INFLUENCE OF AGROFORESTRY BUFFER STRIPS ON SOIL WATER

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Although more farmers are practicing soil and water conservation methods, watersheds under agricultural production still lose soil, nutrients and pesticides. The agriculture sector has been identified as a significant contributor to non-point source pollution of surface water and groundwater in the Midwestern United States. In northeast Missouri, about 20-25% of shallow farm wells have nitrate concentrations exceeding 10 mg L^{-1} (the USEPA drinking water standard). Therefore, federal and state agencies as well as landowners and farmers need scientifically defensible information on different practices that reduce nutrients and herbicides in runoff water from agricultural watersheds.

Agroforestry is a land management and conservation practice that intersperses agricultural crops with trees. This practice has been extensively used in tropical climates but only recently has received attention in temperate zones. Agroforestry has been proposed as a possible conservation practice for row crop agricultural practices in temperate North America. Agroforestry has also been shown to increase soil carbon sequestration, soil quality, water quality and leads to more diversified productivity. Adoption of this conservation practices can receive some support through cost sharing and other federal subsidy programs.

In 2002 (Field Day Report), we reported that agroforestry and contour grass strips reduce non-point source pollutants from watersheds in corn-soybean rotations. However, we did not examine mechanisms which may restrict systematic selection and adoption of such practices for other soils, landuse practices and management systems. In this study, we evaluated changes in soil water content during soil water depletion for a soybean growing season and changes in soil water recharge during fall months. The objective was to determine how crops and buffer areas with agroforestry buffer strips affect runoff (Fig. 1). Soil water sensors were installed at 5, 10, 20 and 40 cm depths and soil water contents were continuously recorded (10 minute intervals) using Campbell soil water content reflectrometer sensors from 17 June 2003. Campbell sensors were calibrated using measured gravimetric soil water content and bulk density. Calibrated soil water contents at the four depths were statistically evaluated to examine differences in water content for crop and tree buffer areas during the growing season and during recharge events.

Results show that soils in the soybean areas had higher soil water content during the early phase of the growing season compared to the tree buffers (Fig. 2). Soil water content at 5, 10, and 20 cm depths from 24 June to 5 August were significantly lower under the tree buffers compared to under soybeans. The number of precipitation events and amount of water required to increase soil water content for sensors in the agroforestry areas were higher compared to crop areas. During the weekly recharge period from 26 August to 2 September, soils in the tree areas showed better infiltration and larger soil water recharge due to lower initial soil water content

and improved soil physical properties (Fig. 2). Soil water content recharge was 23% higher for the agroforestry buffers compared to the row crop areas during the week of high recharge.

Practical Implications of Results:
Results of the study show that agroforestry buffers significantly reduced soil water content during the growing season. Therefore, these agroforestry buffers had a larger capacity to hold more water during rainfall events and thus reduce runoff from soybean cropping practices for claypan soils. Results also indicate that agroforestry practices, when incorporated directly into row-cropped watersheds in the Midwest, can be used to effectively reduce runoff volume and sediment and nutrient losses. In addition to environmental benefits, production from agroforestry buffers generate additional income from nut products, timber, and hay. Although some land is lost to grain production, agrforestry practices provide alternative income as well as highly invaluable environmental and other benefits.

Figure captions:
Figure 1. Study watersheds and experimental design of Campbell soil water sensors in soybean and tree buffers within the agroforestry watershed.

