BY ERIK RUNKLE

Light and Temperature Responses of Bedding Plants

Annual bedding (garden) plants continues to be the largest floriculture crop segment each year. The reported wholesale sales of bedding plants was $1.58 billion, according to the USDA Floriculture Crops 2020 Summary, but that was only for operations in the 17 states surveyed. The top five producing states of bedding plants (Michigan, California, Florida, New Jersey and North Carolina) are diverse geographically and receive a broad range of light and temperature conditions.

Most bedding plants are propagated and grown during the late winter and spring, when outdoor temperatures and light levels are relatively low. Crops are commercially grown in greenhouses with controlled environments to create more favorable environmental conditions, but this requires a significant amount of energy, particularly in the northern U.S. Over the years, we have quantified the temperature and light responses of common bedding plant crops to better understand their impacts on production time and quality, while also considering energy costs to create those conditions.

MICHIGAN STATE UNIVERSITY EXTENSION FLORICULTURE TEAM

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TEMPERATURE RESPONSES

One of the challenges that growers face is variation in crop sensitivity to temperature. We have quantified temperature responses of common bedding plants based on time to flower and estimated their base temperatures (Figure 1). A crop does not grow at or below its base temperature. Crops with a base temperature of 39° F (4° C) or lower can be considered cold tolerant, whereas those with a base temperature of 46° F (8° C) or higher can be categorized as cold sensitive. With this information, we can compare the temperature sensitivity among crops as well as make temperature recommendations for production and when crops cannot be shipped and need to be held.

Growing temperatures for crops is somewhat situational. Generally, a suitable average daily temperature for production of cold-tolerant crops, considering time and quality, is 60 to 65° F (15 to 18° C), while that for cold-sensitive crops is 70 to 75° F (21 to 24° C). Regardless of a crop's base temperature, time to flower increases as temperature decreases. However, the magnitude of the delay is greater for cold-sensitive crops than cold-tolerant crops. For example, decreasing the average daily temperature from 68 to 63° F delays flowering of snapdragon (a cold-tolerant crop) by about 22% whereas it delays flowering of vinca (a cold-sensitive crop) by 42%.

Sometimes crops that are ready to market cannot be shipped on time. Lowering the temperature is usually the best way to slow down growth and flowering. Ideal "hold" temperatures are about 5 to 10° F above the crop base temperature. Therefore, cold-tolerant crops can be held as low as 40 to 45° F (4 to 7° C), whereas cold-sensitive crops should be held at a temperature of at least 50 to 55° F (10 to 13° C).

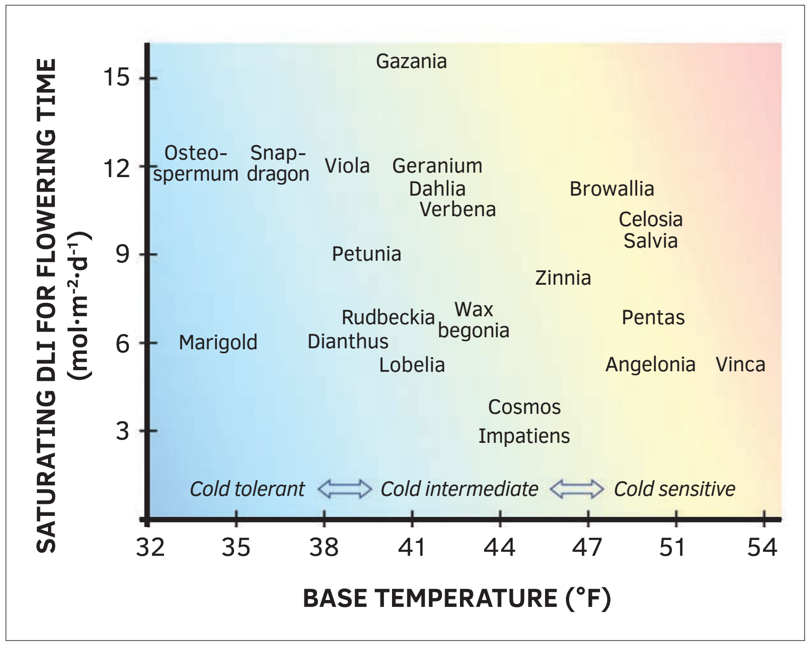

Figure 1. Estimated daily light integrals (DLI) that saturate flowering time and base temperatures (the temperature at which a crop begins to develop) for common annual bedding plants based on research performed at Michigan State University.

DAILY LIGHT INTEGRAL RESPONSES

We have also identified average daily light integral (DLI) values during production (from transplant until flowering) that saturate the flowering response from a timing perspective. This information can guide decisions of which crops better tolerate low-light levels (such as under hanging baskets) and which crops flower earlier under higher light. Flowering time of crops grown under a DLI of 6 $mol{\cdot}m^{-2}{\cdot}d^{-1}$ or lower can be considered DLI tolerant whereas those whose flowering time is saturated at or above 11 $mol{\cdot}m^{-2}{\cdot}d^{-1}$ are DLI sensitive. DLI-sensitive crops include gazania, osteospermum, snapdragon, viola, geranium, dahlia and browallia. These DLI-sensitive crops are the ones to prioritize for higher-light environments.

TEMPERATURE AND LIGHT INTERACTIONS

Temperature and DLI interact to control flowering time as well as crop quality. Most crops that tolerate a low to moderate DLI will be of higher quality when grown with more light. Therefore, the saturating DLIs in Figure 1 are not recommended values but rather, the minimum values for rapid flowering of each crop. When the solar DLI is low (less than 10 $mol{\cdot}m^{-2}{\cdot}d^{-1}$), supplemental lighting can increase quality for virtually all crops. Purchasing and operating supplemental lighting is expensive, so an alternative is to decrease the average daily temperature. However, that also delays flowering time, especially for cold-sensitive crops. Thus, one needs to consider temperature trade-offs that often exist between crop timing and quality when the DLI is low. gpn