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THE INTERACTION BETWEEN LIGHT INTENSITY AND PHOTOPERIOD ON CUT SNAPDRAGON FLOWER INITIATION

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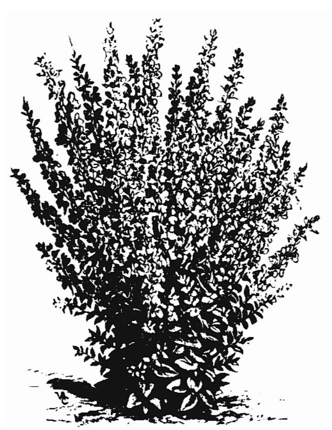
INTRODUCTION

A few months ago when I visited Len Busch Roses Inc., Pat Busch mentioned the difficulty which they were having in consistently scheduling cut snapdragons. Not only was there variation in flowering time, but plant height varied considerably throughout the year. Differences in plant height were due to differences in node number as well as internode length.

Snapdragon (*Antirrhinum majus* L.) is grown as a year round cut flower crop throughout the United States. Prior to 1926 cut snapdragons were only grown during the summer months. Snapdragons are a quantitative long-day plant, i.e. the snapdragon is capable of flowering under short-days but flowers earlier under long-day conditions. The time from flower initiation until flowering was often too long to make winter production profitable (Rogers 1980). However, after 1926 cultivars were introduced which could be produced all year profitably.

We believed the scheduling problem was related to when flower initiation was occurring. Temperatures were similar in the production greenhouse most of the year, but light intensity and photoperiod varied. We, therefore, decided to conduct an experiment to study how photoperiod and light intensity interact to affect when snapdragon flower initiation occurs and the flower number per inflorescence. In addition, we expanded the experiment to determine how much time was needed for 'complete' flower initiation to occur.



MATERIALS AND METHODS

Chamber photoperiods were maintained at 8, 10, 12 or 14 hours.

ne hundred ninety-two snapragon cv 'Winchester' seedlings ЛcGregor Greenhouses) were ansplanted from plugs into 4" plastic pots in a soilless medium ›nsisting of 50% sphagnum peat, 5% perlite, and 25% vermicute at the 2 leaf stage. Plants ere fertilized throughout the :periment at each watering with solution composed of 200-0-)0 ppm (N-P-K). Fertilizer consted of calcium and potassium itrate.

he uppermost leaf on each lant was marked to identify ie stage of development of a lant at the initiation of the :periment. Forty-eight plants ere placed in each of 4 growth ıambers. Lighting was deliv-:ed with cool white fluorescent .mps only. The chambers were :aintained at constant 68°F. hamber photoperiods were .aintained at 8, 10, 12 or 14 ɔurs. Photoperiod was extended ; a day-extension treatment as ɔposed to a night-interruption eatment.

Each group was placed at a different irradiance level (light intensity) within each chamber.

Plants were divided into 4 groups ; 12 plants each within each growth chamber. Each group as placed at a different irradiance level (light intensity) within each chamber (Figure 1). Irradiance levels (light intensities) were 240 (1,200 footcandles), 315 (1,575 footcandles), 380 (1,900 footcandles) and 460 umol s^{-1} m^{-2} (2,300 footcandles). Three plants were removed from each irradiance level within each chamber on day 7, 14 and 21 days after the initiation the experiment. Plants were then placed in a greenhouse maintained at constant 68°F $\pm$ 4°F. Photoperiod and irradiance were that of natural conditions for Minneapolis, Minnesota from January 15 to February 15, 1991. Data were collected when all flowers were visible on an inflorescence. Data were col-

