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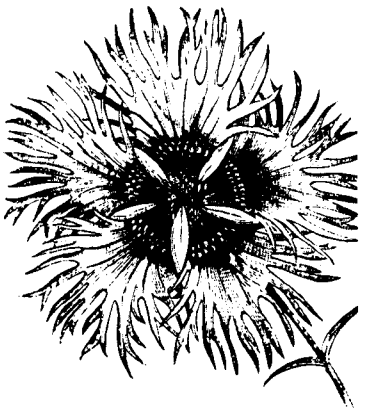
Fast Cropping Annuals

John Erwin and Brian Kovanda
Department of Horticultural Science
University of Minnesota



The pressure to produce high quality bedding plant crops in bloom at a specific time has increased greatly with the advent of chain store marketing of bedding plants. Variation in quality or timing within a season or from year to year is unacceptable to many marketers. As a result, the need for understanding what factors affect flowering of many annuals we grow is essential to time crops precisely. We 'coined' the term 'fast cropping' to describe an alternative production style where seedlings are programmed to flower at a desired time using environmental

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treatments to minimize production time while maintaining or increasing final product quality.

We initiated a project to better understand what factors control flowering of petunia (cvs. 'Dreams Red' (grandiflora), 'Celebrity Burgundy' (multiflora), 'Fantasy Pink Morn' (milliflora), and 'Purple Wave'(surfinia)), pansy (cv. 'Delta Rose'), viola (cv. 'Purple Sorbet'), gomphrena (cv. 'Bicolor Rose'), and nierembergia (cv. 'Mont Blanc'). Our intent was to develop criteria for seedling environmental treatments to insure

a crop is at the desired quality at the desired time when marketed. We looked at the impact of temperature, photoperiod, supplemental lighting, and stage of development of the seedling when treated on final plant quality, appearance, and flowering time. Temperatures ranged from 54-75^{0}F. Lighting treatments were short day (8 hours), night interruption (incandescent lamps from 2200-0200 hr (10 footcandles)), day extension (1000 footcandles of supplemental high pressure sodium lighting from 1700-2000 hr), and continuous 1000 footcandle supplemental lighting with high pressure sodium lamps. All seedlings were treated during the first 6 weeks after germination and were grown under natural daylight conditions for Minneapolis/St. Paul for December-March. In many respects, the information we learned directly affects plug producers most. However, this information has some application to every bedding plant grower we know of. The project was a direct result of a cooperative effort between the University of Minnesota, Wagner's Greenhouses, Inc. (Minneapolis, MN), and Smith Greenhouses, Inc. (Bellingham/ Merrysville, WA). The results we are presenting in this article are preliminary results on flowering time. We will present additional results on overall plant quality with definite recommendations in a subsequent article.

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What Factors Affect Flowering:

Flowering of most annual bedding plants is affected by 4 primary factors: juvenility, photoperiod, total light/day, and stress. Juvenility refers to the age at which a seedling is capable of initiating flowers. Many annual plants are not able to initiate flowers until the seedling unfolds a specific leaf number. Any treatments prior to the seedling reaching the necessary critical leaf number above which a seedling is no longer juvenile will not have an effect on flowering.

Photoperiodism refers to the induction of flowering in plants by daylength (or more appropriately night length). There are short-day, day- neutral, and long-day plant groups. Short-day plants require a short day, or long night, to induce flowering. Day-neutral plants flower regardless of daylength. Long-day plants require a long day, or short night, to flower. Within each group, there are obligate and facultative types. An obligate short-day plant requires short days for flowering. A facultative short day plant will flower under any photoperiod, but will flower faster under short-day conditions. The original research on photoperiodism in annuals was conducted during the 1930's by Post (1942) (Table 1). Amazingly, little research has been conducted since then on photoperiodic responses of many of the common bedding plants!

The total amount of light received by a plant over a 24 hour period affects flowering of some annuals. For instance, the time required for seed geraniums to bloom is reduced approximately 1 day for each day seedlings are lit with supplemental lighting (24 hours) using high pressure sodium lamps. Time to flower of other annuals is also reduced when grown under supplemental lighting. Additional research in this area is absolutely needed as more and more pressure to schedule crops accurately is expected of growers.

