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Soil Nitrogen Availability for Continuous Winter Wheat in Response to Summer 'Green' N Crops

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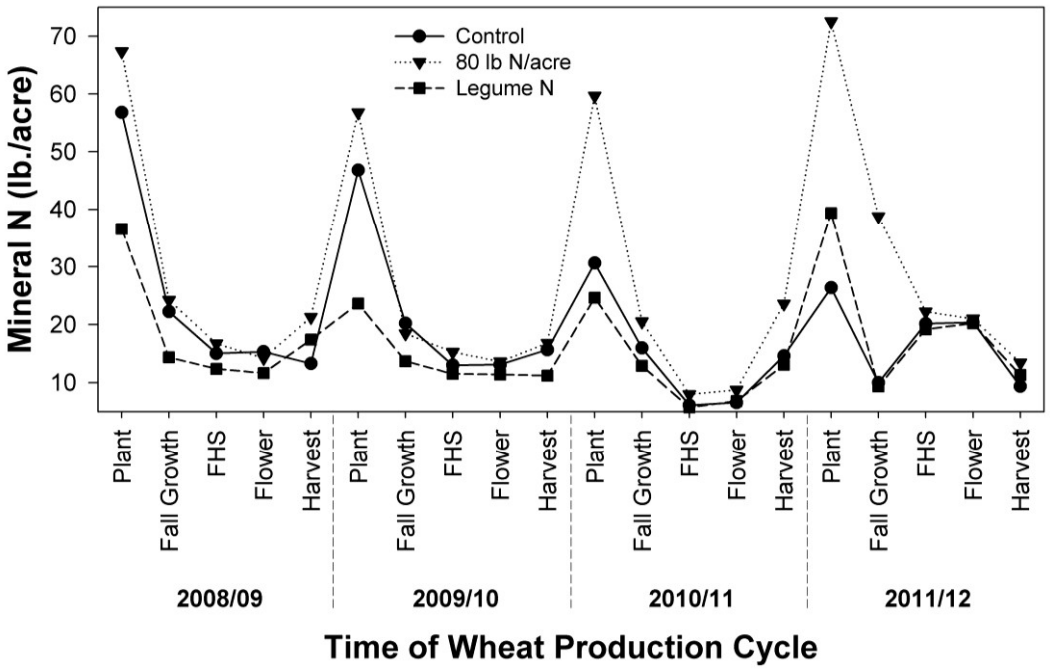
Rationale: The rising cost of inorganic nitrogen (N) fertilizer has renewed interest in supplying cash crops with N fixed, or captured, by cover crops. There is a wide level of variation in N capture by legume cover crops, and capture does not represent the amount of N supplied to following crops. For example, the amount of N fixed by legumes and transferred to following crops can be <30% of the total amount available. Under no-till, the lack of cultivation to incorporate plant residues could also reduce the amount of N available to the following crop. Such issues show the importance of understanding how 'green' N sources function within production systems, to define their value as fertilizers.

Objective: Describe influences of two forage legumes, used as 'green' N sources to support dual-purpose (fall through early-spring grazing + grain production) winter wheat, on mineral N in soil compared to summer fallow + applied inorganic N fertilizer over multiple years.

What We Did: We used two summer legumes ('Laredo' forage soybean, and 'Rio Verde' lablab) as green manures in small plot studies on highly productive clay loam soils in bottomland landscapes. Half of the plots were managed by no-till (herbicides only) and the second half by conventional tillage (disking and roto-tilling). The 'green' N crops were planted after wheat grain harvest (early-June) and grown through late-August to provide N. The plots then received their assigned tillage systems; shred and incorporate plant residues with tillage, or shred and spray with glyphosate (Round-up). Winter wheat was planted in early-September, as is normal for dual-purpose wheat. Additional plots at each location received one of two levels of inorganic N fertilizer (none and 80 lb N/acre) as dry urea. The 80 lb N/acre treatment was similar to recommended fertilizer rates for wheat grown on similar soils. Wheat was grown to maturity (early-June), and soils were sampled to 6 inches depth at different times of wheat production cycles and analyzed for mineral N.

Results: The following results are for a **4-year (2008 to 2012) experiment**.

- The first three growing seasons (September planting in one year through harvest in June the next year) were affected by low amounts of precipitation. Production of both 'green' N crops and wheat were reduced, as was the supply of mineral N for wheat production.
- Conventional tillage provided ~6 lb/acre more mineral N than no-till though this was not a significant difference; natural variation of soil mineral N ranged from 5 to 14 lb/acre.
- The inorganic N, control and legume N treatments provided, respectively, 64(±6), 40(±12), and 31(±7) lb/acre of mineral N in the upper 6 inches of soil at wheat planting (see figure). Mineral N in legume plots rarely exceeded N in plots managed as unfertilized control.



- Legume-treated plots had less N than control plots at planting of the first 3 growing seasons.
- Available mineral N at planting declined under control and legume treatments in the first 3 growing seasons; mineral N under the inorganic N treatment was higher and more consistent.
- The legumes provided 33 and 35 lb N/acre at planting of the first and last growing seasons; little improvement in N over 4 years.
- The low amounts of soil mineral N generated by legume treatments indicated more time will be required to improve soil fertility and support wheat production with 'green' N crops.
- This study provided information used to develop 2 longer-term agro-ecological experiments.

➢ Integrated (soil-plant) systems-level study of annual summer legumes as green N crops for continuous grain-only winter wheat – currently in 6th Year.

➢ Integrated (soil-plant-animal) systems-level study of cool-season annual cover crops as green N sources for continuous grazed sorghum-sudangrass – currently in 5th Year.

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