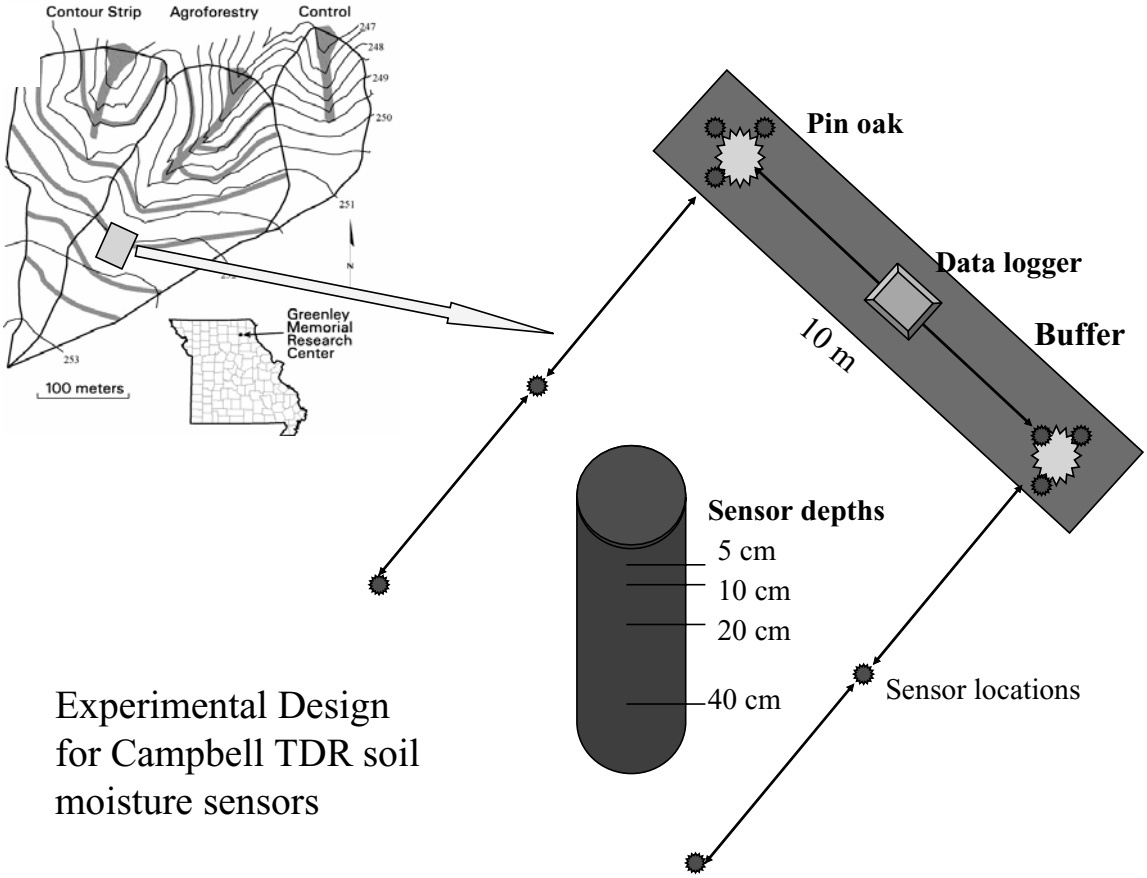
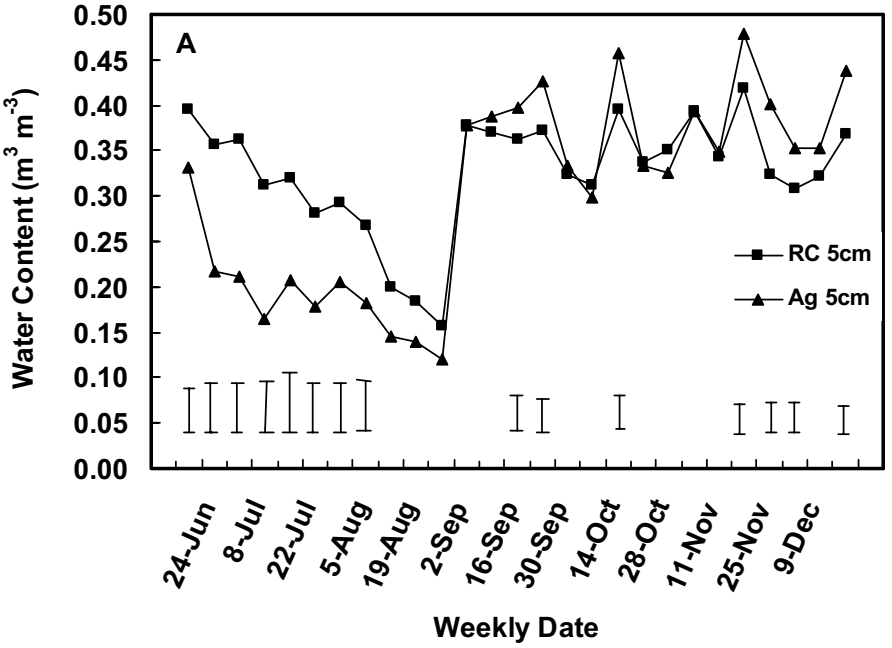
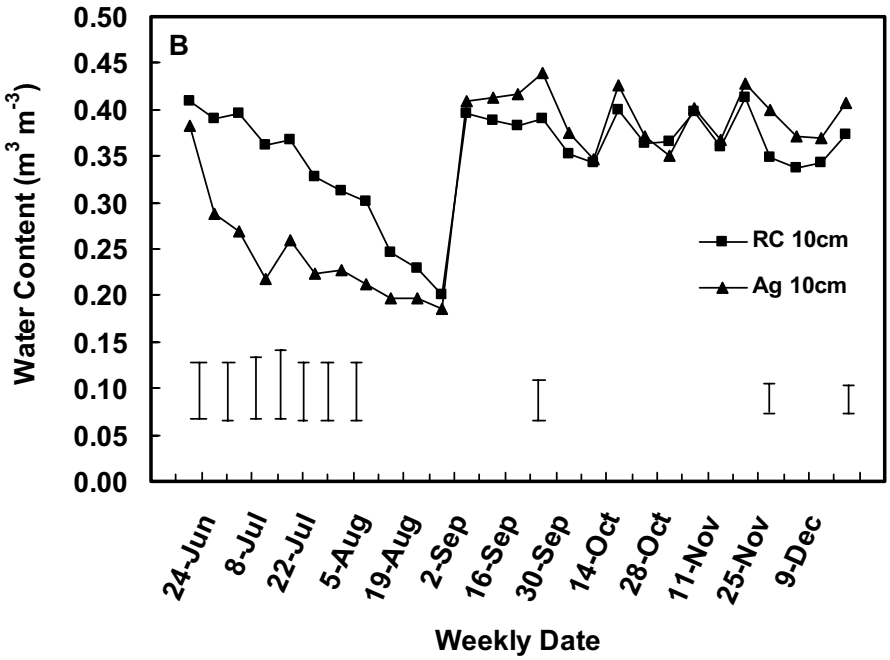
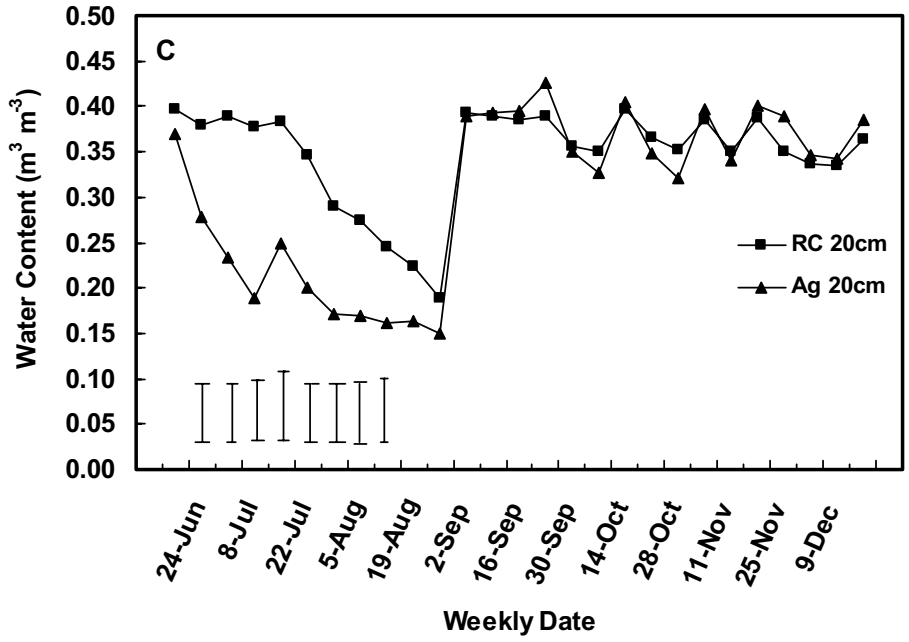
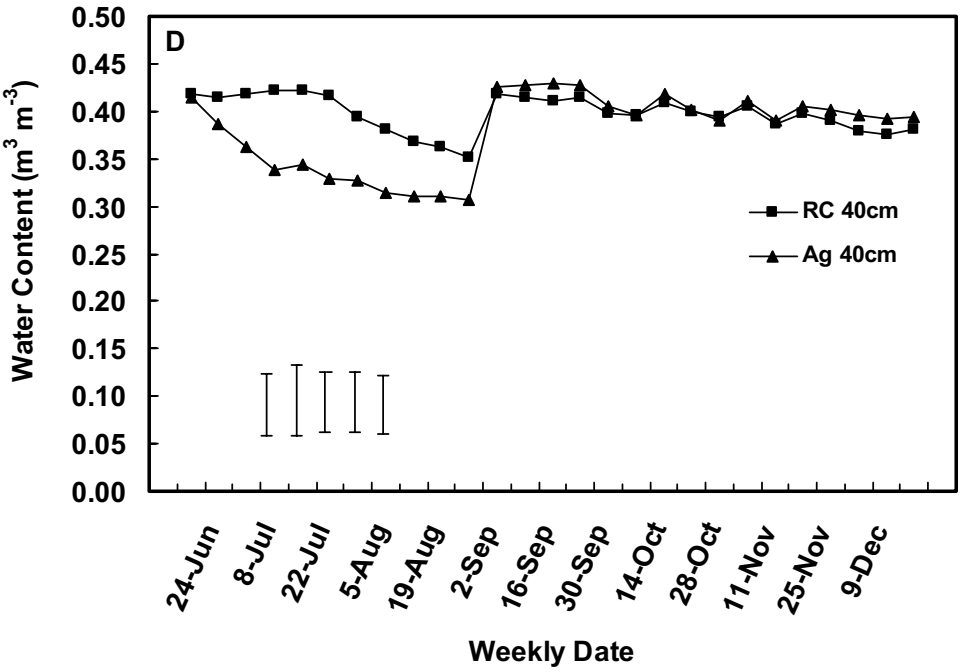


Figure 2. Weekly changes in volumetric soil water content at 5 (A), 10 (B), 20 (C) and 40 (D) cm depths in soybean and tree buffers from June to December, 2003. RC and Ag denote row crop and agroforestry, respectively.






C
Water Content (m3 m-3)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
RC 20cm
Ag 20cm
24-Jun
8-Jul
22-Jul
5-Aug
19-Aug
2-Sep
16-Sep
30-Sep
14-Oct
28-Oct
11-Nov
25-Nov
9-Dec
Weekly Date


D
Water Content (m3 m-3)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
RC 40cm
Ag 40cm
24-Jun
8-Jul
22-Jul
5-Aug
19-Aug
2-Sep
16-Sep
30-Sep
14-Oct
28-Oct
11-Nov
25-Nov
9-Dec
Weekly Date