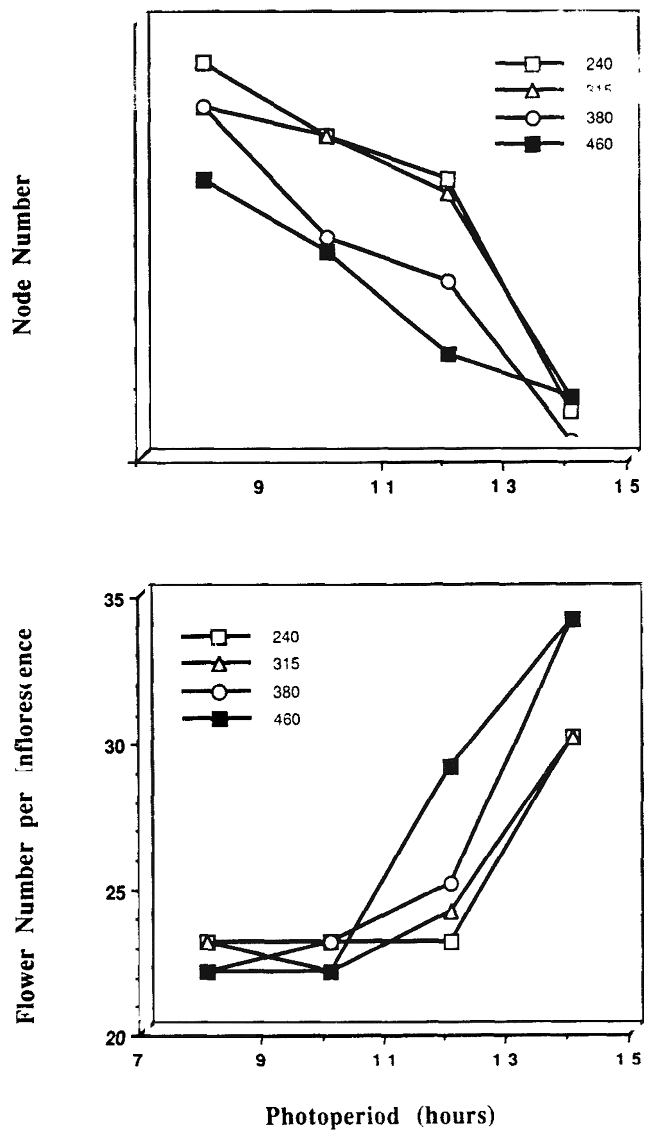
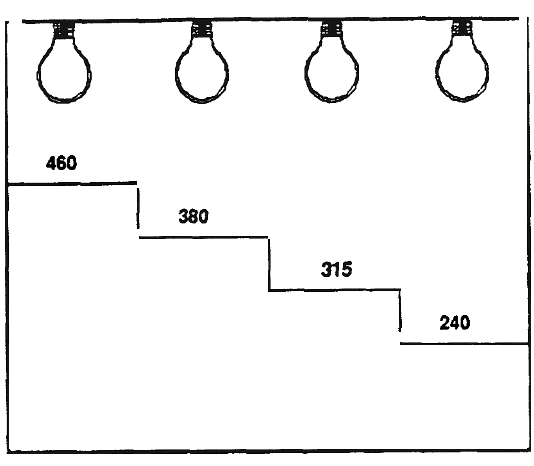


Figure 2. *Node number and flower number per inflorescence as affected by photoperiod.*



