Photoperiodic Responses of Annual Bedding Plants (cont.)

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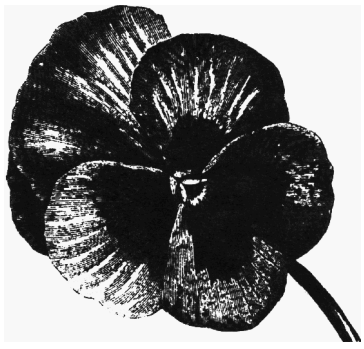

Introduction:

Recent research conducted demonstrated that many common bedding plant species are highly photoperiodic, i.e. they respond strongly to daylength with respect to flowering. Species can be divided into the following photoperiodic classifications:

1) Obligate short-day plants—those plants that only flower when grown with shorter days than nights.
2) Facultative short-day plants—those plants that flower when grown under long- or short- days, but will flower faster when grown with short-days
3) _____ plants—those plants that only flower when grown with longer days than nights.
4) Facultative long-day plants—those plants that flower when grown under long- or short- days, but will flower faster when grown with long-days
5) Day-neutral plants—those plants that flower at the same time when grown with long or short days.

In addition to responding to daylength, flowering in many annuals as affected by the light intensity (irradiance) plants are grown under. For instance, seed geraniums are commonly lighted in the plug stage because this results in earlier flowering.

We initiated a series of studies to determine 1) the photoperiodic classification of numerous annual species and 2) whether increasing irradiance will hasten flowering. On those same species

The results provide some basis for why some of the annuals we grow either flower too early or too late. For example, cosmos appears to be a facultative short-day plant. Late flowering is a result of germinating and growing plants under long-day conditions which result in a delay in flowering. Similarly, desired early flowering of 'Wave' types petunias can be achieved by placing seedlings under long-day conditions early. Flowering is delayed when seedlings are placed under short-day conditions such as early in the spring.

Results of an experiment students conducted this spring was combined with our previous data to produce Table 1-3. We will go over how to use this information.

Hastening Flowering:

One of the most common problems in spring bedding plant production is delayed flowering. There are numerous species such as cosmos, salpiglossus, 'Purple Wave' petunia, African marigold and zinnias that are sold 'green'. As a result, sales of these crops are often less than those species which are in flower even though they may be wonderful garden plants.

Timing of flowering of any bedding plant species requires that 1) a grower know what factors stimulate flowering of a species, and 2) that facilities are available with which to deliver the needed conditions. For instance, morning glory (Pharbitis nil) is a facultative short-day plant. Therefore, in order to achieve earlier flowering plants need to be shaded with black cloth after early April. To flower morning glories a grower must understand 1) that the plant requires short days and 2) have a space where black cloth can be pulled.

Conversely, a number of bedding plant species are facultative or obligate long-day plants. Therefore, earlier flowering is achieved by lighting plants during the night with either high pressure sodium or incandescent lamps. Which light source is best is dependent on the species. Providing early long-day conditions is critical for early flowering for most petunias, pansies, and many minor species that, I believe, would be more popular with the gardener if sold in flower such as salpiglossus, nierembergia.

A number of growers have not had a problem with their crops flowering late because they are purchasing plugs of species that require short-days for early flowering. Many commercially produced plugs are placed in a long-day environment under high pressure sodium lamps during

Table 1. Photoperiodic classification of some annual species studied this spring and last fall.

Plant	Obligate Short-Day	Facultative Short-Day	Obligate Long-Day	Facultative Long-Day	Day Neutral
Acroclinium roseum			X		
Anethum graveolens			X		
Antirrhinum majus				X	
Calendula officinalis				X	
Callistephus chinensis			X		
Convolvulus tricolor			X		
Cosmos bipinnatus		X			
Dianthus chinensis				X	
Dimorphotheca aurantiaca 'Salmon Queen'			X		
Dimorphotheca aurantiaca				X	
Fuchsia x hybrida			X		
Fuchsia 'Gartenmeister'					X
Gomphrena globosa		X			
Helipterum roseum			X		
Impatiens wallerana					X
Limnanthes douglasii			X		
Linaria maroccana					X
Lobelia erinus			X		
Nemophila menziesii				X	
Nierembergia caerulea			X		
Nigella damascena			X		
Ocimum basilicum				X	
Origanum majorana			X		
Petunia x hybrida			X	X	
Pharbitis nil		X			
Platystemon californicus			X		
Reseda alba				X	
Salpiglossus sinuata				X	
Salvia splendens					X

"One of the most common problems in spring bedding plant production is delayed flowering."

"The bottom line is that as growers we need to group those species in which we desire earlier flowering and treat them with the correct environmental treatments at the correct developmental time to achieve this."

