Photoperiod and Bedding Plants

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Many growers are using photoperiod manipulation to control the flowering of bedding plants and other annuals and also as a method of energy conservation. In most cases bedding plant growers use photoperiod to shorten crop time. Many species of common annuals are known to respond to photoperiod and they are classified into five response groups (Table 1).

Bedding plants are either long-day, short-day, or day neutral in response to photoperiod. Some long-day species are "obligate" (or "qualitative") long-day plants meaning that they **require** daylengths **longer** than a certain critical length in order to flower. Other long-day species are "facultative" (or "qualitative") long-day plants. These plants initiate flowers under any daylength, but flower earlier with long-days. Snapdragon, sunflower, salvia, and petunia are some of the important long-day annual species.

Like long-day species, short-day plants have either an obligate or a facultative response to photoperiod; the former type **requires** a daylength **shorter** than a certain critical daylength while the latter type flowers under **any** daylength, but **earlier** with short days. African marigolds, cosmos, celosia, and zinnia are important short-day species.

The flowering of day neutral species is not affected by photoperiod. Geranium, impatiens, and begonia are examples of day neutral species.

It should be noted that there is some disagreement about the photoperiod response of certain species. For example, sometimes African marigolds (*Tagates erecta*) are classified as facultative, rather than obligate short-day plants as in Table 1 (Figure 1). Also, some varieties of French marigold (*T. patula*), like 'Naughty Marietta' (Figure 2), seem to be facultative short-day instead of day neutral plants as in Table 1. Zinnia (Figure 3) may or may not respond to short days.

There can be considerable variation in response to photoperiod among varieties of the same species. For example, the 'Lady', 'Galore', and 'Jubilee' series of marigold show a facultative response to short days, but the 'Inca', 'Antigua', 'Discovery', and 'Excel' series do not, and are day neutral varieties. Also, some dwarf Red Salvia varieties are day neutral, others are long-day plants, and some tall varieties are short day plants (Koranski, 1997).The main point is that growers using photoperiod may see photoperiod responses that don't always match what is expected.

Figure 1. 'First Lady' marigold flowers faster under short-day conditions. Note that the long-day plant is larger.

Figure 2. 'Naughty Marietta' marigold is a facultative short-day plant and it flowers faster under short-days (left) than long-days (right). Note that the long-day plant is larger.

Figure 3. Some zinnias are not greatly affected by photoperiod.

Controlling photoperiod

Generally, short-day plants flower when the daylength is **shorter** than 11 hours and long-day plants will flower when the daylength is **longer** than 14-16 hours (Warner, 2006). Keep in mind, however, that the critical daylength is likely to be somewhat different for each species. A traditional blackcloth system is used to shorten daylength. The amount of area covered by black cloth can be small because many species are treated for only 2-3 weeks in the seedling stage. Cloth is pulled at 4 PM and removed at 8 AM, daily.

Daylength is increased for long-day plants by continuous or cyclical night-lighting with incandescent bulbs 4-6 hours each night or by daylength extension with HPS lamps. A minimum of 10 footcandles of light intensity is necessary for night-lighting systems.

Some ways to use photoperiod

The first example, the inspiration for this article, was a mistake I made two years ago growing annual and bedding plant specimens for my herbaceous plants course. I needed to have specimens ready to view by the last week in January and therefore I had to start seeds during November. Obviously this is the time of year when daylength is shortest. I normally use what amounts to daylength extension with HPS lamps, lighting the plants daily from 6 AM to 8PM (14 hour day) beginning at germination, but one year I forgot to start the lighting system. The result was early-flowering and too short short-day plants like marigolds, celosia, cosmos, and some zinnia types; they were poor examples of what the plants would be like in the landscape. Also, long-day petunias were very compact (but nicely branched) and developed no flowers until it was almost too late to use in class. Using daylength extension to creates long days for **very early** crops would have built larger plants and **slowed** the flowering of short-day plants, but speeded up the flowering of long-day species.

