



SOUTHEAST PURDUE AGRICULTURAL CENTER (SEPAC)

# Soil drainage impacts on cover crop growth and soil improvement:

*Insights from long-term SEPAC study*

Eileen Kladviko  
Agronomy Department  
Purdue University  
West Lafayette, Indiana

Long-term drainage experiment insights on crop yield, cover crop growth, soil improvement, water flow, and chemical transport in southeastern Indiana: Part 2 of 3-part series.

## Drainage pays!

This is Part 2 (of 3) of a study detailing key findings of a 35-year project conducted at the Southeast Purdue Agricultural Center (SEPAC) in Butlerville, Indiana, six miles east of North Vernon in Jennings County.

**Part 1 (AY-397-W)** focuses on cash crop establishment and yield as affected by drain spacing.

**Part 2 (AY-398-W)** discusses the effects of drainage on cover crop growth and the effectiveness of other conservation practices on improving crop growth and soil properties. Key conclusions:

- Drainage improves cover crop growth.
- Drainage enables other conservation practices to work better, to improve soils and crop yields.

**Part 3 (AY-399-W)** discusses drain spacing effects on the amount of water and nitrate-nitrogen leaving the field in drainflow and the effects of cover crops on those losses.

Although these results are specific to this study on the Clermont silt loam soil at SEPAC, most of the findings are more generally applicable across other poorly drained soils, although the specific values will vary with soil and climate.

Parts 1, 2, 3 and the executive summary (AY-396-W) can be downloaded for free at Purdue Extension Education Store. <https://www.edustore.purdue.edu/>

## Background and field design

Naturally poorly drained soils present many challenges for crop production. Subsurface “tile” drainage is a common water management practice for such soils throughout Indiana and much of the Midwest. We have conducted long-term studies on tile drainage at the Southeast Purdue Agricultural Center (SEPAC) on a Clermont silt loam (now sometimes called Cobbsfork), typical of the soils in southeastern Indiana and similar to soils stretching from southwestern Ohio to eastern Kansas. The long-term drainage research studies were begun in 1983.

The original goals of the SEPAC drainage studies were to evaluate 1) subsurface drain spacings on drain flow and corn growth and yield, and 2) combinations of agronomic management practices and drainage on soil physical properties and corn growth and yield. This publication is the second in a 3-part series on results of the long-term study, and it focuses on the interactions of drainage with other conservation practices for soil improvement and crop yields. Key results from both the drain spacing study and the agronomic treatment study are presented.

The drain spacing experiment consisted of three drain spacings plus an “undrained control”, replicated twice in the field. Drains were installed at spacings of 5, 10, and 20 m (16, 33, and 66 ft), with the undrained control being at a spacing of 40 m (133 ft). Due to the very slow permeability of the Clermont soil, the 40 m spacing was considered to be a good proxy for “undrained” conditions. More details on the installation are in Part 1 of this 3-part series.

The agronomic treatment experiment had two blocks, one with tile drainage at 50-ft. spacing and one with no tile drains. Surface drainage was fair but not perfect, with some ponding occurring, especially in the untilled area. The goal was to improve soil physical properties along with crop growth, and to test the synergies between drainage and agronomic conservation practice. There were five main agronomic treatments, split between no-till and chisel tillage, replicated four times in each subfield. The treatments were continuous corn (CC), corn with cover of either wheat or cereal rye (WR), corn with cover of annual ryegrass (RG), corn with dry animal manure (MN), and a 3-yr rotation of corn-wheat-orchardgrass/red clover meadow (RO).

## Drainage improves cover crop growth

Most commonly used cover crops require adequate drainage to grow well. Figure 1 shows the cereal rye growth on May 13, 2016, just prior to termination before planting of soybeans. The tiled plots had around 3100 lbs

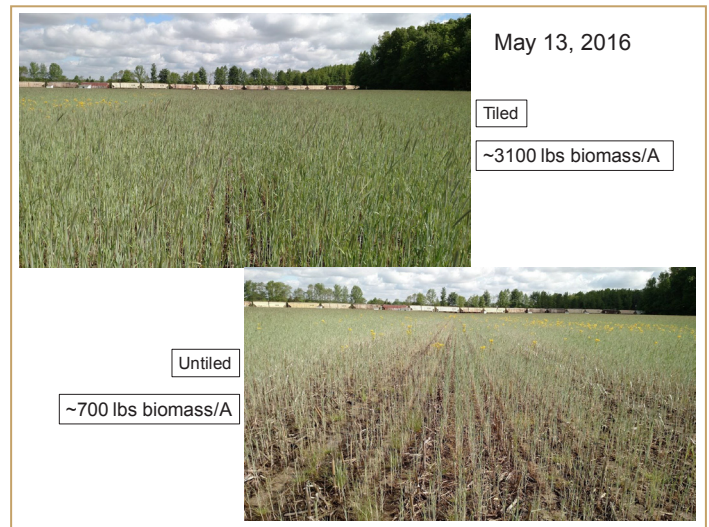


Figure 1. Cereal rye growth on May 13, 2016, just prior to termination before planting of soybeans. The tiled plots had around 3100 lbs of dry biomass per acre, compared to only 700 lbs/A for the undrained control.