Table 1. (continued)

Plant	Obligate Short-Day	Facultative Short-Day	Obligate Long-Day	Facultative Long-Day	Day Neutral
Silene armeria			X		
Tagetes erecta	X				
Tagetes patula					X
Viola x wittrockiana			X	X	
Zinnia angustifolia					X
Zinnia elegans		X			

Stages 2, 3 and 4 in plug production. The basis for lighting is related to producing a plug with high dry/wet weight and a compact and well branched growth habit. It is for this reason that a number of short-day species such as gomphrena, cosmos and zinnia grown from commercially grown plugs will often flower later. In contrast, those growers who germinate their own seed may have delayed flowering in 'Purple Wave' petunia because they are not lighting the seedlings to achieve long-days to have earlier flowering.

The bottom line is that as growers we need to group those species in which we desire earlier flowering and treat them with the correct environmental treatments at the correct developmental time to achieve this.

Premature Flowering:

Premature flowering can be a problem in summer-produced grandiflora pansies, violas, spring produced celosia and other species that require some vegetative growth prior to flower induction to produce a canopy with which to support continued flowering. For instance, both celosia and morning glory can be induced to flower very early but few leaves result in greatly reduced vigor and reduced garden performance and small size. Similarly, summer produced pansies that are intended for finishing in any container size larger than a flat can bloom too early and be slow to fill the pot/basket/container. As a result, it is desirable to delay flowering in some species as we commonly do with some potted plant species such as chrysanthemum and poinsettia to allow early vegetative development to insure numerous/large flowers or bracts.

Supplmental Photosynthetic Lighting:

Flowering of some species is related to the total photosynthetic light that a plant is grown under. It is for this reason that seed geraniums are lighted early in production in the plug stage to reduce the time for flowering. Clearly, in Table 2 we can see that not all species benefit from supplemental lighting with respect to earliness of flowering. For instance, Lobelia and viola flowering occurred at the same time whether seedlings were given extended days with high pressure sodium lamps or a night interruption (10 footcandles) with incandescent lamps. Therefore, incandescent lamps are an economical alternative on these species. In contrast, supplemental lighting using high pressure sodium lighting did hasten flower when compared to incandescent night interruption lighting on numerous species such as petunia, pansy, dianthus, Limnanthes, African daisy and snapdragon.

Proposed Schedules For Bedding Plant Species:

Based on the results we have found, we are beginning the process of revising standrad bedding plant schedules to include this new information. In addition, we are identifying schedules for previously un-

used annuals such as Limnanthes and Acroclinium which have excellent garden performance but have not been sold in flower before. With the schedules and lighting regimes contained in this and future articles, growers should be able to consistently flower some traditionally difficult plants such as gomphrena, cosmos, dianthus and purple Wavw petunias. In contrast, recent work on herbs should allow growers to maintain these species in a vegetative condition and increase 1) their yield, and 2) their marketable life and overall quality.

Table 3 shows some proposed schedules for selected bedding plant species. The timing of flowering will vary with greenhouse grower based on the average daily temperature a grower's greenhouse is. The traditional times are for those growers who have lighted plugs and grown their crop with a traditional 68° day and 61-63°F night temperature. Traditional times reflect seeling some species such as gomphrena and cosmos without flowers. The non-traditional schedules are for those who give the identified lighting treatment and grow with a 70° day and 66-68°F night temperature. Schedules for herbs assume that growers will keep them vegetative. It must be emphasized that many species benefit from a short vegetative period prior to inducing flowering with respect to garden performance.

Table 2. The effect of increasing irradiance from ambient light intensity to ambient plus 50 umol m-2 s-1 (250 footandles).

Plant	Positive Irradiance Response	No Response to Irradiance
Acroclinium roseum		X
Anethum graveolens		X
Anthirrhinum majus	X	
Calendula officinalis		X
Convolvulus tricolor		X
Cosmos bipinnatus		X
Dianthus chinensis	X	
Dimorphotheca 'Salmon Queen'		X
Dimorphotheca aurantiaca	X	
Helipterum roseum	X	
Impatiens wallerana		X
Limnanthes douglasii	X	
Linaria maroccana		X
Lobelia erinus		X
Nemophila menziesii	X	
Nierembergia caerula		
Nigella damascena		X
Ocimum basilicum		X
Origanum majorana	X	
Petunia x hybrida	X	
Platystemon californicus		X
Reseda alba	X	
Salvia splendens	X	
Silene armeria		X
Viola x wittrockiana	X	
Zinnia angustifolia		X

"Species vary as to whether additional H.P.S. lighting hastened flowering even with long-day species."

