Research boosts nitrogen use efficiency in barley

by Kieran Brett

Funding support from ACIDF and ALMA allowed this plant scientist to bring valuable attributes from rice into prairie barley.

The relationship between Alberta's beef producers and barley growers is one of the most successful and productive in Canadian agriculture.

After all, the regional availability of high-quality feed provides the backbone of a beef production system that finishes 1.8 million cattle and creates $3 billion in economic impact annually.

What if each group wanted one improvement to their strong relationship? Feedlot operators might wish for an even more abundant supply of reasonably priced barley on their doorstep. Barley growers might want higher yields and, at the end of the season, higher profits per acre.

Over the past four years, University of Alberta plant scientist Allen Good (pictured right) has worked to make these goals a reality. With support from the Alberta Crop Industry Development Fund (ACIDF), under the $8 million Feeding Initiative funded by the Alberta Livestock and Meat Agency (ALMA), he's laid the genetic foundation for barley varieties that use nitrogen more efficiently.
This could allow crop producers to increase revenue and trim their fertilizer bill, while increasing the supply available to cattle feeders.

"That's the ideal scenario," says Good, "But of course, as far as producers are concerned, it doesn't matter what you do for nitrogen use efficiency, you have to maintain yield."

From rice to barley

How is nitrogen in the soil translated into grain production by the plant? It comes down to how well the plant takes up what's in the soil and how that nitrogen is used. These two ideas make up the concept of nitrogen use efficiency.

Cereal plants – such as wheat, barley and rice -- can vary widely in their nitrogen use efficiency. A certain *Japonica* rice variety is known to be highly nitrogen-efficient and has been part of

plant breeders' genetic toolbox for years. Good's objective was to develop novel transgenes by moving the rice gene associated with nitrogen use efficiency into prairie barley.

"You establish a way to introduce the gene into the tissue of the plant," he explains. "To make a transgenic plant, it can take nine months to get a mature plant. Then you want to get a sense of, is the effect you see in the plant coming from *your* gene or for some other reason?"

Good and his team developed stable gene constructs for barley with higher nitrogen use efficiency, as well as similar or higher grain yields. Laboratory results indicate that an efficiency improvement of up to 10% could ultimately be possible in commercial barley varieties.

Long road to commercialization

What's next? As Good points out, commercializing a new variety – and a transgenic one, to boot – is a lengthy, expensive and technically complex exercise. While it's beyond the mandate of a university program, the gene constructs developed by Good and his team are ready to be introduced into elite germplasm. One seed company is already evaluating this possibility with respect to wheat.

Having a cereal crop that uses nitrogen more efficiently looks like a win-win for those along the beef production chain. Crop producers could see higher yields and reduced fertilizer costs, while cattle feeders get more of the high-quality barley they need. Allen Good believes his results are good news for feedgrain production in Western Canada.

"It's logical to think that improving nitrogen use efficiency would work well in crops for feed," says Good. "With food crops, you need protein for dough characteristics. But if cattle are eating corn or feed barley, you don't care how much protein is in the seed, because you can add amino acids. For feed, we're interested in carbon and that's where this research can be effective."

Allen Good's team

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ACIDF
Alberta Crop Industry Development Fund Ltd.

ALMA
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