A second example, related to the first, concerns the flowering of facultative short-day African marigolds. The critical daylength for these plants is about 11 hours. In New England, if the seed is sown before 15 February natural short days will accelerate flowering with the result being what I observed in my "mistake". On the other hand, if seed is sown after 20 February when daylength is longer than the critical daylength flowering will be delayed and the plants will grow tall. Black cloth is needed here. This applies to the 'Lady', 'Galore', and 'Jubilee' series mentioned earlier.

A third example is the prevention of "ugly buds" on early crops of greenhouse grown sunflowers for cutting (Wien, 2009). Sunflowers are facultative short-day plants and when they are planted under natural short days the plants finish short, flower early, and develop many small "ugly buds" crowding the terminal flower bud. Three weeks of long days (16 hours) delayed flowering 18 days, nearly doubled plant height, doubled terminal flower size, and prevented the formation of "ugly buds".

Finally, most growers using photoperiod control on annuals do so to shorten crop time and perhaps save some energy by being able to delay seeding/planting. This approach is used with success on long-day species. Plugs are provided with long days by night-lighting beginning during the last two weeks before transplanting until flower buds become visible after transplanting. Night-lighting is not needed after early April when days become naturally long. This method was described by Eric Runkle of Michigan State University in his talk "Energy Efficient Crop Production Strategies" presented at the 2008 New England Greenhouse Conference. He showed a 27 day reduction in the time to flower of petunia 'Fantasy Pink Morn' through the use of long days.

References

Kornaski, D. 1997. Ask Dr. Kornaski. *Grnhse. Prod. News*, June issue, page 6.

Warner, R.M. 2006. Supplemental lighting on bedding plants – Making it work for you. *OFA Bull.* No. 899.

Wien, C. 2009. No more ugly buds! *The Cut Flower Quar.* 21(1):56.

Table 1. Photoperiodic response groups for numerous annual bedding plants[z].

Obligate Long-Day Plants	
Ammi majus	Asperula
Bachelor's Buttons (*Centaurea*)	Catananche
China Aster (*Callistephus*)	Dill
Flax (*Linum*)	*Fuchsia* x *hybrida*
Gazania	Ipomopsis
Lavatera	Legousia
Leptosiphon	Limnanthes
Lobelia	Love-in-the-Mist (*Nigella*)
Monkey Flower (*Mimulus*)	Nierembergia
Primrose (*Oenothera*)	Petunia ('Purple Wave')
Platystemon	Rudbeckia
Strawflower	Sweet Pea (*Lathyrus*)
Tuberous begonia (*Begonia* x *tuberhybrida*)	
Facultative Long Day Plants	
African Daisy (*Dimorphothica*)	Ageratum
Basil	Calendula
Collinsia	*Dianthus chinensis*
Linaria	Mexican sunflower (*Tithonia*)
Pansy (*Viola*)	Petunia (Grandiflora types)
Phacelia	Reseda
Salpiglossus	Blue Salvia
Snapdragon	Statice
Sunflower	
Obligate Short-Day Plants	
Mina Vine	Hyacinth Bean
African Marigold (*Tagetes erecta*)	
Facultative Short-Day Plants	
Celosia	Cosmos
Creeping Zinnia (*Sanvitalia*)	Globe amaranth (*Gomphrena*)
Hiemelis begonia	Moonflower (*Ipomea*)
Morning Glory (*Pharbitis*)	Signet marigold (*Tagetes tenuifolia*)
Zinnia (*Zinnia elegans*)	
Day-Neutral Plants	
Amaranthus	*Asclepias curassavica*
Balsam (*Impatiens balsamina*)	Wax begonia (*Begonia* x *semperflorens*)
Carpanthea	Centranthus
Cleome	Cobea
Dianthus barbatus	French marigold (*Tagetes patula*)
Geranium	Common Impatiens
Nemophila	New Guinea impatiens
Oxypetalum	Stock
Verbascum	Narrow-leaved Zinnia (*Zinnia angustifolia*)

[z] Warner, R.M. 2006. Supplemental lighting on bedding plants – Making it work for you. *OFA Bull.* No. 899.