Doing more of what doesn't work is_____?

EPA's recommended "fixes" for Lake Erie are warmed-over H2Ohio programs, paid for by taxpayers, that reduce nitrogen and silt *but actually increase the Dissolved Phosphorus* *that fuels algal blooms!*

Result?

- **Good money after bad**
- **No accountability for polluters**
- **Lake Erie keeps getting worse**

EXCERPTS FROM SCIENCE OF THE TOTAL ENVIRONMENT
1 DEC 2017, VOL 601-602, PGS. 580-593

A Review on Effectiveness of Best Management Practices (BMP) in Improving Hydrology and Water Quality: Needs and Opportunities

"Increasing numbers of BMPs have been studied in research projects and implemented in watershed management projects, but a gap remains in quantifying their effectiveness through time. In this paper, we review the current knowledge about BMP efficiencies, which indicates that most empirical studies have focused on short-term efficiencies, while few have explored long-term efficiencies."

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https://www.sciencedirect.com/science/article/abs/pii/S0048969717313207?via%3Dihub

Literature Citation	BMP's Reviewed	Reductions by BMP's	# Studies
Hoffman Et al 2009	Buffer Strips with overland flow	Dissolved Reactive P -71% to 95%	9
Dodd & Sharpley 2016	Buffer strips/ Constructed Wetlands	DRP -72% to 94%	6
	Grass Waterways	DRP -83% to 81%	2
Kay et al 2009	Buffer strips	DP -475% to 30%	11
	Wetlands	DP -33% to 33%	11
Roberts et al 2012	Vegetated Buffer strips	DRP -64% to 42.7%	5
Dinnes et al 2004	Drainage management	TP −100% to 50%	12
Dorioz 2006	Grass Buffer Strip	DP −83% to 93%	11

Notes: 1) The above summarize a number of studies with results expressed in a range. Of more interest would be results of individual studies to see how many indicated significant DRP loss. 2) Very few studies include the impact of subsurface drainage, a significant contributor to DRP loss.

Cover crop and phosphorus fertilizer management effects on phosphorus loss and nutrient cycling

Carver, Robert Elliott **2018**
https://krex.k-state.edu/dspace/bitstream/handle/2097/39057/RobertCarver2018.pdf?sequence=3

Phosphorus (P) loss from non-point agricultural sources has been identified as a main contributor to degraded surface water quality throughout the United States. Excessive P inputs to surface waters can lead to eutrophication, increased water treatment costs, and negative health impacts. Therefore, agricultural best management practices (BMP) that promote water quality, through minimizing P loss, must be identified. Studies outlined in this thesis aim to determine the impacts of cover crops and P fertilizer placement on P loss in surface runoff and nutrient cycling in a no-till corn (Zea mays)-soybean (Glycine max) rotation and provide insight into how cover crop species selection and termination method affects potential P loss from crop tissue. The first study examined combined effects of cover crop and P fertilizer placement on total P, dissolved reactive P (DRP) and sediment losses in surface runoff from natural precipitation events. This large-scale field study was conducted near Manhattan, Kansas, at the Kansas Agricultural Watershed (KAW) Field Laboratory during the 2016 and 2017 cropping years. Two levels of cover crop **[no cover crop (NC) and cover crop (CC)]** and three levels of P fertilizer management [no P (CN), fall broadcast P (FB), and spring injected P (SI)] were used. Flow-weighted composite water samples were collected from precipitation events generating greater than 2.0 mm of surface runoff. Results from this study found the **Cover Crop treatment increased DRP losses compared to No Cover Crop** in both cropping years; however, CC reduced sediment loss by over 50% compared to NC. Application of P fertilizer increased DRP losses compared CN in both cropping years, although SI resulted in lower quantities of DRP loss compared to FB. In addition, this study found that CC reduced biomass and yield of corn compared to NC and therefore decreased nutrient uptake, removal, and deposition during the 2017 cropping year. However, no negative impacts of CC on biomass or yield were observed during the 2015 (corn) and 2016 (soybean) cropping years. Application of P fertilizer increased the concentration of Melich-3 P and total P in the top 0-5 cm of soil compared to CN; however, no differences between P fertilizer management practice were observed for concentrations of Melich-3 P at 5-15 cm. A greenhouse-based study determined the impacts of cover crop species (brassica, grass, and legume), termination method (clipping, freezing, and herbicide), and time after termination (1, 7, and 14 days after termination) on total P and water-extractable P (WEP) release from cover crop biomass. **Freezing increased WEP concentration of crop tissue by more than 140% compared to clipping and herbicide.** Additionally, at 7 and 14 days after termination, both concentration of WEP and fraction of WEP compared total P increased compared to 1 DAT. **Findings from these studies suggest the use of cover crops may unintentionally result in greater DRP losses in surface runoff**. However, addition of a cover crop can dramatically reduce erosion losses. In addition, cover crop species selection can directly impact the quantity of P being taken up and released by crop tissue. Understanding the impact of crop species selection may help create new BMPs which aim to reduce P loss.