of dry biomass per acre, compared to only 700 lbs/A for the undrained control. Four years of data are shown in Figure 2. Biomass amounts varied from year to year due to the weather, the goal for the succeeding cash crop, and the type of cover crop, but the drained plots always produced more biomass than the undrained control. Obviously if we are growing a cover crop for nitrogen scavenging and soil health improvement, then we want the cover crop to grow well and produce enough biomass to have a positive impact. For over-wintering cover crops, such as cereal rye, much of their growth

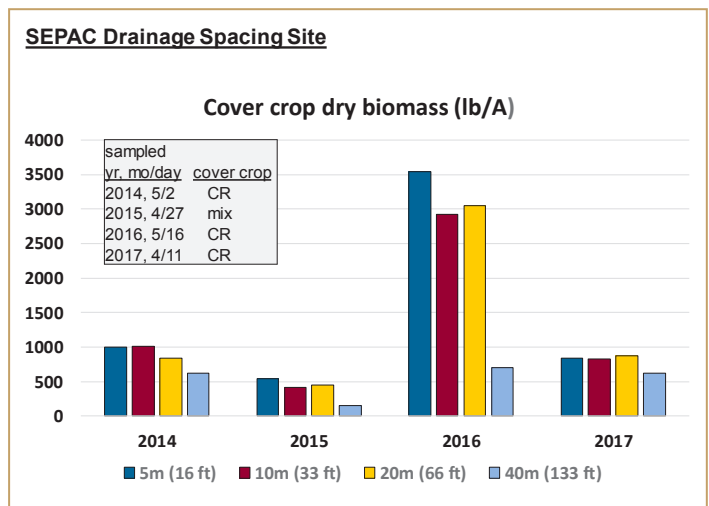


Figure 2. This chart shows four years of data. Biomass amounts varied from year to year, but the drained plots always produced more biomass than the undrained control.

occurs during the wettest part of the fallow season (late winter-early spring), so tile drainage can have a significant impact on the growth and therefore potential effectiveness of the cover crops on improving soil health.

### Drainage enables other conservation practices to work better, to improve soils and crop yields

As illustrated with the cover crop discussion above, adequate drainage is needed for other conservation practices to work to their full potential. Average corn yields over the 9-yr agronomic treatment experiment are shown in Figure 3. For the continuous corn control, the tilled block averaged 12% higher yield than the untilled block; for the conservation treatments of wheat/rye cover, ryegrass cover, and manure, the yields were about 20% higher in the tilled than in the untilled block. Average continuous corn yields were 16 to 25 bu/A higher in the tilled than in the untilled block, depending on the agronomic treatment. Plots with cover crops, manure, and rotation had equal or greater corn yields than the control in the tilled subfields, but equal or lower yields than the control in the untilled subfield. These results illustrate the importance of tile drainage in enabling other conservation practices to be effective in improving crop yields.

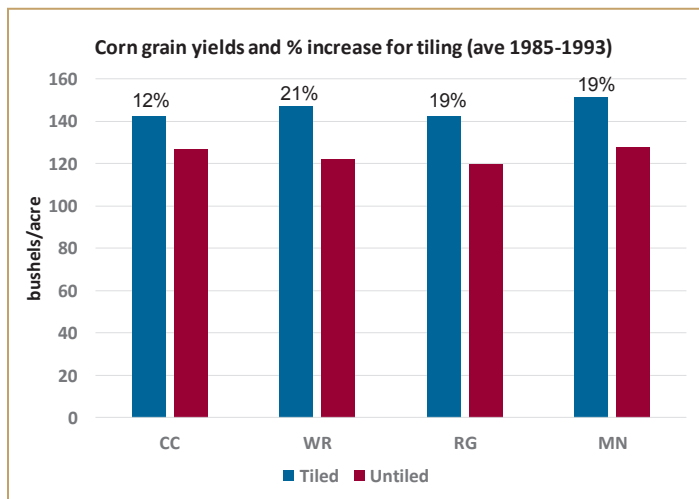


Figure 3. Average corn yields over the 9-year agronomic treatment experiment. Average continuous yields were 16 to 25 bu/A higher in the tilled than in the untilled block, depending on the agronomic treatment.

Other soil measurements were made at various times during the study. Earthworm populations were generally higher in no-till vs. chisel plots, tilled vs. untilled plots, and plots with covers, rotation, or manure vs. the control. Soil physical properties of aggregate stability and infiltration tended to be improved by cover crops and rotation, compared to the control, especially in the tilled block.

The overall conclusion from this part of the drainage studies is that a good drainage system is a necessary first step to improving crop yields and soil health on naturally poorly drained soils. Agronomic conservation practices alone are not likely to make up for an inadequate drainage system. The shallow water table of naturally poorly drained soils is the first limitation to growth of cover crops or cash crops, and it must be managed in order to provide adequate aeration for crop roots and soil biology and their subsequent improvement of soil health. Cover crops and no-till will generally be more effective at improving soil health and increasing crop yields if they are used on soils with a good drainage system.

### Drainage is a long-term investment

Installation of tile drainage is a long-term investment in a field. Drainage flow paths seem to develop over time, at least for the first several years after installation. Crop yield effects vary from year to year, based on the weather, so drainage will not have any effect on yields in some years. Other conservation practices also take time to improve soil health, and the effects of drainage on these improvements will likely become more evident with time. But the long-term improvement in cash crop yields, cover crop growth, and effectiveness of other conservation practices make the installation of tile drains on naturally poorly drained soils a good investment in the long-term productivity of a field.

### Acknowledgements

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