It's a Short Night You Want

What time during the night do you light chrysanthemums or other plants treated to give a long day? Floricultural departments and growers over the country are continually experimenting to find the best time. There would be no confusion and much experimental time could be saved if we all understood a simple theoretical fundamental which has been found with all plants responding to day length.

The length of the dark period determines the reaction of the plant. It is not the length of the light period.

Length of Night

If you wish to prevent chrysanthemums from budding during the short days of winter, you must give them a short night. The minimum length of the continuous dark period necessary for bud initiation varies with the kind of plant. Chrysanthemums form crown buds if the dark period is 9 1/2 hours or more. Thus, if the longest dark period is less than 9 1/2 hours, they remain vegetative but if it is longer than 9 1/2 hours, buds initiate. Poinsettias require a minimum dark period of 11 3/4 hours and kalanchoe requires a dark period of 11 1/4 hours to bud. Chrysanthemum crown buds formed, with a dark period of 9 1/2 hours; or buds in a terminal cluster, formed with a 10 1/2 hour dark period, fail to develop unless the dark period is 10 1/2 or more hours.

During the middle of the winter the light period at 42° N. latitude (Ithaca) is 10 1/2 hours and the dark period is 13 1/2 hours. It is dark at 5:15 p.m. (Ithaca) and daylight at 6:45 a.m. On real cloudy days or in industrial areas the night is much longer. Our light records show on a cloudy day in December it sometimes is dark at 4:45 p.m. and light at 7:30 a.m., giving a dark period of 14 3/4 hours. In a lighting program one must consider the most exaggerated condition unless he is following the daily dark period and adjusting it accordingly.

Light During the Dark Period

If a grower starts artificial light at 5:00 p.m., on this longest night (Dec. 21) and continues the light to 9:00 p.m., he has given 4 hours of light, but the dark period after the light treatment is still from 9:00 p.m. to 7:30 a.m. or 10 1/2 hours. This is a sufficient dark period for chrysanthemums to bud and flower. It is near the critical dark period for development of the buds and due to varying natural length of night, because of weather, the buds will develop more slowly than with no lights. If the lights were on from 5:00 to 10:00 p.m. (5 hours of light) the dark period which follows would be from 10:00 p.m. to 7:30 a.m. or 9 1/2 hours. This is enough dark hours to produce some crown buds but it prevents buds from developing. To be certain of preventing budding this program would require lights from 5:00 to 10:30 p.m. (5 1/2 hours) and the dark period remaining would be 9 hours which is below the critical for budding and no crowns form due to photoperiod.

If the light treatment joined the morning light as lighting from 2:30 a.m. to 7:30 a.m., the result would be the same as lighting in the evening because a dark period in excess of 9 1/2 hours would precede the artificial light.

You can get by with lighting from 7:30 p.m. to 10:30 p.m. (3 hours of light) and obtain the same results as the 5-hour treatment because the longest dark period is 9 hours. If the lights are on during the middle of the dark period (10:30 p.m. to 1:30 a.m.) it is more certain to be effective than at either end of the dark period because then the longest dark period would be only 6 hours. You have plenty of leeway (3 hours) to care for an extra cloudy morning or afternoon.

How it Works

The reason for the dark period affecting flower bud initiation and development is not completely understood. Some hormone is probably involved, whether the dark period causes the production of a substance which causes flowering or reduces a substance formed during the light period which inhibits flowering is still unknown. We know that a 10 1/2-hour dark period, or more, is necessary to develop the buds of chrysanthemums. If we assume the flowering substance accumulates during the dark period and is reduced during the light period, we are then in a position to follow the lighting effect. The flowering substance produced during the first 6-hour dark period is destroyed by the artificial light treatment and the flowering substance produced during the dark period, following the light treatment, is destroyed by the natural light the following day. Thus, no budding results.

Short Day Treatment

Whether you are increasing the dark during the short nights of summer for flowering or using lights to reduce the length of the dark period in winter for vegetative growth, the same principle operates.

When covering plants to lengthen the dark period in summer there is no advantage, but some disadvantage in darkening more than eleven or twelve hours. Most cloth will not give darkness to plants until natural intensity is less than 100 foot candles. Cloth placed over plants before 6 p.m. or left on plants after 6 a.m. (standard time) usually does not supply darkness. It is shading the plants during these periods and acts as any shade in reducing photosynthesis and the increase in the temperature causes the utilization of the food produced during the light period. The reason for placing the cloth over the plants in late afternoon and removing it the following morning is to add a little more darkness to each end of the normal dark period. It also fits nicely with the working hours.

Intensity x Time

How long you should give lights during the dark period to kill the effect of the previous dark period depends on the intensity. The higher the intensity the shorter the interval necessary. Our experiments show we get crown buds with 2 hours of 8 foot candles minimum in the middle of the dark period of December and January. They do not develop into flowers under these conditions. Three hours of light of this intensity completely prevents budding. Probably between 2 and 3 hours is best but since spots in the bench may receive only 5 foot candles the 3 hours of light is desirable at this latitude. Treatments which should give similar results are:

5 foot candles for 5 hours = 25 foot candle hours
8 foot candles for 3 hours = 24 foot candle hours
25 foot candles for 1 hour = 25 foot candle hours
100 foot candles for 1/4 hour = 25 foot candle hours

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Questions This Should Answer

1. When should I light chrysanthemums and other plants requiring long nights to flower?
   a. Middle of the dark period to produce 2 short dark periods.
2. How long need I light?
   a. Three hours of 8 foot candles is ample.
3. How do I space bulbs and what size?
   a. Determine this by a light meter.
4. What is the benefit of longer lighting?
   a. None. It is a waste of electricity.
5. Does black cloth every other night have the same effect as black cloth every night?
   a. No, because only every other night is long and the reaction is about in relation to the treatment.
6. Can I place black cloth over plants at dark and remove it at 10:00 a.m. and get the same effect as 5:00 p.m. to 7:00 a.m.?
   a. Depending on the thickness of cloth and the nearness to the critical dark period the plants get normally. During summer almost no cloth produces darkness after 8:00 a.m. and much cloth will allow enough light to pass to act as daylight by 6:00 a.m.; thus, the dark period would be only about 10 hours and crown buds would form but terminals would not. Later in summer (August 1) it would probably be satisfactory. A better effect would result if the cloth were removed not later than 8:00 a.m.
7. Could I put cloth on after daylight and run it until 10:00 a.m.?
   a. No. The small amount of light (10 to 100 foot candles) would soon destroy the hormone produced during the dark and the treatment would act only as a shade and not give darkness.
8. How long is the night when cloth is placed over plants at 4:00 p.m. and removed at 8:00 a.m.?
   a. Probably 11 to 12 hours of darkness and 4 to 5 hours of heavy shade. Better for the plants would be a 6:00 p.m. to 6:00 a.m. treatment (standard time).

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Your Editor,

Kenneth Post