# Photoperiod and Flowering of Snapdragon

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Up to the present, the influence of photoperiod on the growth and flowering of snapdragons would appear to be underestimated. Work reported by Maginnes and Langhans in N. Y. S. F. G. Bulletin #171, March, 1960, showed (1) flowering occurred sooner under longer photoperiods (18-hour) than short photoperiods (9-hour), (2) flowers were initiated after fewer leaves under long photoperiods than short photoperiods, and (3) flowering could not be turned "on"and "off" in the same manner as with chrysanthemums and poinsettias. The results of that work and subsequent work to be described herein, show photoperiod does not influence flowering over the entire period from germination to flower bud initiation, but rather during a definite period just prior to flower bud initiation.

## Evidence for a "Light Sensitive" Stage Influencing Flowering

Leaf numbers and what may be termed "shifting experiments" have aided in disclosing the influence of photoperiod on flowering. In the investigation outlined in N. Y. S. F. G. Bulletin #171 it was found that plants of the variety Jackpot produced approximately 18 leaves when grown entirely under 18-hour photoperiods and approximately 40 leaves when grown entirely under 9-hour photoperiods. Plants grown under 18-hour photoperiods also flowered about one month sooner than those under 9-hour photoperiods. These characteristics have helped to interpret the results of experiments in which a group of plants was shifted from long to short periods, (18- to 9-hour) every fourth day. Plants shifted from 18- to 9-hour photoperiods starting shortly after germination produced leaf numbers similar to those grown entirely under 9-hour photoperiods, even though they were initially under 18-hour photoperiods. This trend continued until a point was reached, after which, the next group of plants shifted (from 18- to 9-hour) either responded similar to plants grown entirely under 18-hour photoperiods or showed a split population (some of the plants characterized those grown entirely under 9-hour photoperiods, while the remainder characterized plants grown entirely under 18-hour photoperiods). Subsequent shifts from 18- to 9-hour photoperiods produced plants which characterized those grown entirely under 18-hour photoperiods even though

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they completed their growth under 9-hour photoperiods. Thus, the photoperiod received after the plants reached a definite stage of maturity influenced the change from leaf production (vegetative state) to flowering (reproductive state). Actual values illustrating this trend are present in Table 1. Note the split population occurred 44 days after germination.

Plants shifted from 9-to 18-hour photoperiods did not show the same characteristic trend as those shifted from

*(continued on page 2)*

### Photoperiod and Flowering

*(continued from page 1)*

TABLE 1. Average number of leaves produced by plants of the variety Jackpot shifted from 18- to 9-hour photoperiods at 50°F.

| Days from Germination to Shifting | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 | 68 | 72 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leaf Number | 47 | 48 | 51 | 47 | 46 | 41 | 40<br>19 | 18 | 17 | 18 | 17 | 18 | 18 | 18 |

18-hour check—Ave 18 leaves
9-hour check—Ave 47 leaves

18- to 9-hour photoperiods. Initial shifts from 9- to 18-hour photoperiods resulted in plants that characterized those grown entirely under 18-hour photoperiods, even though they had previously received 9-hour photoperiods. This trend continued to a point when the leaf number started to gradually increase with each successive shift. Leaf numbers increased until they became representative of plants grown entirely under 9-hour photoperiods. Plants shifted from 9- to 18-hour photoperiods at 4-day intervals showed the change from leaf production (vegetative state) to flowering (reproductive state) was influenced by the photoperiod. This period, in the course of this work, has been designated as the "light sensitive stage." Actual values illustrating the 9- to 18-hour photoperiod trend are presented in Table 2. In this table it may be seen there was a definite range over which leaf numbers increased reaching a maximum approximately 84 days after germination. Leaf numbers for plants grown under 9-hour photoperiods show considerable variation because leaves do not always occur in pairs after approximately 20 leaves are formed.

### Questions to be Answered

Once the significance of the above findings were realized, many questions arose which formed the basis for a series of experiments. Some of the questions about the "light sensitive stage" influencing flowering were:

1. How is it influenced by the length of photoperiod and temperature?
2. How do varieties of different commercial response groups respond?
3. What influence has time of year on the response?
4. How can light sensitivity be recognized visually?
5. What is the commercial value of this "light sensitive stage"?

### Length of Photoperiod and Temperature

In order to evaluate the influence of the length of photoperiod and temperature on the "light sensitive stage", an experiment was set up to observe groups of plants shifted every fourth day from 18- to 9-hour, 9- to 18-hour, 13- to 9-hour and 9- to 13-hour photoperiods at 50° and 60°F. In Table 3 it can be seen that the number of leaves on plants grown entirely under 9-, 13-, and 18-hour photoperiods characterize the photoperiod under which they were grown. Using a split population or drastic change in leaf numbers as an indicator of light sensitivity, (i.e. shifting from long to short photoperiods), Table 4 shows the change in leaf number occurred sooner at 18- than 13-hour photoperiod and, these in turn, sooner at 60° than 50°F. The drastic change in leaf number when plants were shifted from long to short photoperiods must be considered as an indicator or an event during the "light sensitive stage", and not the beginning of light sensitivity because its occurrence was influenced by photoperiod and, as pointed out above, photoperiod had an influence on flowering in the early stages.