U.S. DEPARTMENT OF AGRICULTURE

Swine Manure Injection with Low-Disturbance Applicator and Cover Crops Reduce Phosphorus Losses

J.L. Kovar, T.B. Moorman, J.W. Singer, C.A. Cambardella, M.D. Tomer

Journal of environmental quality 2011 v.40 no.2 pp. 329-336

https://pubag.nal.usda.gov/catalog/2329016

Abstract:

Injection of liquid swine manure disturbs surface soil so that runoff from treated lands can transport sediment and nutrients to surface waters.

We determined the effect of two manure application methods on P fate in a corn (Zea mays L.)–soybean [Glycine max (L.) Merr.] production system, with and without a winter rye (Secale cereale L.)–oat (Avena sativa L.) cover crop.

Treatments included: i) no manure; ii) knife injection; and iii) low-disturbance injection, each with and without the cover crop.

Simulated rainfall runoff was analyzed for **dissolved reactive P (DRP) and total P (TP).** Rainfall was applied 8 d after manure application (early November) and again in May after emergence of the corn crop.

Manure application increased soil bioavailable P in the 20- to 30-cm layer following knife injection and in the 5- to 20-cm layer following low-disturbance injection. The low-disturbance system caused less damage to the cover crop, so that P uptake was more than threefold greater.

Losses of DRP were greater in both fall and spring following low-disturbance injection; **however, application method had no effect on TP loads in runoff in either season**. The cover crop reduced fall TP losses from plots with manure applied by either method.

In spring, DRP losses were significantly higher from plots with the recently killed cover crop, **but TP losses were not affected.** Low-disturbance injection of swine manure into a standing cover crop can minimize plant damage and P losses in surface runoff while providing optimum P availability to a subsequent agronomic crop.

Note: The title claim of reduced Phosphorus loss is refuted by the study's DRP results.

"Phosphorus losses from monitored fields with conservation practices in the Lake Erie Basin, USA"

http://link.springer.com/article/10.1007/s13280-014-0624-6/fulltext.html

Authors: Smith, Douglas; Francesconi, Wendy; Livingston, Stanley; Huang, Chi Hua
Prepared by: United States Department of Agriculture Agricultural Research Service

From the Abstract:

No-tillage doubled SP loading compared to rotational tillage (e.g., tilled only before planting corn); however, no-tillage decreased TP loading by 69 % compared to rotational tillage. Similarly, **grassed waterways were shown to increase SP loads**, but not TP loads. A corn–soybean–wheat–oat rotation reduced SP loads by 85 % and TP loads by 83 % compared to the standard corn–soybean rotation in the region. We can potentially attain TP water quality goals using these Farm Bill practices; however, additional strategies must be employed to meet these goals for SP.

Subsurface tile

Early work with tile suggested that little P was transported via this pathway (Kladivko et al. 1991; Brady and Weil 1999). However, more recent work indicates that **significant amounts of P (40–50 %) can be transported through subsurface tile** (Schoumans and Breeuwsma 1997; King et al. 2014). Recent work in Belgium has shown that P leaching in watersheds occurs quicker than previously recognized (de Bolle et al. 2013). In a study of transport pathway from the fields used in the current study **20–80 % of the P lost was via the tile network** (Smith et al. 2014). Hodgkinson and Withers (2007) found that **between 31 and 55 % of P loss in three English headwater catchments occurred via tile drainage**. None of the conservation practices tested made an impact on concentrations and loads of SP or TP through subsurface tile discharge. Many conservation practices, including no-tillage, grassed waterway, and blind inlets, were primarily designed to minimize erosion from agricultural fields.

