High Temperature Produces Long-day Effect on Chrysanthemums*

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Irregular budding or poor flower development of chrysanthemums (especially late varieties) during summer is probably due to high temperature. High temperature counteracts the short day. High day temperature, as well as high night temperature is important.

During a study of the minimum number of short days required for budding conducted by Post and Kamemoto (1950) in the summer of 1949, the temperature soared to 105°F for two days. The average maximum greenhouse temperature was 96.1° for the ten day period between August 22 and September 1, and the average minimum was 66.4°. Plants given a short-day treatment at this time required a longer period to initiate buds than did those given short days during a cooler period. During the summers of 1950 and 1951 the present experiments were made with similar results.

Seven varieties of standards were grown under four temperature conditions: (1) 90° night and day, (2) 90° night and 60° day, (3) 60° night and 90° day, (4) 60° night and day. These were grown in small Orlyt greenhouses with automatic heat and ventilation. There were seven plants per treatment which were planted July 7, pinched July 17, and given short days on August 15. The table shows the average date (1950) when the buds were first visible to the unaided eye, and the average date buds showed color.

High Temperature Delays Flowering

Bud initiation occurred with any temperature combination used. Bud development to the flowering stage was most rapid at a lower temperature (60° in this case), with 60° night and day being favorable for most rapid bud development and a low night temperature more favorable than a low day temperature.

Apparently varieties differ considerably in their temperature requirements for bud development but are quite uniform in their requirements for bud initiation. In

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Effects of Temperature Upon Budding and Flowering of Seven Varieties of Standard Chrysanthemums - 1950

		90°Night & Day		90°Night - 60°Day		60°Night - 90°Day		60°Night & Day	
		No. Plants Budded	Av. Date	No. Plants Budded	Av. Date	No. Plants Budded	Av. Date	No. Plants Budded	Av. Date
DETROIT NEWS	Buds	7	Sept. 10	2	Sept. 4	7	Sept. 4	7	Sept. 2
	Color	2	Oct. 27	2	Oct. 1	7	Oct. 13	7	Sept. 26
INDIAN-APOLIS BRONZE	Buds	7	Sept. 9	2	Sept. 4	7	Sept. 6	7	Sept. 4
	Color	0	-------	2	Sept. 30	5	Oct. 23	7	Sept. 26
INDIAN-APOLIS PINK	Buds	5	Sept. 11	2	Sept. 4	7	Sept. 5	7	Sept. 3
	Color	0	--------	2	Sept. 30	6	Oct. 18	7	Sept. 25
MARIE DE PETRIS	Buds	6	Sept. 15	1	Sept. 9	7	Sept. 19	7	Sept. 9
	Color	0	---------	0	--------	0	--------	7	Oct. 5
MONU-MENT	Buds	7	Sept. 12	3	Sept. 5	7	Sept. 10	7	Sept. 5
	Color	1	Oct. 8	3	Oct. 2	1	Oct. 30	7	Sept. 26
QUEEN'S LACE	Buds	7	Sept. 16	3	Sept. 10	7	Sept. 14	7	Sept. 7
	Color	0	--------	3	Oct. 4	3	Oct. 19	7	Sept.28
YELLOW MEFO	Buds	7	Sept. 9	2	Sept. 9	7	Sept. 9	7	Sept. 7
	Color	7	Oct. 19	2	Oct. 5	7	Oct. 21	7	Sept. 30

Seven plants of each variety were used in each treatment.

* Experiment conducted in the temperature control Orlyt greenhouses provided by the New York State Flower Growers Association. Plants were cared for by Mr. F. F. Horton and staff.

