Life Cycle Assessment of Canadian Dry Bean and Faba Bean Production

Fertilizer was the biggest contributor (74-80%) to climate change impacts of navy, pinto and red kidney beans, whereas both fertilizer (48%) and fuel for field operations (37%) contributed the most for faba beans.

THERE IS A growing desire to better understand the environmental impacts associated with the production of pulses destined for the food industry. A life cycle assessment (LCA) is the systems-level approach used to quantify these impacts, including emissions (e.g., greenhouse gases, pollutants) and inputs (e.g., fuel, fertilizer, water) required to produce pulses across their entire life cycle, or value chain.

An LCA offers insight into the sustainability of a product, which can inform policy and management decisions, such as improved crop management and reduced input use. While LCAs have already been conducted for Canadian peas and lentils, comparable assessments have not been reported for dry beans and faba beans.

From 2020 to 2021, Pulse Canada worked with the University of British Columbia to: 1) develop regionalized life cycle inventories (LCIs) for Canadian dry beans and faba beans and 2) provide a comprehensive report to support the Canadian pulse industry's initiatives around the sustainability of pulses. An LCI is a high-quality, regionalized dataset that is representative of Canadian production conditions and made available publicly for stakeholders, like food companies, to utilize.

LCI data were collected from navy, pinto, red kidney and faba bean farmers in Alberta, Manitoba, Saskatchewan and Ontario via survey. Farmers were asked about practices including soil preparation, seeding, fertilizer application, pest management and pesticide applications, harvesting and crop drying. The environmental impact categories assessed in this study included climate change, mineral resource use, fossil and nuclear energy use, terrestrial acidification, freshwater eutrophication and ecotoxicity, and others.

A total of 181 responses were used to compile the LCI. Of these, 65 responses were on navy beans (36%), 31 (17%) on pinto beans, 34 (19%) on red kidney beans and 51 (28%) on faba beans. Across all four bean types, 14% of the responses were from SK, 27% from MB, 36% from ON and 22% from AB.

At the national scale, faba beans had lower environmental impacts across all categories than the three types of dry beans. This is due to the ability of faba beans to acquire up to 90% of their nitrogen (N) needs through biological N fixation and leave behind an N-credit for subsequent crops. Whereas in dry beans that have a comparatively lower capability of fixing N (<45%), there has traditionally been a greater reliance on fertilizer to supply the crop with N. Among the dry bean types in this study, pinto beans had the lowest environmental impacts across most categories. In part, this is due to greater pinto bean yields with similar inputs to other bean types.

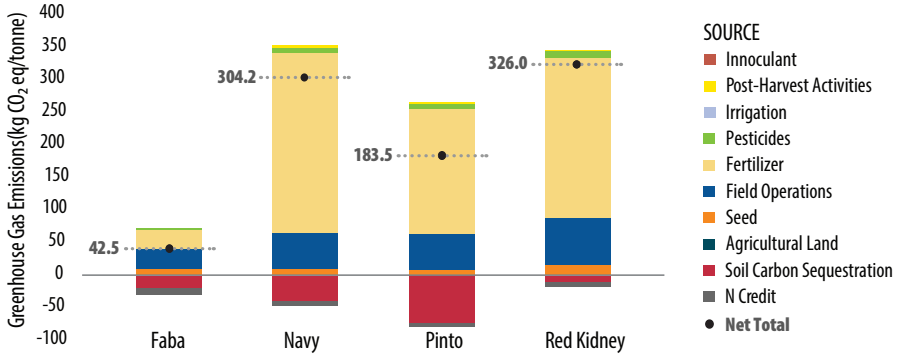
While there were some variations between crops and regions, fuel and fertilizer were identified as hotspots for potential reductions in emissions and input use. At the national level, fertilizer contributed most (74-80%) to climate change impacts in dry bean crops. In faba beans, fertilizers (48%) and fuel for field operations (37%) were the biggest contributors.

Soil carbon sequestration was responsible for climate change reductions of 25% and 3% in pinto and red kidney beans, respectively. N fixation produced a 13% reduction in faba beans. The impacts of N fixation were considerably lower (2%) in dry beans due to lower N fixation and higher levels of fertilizer use.

Adopting the most recent best management practices on N management in dry beans is one way to reduce the effects on climate change. Recent fertilizer and inoculant research findings (pg. 2-4) further discuss N management practices and suggest fertilizer reductions and biological N fixation improvements are possible for dry beans.

For more information on the LCA in pulses and their impact on the industry, visit pulsecanada.com/sustainability.

Figure 1. Greenhouse gas emissions resulting from faba, navy, pinto and red kidney bean crops across Canada.



PRINCIPAL INVESTIGATOR Dr. Nathan Pelletier, University of British Columbia

DURATION 2 years

TOTAL INVESTMENT $124,500 (75% AAFC; 25% Pulse Canada)