Conclusion:

Most of the conservation practices applied to fields were developed to decrease sediment loss from fields. While sediment losses were not explored in this paper, **when these practices were developed, the common knowledge was that if you stop the sediment you will stop the P. This mindset has been disproven**. No-tillage decreased surface runoff TP loads by 223 g ha^{-1} compared to rotational tillage, but SP was nearly double from no-tillage. Soluble P and TP were 34 and 52 g ha^{-1} less in surface runoff and tile discharge from the conservation crop rotation than the corn–soybean rotation. Grassed waterways decreased SP by 67 g ha^{-1} and TP by 42 g ha^{-1} in surface runoff. Blind inlets decreased SP and TP loads in surface runoff by 14 and 87 mg L^{-1}, respectively, compared to the tile risers.

Between 2005 and 2013, there were 36,112 ha of conservation practices applied within the 281,232 ha St. Joseph River watershed. On the land base of applied conservation practices, we estimate that SP was decreased from 2010 to 1670 kg P per growing season and TP was decreased from 15 200 to 6400 kg per growing season. This represents a decrease of 17 and 58 % in SP and TP loads, respectively, for the treated acres. Adoption of these practices on many fields predates the 2005–2013 period when we were able to collect these records, so it is difficult to discern how many more acres would need adoption of these practices to achieve the goal of a 39 % decrease in total P loading; however, it does appear that this level could be achieved through adoption of these practices. However, based on the relatively low impact on SP, it does not appear adoption of these practices will achieve the target of a 41 % decrease in SP loading to Lake Erie. Thus, our results concur with other reports in that greater adoption of these practices in addition to new strategies will need to be adopted in order to achieve water quality goals.

Journal of Environmental Quality

Phosphorus Mitigation to Control River Eutrophication: Murky Waters, Inconvenient Truths, and "Postnormal" Science

Helen P. Jarvie, Andrew N. Sharpley, Paul J. A. Withers, J. Thad Scott, Brian E. Haggard, Colin Neal March 2013