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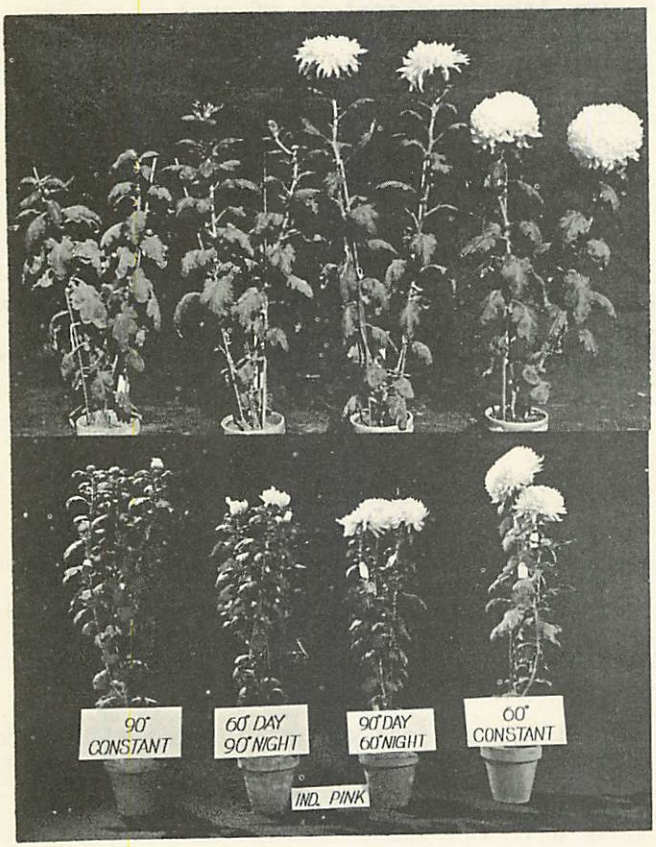
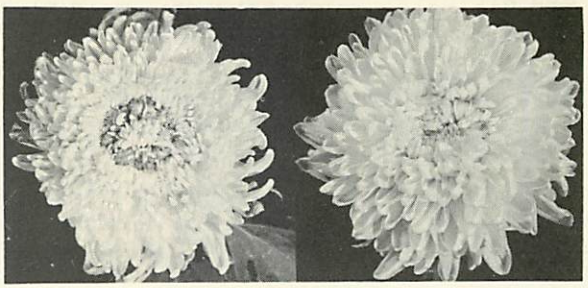
1950 bud development of Yellow Mefo took place 100 per cent at a temperature of 90° night and day while no buds of Indianapolis Bronze, Indianapolis Pink, Marie De Petris, or Queen's Lace developed under those conditions. Buds of Marie De Petris did not develop unless a temperature of 60° maximum night and day was maintained. Detroit News developed 100 per cent of the buds initiated at 90° night and 60° day temperature but considerably less at 90° night and day. All plants flowered in 1951 but were delayed at the high temperature.

From the results obtained from this experiment a temperature not greater than 60° night and day was optimum for bud initiation and development. Blindness might well be caused by a period of hot weather at the time of bud initiation. High temperature night and day being most detrimental, high night temperature next and high day temperature retarded development considerably but less than other treatments. In regions where night and day temperatures are high during the time of bud development, such varieties as Yellow Mefo should be substituted for Marie De Petris or others which failed to develop under the 90° night and day situation, and Marie De Petris should be avoided if temperatures much above 60° are expected during the bud development period.



Indianapolis Pink - top, 1950; bottom, 1951. Effects of temperature on budding and bud development. General effects are similar in the two years but the high temperature prevented development in 1950 and merely delayed it in 1951.



Mal formed buds produced on plants grown at high temperature. Green bracts in the center of the head with increased petalage to abnormal doubling was the result of high temperature. These reactions are similar to the effects of long day after a short day treatment for bud formation.

Furuta (1951) reported retardation in budding and flowering when the night temperature was increased under black cloth to near 90 degrees. He also found varietal differences to this treatment and suggested heat accumulation under black cloth could delay budding during warm periods. Revelation failed to bud at the high night temperature while Sea Gull was not seriously affected until the night temperature was above 90 degrees.

Tests previously made at Ithaca show the temperature would rise under cloth a few degrees above normal air temperature as long as the sun was shining. After sunset the temperature lowered to nearly the same under cloth as in the open. In our work, as well as Furuta's, the high temperature was maintained during the entire dark period.

Probably the slight increase in temperature, due to the black cloth, in afternoon would have much less effect on the developing buds than the general high temperature at some time of the year.

High Temperature Counteracts Short Day

High temperature increases respiration and uses the products of photosynthesis. It is well known that these products (carbohydrates) are necessary for flower bud formation and development. Part of this effect is probably one of respiration but evidently the effect is also on the substance which causes flower bud formation and development.

The production of a crown bud is the result of a few short days which produce sufficient bud forming substance for the one bud. If more short days occur, then more of this substance results and more than one bud forms (Post, 1934).

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After buds form they may be delayed in development by long days. A continuous short day period with high temperature caused one crown bud after another to form on some varieties in 1950. None or few of these developed but the result was similar to a long day treatment. 1951 treatments all budded and all plants developed flowers.

An increase in the number of florets per head may result from long days after buds initiate (Post and Lacey, 1951). Many flowers developed green bracts at high temperature, all or part of the time, and an unusual apparent large number of florets developed in the head. This reaction is similar to long day treatment.

Generally speaking, late varieties are more difficult to bud in summer than in winter. This work shows that Marie De Petris (late) and Furuta showed Revelation (late) more seriously affected by high temperature than early ones. These same late ones require more exposures to short photoperiods to set flower buds than "earlies" require. It is quite probable that late varieties bud with difficulty in summer because temperature is too high, the high temperature acting to nullify the effects of the short photoperiod.

The high temperature was much more effective in preventing flowering in 1950 than in 1951. This was probably due to differences in the amount of light in the two years at some critical period of growth. Probably temperatures lower than 90° and higher than 60° prevent budding of many varieties. Apparently the late varieties have narrow temperature requirements because they also appear to be prevented from flowering at low temperature more readily than early varieties.

Furuta, Tok. Chrysanthemum Tests. Ohio Florists Assn. Bul. 256:3-7, 1951.

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