Sensitivity to long days for flowering is reduced in Arabidopsis by yearly variation in growing season temperatures

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Abstract

Conservative flowering behaviors, such as flowering during long days in summer or late flowering at a high leaf number, are often proposed to protect against variable winter and spring temperatures which lead to frost damage if premature flowering occurs. Yet, due the many factors in natural environments relative to the number of individuals compared, assessing which climate characteristics drive these flowering traits has been difficult. We applied a multidisciplinary approach to ten winter-annual *Arabidopsis thaliana* populations originating along a wide climactic gradient in Norway. We used a variable reduction strategy to assess which of 100 climate descriptors from their home sites correlated most to their behaviors when grown in common garden and assessed sequence variation of 19 known environmental-response flowering genes. Photoperiod sensitivity inversely correlated with interannual variation in timing of growing season onset (start of favorable spring temperatures). Time to flowering appeared driven by growing season length, curtailed by cold fall temperatures. The distribution of *FLM*, *TFL2*, and *HOS1* haplotypes, genes involved in ambient temperature response, correlated with growing-season climate. We show that long-day sensitivity and late flowering may be driven not by risk of spring frosts, but by growing season temperature and length perhaps to opportunistically maximize growth.

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