Agricultural Tile Drains Clogged With Cover Crop Roots?

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During the winter and spring of 2016, specialists at Purdue University and the USDA-Natural Resources Conservation Service (USDA-NRCS) received numerous reports that roots were clogging tile drains. Other agricultural advisers were hearing similar stories and many were posting and reading about these reports online. The reports suggested that cover crop roots were to blame and some had photos showing roots and sediment blocking short sections of tile drains.

Roots and sediment clogging tile drain.

Questions arose. Why would cover crop roots enter and proliferate in the tile this year and seemingly not in other years (there were some reports of roots in tile in prior years, but not as many)? Why did this appear to happen in specific locations and not others? Why would it happen with cover crops when it's generally not been a problem under grass waterways, hay fields, or wheat? And how can one manage cover crops or tile drainage systems to avoid this problem in the future?

We do not currently have good answers for most of these questions, and other than anecdotal findings, research is limited. We will need research to provide better answers. We have talked with producers, contractors, and drainage engineers; have searched for published information; and have used our experience and knowledge of this year's conditions, and we think we can offer some possible reasons for what happened and possible solutions in the short-term.

What might have caused roots to clog tiles?

Although observations make it clear that apparently live roots (along with sediment) were present in the tiles, the causes of the clogging might originate with the cover crops, with the tile system, or with both. We'll discuss some possible contributing factors under both of these categories.

Cover crops

The warm fall of 2015, followed by the warm winter of 2016 and the warm and very wet spring of 2016, provided excellent conditions for extensive cover crop growth. In some fields this spring, cereal rye grew waist- to shoulder-high (in some cases by choice), meaning there was also greater root growth than usual.

Other covers that grew extensively included rapeseed, wheat, and annual ryegrass, mostly in fields that included these as part of a mix. Although cereal rye or wheat would not normally be called “deep-rooters,” the extra time and excellent growing conditions may have allowed them to grow more roots with depth than they typically do.

Specialists in Ontario wrote a fact sheet (*Farm Tile Drains and Tree Roots*, OMAFRA Fact Sheet 555, www.omafra.gov.on.ca/english/crops/facts/12-055.htm) that discusses conditions that can lead to tree roots growing into tiles, but some of those same conditions may pertain to cover crops or even corn or wheat roots — and the authors also list a large number of other plants that have been known to clog tiles including field horsetail, dandelion, canola, kale, and brambles.

The authors say that growers may be more likely to find roots in a tile after a rainy period followed by a prolonged dry period. That’s because roots grow downward in the soil profile to reach available water, if there is not enough moisture in the upper soil layers. Roots may enter a dry tile but are unlikely to proliferate if there is no water there. Once water starts flowing again, however, the roots may proliferate.

Tile system

There are several factors related to tile systems that might contribute to the potential for clogging by roots. Tile risers are often placed in low spots in the field, which allow ponded water to drain through the riser and into the tile system more quickly than would occur if all the water had to infiltrate the soil. The holes on the risers are relatively large, which can permit not only water but also residues and other debris to pass through and enter the tile.

Surface riser in depression, with potential for residues and sediment to enter tile drain system through surface runoff.

Sediment exiting tile, likely originating from surface riser.

With the rising popularity of vertical tillage and similar practices that “size” the residue into smaller pieces, more residue is moving with surface runoff, and these particles could enter risers. As such, residues and sediment have the potential to accumulate in the tile, partially restricting flow and providing nutrients and an attractive environment for any roots (if they are present) to proliferate.

Surface riser nearly buried by sediment and debris near roadside culvert.

The frequency and intensity of rainfall in spring and early summer 2015 may have contributed to a greater than usual accumulation of residues and sediments in fields with risers. Some risers have been found that were nearly covered with sediment and debris and are obvious sources for materials to get in and clog a drain.

Internal coupler for drain tubes.

Internal couplers, used where laterals are connected to mains or submains within the drainage system, may serve to catch residue or other debris. Lateral tile can also be inserted into the main drain simply by cutting the main and inserting the lateral (sometimes further than necessary), but this is not an approved method of making connections. The amount of debris may grow larger as more debris is caught, eventually restricting drain flow. External couplers are a better alternative to making connections as they provide little if any internal restriction from the connection. Internal couplers are easier to install while contributing to potential blocking problems as described above. External couplers are a little more difficult to install, but may alleviate the problems with flow obstruction.

Drainage plow installing drain tubing in field.

Although installers aim to carefully control the grade of the tile, it is nearly impossible to have perfect installation of every foot of tile, especially on difficult, undulating landscapes, uneven soil surfaces, very dense subsoils, and subsoils with stones or rocks. ASTM standards allow slight deviations in pipe installation grade, but these are limited. Additionally considering the increase in use of self-propelled drainage plows, and tractor pulled plows, drainage systems are installed faster than with trenchers. ASTM standards specify plow speed limits.

Even football-sized or larger glacial rocks may cause a dip or hump in a tile line as the installation machine works through the field. Although most installers often catch and correct some of these anomalies by manually excavating and splicing the lines at the time of installation, it's likely that some of these dips will be missed, especially on very flat grades. Some slight dips or humps that may not even be detectable by the operator may eventually cause problems with sediment and root mass accumulation. In addition, rocks can partially crush the tile and constrict

or damage the tile material itself. All these factors may contribute to restricting flow, which then causes water, sediment, and debris to pond in portions of the tile, which in turn provides an attractive place for roots to grow.

Finally, some rural homes may have old connections from their septic systems to field tile — often unbeknownst to the current residents. Such connections provide a nearly continuous trickle flow of nutrients and water, which might provide an attractive environment for roots to enter and proliferate. Also, any part of the drainage system that intercepts hillside seeps, springs, and other sources of subsurface water during the growing season will most likely create conditions that potentially lead to drain blockage by roots and sediment, regardless of the crop.