Lastly, flowering of some bedding plants is hastened if plants are stressed. For instance, water stressing celosia early in development will cause premature flowering. Similarly, garden mums will often initiate flowers early if nutrient stressed.

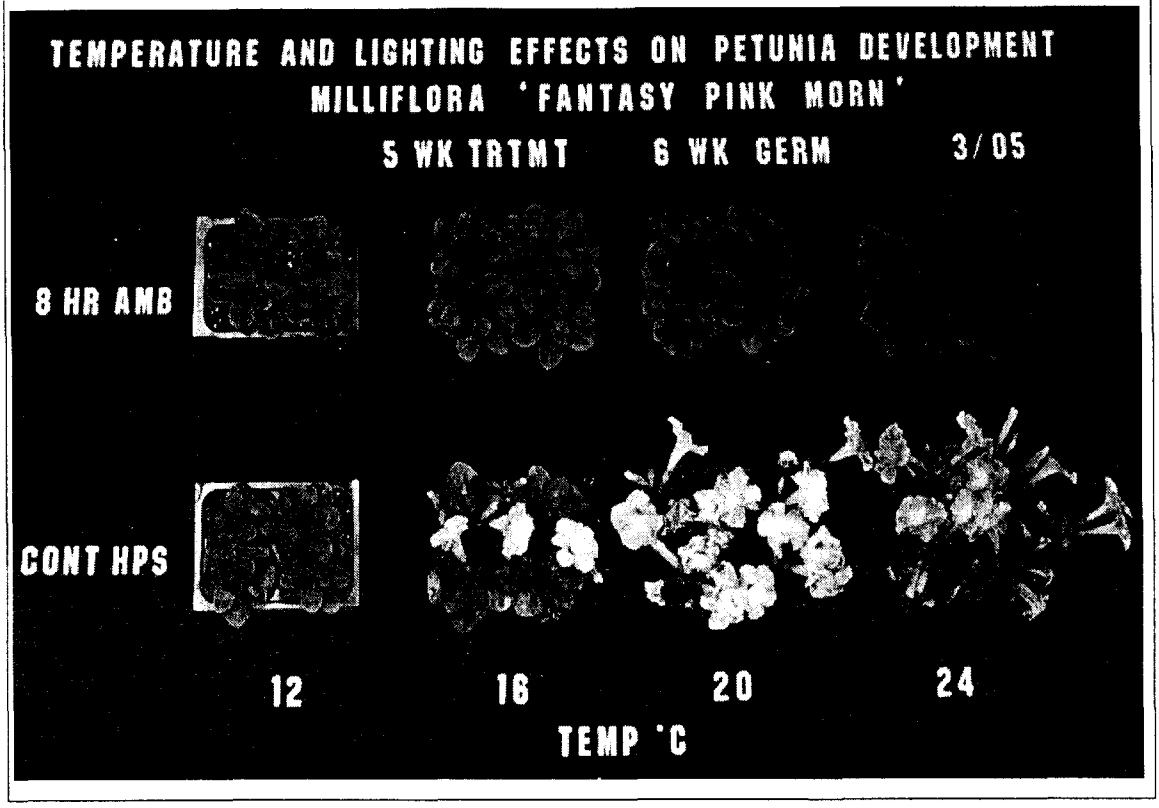
Table 1. Effect of daylength on bedding plant growth and flowering (extracted from Cathey, 1976).

Crop	Daylength	
	Long Days	Short Days
Balsam	none	none
Basil	delay flowering	hasten flowering
Cleome	delay flowering	hasten flowering
Cosmos	no flowering	induce flowering
Gaillardia	induce flowering	no flowering
Gypsophila	induce flowering	no flowering
Morning Glory	delay flowering	hasten flowering
Petunia	hasten flowering	delay flowering
Rudbeckia	delay flowering	hasten flowering
Verbena	induce flowering	delay flowering
Zinnia	delay flowering	hasten flowering

What We Found On Petunias:

Time of petunia flowering is dramatically affected by photoperiod, supplemental lighting and temperature. The factor that had the greatest impact on petunia flowering was supplemental lighting. In particular, lighting with high pressure sodium lamps (1,000 footcandles) for 24 hours a day greatly decreased time to flower on all petunia cultivars (Figure 1). The cultivars differed in their response to supplemental lighting with 'Dreams Red' showing the greatest response (days to flower decreased from 105 to 66 days) and 'Purple Wave' showing

Figure 1. Effect of lighting treatments (8 hr = short days; Cont HPS= continuous high pressure sodium lamps) and temperature on *Petunia* x *hybrida* 'Fantasy Pink Morn' development.



