SOUTHEAST PURDUE AGRICULTURAL CENTER (SEPAC)

Drainage for the long haul:

Key takeaways from the SEPAC study

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Subsurface "tile" drainage is an essential agricultural water management practice on naturally poorly drained soils in Indiana and throughout much of the Midwest. We have conducted a long-term (35yr) drainage research study at the Southeast Purdue Agricultural Center (SEPAC) on high silt, low organic matter, poorly-structured soils that were not typically tile-drained prior to the 1980s. This publication presents a brief synopsis of some of the key takeaways from this project, in headline form. More detailed discussion of each of the points is provided in a series of three publications, AY-397-W, AY-398-W, and AY-399-W, all downloadable for free at The Education Store. This publication, AY-396-W, is also available there.

Drainage pays!

1. **Drainage improved timeliness of fieldwork by 1 to 15 days**
   During the first 10 years of the study, different drain spacing plots were chiseled and planted when the soil was "ready." The undrained control plots were delayed between one to 15 days for tillage and planting compared to the narrowest (most intense) drain spacing. The ability to get in the field on a timely basis is a major benefit of drainage to most farm operations.
2. **Drainage improved corn yields**
   Corn yields were generally higher in the three drained treatments (5, 10, and 20m (16, 33, and 66 ft)) compared to the undrained control (40m spacing, 133 ft). Over the 24 years of corn during the 35-yr project, yields averaged 168, 163, 162, and 144 bu/acre for the 5, 10, 20, and 40m spacings, respectively. On average for the 11 soybean years during 1994 to 2018, there were no significant differences in soybean yields due to drainage treatment, and yields averaged 57 bu/acre.
3. **Drainage improves cover crop growth**
   Most commonly used cover crops require drainage to grow well on naturally poorly-drained soils. For over-wintering cover crops, such as cereal rye, much of their growth occurs during the wettest part of the fallow season (late winter-early spring), so tile drainage had a significant impact on their growth and therefore potential effectiveness in improving soil health.
4. **Drainage enables other conservation practices to work better**
   Adequate drainage is needed in order for other conservation practices to work to their full potential. A separate experiment at SEPAC assessed the impacts of different

conservation practices, including no-till, cover crops, dry animal manure, and rotation with hay crops, on a drained block vs. an undrained block, compared to continuous corn with chisel tillage. Plots with cover crops, rotation, and manure had equal or greater corn yields than the control in the tiled block but equal or lower yields than the control in the untiled block. Earthworm populations, soil aggregate stability, and infiltration were generally improved by no-till vs. chisel, and covers, rotation, and manure compared to the control, especially in the tiled block.

Drainage affects water flow and water quality

1. **Closer drain spacings lose more water and nitrate in tile drainflow**
   When tile drains are installed closer together, the purpose is to remove more water faster. So it is no surprise that the narrower drain spacings removed more water per acre than the wider drain spacings. When expressed as a percent of total annual rainfall, on average from 1985-1999 the drainflow was 12, 15, and 21% for the 20, 10, and 5m spacings, respectively, with average annual rainfall of 44 inches. Because of the greater water flow in the narrow spacings, nitrate-nitrogen losses in the drains were also greater. During the first 3 years of measurement (1985-1988), N losses were 24, 32, and 44 lbs N/acre for the 20, 10, and 5m spacings, respectively (Fig. 1, first set of bars on graph).
2. **Cover crops reduce nitrate losses from tiles**
   Management practices were changed over the course of this long-term experiment, and nitrate-N concentrations and losses have been reduced as a result. Concentrations and losses were greatly decreased from the 1986-88 time period to the 1997-99 time period by a combination of growing cover crops, switching from continuous corn to corn-soybean rotation along with reduction in fertilizer N rate, and switching from chisel tillage to no-till (Fig. 1, second set of bars). Although we cannot clearly separate the amount of reduction due to the cover crop vs. the amount due to the reduced fertilizer rate, other work in the Midwest clearly shows the effectiveness of the cover in reducing nitrate concentrations and loads. During the third time period on the graph (2000-15), nitrate concentrations were still low but the annual rainfall and therefore drainage were increased, leading to greater losses than in the late 1990s.

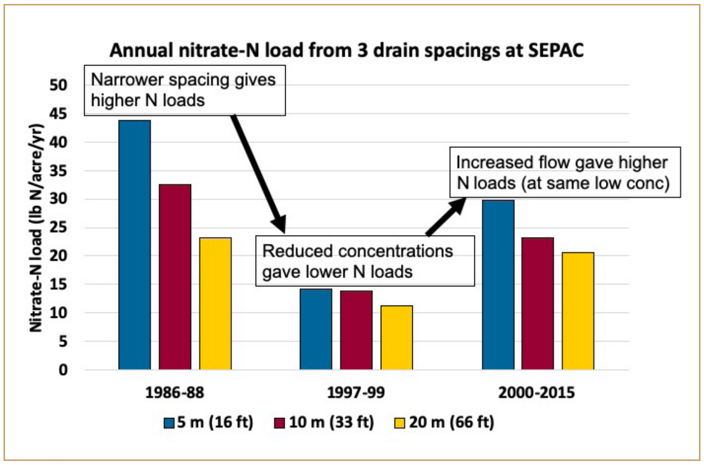

Figure 1.

The bottom line from these data:

- Drain spacing matters. The narrower the drain spacings, the more water and more nitrate will be lost in the tile drains.
- Rainfall (excess) matters. A year with greater rainfall, especially if it is in the non-growing season, will give more drainage and more nitrate loss.
- Cover crops reduce nitrate-N concentrations and loads in tile flow.
- Implication: If we intensify drainage, which will increase flow, then we should also intensify management of some other aspects of the system, such as cover crops or controlled drainage, to reduce the "leakiness" of the 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 some years drainage will not have any effect on yields. 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.

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