerhead length (in.)	*Number of buds per spike
De-eyed	75.4	15.7	12.1
Check	80.5	12.6	9.7

*Mean of 32 plants flowering

EXPLANATION OF PLATE IV

Fig. 6. Characteristic plant growth from de-eyed corms of 'Repartee'.

Fig. 7. Characteristic plant growth from check (non-de-eyed) corms of 'Repartee'.

PLATE IV

DISCUSSION

When considering quality factors in a gladiolus, the length of the flowerhead and the number of buds on a spike are the principal criteria involved and were those measured in this study. Other criteria such as color, floret texture and substance, and other factors were not measured.

From a practical standpoint, those cultivars requiring the least number of days to flower from planting should prove to be the most economical and valuable for greenhouse forcing.

Many of the flower spikes and stems produced were "soft". Some stems lacked the necessary rigidity to support the flowerheads and open blossoms properly. Stem softness was particularly noticeable among the spikes grown at the higher temperature of 65°F night-75°F day. 'Friendship' and 'White Friendship' produced more spikes with soft stems than did 'Repartee' or 'Spic and Span'.

From the data recorded in this study, as well as visual observations of such factors as stem stiffness and errectness of flowerhead, it was shown that the gladiolus cultivars tested responded most favorably when forced at the 55°F night and 65°F day temperature. This study lends further support to the observations by Cowee, Taft, and Bebbington (4), and Post (10) that most favorable results are obtained when the forcing temperature is maintained at 55°F night and 65°F day after roots become established.

Since no significant differences were shown among the various photoperiod treatments, this study did not support the work of those researchers who have related supplemental light to earliness of flowering. Much of the previous work on greenhouse gladiolus culture, as cited in the review of literature, was done 25 to 30 years ago, and much of it at research stations in the northern tier of states. The suggestion by these workers that the use of supplemental lighting is a desirable means for advancing flower production has two implications which must be considered. First, the winter weather in the northern states boasts a large number of cloudy days, wherein light intensity is diminished. Prolonged periods of low natural light intensity exist. The use of supplementary periods of artificial light under such conditions has undoubtedly proven advantageous. Secondly, during the last 30 years tremendous advancements have been made in greenhouse construction and glazing materials. Present day greenhouse design and glazing provide for greater incidence of light in the greenhouse. More natural sunlight is available for plant utilization.

Apparently, the supplemental artificial light supplied in this study was of little value to the plants because their light requirements were being supplied by natural sunlight and daylength. The naturally occuring light duration and intensity at Manhattan, Kansas are apparently sufficient to promote satisfactory growth and flowering without the aid of supplemental lighting. These results would tend to substantiate the findings by Gilbert and Pember (3) that good flower yields can be produced if the early forcing period contains a large number of cloudless days. Under such conditions, Gilbert and Pember state that little or no shortening of the period between planting and flowering can be achieved through additional illumination.

Shallow planting of gladiolus, such as is the case in greenhouse flats, tends to accentuate the growth and development of numerous "eyes" or shoots from the corms. Individual corms of such cultivars as 'Repartee' will often produce 4 or 5 shoots. These compete for the utilization of water, nutrients and light, and as a result, blooming is delayed, and quality of the individual spikes is reduced. By removing all eyes except one, prior to planting, and allowing only the one plant to develop per corm, earlier flowering by several days is achieved, as well as longer flowerheads and more buds per spike.

The use of flats for forcing of the corms allowed for an overlapping of crops; thus providing better utilization of valuable greenhouse space. The 6-inch depth flat furnished adequate support for the growing plants and blossoms. Very little additional support was necessary to maintain the plants in an errect position.

SUMMARY AND CONCLUSIONS

Data and observations obtained in this study show that there were significant differences in the earliness and overall quality of gladiolus spikes produced under the cooler growing conditions of 55°F night and 65°F day as compared to 65°F night and 75°F day. The cooler growing conditions produced earlier flowers and consistently longer flowerheads. Bud count did not vary significantly at the two temperature levels.

Photoperiod was shown to have little effect on flowering in the latitude of Manhattan, Kansas. Few significant differences were observed among the four photoperiod treatments in this study. Satisfactory growth and flowering occurred under normal greenhouse conditions. Supplemental artificial light for corms planted after February 11 was of negligible benefit.

De-eyeing of corms was both valuable and worthwhile in the production of earlier flowers and higher quality spikes. Flowering was shown to occur 5 days earlier with de-eyed corms as compared to the check. By removing all but a single eye, only one plant develops and maximum earliness of blooms is achieved.

In order to provide the most economical use of the greenhouse, the earliest flowering cultivars must be raised. From a practical standpoint, "Friendship", 'White Friendship', and 'Repartee' were shown in this study to be more desirable for forcing, as compared to the later blooming Spic and Span, since more crops could be produced per unit of time.

Much detailed work remains to be done in the area of winter greenhouse forcing of gladiolus in order for them to become an economical cut-flower crop to the greenhouse operation. The ideal which was envisioned at the outset of this study--that of one uniform crop with all the plants of one variety flowering over a relatively short period of time--did not occur.

