# Snapdragon Lighting

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One of the greatest problems in the commercial production of winter snapdragons has been the expense brought about by extremely slow growth of this crop during mid-winter. Several good approaches to this problem have been used by researchers. One of the most fruitful has been the breeding of varieties for commercial production at specific times of the year. Another approach has been that of raising the growing temperature and still another has been artificial lighting.

Petersen (New York State Flower Growers Bulletin No. 122) has shown that supplemental lighting can be used more effectively by lighting seedlings during the night, before benching. In some of the previous work it had been attempted to light plants after benching and in some cases during the day rather than at night. Most of the work done prior to Petersen's research had produced results which were not spectacular. These experiments were designed to show the effects of lighting at different times of the year and also to investigate some of the factors involved in lighting snapdragon plants to commercial advantage.

## Ways in Which Light Affects Plants

Before dealing with the observations which have been made during the course of this work and Petersen's work, it is well to consider some of the ways in which light can affect plants.

### Food Manufacture

The best known function of light in growing plants is to furnish energy for photosynthesis, the process by which plants manufacture their food. In snapdragons, the amount of food manufactured is proportional to the light intensity except where the light intensity is quite high. For this reason, snapdragons grow very slowly during the winter months, since the small amount of sunlight received is insufficient to build up a food supply large enough to make rapid growth possible.

The relationship between light and temperature is not only with food manufacture but also with respiration, the process by which plants (and animals) burn up food and convert the energy derived from it into energy for growth and other activities of the plant. For the best kind of growth, these processes of food manufacture and food

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utilization must be regulated so that the food supply is large enough to maintain respiration and rapid growth, and yet so that respiration is rapid enough to prevent the plant from simply acting as a storehouse for food which could be used for growth. In animals, there is a gland, the thyriod, which serves to regulate food utilization. In plants, the temperature at which they are growing accomplishes about the same thing, since higher temperatures result in a higher rate of respiration and lower temperatures bring about a lower rate. For this reason, we have temperatures which we consider best for the growth of particular plants.

## Daylength Effects

Some plants, such as asters, poinsettias and chrysanthemums vegetate or flower depending upon the length of day. Many summer flowering varieties of snapdragons belong to this group. Some other plants do not seem to be affected by daylength. There are, in addition, plants which behave differently at different daylengths, but in a more subtle way. These plants, rather than flowering at one daylength and failing to flower with a longer or shorter day, simply flower earlier at certain daylengths than at others. Winter snapdragon varieties belong to this group.

**Formative Effects**

It has been shown by workers in The Netherlands and in this country that light of different colors and intensities can affect the form of plants. Stem elongation, leaf growth, chlorophyll production, and bending toward light are processes depending more or less heavily on certain wavebands or colors in the light spectrum. Blue light, for instance, promotes leaf growth and reduces stem elongation in many plants, while red light produces tall, spindly plants. No single waveband has ever been shown to be as good as light which contains all the colors in balanced amounts. It is not necessarily true, however, that sunlight is the ideal balanced mixture of colors.

**Light Sources**

The three general types of light sources are arc, incandescent, and gaseous discharge lamps. The lamps of the carbon arc type were used experimentally for growing plants before the turn of the century, but never proved very useful. Incandescent lamps have been most widely used for lighting. Gaseous discharge lamps include such lamps as neon, sodium, and mercury vapor lamps and the common fluorescent tubes. Most of these have been used for plant lighting at one time or another.

Incandescent lamps produce more heat per watt than the other common lamps. They also produce less light for human vision; whether or not they produce less light useful to plants has not been fully determined. Fluorescent lamps are very cool and very efficient light-producers. Mercury vapor lamps are not so cool as fluorescent lamps but are much cooler than incandescent lamps. They are also very efficient light-producers, but not necessarily very efficient in the production of light useful to plants. Color-corrected mercury vapor lamps are now in use and are probably better for plant growth than the older clear mercury lamps.

**Results of Lighting at Different Times of the Year**

By sowing snapdragon seeds at a number of different times during a growing season, it was possible to see the amount of earlier flowering brought about by different methods of lighting and at the same time to compare the products obtained by the various methods.

Table 1 lists a number of flowering dates and the length of time later than the normal sowing date that sowings can be made using different lighting methods. Normal weather is assumed and variations from normal will have the usual disrupting effects. This information is obtained from crops grown during the 1955-6 and 1956-7 seasons at Ithaca. Lighting crops to flower later than March cannot be recommended from the data so far obtained, since the rapidly increasing light and temperature after that nullifies much of the effect of the previous lighting. The data given apply to Jackpot and other varieties will undoubtedly vary in their response to lighting, although it would be expected that winter $F_1$ varieties would behave somewhat alike and spring varieties somewhat differently.