TABLE 3. The influence of photoperiod length and temperatures on the number of leaves formed before flowering.

| Photoperiod | 50°F | 60°F |
|---|---|---|
| 9-hour | 47 | 57 |
| 13-hour | 27 | 30 |
| 18-hour | 18 | 22 |

Although under any given set of conditions photoperiod was observed to influence the number of leaves formed, temperature had a minor influence on the number of leaves formed. Statistical computations showed plants grown at 60°F consistently produced significantly more leaves than those grown at 50°. Comparison of leaf numbers for 50° and 60° and 9-, 13-, and 18-hour photoperiods is presented in Table 3.

### Varietal Response

In the early stages of this study only the variety Jackpot was grown, but later four varieties representing the snapdragon response groups put forward by George J. Ball, Inc. were also grown. The varieties in addition to Jackpot (Group 2) were Rosita (Group 1), Rosanna

TABLE 2. Average number of leaves produced by plants of the variety Jackpot shifted from 9-hour to 18-hour photoperiods at 50°F.

| Days from Germination to Shifting | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 | 68 | 72 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leaf Number | 19 | 19 | 18 | 19 | 19 | 22 | 23 | 25 | 28 | 30 | 23 | 35 | 36 | 44 |
| Days from Germination to Shifting | 76 | 80 | 84 | 88 | 92 | 96 | 100 | 104 | 108 | 112 | 116 | 120 | 124 | 128 |
| Leaf Number | 44 | 43 | 45 | 46 | 46 | 49 | 47 | 46 | 46 | 47 | 45 | 47 | 51 | 50 |

9-hour check—Ave 47 leaves
18-hour check—Ave 18 leaves

*(continued on page 3)*

**Photoperiod and Flowering**

*(continued from page 2)*

TABLE 4. The influence of photoperiod and temperature on the occurrence of a split population or drastic change in leaf number.

| Temperature | Photoperiod Combination | Days from Germination to Split Population |
|---|---|---|
| 60°F | 13- to 9-hour | 44-48 |
| | 18- to 9-hour | 36-40 |
| 50°F | 13- to 9-hour | 52-56 |
| | 18- to 9-hour | 44 |

(Group 2), Potomac Rose (Group 3) and Rockwood's Summer Pink #1 (Group 4). These five varieties were employed in a study using shifts only from 18- to 9-hour photoperiods at 4-day intervals. The number of days from germination to the occurrence of a split population for the five varieties at three sowing dates are presented in Table 5. In this table it may be seen that regardless of sowing date, varieties representing groups 1 and 2 tend to respond similarly and respond faster than group 3 and in turn, respond faster than group 4.

TABLE 5. The number of days from germination to the occurrence of a split population for 5 varieties at 3 sowing dates (Shift from 18- to 9-hour)

| Variety | Date of Sowing | | |
|---|---|---|---|
| | Feb. 22, '61 | Mar. 25, '62 | July 10, '61 |
| Jackpot | 40 | 40-44 | 28-32 |
| Rosita | 40 | 40 | 28 |
| Rosanna | 44 | 44 | 32 |
| Potomac Rose | 48-52 | 44-48 | 28-32 |
| Rockwood's S. P. #1 | 48-52 | 52 | 32-36 |

**Influence of Time of Year on Response**

The effect of time of year on the light sensitive stage influencing flowering can be observed in Table 5. There is little difference between the February 22 and March 25 sowings, but in the July 10 sowing all the varieties responded sooner than in the other two sowings. Hastening of the July 10 sowing was due to the increased temperature and light intensity of summer.

**Visual Recognition**

Shortly after the "light sensitive stage" influencing flowering was observed, it was realized that in order for this stage to be of value commercially, it would have to be recognized visually. Of all the characteristics considered, the number of leaves that can be readily observed on a plant would appear to be the most promising. In numerous experiments the variety Jackpot was observed to have 10 to 12 leaves when the drastic change in leaf number or split population occurred. Information from three shifting experiments (started February 22, 1961, July 10, 1961 and March 25, 1962) involving Jackpot, Rosita, Rosanna, Potomac Rose, and Rockwood's Summer Pink #1, showed that Jackpot, Rosita and Rosanna responded quite similarly (10 to 12 leaves) and that Potomac Rose and Rockwood's Summer Pink #1 tend to respond after more leaves are formed. Experiments started under summer conditions tend to show little or no difference in leaf numbers for the commerical response groups. This is probably due to the higher temperatures, increased day-length and higher light intensity encountered during summer. Also, under these conditions the shift interval may not be short enough to detect differences. Further work is needed in order to make a definite statement about commercial response groups or varieties, with regards to recognizing this event.

## Commercial Value

Knowledge of the "light sensitive stage" and its influence on flowering has revealed several commerical possibilities.

Early experiments with the variety Jackpot showed plants grown under 18-hour photoperiods flowered about four weeks before those grown under 9-hour photoperiods. However, plants grown under 18-hour photoperiods were of lower quality than those grown under 9-hour photoperiods. In order to try to combine earliness and quality, an experiment was designed in which plants were shifted from short to long to short photoperiods. The results of this work showed that plants which received 9-hour photoperiods until the initial stages of "light sensitive stage", then twelve days of 18-hour photoperiods then returned to 9-hour photoperiods, bloomed three weeks sooner than and were of comparable quality to those plants grown entirely under 9-hour photoperiods. Thus, with a knowledge of the influence of photoperiod and temperature on flower quality, a grower could produce flowers of a specific quality in the least growing time on a year-round basis.

Results of this work also indicate the feasibility of using these conditions to determine the commercial response group of a new variety.