igure 1. *Irradiance levels used (umol* ^{1} *m^{-2}).*

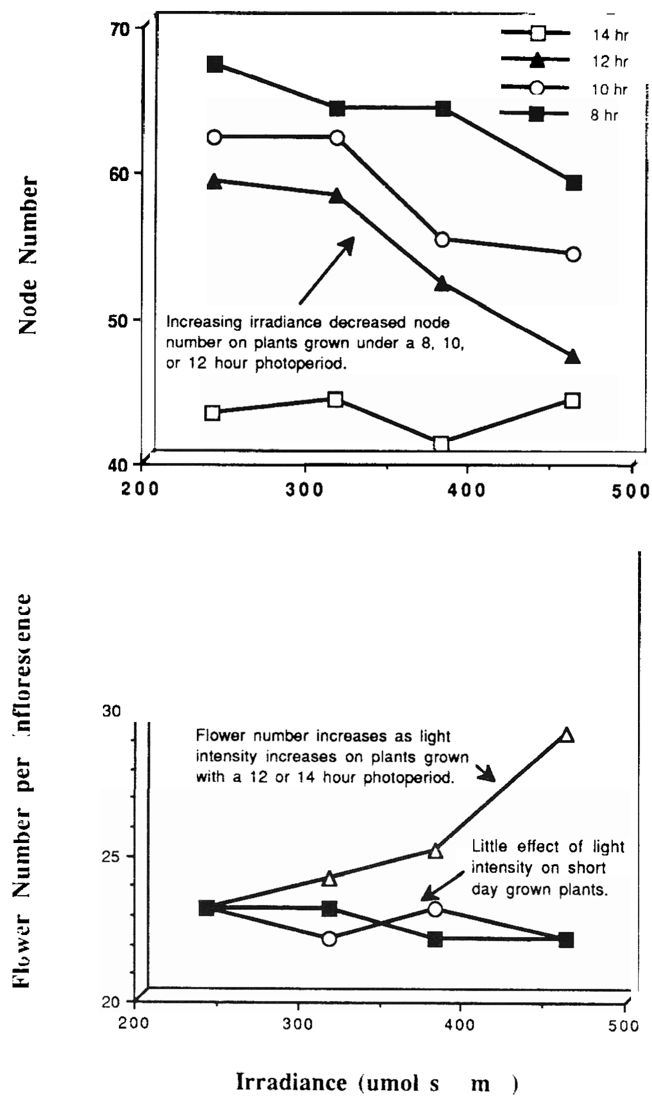


Figure 3. *Node number and flower number per inflorescence as affected by irradiance.*

ected on flower number and the number of nodes from the dotted leaf to the first flower.

RESULTS

Flower Initiation

Both photoperiod and light intensity affected snapdragon flower initiation and flower number per inflorescence. Flower initiation occurred significantly earlier on snapdragon seedlings grown under a 14 hour photoperiod compared to plants grown under 12, 10 or 8 hour photoperiod (Figure 2). We can tell flower initiation occurred earlier because there were fewer nodes which formed from the time of the initiation of the experiment (identified by the dotted leaf) until the first flower. Node number decreased from 67 to 43 nodes at the lowest irradiance of 240 umol s^{-1} m^{-2} (1200 footcandles) as photoperiod increased from 8 to 14 hours. Similarly, node number decreased from 59 to 44 nodes on plants grown at the highest irradiance of 460 umol s^{-1} m^{-2} (2300 footcandles) as photoperiod increased from 8 to 14 hours. These results are consistent with previous reports on the effects of photoperiod on snapdragon flower initiation (Cockshull, 1985).

There was an interaction between light intensity and photoperiod on snapdragon flower initiation. Flower initiation occurred earlier on plants which received a higher light intensity when plants were grown with an 8-12 hour photoperiod (Figure 3). Light intensity had no effect on the node number of plants of plants grown with a 14 hour photoperiod. For instance, node number decreased from 67 to 59 nodes as light intensity increased from 240 to 460 umol s^{-1} m^{-2} on plants grown under an 8 hour photoperiod. In contrast, node number essentially stayed the same or was unaffected by irradiance on plants which were grown under a 14 hour photoperiod (Figure 3).

Flower Number

Flower number increased as photoperiod increased (Figure 4). Flower number increased from 23 to 30 flowers per inflorescence as photoperiod increased from 8 to 14 hours per day.

Flower initiation occured significantly earlier on snapdragon seedlings grown under a 14 hour photoperiod compared to plants grown under 12, 10 or 8 hour photoperiod.

Flower initiation occured earlier on plants which received a higher light intensity when plants were grown with an 8-12 hour photoperiod.

Light intensity had no effect on the node number of plants of plants grown with a 14 hour photoperiod.

Flower number increased as photoperiod increased.

Light intensity had little effect on flower number in the range of intensities studied in this experiment.

The time which plants were maintained under 'inductive' conditions had a significant effect on both node and flower number on plants grown under a 12 to 14 hour photoperiod.

Flower number increased from 22 to 31 flowers per inflorescence as the time plants were treated with a 14 hour photoperiod increased from 7 to 21 days.