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**TABLE 1.** Delayed sowing and probable results using different methods of artificial lighting with single stem Jackpot.

| | . . . using this type of lighting . . . | . . . sow seed this much later than normal . . . | . . . and expect this much difference in grade . . . |
|---|---|---|---|
| *To flower on December 15—* | Incandescent lamps* | 3 weeks | 1 grade lower |
| | Mercury lamp* (every night) | 3 weeks | ½ to 1 grade lower |
| | Mercury lamp* (alternate nights) | 1-2 weeks | None to ½ grade lower |
| | Fluorescent lamps† | 1 week | None |
| *To flower on January 15—* | Incandescent lamps* | 3-4 weeks | 1 grade lower |
| | Mercury lamp* (every night) | 3 weeks | 1 grade lower |
| | Mercury lamp* (alternate nights) | 1-2 weeks | ½ to 1 grade lower |
| | Fluorescent lamps† | 1-2 weeks | None |
| *To flower on February 15—* | Incandescent lamps* | 3-4 weeks | 1 grade lower |
| | Mercury lamp* (every night) | 3 weeks | 1 to 1½ grade lower |
| | Mercury lamp* (alternate nights) | 1-2 weeks | ½ to 1 grade lower |
| | Fluorescent lamps† | 1-2 weeks | None |
| *To flower on March 15—* | Incandescent lamps* | 3-4 weeks | ½ to 1 grade lower |
| | Mercury lamp* (every night) | 3 weeks | 1 grade lower |
| | Mercury lamp* (alternate nights) | 1-2 weeks | ½ to 1 grade lower |
| | Fluorescent lamps† | 1-2 weeks | None |

*10-15 watts per sq. ft. (30 inches above plants)
†10-15 watts per sq. ft. (8-10 inches above plants)

## Factors to be Considered when Lighting Snapdragon Seedlings

### Time of day to Light

Petersen (NYSFG Bul. 122) has shown that lighting of seedlings at night is much more effective than lighting during the day. More recent work here has shown that light applied at night is used more efficiently by the plant in food production than the natural light during the day. In addition, the effect on the daylength of lighting all night has been shown to be important in producing a faster maturing plant.

### Length of Time to Light

It has been shown that snapdragon plants cannot easily be kept in good condition in a 2¼ inch pot for over 30 days. In fact, during warm, bright weather, the length of time in pots should be shortened considerably. With the variety Jackpot, it was found that during bright weather, seedlings made better growth when planted in the bench after 20 days of lighting than they did when left under lights for an additional 10 days in 2¼ inch pots. One important reason for this was that, ten days after planting in the bench, the snapdragon plants had a leaf area half again as great as similar plants which had been left in pots. In other words, benched plants had 50% more surface to intercept light, which furnishes the energy for food manufacture. This shows that the supply of water and nutrients can limit the growth of plants long before they have a hardened appearance. These plants were all growing rapidly and were in good condition. It is possible that the length of time plants can be kept in pots might be lengthened by the use of peat or plastic pots or by the use of plant bands.

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**Daily Cycles**

It was found that lighting every other night for 20 days gave a similar result to lighting every night for 10 days. It might be better to light every night for the shorter length of time, so that plants could be benched at any time thereafter when space became available.

On the other hand, it might be possible to maintain the size of the plant at the expense of extremely early flowering with incandescent lamps by lighting every other night.

**Temperature**

For winter varieties of snapdragons, 50°F has long been considered the best night temperature. Robert O. Miller (see article this issue), however, has recently shown that the best night temperature varies with the size of the plant and the light conditions. It would be expected that the night temperature could be raised for plants receiving artificial light at night. The exact temperature requirements for different varieties at different ages has not yet been worked out. Petersen, however, obtained excellent results by growing seedlings of Jackpot and Golden Spike from germination until pricking off at a constant 68°F. Miller's work indicates that 50°F is too low a temperature for seedlings being lighted in 2¼ inch pots, except perhaps during extremely dark weather.

**Fertilization and Watering**

The law of limiting factors tells us that if we expect to obtain better growth by lighting snapdragon seedlings artificially, no other factor should be allowed to limit plant growth. When snapdragons are to be lighted, it is even more important that the water and fertilizer supply be adequate, since if these factors limit growth, there will be no return for the added expense involved.

**Timing**

Lighting does not elimiate the timing problem, although somewhat smaller variations may be expected. Timing schedules are still subject to a certain amount of disruption as a result of "unseasonal" light and temperature conditions.