Table 3. Traditional (64° ADT (average daily temperature) plus plug lighting) and non-traditional (68°F ADT + lighting treatments) schedules for production of bedding plant species in flower early in spring (February– April). The first week column represents the first week after the cotyledons unfold. We assume 1 week for germination. The schedules constitute both the plug and finishing times together.

Plant	First week	Remaining Time	Traditional Production Time (days)	Non-Traditional Production Time (days)
Acroclinium roseum	SD	LD	-	11 weeks
Ageratum houstonianum	LD	LD	13 weeks	11 weeks
Anethum graveolens	SD	SD	Vegetative	Vegetative
Antirrhinum majus	SD	LD	11 weeks	9 weeks
Begonia semperflorens	LD	LD	13 weeks	11 weeks
Calendula officinalis	LD	LD	-	11 weeks
Callistephus chinensis	SD (2 weeks)	LD	11-12 weeks (green)	11-12 weeks (in flower)
Catharanthus roseus	DN	DN	13 weeks	10 weeks
Celosia plumosa	LD	SD	8 weeks	9 weeks
Coleus x hybrida	SD	SD	Vegetative—9 weeks	Vegetative—8 weeks
Convolvulus tricolor	LD	LD	-	11 weeks
Cosmos bipinnatus	LD	SD	10 weeks (sold green)	8 weeks (in flower)
Dianthus chinensis	LD	LD	14 weeks	11 weeks
Dimorphotheca aurantiaca	LD	LD	-	11 weeks
Helipterum roseum	LD	LD	-	10 weeks
Impatiens wallerana	DN	DN	10 weeks	9 weeks
Limnanthes douglasii	LD	LD	-	11 weeks
Linaria maroccana	LD	LD	-	9 weeks
Lobelia erinus	SD	LD	11 weeks	10 weeks
Nemophila menziesii	SD	LD	-	12 weeks
Nierembergia caerulea	SD	LD	12 weeks	10 weeks
Nigella damascena	SD	LD	-	11 weeks
Ocimum basilicum	SD	SD	Vegetative	Vegetative
Origanum majorana	SD	SD	Vegetative	Vegetative
Pelargonium x hybrida	LD	LD	17 weeks	12 weeks
Petunia x hybrida	LD	LD	10-11 weeks	8 weeks
Reseda alba	LD	LD	-	8 weeks

Plant	First week	Remaining Time	Traditional Production Time (days)	Non-Traditional Production Time (days)
Salvia splendens	DN	DN	10 weeks	9 weeks
Silene armeria	LD	LD	-	11 weeks
Tagetes erecta	LD	SD	8 weeks (green)	8 weeks (in flower)
Tagetes patula	DN	DN	8 weeks	7 weeks
Viola x wittrockiana	SD	LD	12-15 weeks	9-10 weeks
Zinnia angustifolia	DN	DN	10 weeks	9 weeks
Zinnia elegans	LD	SD	6-8 weeks (green)	6-7 weeks (in flower)

Excessively early flowering of some vine species will produce short vines that flower early but never yield the vigorous vegetative growth than the consumer may desire from the vine. Similarly, excessively early flowering of celosia will result in a plant that will never achieve the desired height. Therefore, you should be careful to make sure that you do not flower some species too early to the detriment of garden performance.

Future articles will contain specific schedules that you will be able to use. In addition, we integrate this information into a downloadable spreadsheet to directly integrate into some growers software.

"Future articles will contain specific schedules that you will be able to use for specific difficult-to-flower or unpredictable species."

News You Can Use

By John Erwin

Washington Post reported last week that U.S. EPA announced recently that the commonly used pesticide chlorpyrifos (commercial name **Dursban**) may be more dangerous to people than previously thought. EPA is expected to remove the chemical from all over-the-counter products. Chlorpyrifos, an organophosphate, can be applied to ag crops, but its use will be reduced to a lower rate. About 11 million lbs. of the chemical are used annually by farmers and fruit growers. EPA is negotiating with Dow Chemical, the only American manufacturer, over what uses of chlorpyrifos will be permitted. http://washingtonpost.com New restrictions will be in place very soon. We are not sure how this will affect the floriculture industry as of yet.

Garden.com, Knox Nursery and Scotts Co. are collaborating on a new line of flowering annual flats named Miracle-Gro Select Plants. The line, which includes Festival gerberas and Queens Mix begonias, among others, is available in flats of 10 4-inch round pots from the Garden.com site. "We have just begun our initial marketing campaign for these products, including an insert in approximately 650,000 new catalogs, as well as a targeted direct-mail campaign to Internet gardening customers," said Bill Pond, director of product mgt. for Garden.com. Shipping continues through June. http://www.garden.com