RESEARCH TARGETS A NEW PARADIGM FOR PULSE IMPROVEMENT

The hunt is on for ways to improve pulse crops without waiting for traditional breeding and without crossing the transgenic threshold. Here's one scientist's vision.

Root nodules form in legume crops following infection with rhizobia bacteria, which is a vital symbiotic relationship.

As Dr. Ravinder Goyal explains, traditional plant breeding could have a role to play, but it also brings conditions.

"If you look at the germplasm, there are some cultivars that are better-performing than the others in terms of drought," said Goyal, Lacombe-based Research Scientist with Agriculture and Agri-Food Canada. "The problem is, it's a very long process – 12 or 13 years – to transfer a trait of interest through traditional breeding."

What's more, such cultivars would tend to outperform other cultivars only during the stress period. In other words, they'll yield better than standard varieties if there's a drought. If there's no drought, they won't.

Transgenic breeding tools could move the desired trait into new varieties far quicker than traditional breeding. The position of the pulse industry and growers, however, is that they do not want genetically modified crops. If traditional breeding takes too long (given today's dynamic climate) and genetic modification is off the table (by industry consensus), does that mean a scientist like Goyal is out of options?

Not by a long shot. In the spring of 2019, he began a three-year project that aims to improve water use efficiency in field pea in an entirely different way.

Modify the rhizobia, not the plant

Between traditional plant breeding on one hand, and genetic modification on the other, plant scientists have access to a range of new gene-editing tools. One such technology is CRISPR (clustered regularly interspaced short palindromic repeats). These tools can be used as a kind of bridge between traditional and transgenic techniques. That's Goyal's idea for drought tolerance and field pea.

"I proposed, let's not modify the crop; let's modify the rhizobia that sit in the roots, in the nodules," he said. "We can express what we want through the rhizobia – for example, increased drought tolerance – without adding foreign DNA to the crop."

That's a big idea for field peas alone. Now consider that the same approach could in concept work for other pulse crops and for soybeans. For the next three years, however, Goyal's focus is field peas.

"Opening a line of communication between the rhizobium and the host is not easy," he said. "It's quite a challenging process, but there is so much value down the road if you succeed that it's worth trying."

Sometimes a constraint doesn't end the process of discovery. It merely compels a creative thinker to seek another way. With neither traditional nor transgenic breeding strategies being appropriate, Goyal is finding a third way forward on drought tolerance of pulses.

"This past year was very wet, but we've seen dry conditions in recent years as well, it's unpredictable," he said. "This way we can have something in our hands if water is scarce."