Loss of freezing tolerance of *Hydrangea* under natural and experimental temperature changes

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Temperate winters are becoming progressively milder due to global warming, and temperature patterns are becoming increasingly irregular with risk of warm spells. Warm spells may cause premature cold deacclimation, thereby increasing the risk of subsequent freezing injury. This research investigated the timing and rate of deacclimation in stems of non-endodormant *Hydrangea macrophylla ssp. macrophylla* (Thunb.) Ser. ‘Alma’ and *Hydrangea paniculata* Sieb. ‘Vanille Fraise’ under both natural conditions and in response to a simulated warm spell (22°C/17°C day/night).

In both *H. paniculata*, the mid-winter hardier genotype, and *H. macrophylla* small fluctuations in air temperature during late winter and spring had a direct effect on cold hardiness of stems, whereas the long-term effect of increased temperatures caused a sigmoid deacclimation pattern. Under natural conditions the two species started to deacclimate at approximately the same time, but *H. paniculata* deacclimated faster than *H. macrophylla*. Similarly, under a simulated warm treatment, *H. paniculata* deacclimated to a greater extent than *H. macrophylla*. This implies that greater risk of frost injuries in *H. macrophylla* than in *H. paniculata* is not due to earlier or faster deacclimation in the former than the latter species, but is merely a result of the relative lower absolute cold hardiness of *H. macrophylla* during mid-winter and spring.

Temperature alterations drive or, at least, are closely related to carbohydrate catabolism, which is an important component of deacclimation physiology in *Hydrangea*. Significant differences in accumulation patterns of specific soluble carbohydrates between *H macrophylla* and *H. paniculata* indicated contrasting species-specific responses; including the possible involvement of 1-kestose, heretofore not implicated in freezing tolerance of woody perennials.

A recent, more detailed study of *H. paniculata* revealed that, in addition to changes in carbohydrate metabolism, loss of freezing tolerance is also associated with significant changes in the bark proteome. Using two-dimensional difference gel electrophoresis (DIGE) ca. 100 spots were identified differing significantly in abundance in the bark of *H. paniculata* during deacclimation and showing a clear seasonal separation.

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