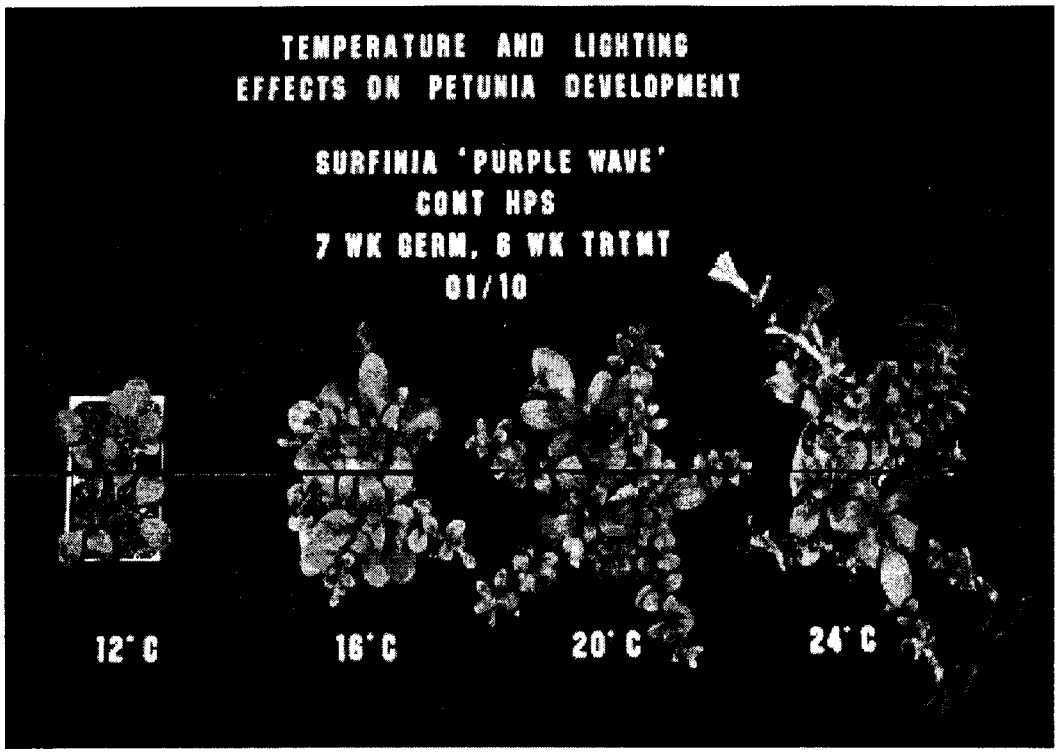


Figure 2. Effect of temperature on *Petunia* x *hybrida* 'Purple Wave' development.

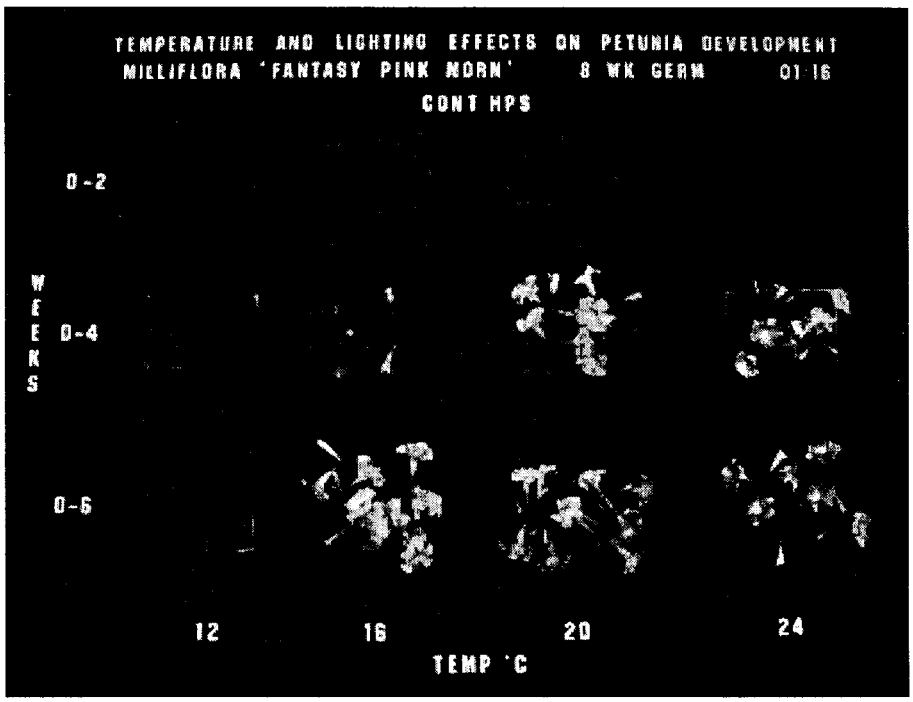
did not initiate flowers even after 18 weeks. Because of this, we would classify the petunias we studied as 'obligate long-day plants', i.e. long-day requiring for flowering.

