Gene discovery may yield lettuce that will sprout in hot weather

March 29 2013

Discovering the gene mechanism that inhibits hot-weather germination in lettuce seeds could be increasingly important as global temperatures rise plant, predicts plant scientist Kent Bradford.

(Phys.org) —A team of researchers, led by a University of California, Davis, plant scientist, has identified a lettuce gene and related enzyme that put the brakes on germination during hot weather—a discovery that could lead to lettuces that can sprout year-round, even at high temperatures.

The study also included researchers from Arcadia Biosciences and Acharya N.G. Ranga Agricultural University, India.

The finding is particularly important to the nearly $2 billion lettuce industries of California and Arizona, which together produce more than 90 percent of the nation's lettuce. The study results appear online in the journal *The Plant Cell*.

"Discovery of the genes will enable plant breeders to develop lettuce varieties that can better germinate and grow to maturity under high temperatures," said the study's lead author Kent Bradford, a professor of plant sciences and director of the UC Davis Seed Biotechnology Center.

"And because this mechanism that inhibits hot-weather germination in lettuce seeds appears to be quite common in many plant species, we suspect that other crops also could be modified to improve their germination," he said. "This could be increasingly important as global temperatures are predicted to rise."

Most lettuce varieties flower in spring or early summer and then drop their seeds—a trait that is likely linked to their origin in the Mediterranean region, which, like California, characteristically has dry summers. Scientists have observed for years that a built-in dormancy mechanism seems to prevent lettuce seeds from germinating under conditions that would be too hot and dry to sustain growth. While this naturally occurring inhibition works well in the wild, it is an obstacle to commercial lettuce production.

In the California and Arizona lettuce industries, lettuce seeds are planted somewhere every day of the year—even in September in the Imperial Valley of California and near Yuma, Ariz., where fall temperatures frequently reach 110 degrees.

In order to jump-start seed germination for a winter crop in these hot climates, lettuce growers have turned to cooling the soil with sprinkler irrigation or priming the seeds to germinate by pre-soaking them at cool temperatures and re-drying them before planting—methods that are expensive and not always successful.

In the new study, researchers turned to lettuce genetics to better understand the temperature-related mechanisms governing seed germination. They identified a region of chromosome six in a wild ancestor of commercial lettuce varieties that enables seeds to germinate in warm temperatures. When that chromosome region was crossed into cultivated lettuce varieties, those varieties gained the ability to germinate in warm temperatures.

Further genetic mapping studies zeroed in on a specific gene that governs production of a plant hormone called abscisic acid—known to inhibit seed germination. The newly identified gene "turns on" in most lettuce seeds when the seed is exposed to moisture at warm temperatures, increasing production of abscisic acid. In the wild ancestor that the researchers were studying, however, this gene does not turn on at high temperatures. As a result, abscisic acid is not produced and the seeds can still germinate.

The researchers then demonstrated that they could either "silence" or mutate the germination-inhibiting gene in cultivated lettuce varieties, thus enabling those varieties to germinate and grow even in high temperatures.

Provided by UC Davis