United States Department of Agriculture
Agricultural Research Service

Soil Water Availability in Continuous Winter Wheat-Summer 'Green' N Crop Rotations

Grazinglands Research Laboratory, El Reno, Oklahoma May 2017

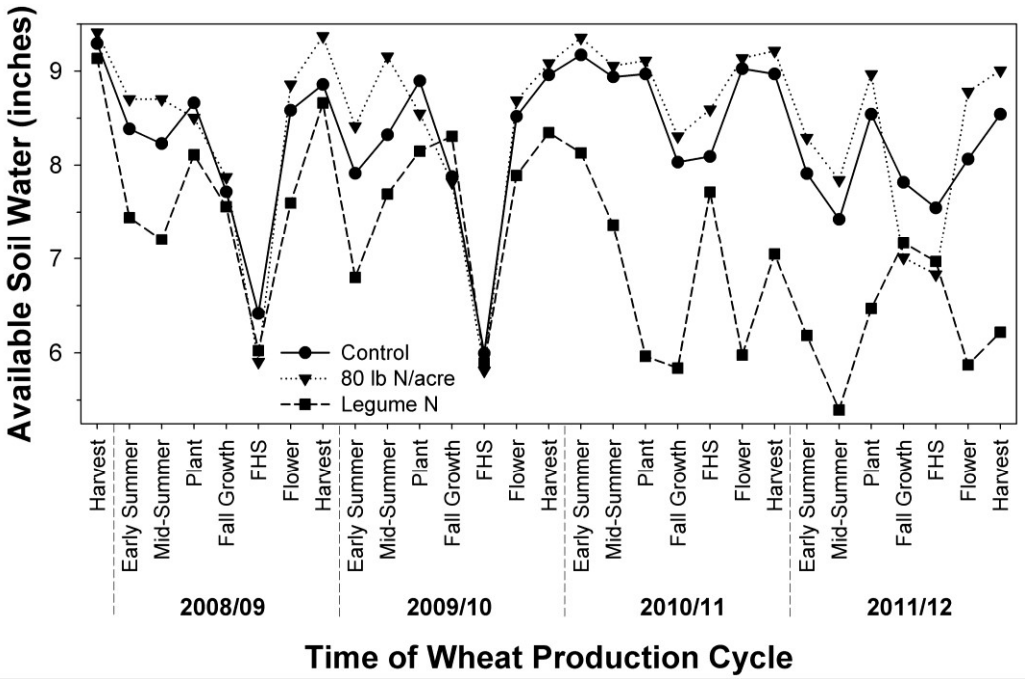
Rationale: Rising cost of inorganic nitrogen (N) fertilizer has renewed interest in supplying cash crops with N fixed, or captured, by cover crops. There is a wide level of variation in N capture by legumes, and capture does not always represent the amount of N supplied to following crops. Further, capture of green N with crops grown during summer fallow requires use of soil water normally conserved for the next wheat crop. Such repeated double-cropping could affect system productivity. Such issues show the importance of understanding how 'green' N will affect available soil water over the full period of wheat production cycles.

Objective: Describe the effects of 2 forage legumes used as 'green' N crops to support dual-purpose (fall through early-spring grazing + grain production) winter wheat, compared to summer fallow + applied inorganic N, on available soil water over multiple years.

What We Did: Half the plots were managed by chemical no-till and half by conventional tillage (disking and roto-tilling). 'Green' N crops were planted after wheat grain harvest (early-June) and grown until early-September to provide N. We used two annual legumes ('Laredo' forage soybean, and 'Rio Verde' lablab) as 'green' N crops. The plots then received assigned tillage systems; shred and incorporate plant residues by tillage or shred and spray with Glyphosate (Round-up). Winter wheat was planted 10 days after terminating legumes. Additional plots managed by summer fallow received 2 levels of inorganic N; none (the control) and 80 lb N/acre as dry urea to support wheat. Wheat was grown to maturity and amounts of soil water in the upper 30 inches of soil were measured during the summer fallow and wheat growth phases of the traditional production cycle of winter wheat for 4 years.

Results: The following results (reported amounts of soil water are similar to inches of rainfall) for a **4-year experiment (2008 to 2012).**

- Tillage system had minor effects. No-till provided 0.12 inches more water per 7.5 inch soil depth than conventional till. Natural variation in water per soil depth was ±0.15 inch.
- Greatest amounts of soil water during summers were recorded under the fallowed 80 lb N/acre treatment (see figure). Fallowed plots receiving the unfertilized control had slightly lower amounts of water present; legume-treated plots had the least.
- Legume-treated plots utilized 1.4 to 3.2 inches more soil water than summer fallowed treatments in June to early-September.
- Legumes resulted in 2.2±0.8 inches less soil water at wheat planting than fallowed plots; the lower amounts started at legume planting (10 days post-harvest, vertical dashed lines) in June.



- Water under legume treatments was more similar to fallowed treatments in early-March at first hollow stem (FHS).
- Much of the soil water removed from fallowed plots in Sept through March was related to high rates of wheat growth from planting through FHS.
- Water availability under legume treatments declined with length of study; fallowed treatments provided more uniform amounts of available soil water over life of study.
- Results show 'green' N treatments used as long-term planned tools have costs (use of scarce water resources) and potential carryover effects on wheat production over a series of years.
- This study provided information that helped develop 2 long-term agro-ecological experiments.

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

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

Contact Persons:

Dr. Brian K. Northup (Brian.Northup@ars.usda.gov)
Dr. Srinivas C. Rao, Retired

7207 West Cheyenne Street
Grazinglands Research Laboratory
El Reno, OK 73036
Telephone: (405) 262-5291
FAX: (405) 262-0450

https://www.ars.usda.gov/plains-area/el-reno-ok/grazinglands-research-laboratory/