Increasing temperature also greatly hastened flowering of petunias (Figure 2). Increasing temperature above 68°F did not significantly decrease the time to flower across cultivars. However, increasing temperature from the more traditional 63 to 68°F during the first 6 weeks of development decreased the time to flower

the least response (day to flower decreased from 102 to 76 days) when plants received a 6 week short day treatment versus a 6 week continuous lighting treatment with high pressure sodium lamps followed by long-day conditions.

Short days inhibited flowering of petunias (Figure1). Seedlings grown under continuous short-day conditions

Figure 3. Time of lighting in *Petunia* x *hybrida* 'Fantasy Pink Morn' development affects time to flower.



significantly across cultivars. For instance, increasing a 6 week temperature treatment under continuous high pressure sodium lamps from 63 to 68°F decreased days to flower on 'Dreams Red' from 74 to 56 days (17 day reduction). However, further increasing temperature for the same treatment and cultivar from 68 to 75°F decreased flowering time from 56 to 50 days (6 day reduction).

Seedlings were most sensitive to lighting treatments early in development. 'Fantasy Pink Morn' was most sensitive to lighting from week 0 to flower (before week 6) (Figure 3). In contrast, the other cultivars were most sensitive from week 2 to 6 after germination. In contrast, flowering was most delayed in petunia when seedlings were placed under short-day conditions during week 0-6 for 'Fantasy Pink Morn' or weeks 2 to 6 after germination for the other cultivars studied.

What We Found on Pansies and Violas:

Pansies responded to light and temperature in a similar way as petunias. However, all pansy seedlings eventually flowered indicating that 'Delta Rose' is a 'facultative long-day plant', i.e. long-day hastens flowering but is not essential. Flowering time decreased as the total amount of light delivered to 'Delta Rose' increased under long-day conditions. As with petunias, flowering time was hastened by increasing temperature from 63 to 68°F; but, further increasing temperature above 68 to 75°F did not decrease the days to flower significantly.

In contrast to pansy and the petunias, Viola 'Sorbet Purple' flowering was hastened by either night interruption lighting with incandescent lamps or 24 hour lighting with supplemental lighting. Day extension lighting did not hasten flowering in viola. Therefore, the most cost effective way to induce flowering in viola is by lighting with 'mum lighting'. Interestingly, plant height was very short if pansies or violas were initiated and then returned to short-day conditions.

What We Found on Nierembergia, Gomphrena, and Blue Salvia:

Flowering of Nierembergia was hastened by either night interruption lighting or 24 hour lighting with high pressure sodium lighting, as with violas. Day extension treatments resulted in delayed flowering compared to the before mentioned treatments. Very little growth occurs on nierembergia under short day conditions although branching appeared to be encouraged suggesting that some early short-day treatment may be beneficial with this crop when grown for baskets.

No flowering occurred on either gomphrena or blue salvia in our experiment indicating that 1) there is a long juvenile period in these species, 2) the total amount of light required for flowering was higher than what we delivered, and/or 3) there is an effect of nutrition on flowering. In my opinion, there is a long juvenile period with these species that can be shortened by supplementing with H.P.S. lights. Further experiments will identify whether this is the case.

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