Reconnaissance or "detective work" needed

When observing or hearing about roots clogging tile drains, it is important to observe and record other information to help us understand better what conditions might contribute to the issue.

We urge you to gather the following information.

For the roots-

- Can you distinguish what roots are in the tile? Are the roots from cash crops, cover crops, weeds, or trees? If unsure, there may be some advanced DNA tests available in the future that can confirm or deny specific cash or cover crops, if you provide a sample of roots from the known cash and cover crops grown in the field too.
- Is the clogged location within the dripline of trees, or near an old fence line, or perennial sod?

If you suspect cover crops

- When were the cover crops planted and what types of plants were they?
- When were they terminated?
- What were the weather conditions during cover crop growth period, as well as weather conditions during the previous cropping season and the current weather conditions?
- How many years have cover crops been used? What types of cover crops have been grown?
- What tillage or no-tillage practices are used in the field?

For the drainage system

- How long ago was the drainage system installed?
- What is the tile material (plastic or clay)?
- If it is plastic pipe, is it ASTM- or AASHTO-certified?
- What is the perforation type in the tile (for example, slotted, perforated, hole punched, knife slit, etc.)?
- How were tiles installed (wheel, chain, plow; laser, RTK, others)?
- What type of couplers are used in the tile system (internal or external or none) near where the blockage occurred? Was the blockage primarily occurring at or near junctions of laterals with mains?
- How flat is the grade on the tile? Throughout the Midwest, laterals in subsurface drainage systems may be installed at about 0.1% grade, unless topographic conditions require a

steeper slope. Laterals are usually installed following the general slope of the landscape, and usually at a depth of 3 to 4 feet. Drainage mains will be of larger diameter and most likely installed deeper than the laterals.

- How well was the grade maintained during drain installation, especially near the location of the blockage?
- How deep is the tile?
- Are there tile risers feeding into the drainage system?
- Does the tile tend to run all year, or mainly in the late fall through spring?
- Is an on-site septic system outflow connected to the drainage system?

Potential management to reduce the potential for pipe blockage by crop roots

While it isn't clear what caused the apparent surge of roots clogging tiles this past season, we can suggest some ideas that might help reduce the problem. We offer these as possibilities to consider while we strive to learn what the underlying causes of the problems really are. These are not provided as definitive answers.

For the plant roots, if it is fairly certain that the roots are from the cover crop (and not from the cash crop, trees, or weed species), consider:

- Alternating shallow-rooting covers with deep-rooting covers
- Terminating the cover crop earlier in the spring
- Alternating winter-kill covers with those that overwinter
- For new drainage system installations, avoid seeding the cover crop immediately over the new tile trench for the first year while the soil is still quite loose.

Any one of these practices might reduce the potential for roots to reach and enter the tile drain. Now that we are more aware of potential problematic weather —like a rainy period followed by a prolonged dry period and a mild winter — it is advisable to have an early termination strategy. Cover crop rooting substantially benefits soil health, and we need to consider ways to achieve these benefits without having the roots enter and proliferate in the tiles.

Anecdotal information also suggests that at least in some cases, once the cover crop is terminated and the roots die, the blockage will clear itself up over the next month or so, allowing water to flow freely again. Anecdotal information about the type of cover crop roots that have been found include conflicting observations about cover crop types that either have or have not shown issues, suggesting that species selection may not be a definitive solution.

If you notice small imperfections in the tile system (like dips, humps, or crushed tile) repair them promptly. Consider repairing these as you repair more traditional "blowouts" that routinely become apparent in fields. Root blockage problems resulting from some of these imperfections may not become apparent until enough sediment or residue builds up to provide an attractive place for roots to grow.

For surface risers, consider installing a filter or sock on the riser to reduce the potential for residue and sediment from entering. Or, consider replacing the riser with a blind inlet. Blind inlets filter sediment and phosphorus from a low spot while still allowing the depression to drain

rapidly. Blind inlets also improve field efficiency, because you no longer need to farm around the riser — you can farm right over the top of the blind inlet.

We may need to investigate different types of tile materials that make it less likely for roots to enter tile in the first place. There are various perforation sizes and shapes for different soil conditions, and perhaps some of these might also provide benefits related to roots. Socks or filters might be another possibility. Perhaps we need to consider non-perforated tiles for the mains.

Consider using taped external couplers for tile junctions rather than internal couplings. This practice could reduce the potential internal restrictions that may trap residues and sediment that roots find attractive. If you use internal couplers, be sure to trim any excess that could extend into the main and capture sediment.

Consider avoiding tillage practices that cut the residues into small pieces that tend to float away, especially if the tile system has surface risers. This would reduce the potential for residue to enter the tile system and clog the tile lines.

Finally, there is some equipment that can clean out sections of tile lines without replacing them. You can mechanically clean out roots, or use high-pressure water or air to blow out obstructions between two cuts in a tile line. Although not particularly common, some have had success with these practices.

Where do we go from here?

We do not know the complete story about why roots have clogged tile drains more this past season than in other years. Although some of the observations were of cover crop roots, we also don't know how often this may have happened with roots of corn or some weed species. It could just be that we had the "perfect storm" of conditions last summer — so much sediment and residue pieces to move into risers and accumulate in tiles, and then the weather was conducive to much greater cover crop growth than normal. Most farmers have not experienced this issue (not comforting to those who have).

We may not observe this situation again for many years, but it is important to keep investigating. We welcome your observations and detective work. If you encounter clogged tile drains, please share them with us so that we can all learn more about the potential causes and potential management practices to minimize such issues in the future.

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