More extensive physiological studies are necessary to determine the exact stage of growth at which flower initiation occurs. To date, this has not been definitely established.

In conclusion it may be said that out-of-season greenhouse gladiolus forcing appears to show economical merit if a uniform crop can be produced and sufficient quantity can be raised to justify the expense of greenhouse bench space.

APPENDIX

APPENDIX TABLES

Table 8. Analysis of variance of the average number of days required from planting to flowering of four gladiolus cultivars grown at 55°F night-65°F day, and 65°F night-75°F day.

Sources	DF	SS	MS	F
Cultivars	3	2224.49	741.49	15.34*
Temperature	1	3738.27	3738.27	77.38*
Cultivar x Temperature	3	2740.09	913.36	18.90*
Error	40	1932.60	48.31	
Total	47	6770.25		

*Significant at 5 percent level

Table 9. Analysis of variance of the average flowerhead length of four gladiolus cultivars grown at 55°F night-65°F day, and 65°F night-75°F day.

Sources	DF	SS	MS	F
Cultivars	3	256.03	85.34	68.82*
Temperature	1	27.76	27.76	22.38*
Cultivar x Temperature	3	16.26	5.42	4.37*
Error	40	49.65	1.24	
Total	47	349.70		

*Significant at 5 percent level

Table 10. Analysis of variance of the average number of buds produced per spike of four gladiolus cultivars grown at 55°F night-65°F day, and 65°F night-75°F day.

Sources	DF	SS	MS	F
Cultivars	3	121.65	40.55	60.55*
Temperature	1	0.52	0.52	0.77 N.S.
Cultivar x Temperature	3	17.87	5.95	8.88*
Error	40	26.82	0.67	
Total	47	166.86		

*Significant at 5 percent level

N.S. = No statistical significance

Table 11. Analysis of variance of the average number of days from planting to flowering of four gladiolus cultivars at four photoperiod levels.

Sources	DF	SS	MS	F
Cultivars	3	1853.46	617.82	92.34*
Photoperiod	3	79.69	26.56	3.97*
Cultivar x Photoperiod	9	135.77	15.08	2.25*
Error	48	321.12	6.69	
Total	63	2390.04		

*Significant at 5 percent level

Table 12. Analysis of variance of the average flowerhead length of four gladiolus cultivars at four photoperiod levels.

Sources	DF	SS	MS	F
Cultivars	3	21.88	7.29	5.02*
Photoperiod	3	2.02	0.67	0.05 N.S.
Cultivar x Photoperiod	9	40.94	4.54	3.13*
Error	48	69.87	1.45	
Total	63	134.71		

*Significant at 5 percent level

N.S. = No statistical significance

Table 13. Analysis of variance of the average number of buds produced per spike of four gladiolus cultivars at four photoperiod levels.

Sources	DF	SS	MS	F
Cultivars	3	19.99	6.66	4.21*
Photoperiod	3	1.74	0.58	0.36 N.S.
Cultivar x Photoperiod	9	31.94	3.54	2.24*
Error	48	76.27	1.58	
Total	63	129.97		

*Significant at 5 percent level

N.S. = No statistical significance

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Gladiolus are one of the important crops in year-round use by the floral industry. Because they are in demand throughout the year, winter production is a necessity. The state of Florida is presently the total supplier of gladiolus in use during the winter months.

The possibility of winter production of gladiolus in the greenhouse on a commercial scale continues to be over-looked or discounted by floriculturists.

Four gladiolus cultivars, 'Friendship', 'White Friendship', 'Repartee', and 'Spic and Span' were selected for greenhouse adaptability studies during the winter and early spring of 1968. Standard greenhouse flats were used for forcing, with 16 corms planted per flat.

Response to temperature, photoperiod, and corm de-eyeing were considered. Two temperature regimes were used: (1) 55°F night - 65°F day, and (2) 65°F night - 75°F day. Photoperiods studied included, 8, 11, 14, and 17 hours per day. Artificial light was supplied to supplement natural daylength.

Data were taken based on number of days required for the plants to flower; the length of individual flowerheads; and the total number of buds per spike. Spike quality was considered on the basis of flowerhead length and bud count.

The data on days to flower, flowerhead length, and bud count were subjected to an analysis of variance test of significance. The 55°F night - 65°F day temperature regime produced significantly earlier flowering and consistently longer flowerheads than 65°F night - 75°F day. Bud count did not vary significantly at the two temperature levels.

Supplemental lighting was shown to have little effect on the flowering of corms planted February 11 in the latitude of Manhattan, Kansas. There were few significant differences and no trends noted among the four photoperiods. Certain cultivars performed better without the aid of supplemental lighting, while others showed a slight tendency to favor additional lighting which exceeded that of normal daylength. Satisfactory growth and flowering occurred under each of the four photoperiods studied.

De-eyeing of corms was shown to produce flowers an average of five days earlier than non de-eyed corms. A significant increase in average flowerhead length and number of buds per spike were also noted with the de-eyed corms.