The ISU Coles Memorial Farm: Nutrient Management and Research

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Tim Goode, farms manager
Mark Honeyman, farms coordinator
ISU Research and Demonstration Farms

Background. The Coles Memorial Farm was given to Iowa State University College of Agriculture in 1974. The farm consists of 285 acres m/l in Williams Township, Hamilton County, one-half mile east of Williams, Iowa.

The Iowa Board of Regents accepted the farm as a gift from Jessie V. Coles via resolution that stated… "the farm subject to the following conditions:…net proceeds be used at the discretion of (Iowa State) University to aid either research in agriculture or scholarships in agriculture with due recognition to the parents of Jessie V. Coles, that is John Wesley Coles and Eda E. Coles,…"

A bronze plaque on a granite boulder was sited permanently near the driveway of the farmstead to recognize Jessie V. Coles, her parents, and ISU College of Agriculture. An endowed scholarship – the John Wesley Coles and Eda Coles Scholarship in Agriculture was established in the ISU Foundation and is awarded to "undergraduate students in the College of Agriculture and Life Sciences with preference in production agriculture."

Jessie Coles requested the farm's tenant operator, Raymond Rigter, be allowed to rent the farm "as long as he was able to perform." Mr. Rigter ably operated the farm until 2015, when he died at the age of 87. The farm was managed as a crop-share lease by ISU with Mr. Rigter from 1974 through 2015. Proceeds from the farm operations funded a variety of research priorities including assistantship stipends, research equipment, as well as research station facilities and improvements.

Farm operations. From 1974 through 2015, the farm was generally in a corn-soybean rotation with conventional tillage. Therefore, when a new farm operator was needed, ISU decided it was an opportunity to be more innovative with the farming practices.

Soils. The Coles Farm has typical-to-wet soils for the Clarion-Nicollet-Webster soils association. The overall CSR is 85.70. The farm has 41 percent Canisteo soils, 31 percent Clarion soils, 12 percent Nicollet soils, 8 percent Webster soils, 6 percent Harps soils, < 2 percent Okoboji soils, and < 2 percent Knoke soils. Most of these soils are poorly drained, heavy, wet soils that benefit from field tile drainage.

Nutrient management. In order to demonstrate strategic nutrient management strategies, the crop share farming operation was shifted to a custom farming arrangement at the ISU Coles Farm with several new practices (Table 1). A corn-soybean rotation was continued.

The overall goal was to employ practices of the latest known science and GPS technologies to reduce nutrient losses from the Coles Farm and to demonstrate these techniques to the agriculture of the area. It is expected the practices will have no or little impact on the farm's grain yield.

Advanced research flux towers. At the same time, advanced research was added to the Coles Farm. This advanced research included USDA and ISU instrument towers. The USDA National Laboratory for the Environment

(NLAE), Ames, Iowa, installed two energy balance and flux towers at the Coles Farm.

According to Jerry Hatfield, lead USDA researcher for this project, these systems measure environmental parameters required to quantify the energy balance over corn and soybean and compute the fluxes of water and carbon dioxide for these surfaces. These instruments were placed in the field to measure these parameters continually throughout the year and provide a continuous assessment of the energy balance and fluxes over all of the surfaces an agricultural system has during a year.

The instrumentation consists of a series of radiometers to measure the components of the radiation balance. The flux measurements determine the carbon dioxide exchange between the soil and the atmosphere and the water evaporated and transpired from the soil to the atmosphere. All of these measurements are made at 20 Hz and evaluated at 15-minute intervals throughout the day.

The goal is to provide a direct comparison in a field with cover crops and strip tillage with a field with no cover crop and conventional tillage systems. These data also are being linked with several NASA systems to evaluate soil moisture and carbon dioxide over the Midwest, and this site will serve as a ground reference point. In the future, this site will be used to evaluate airborne instruments to compute crop stress as part of a NASA-USDA effort.

Advanced research – cosmic-ray neutron probe. According to Brian Hornbuckle, ISU associate professor of agronomy, the ISU tower at the Coles Farm will have a new type of soil moisture sensor under development, which is able to monitor the water content of the top foot of the soil surface over an area of nearly 80 acres. This will produce a value of soil moisture much more closely related to what a crop in a typical Iowa farm field is currently experiencing.

This new instrument is called a cosmic-ray neutron probe. It detects neutrons liberated from atmospheric gases by cosmic rays originating in outer space, which are constantly bombarding Earth's atmosphere. These free neutrons then rain down on Earth's surface and are absorbed by hydrogen in the soil. Because most of this hydrogen is associated with soil water, when the soil is wet, fewer neutrons escape the soil and are detected by a cosmic-ray neutron probe mounted on a pole about five feet above the soil surface. The instrument is part of the Cosmic-ray Soil Moisture Observing System (COSMOS, http://cosmos.hwr.arizona.edu) funded by the National Science Foundation. Hornbuckle is working with colleagues at the University of Nebraska and the University of Arizona to determine how rapidly growing plants (i.e., crops such as corn and soybean), which also contain significant amounts of water as well as other forms of hydrogen, affect the measurements made by cosmic-ray neutron probes.

The new farming practices and advanced research implemented at the ISU Coles Farm will maximize its value to ISU and Iowa agriculture.

Table 1. Nutrient management practices at the ISU Coles Farm, Williams, Iowa, with projected nutrient loss reduction.*

Practice	%Nutrient loss reduction**	
	N	P
Cover crop annual rye	31	29
Strip tillage***	0	60
Spring preplant or sidedress N fertilizer on corn	6	0
O, K, and lime with grid sampling and crop removal	4	17
Incorporated P fertilizer	0	36
N rate at MTRN	10	0

*In combination, reductions are not additive.
**N or P nutrient load reduction per ISU SP-435.
***Estimate based on ISU SP-435.