Controlling temperatures for inexpensive plant experiments

June 15 2019

A study out of Clemson University has demonstrated that inexpensive, easy-to-use temperature controllers are able to provide reliable set temperatures for the detailed observation of developmental rates in response to different temperature treatments.

Researchers Douglas Bielenberg and Ksenija Gasic engaged a methodical examination of the practical applications of these temperature control devises on cut stems, buds, and seeds.

The results of their study are detailed in the article, "Controlled-temperature Treatments with Low-cost Off-the-shelf Equipment for Bud or Seed Forcing Experiments," published in *HortScience*.

Inexpensive plug-and-play temperature controllers have recently become available. These allow a chest freezer to be programmed easily to hold a desired set point across a range of biologically relevant temperatures. Installation can be completed in a few minutes using consumer-grade chest freezers.

Characterizing the regulation of plant and seed development by temperature requires controlled exposure of replicate plants (whole or in part) to multiple temperature environments simultaneously. Experiments with seeds or other small plant segments can be performed on a thermal gradient table, which can generate many temperatures at once.

However, experiments involving larger plant parts, such as cut stems,

require temperature control of a larger three-dimensional volume, such as an environmental chamber. Inexpensive access to the number of environmental chambers required for this sort of scientific observation is not easily available and can therefore limit the scope of experiments.

However, newly available plug-and-play temperature controllers allow conversion of a standard chest freezer into a controlled-environment chamber in minutes, with no custom modification.

To test the equipment, the researchers subjected an array of identical plant types and seeds to a variety of precise temperatures within an array of identical box freezers (chambers). They tested each chamber's temperature controller, recording internal temperatures at 10-minute intervals, to ensure the integrity of the equipment and the consistency of its output to maintain an exact and controlled environment during a 48-hour period, during which the chambers were not opened.

The effectiveness of the chambers on the effects of temperature on developmental rates was assessed with two biological assays: budbreak progress of peach floral buds warm-forced at different temperatures, and sunflower seed germination. Both budbreak and germination showed a clear temperature-dependent effect on development, with each decrease in temperature slowing development form the previous temperatures.

Understanding the minimum temperature for development is an important realm of knowledge for modeling plant phenology. The relationship between development rate and suboptimal temperatures can be used easily to calculate an estimated base temperature for optimal growth.

These newer inexpensive temperature-controllers will allow horticulturists, agronomists, foresters, and educators to design and perform experiments when multiple controlled-temperature

environments are required without access to specialized facilities or skills. Off-the-shelf, easy-to-use components offer the potential to expand greatly the community of researchers who are able to incorporate temperature physiology into their investigations of plant development and phenology, particularly workers outside of traditional research institutions.

More information: Douglas G. Bielenberg et al, Controlled-temperature Treatments with Low-cost, Off-the-shelf Equipment for Bud or Seed Forcing Experiments, *HortScience* (2019). DOI: 10.21273/HORTSCI13649-18

Provided by American Society for Horticultural Science