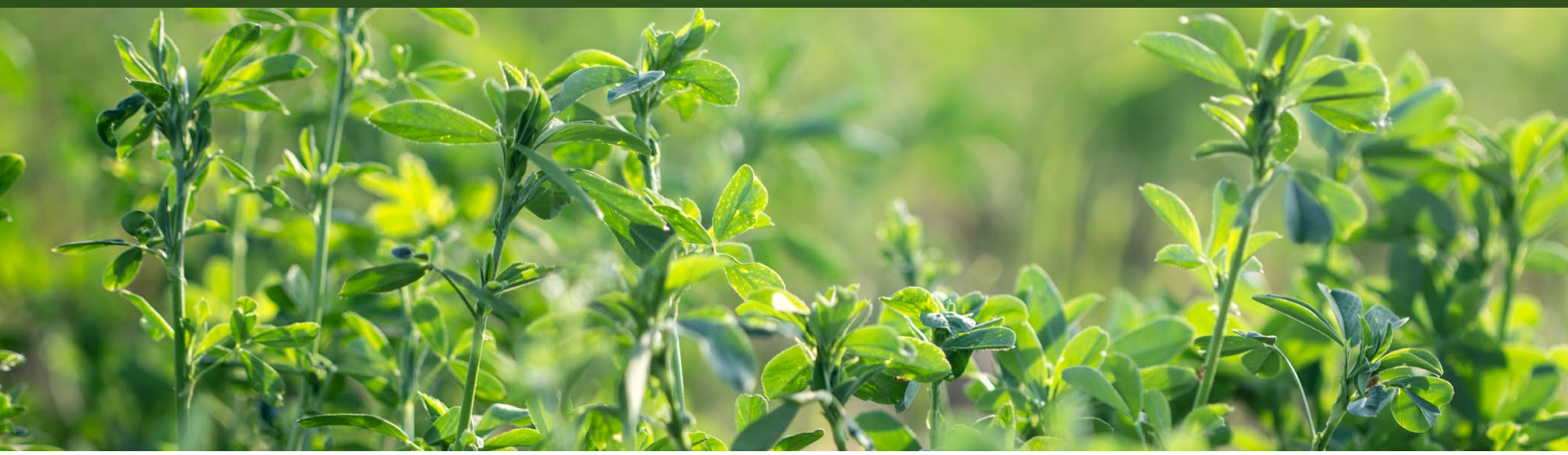

Genetic selection for a more energy-rich alfalfa

Protein-rich alfalfa is an important part of the diet for Canada's estimated 1.4 million cows (2024), raised at some 9,450 dairy farms. However, in order for cows to maximize the use of that protein, beneficial microbes in their rumen (a part of their stomach) need more energy from carbohydrates (sugars); otherwise, the nitrogen they are unable to use risks being released into the environment.

To help solve this issue, scientists at Agriculture and Agri-Food Canada (AAFC) and two Canadian universities started working on genetically improving alfalfa through conventional breeding techniques, aiming to increase its carbohydrate content. They also conducted laboratory assays (tests) to evaluate how the alfalfa, with an increased carbohydrates content relative to its protein content, could affect in dairy cows the digestion of protein—its nitrogen component in particular.

Starting with 2,000 field-grown alfalfa plants in 2013, scientists successively selected and crossed plants with the highest carbohydrate content (e.g., water-soluble sugars, starch, and pectin). More than a decade later, the fourth generation of plants, when tested in the greenhouse, contained 20% more carbohydrates than the initial population, including 35% more soluble sugars and starch. It is the first alfalfa in Canada, developed through crossbreeding, to genetically have a higher carbohydrate content.

On the other hand, to assess how an increased level of carbohydrates content (relative to the protein content) in alfalfa could influence the digestion in dairy cows, scientists kept alfalfa samples in cow rumen liquid for 24 hours. They found that a higher carbohydrate-to-protein ratio improved digestion in the rumen liquid, by allowing microbes to use available nitrogen more efficiently, which decreased the amount of ammonia (a nitrogen source) produced during the digestion.

Improving cows' digestion in this way could reduce the levels of nitrogen present in the urine, which is ultimately released in the environment, and can run off into ground and surface water or turn into nitrous oxide, a potent greenhouse gas.

In a scientific first, researchers have improved the energy composition of alfalfa by increasing its carbohydrate content. Not only will this new, energy-rich alfalfa provide dairy farmers with a superior feeding option for their cows, but it may also reduce the environmental footprint of their operations.

NEXT STEPS: In response to these promising results, a new project funded by the Dairy Farmers of Canada will enable this team to conduct the field trials and seed multiplication required for the registration of this new cultivar.

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