

Legumes can Reduce Need for Nitrogen Fertilizer

Summary: Legumes can replace fallow to add nitrogen and other benefits to soil health.

3/25/10 Contact: Clain Jones (406) 994-6076 or clainj@montana.edu

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BOZEMAN – Adding legumes to a crop rotation has many benefits, including reducing the need for external nitrogen input.

"As spring seeding time approaches, it's a good time to think about crop rotation and consider replacing some fallow ground with a legume crop," said Clain Jones, Extension soil fertility specialist in the Department of Land Resources and Environmental Sciences (LRES) at Montana State University (MSU). Annual legumes grown in Montana include field pea, lentils and chickpeas, whereas perennial legumes include alfalfa and sainfoin.

Dryland grain producers might be hesitant to plant a crop rather than fallow because soil moisture is often a limiting factor to wheat production. However, planting legumes rather than fallow can have several benefits. Legumes, with the proper soil bacteria, convert nitrogen gas from the air to a plant available form. Therefore, they do not need nitrogen fertilization, and can even add nitrogen to the soil.

"Much of the nitrogen benefit of legumes comes from the plant residue – shoots and roots. This gradually decomposes over a few years to provide plant available nitrogen and increase long term soil fertility," said Jones. Replacing fallow with any kind of crop has also been found to decrease nitrate leaching and saline seeps.

Whether as a replacement to fallow or part of annual rotations, the benefits of legumes go beyond nitrogen addition. According to work done in Saskatchewan, only a portion of the benefit from a legume in rotation—compared to continuous small grains—comes from the added nitrogen. The greatest benefit is improved soil structure, and breaking weed, disease, and insect cycles.

"Unincorporated pea residue may also enhance germination and survival of wheat under dry fall conditions because it provides soil cover to reduce evaporation loss," said Perry Miller, MSU professor in LRES.

These benefits generally add up to higher yields and protein in wheat planted after an annual legume rather than a cereal. How much higher depends not only on the growing season, but largely on whether the legume was grown as green manure, that is, terminated early before maturity, or for a grain or forage crop. The management objectives will determine whether or not the legume should be harvested and whether an annual or perennial legume is the better choice.

"If replacing fallow, you want to select a shallow rooted crop that uses little water and nitrogen, such as annual legumes," said Miller.

For water conservation, terminate the legume as green manure by first bloom (when 50 percent of plants have one flower). If adding nitrogen and organic matter is a higher priority, then the legume can be terminated at the pod stage. This practice generally increases grain protein in the following wheat crop. An annual legume crop can also be harvested as grain for an immediate economic benefit.

"Remember," said Jones, "legume grain and forage harvest remove a large portion of the potential nitrogen gained and there will be less benefit to the soil." When legume grain prices are high, such as currently with lentils, harvesting legume grain makes sense, but decreased yield of the next crop due to lower water availability needs to be considered.

Of course, management for good stand establishment and growth are important to optimize benefits of legumes. This includes seed quality, seeding rates and dates and proper inoculation. Legumes also need sufficient phosphorus, potassium and sulfur for adequate nitrogen fixation, and will not fix much nitrogen in soil that already has high nitrogen levels. Cutting back on tillage helps retain nitrogen in the system. "Minimum or no-till management slows decomposition and erosion loss," said Jones.

Be sure to have your next rotation planned to take advantage of increased nitrogen. High protein wheat is a good option. Be aware that high persistence sulfonylurea (SU)-herbicides such as Ally (metsulfuron), Glean (chlorsulfuron), Finesse (chlorsulfuron) and Amber (triasulfuron), among others, can damage subsequent annual legumes.

"If you have been using these products and want to grow legumes, you'll likely need to avoid their use for three to four years minimum prior to seeding legumes, depending on the product, application rate, and climate," cautioned Fabian Menalled, assistant professor in LRES at MSU. A study in Bozeman showed 16-19 percent reduced pea yields 4.5 years after applying an SU-herbicide.

"It may be necessary to conduct a field bioassay for SU residual, by planting a row of a desired crop and checking for herbicide damage, before seeding an entire field to legumes," added Menalled.

"The nitrogen 'credit' following a legume harvested for grain is approximately 10 pounds per acre and can be more if the crop is terminated as a green manure," said Jones.

Properly managed legumes in rotation can increase crop income by providing a legume forage or grain crop, or improving wheat yields after a legume green manure. Legumes improve soil health, especially compared to fallow, by adding nitrogen and organic matter and reducing potential erosion and leaching loss. Legumes may reduce the energy footprint of cropping systems by reducing the need for nitrogen fertilizer, and improve the stability and health of agro-ecosystems.

MSU Extension has documents on both field pea (MT200502AG) and chick pea production (MT200204AG). For these and other Extension publications, visit the Web at <http://msuextension.org/publications.asp>, or call Extension Publications at (406) 994-3273 for more information.