Gene discovery may lead to new varieties of soybean plants

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Purdue's Jianxin Ma, from left, and postdoctoral researcher Zhixi Tian are using crosses of wild-type soybean and modern U.S. cultivar soybean plants to discover and pinpoint genes. (Purdue Agricultural Communication photo/Tom Campbell)

(PhysOrg.com) -- Just months after the soybean genome was sequenced, a Purdue University scientist has discovered a long-sought gene that controls the plant's main stem growth and could lead to the creation of new types of soybean plants that will allow producers to incorporate desired characteristics into their local varieties.

Jianxin Ma (Jen-Shin Ma), an assistant professor of agronomy, used the research model plant Arabidopsis thaliana to discover the soybean gene that controls whether the plant's stem continues to grow after flowering. The find is a significant key to diversifying the types of soybeans growers can produce all over the world.

"The approach that we used in this study proves to be promising for rapid gene discovery and characterization in soybean," said Ma, whose findings were published Monday (April 26) in the *Proceedings of the National Academy of Science*. "With the genomic resources and information available, we spent only six months pinpointing and confirming the candidate gene - the time it takes to grow one generation of soybean."

Soybean plants generally fall into two categories: determinate plants whose main stem tips stop growing after flowering, and indeterminate plants that continue main stem growth after flowering. In the United States, indeterminate soybeans are grown in the northern states, while determinate are grown in the southern states, Ma said. A northern U.S. grower who may want the characteristics found only in a type of determinate soybean would not be able to successfully grow a determinant cultivar in the north.

Ma was able compare the gene known to control Arabidopsis thaliana's stem growth pattern with the soybean genome to identify four soybean candidate genes. Those genes were then sequenced in a sample of different families of soybeans, including Glycine soja, a wild type of soybean; Glycine max landraces, which were varieties developed through selection in Asia thousands of years ago; and elite cultivars, which are grown today in the United States.

A single base-pair nucleotide mutation in the gene Dt1 was found to be the reason some plants are determinate.

"Wild soybeans are all indeterminate. This mutation that makes them determinate was selected by ancient farmers a few thousand years ago," Ma said. "It seems determinate stem was a favorable characteristic for ancient farmers."

Ma tested the find by using an indeterminate soybean Dt1 gene to change an Arabidopsis thaliana plant from determinate to indeterminate.

Ma believes that ancient farmers selected determinate plants that stay relatively short because they are less likely to lodge, or bend at the stem.

"Their appearance probably resulted in an ancient 'green revolution' in soybean cultivation in the southern parts of ancient China," Ma said.

Ma collaborated with Lijuan Oiu at the Chinese Academy of Agricultural Sciences, Phil McClean at North Dakota State University, Randy Nelson at the University of Illinois and Jim Specht at the University of Nebraska.

Provided by Purdue University