

# Environmental benefits of growing perennial legumes in cropping systems

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Perennial legumes provide many environmental benefits in cropping systems, the best known of which are improved soil N supply, reduced soil erosion, and reduced weed and pest pressure in the annual crops. Other benefits that are less thoroughly understood and appreciated include accretion of soil organic matter, generally lower greenhouse gas emissions, better soil tilth, and usually better water quality. Short-term research efforts that may lead to substantial improvement of the sustainability and utilization of perennial legumes (and legume/grass mixtures) in North American crop rotations fall into five general topic areas:

## **Greenhouse gas emissions and C sequestration** (*very expensive; of public interest*)

1. Determine amounts and regulating factors of net greenhouse gas emission (CO<sub>2</sub>, N<sub>2</sub>O; mainly management, possibly genetic);
2. Quantify whole-field C flux for legume phase and entire crop rotation; <sup>E</sup>
3. Quantify and predict total organic and inorganic C accumulation in subsoil (below 30 cm); <sup>E</sup>
4. Determine genotypic variation for root suberin, lignin, and tannin concentration, and continue gene discovery and elucidation of biosynthesis pathways;

## **N retention, cycling, and loss** (*moderately expensive; of public interest*)

5. Quantify impacts of manure management on N cycling and loss in the legume phase; <sup>E/R</sup>
6. Determine effects of host/rhizobial genotypes on symbiotic response to labile N availability;
7. Validate reduction of nitrate losses through tile drainage to surface water and via leaching to shallow groundwater; <sup>R</sup>
8. Increase legume by-pass protein (N) to reduce urea excretion by ruminants; <sup>E/R</sup>
9. Improve predictability of the legume N credit to succeeding crops; <sup>E</sup>

## **Other water quality issues** (*moderately expensive; of public interest*)

10. Assess the effects of fall herbage removal on P runoff to surface water. <sup>R</sup>

## **Other effects on subsequent crops** (*inexpensive; private interest*)

11. Quantify, predict, and enhance non-N rotation effect of perennial legumes, and avoid yield-limiting effects (synthesis of the literature with additional in-field measurements); <sup>E</sup>

## **Reducing inputs in short rotations** (*inexpensive; private interest*)

12. Reevaluate soil fertility requirements and optimize crop management of short-lived legume stands. <sup>E</sup>

<sup>E</sup> indicates potential for rapid impact on expanded utilization and/or economic return.

<sup>R</sup> indicates potential to reduce regulatory pressures