Gene discovery could lead to better soybean varieties for Northern United States

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Doctoral student Jieqing Ping, at left, and agronomy professor Jianxin Ma examine soybeans in a greenhouse at Purdue University. Credit: Purdue University / Tom Campbell

Researchers from Purdue University and the University of Nebraska-Lincoln have discovered a soybean gene whose mutation affects plant stem growth, a finding that could lead to the development of improved soybean cultivars for the northern United States.

Purdue agronomy professor Jianxin Ma (pronounced Jen-SHIN' Ma) and collaborators identified a gene known as Dt2, which causes

semideterminacy in soybean plants. Semideterminate soybean plants - mid-size plants that continue vegetative growth even after flowering - can produce as many or more pods than current northern cultivars but do not grow as tall. Their reduced height makes them more resistant to lodging, a bending or breaking of the main plant stem.

"This gene could help us improve the yield potential and adaptability of soybeans for specific growing areas," Ma said. "We can now focus on developing a variety of elite semideterminate soybean cultivars, which could perform very well in high-yielding, irrigated environments such as Nebraska and northeastern Indiana."

Soybean cultivars are often divided into two groups: indeterminate - tall plants whose main stem continues to grow after flowering - and determinate - shorter, bushier plants whose main stem halts growth when blossoms begin to form.

Determinate soybean plants thrive in the longer growing season of the south while indeterminate plants' overlapping vegetative and reproductive stages make them better suited to the north. But the height of indeterminate cultivars renders them prone to lodging.

For northern soybean producers, semideterminate soybean plants could represent a "Goldilocks" cultivar, a "just right" alternative between the two. Semideterminate soybeans are easy to manage, have similar or better yields than indeterminate plants and can handle a short growing season, Ma said.

Only one semideterminate soybean cultivar, NE3001, is common in the United States. Having pinpointed Dt2 will enable Ma and his researchers to use natural plant breeding methods to develop a variety of semi-determinate cultivars.

"The potential for soybean yield productivity in the U.S. has not been fully explored, in part because of the lack of semideterminate cultivars," he said. "We're now working on converting high-yielding indeterminate cultivars to semideterminate types to test their yield potential."

Ma - who had previously identified Dt1, the gene that causes indeterminancy in soybeans - used an integrated genetic approach to isolate and characterize Dt2. After identifying the gene, he inserted it into indeterminate cultivars to confirm that it caused the plants to become semideterminate. Dt2 suppresses the expression level of Dt1, causing soybean plants to grow shorter.

Ma said this type of mutation appears to be unique to soybeans as semideterminancy in other plants such as tomatoes and chickpeas is caused by a different genetic mechanism.

Study co-author James Specht, a professor of agronomy and horticulture at the University of Nebraska-Lincoln, said the identification of Dt2 gives soybean breeders a powerful tool for breeding new cultivars.

"This provides breeders with a perfect genetic marker for identifying semideterminancy in soybean seeds and seedlings," he said.

More information: The paper was published in The *Plant Cell* and is available at www.plantcell.org/content/earl … 126938.full.pdf+html

Provided by Purdue University