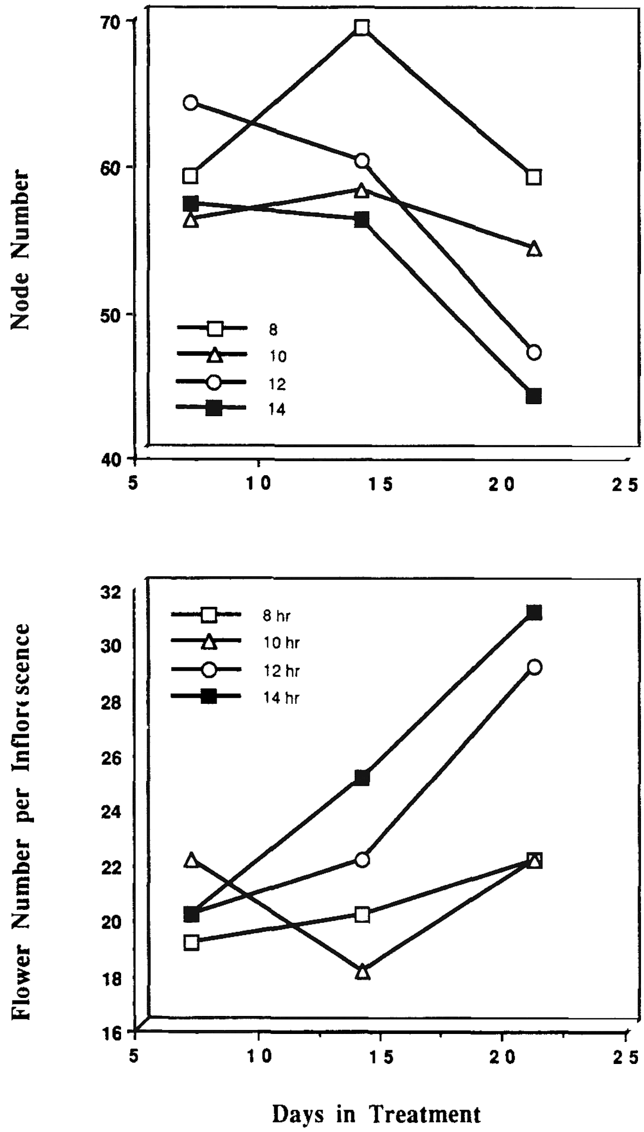


Figure 3. *Flower number per inflorescence and node number as effected by days in treatment.*

Light intensity had little effect on flower number in the range of intensities studied in this experiment (Figure 5). However, flower number tended to increase slightly as light intensity increased when plants were grown under 12 and 14 hour photoperiods. Since flower initiation occurred earlier on plants grown under long photoperiods versus short photoperiods total photosynthates may be limiting under long day grown plants which have fewer nodes at the time of flower initiation.

Time Necessary For Flower Initiation

The time which plants were maintained under 'inductive' conditions had a significant effect on both node and flower number on plants grown under a 12 or 14 hour photoperiod. For instance, node number decreased from 57 to 44 nodes below the inflorescence as time in the inductive treatment increased from 7 to 21 days on plants grown under a 460 umol s^{-1} m^{-2} irradiance. In contrast, node number was unaffected by the time in short day conditions. These results contrast previous research which suggested that a 2 day long-day treatment was as effective as a continuous long-day treatment on flower initiation (Hedley and Harvey, 1975).

Flower number was also effected by the time which plants were treated in the growth chambers. For instance, flower number increased from 22 to 31 flowers per inflorescence as the time plants were treated with a 14 hour photoperiod increased from 7 to 21 days. In contrast, flower number essentially stayed the same on plants grown under short day conditions.

Practical Implications

These data suggest the following conclusions on cut snapdragon production:

1. Flowering is most rapid and inflorescence size is greatest when the photoperiod is extended from 8 to 14 hours as a day extension.

2. The flower number per inflorescence increases as irradiance increases from 240 to 460 umol s^{-1} m^{-2} when flower initiation occurs under a 12 or 14 hour photoperiod. The effects of

light intensity on flower number may be related to the available photosynthates during flower initiation. If this is the case, the effect of irradiance on flower number would probably be lessened if plants were allowed to unfold more leaves prior to placing them under a 14 hour photoperiod.

3. Irradiance has no effect on the time to flower when plants are initiated under a 14 hour photoperiod.

4. The longer plants are under inductive treatments the better. Node number decreased and flower number per inflorescence increased as the treatment time increased from 7 to 21 days. These results may be different if the long-day treatment is delivered with night-interruption lighting as opposed to day-extension lighting.

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