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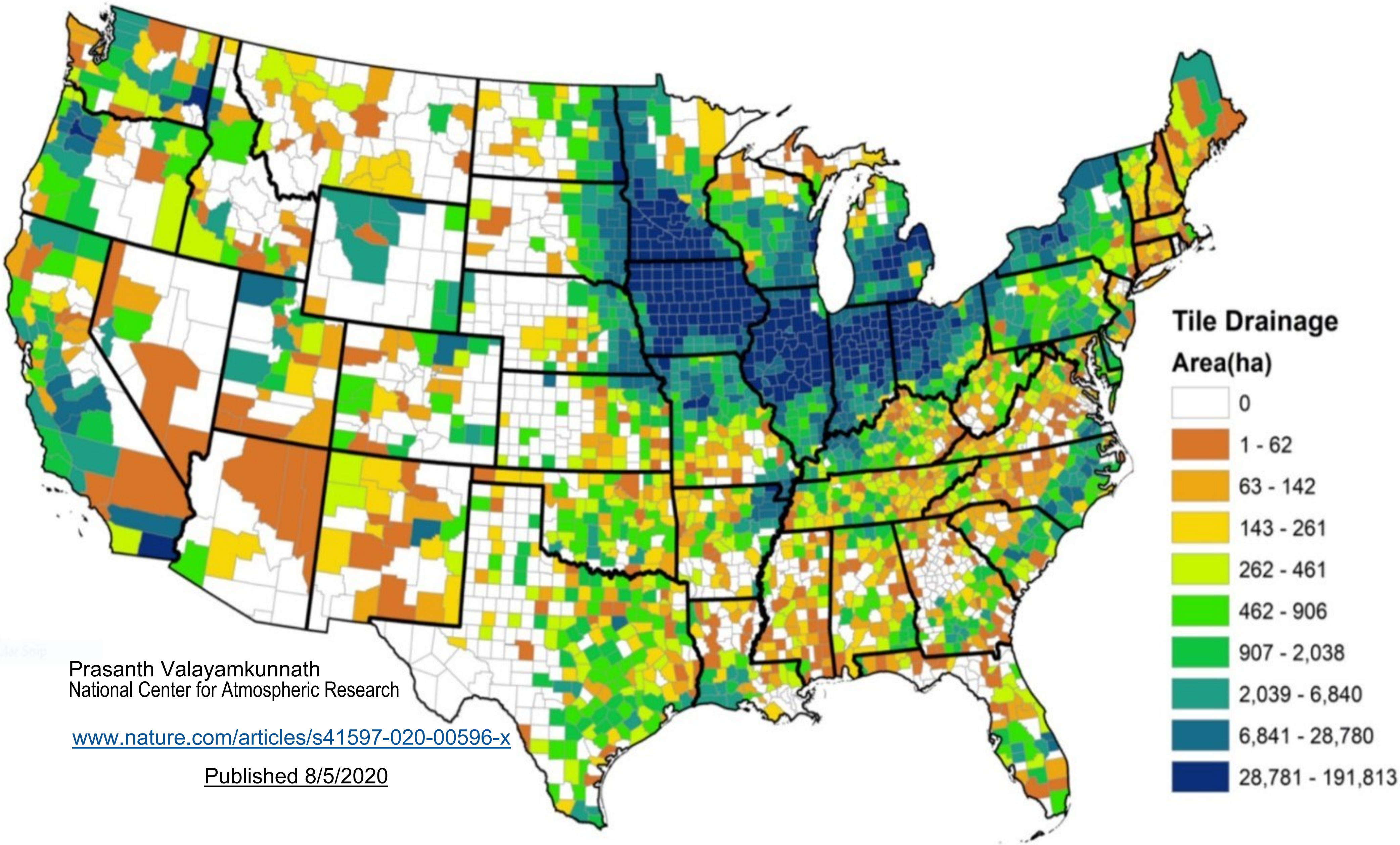
For watershed management, P is regarded as the primary limiting nutrient for nuisance algal growth in freshwaters (Smith and Schindler, 2009), and over the last 40 years, mitigating P inputs from wastewater (point) and agricultural (nonpoint) sources has been adopted as the main watershed management tool to control freshwater eutrophication (Daniel et al., 1994; Sharpley et al., 1994).

However, eutrophication-control policies based solely on P are coming under increasing scrutiny as **evidence to support ecological improvements with P-based mitigation is proving elusive, especially regarding costly measures to reduce P loads from agriculture. Over the past four decades, many watershed nonpoint source projects have reported little or, in some cases, no net improvement in P loss reduction, even after extensive best management practice (BMP) implementation** (Meals et al., 2010). In some cases, reduced P concentrations, largely associated with point-source P controls, have resulted in improvements in river ecology (Bowes et al., 2011; Kelly and Wilson, 2004). **In other cases, however, even after dramatic reductions in river-water P concentrations have been achieved through P source mitigation, ecological improvements have not occurred and, in some instances, nuisance algal growth has actually increased** (Bowes et al., 2012; Jarvie et al., 2004; Neal et al., 2010b). The difficulties of demonstrating benefits of watershed management measures are not restricted to the impacts of reducing land-based P inputs on river eutrophication; more widely, **the successes and benefits of water resource management, river restoration, and agri-environment schemes have proved elusive** (Bernhardt and Palmer, 2011; Harris, 2012; Harris and Heathwaite, 2012).

Subsurface tile drainage in U.S. 2020



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STATE LINE Observer

Frank Gibbs: Liquid manure is too wet

August 30, 2006

By DAVID GREEN

Don't blame tile lines for discharges of liquid manure into drains, says soil scientist and farmer Frank Gibbs, and don't blame the rich soil with its worm holes leading to the tile.

Put the blame on the watered down manure. That's where the problem lies.

Gibbs, from the National Resources Conservation Service office in Findlay, Ohio, spoke to farmers last Wednesday at the annual Center for Excellence Field Day at Bakerlads Farm north of Clayton, Michigan.

Gibbs told how he came to this conclusion several years ago, after he got a call from a producer in Ohio who had a problem. He was applying manure from his swine operation at only about half the recommended rate, but it was still finding its way into tile and drains.

A DNR officer told the farmer that he wouldn't cite him for discharges this time, but it had to be stopped.

"I went down there thinking I'd see big cracks in the ground," Gibbs said, "but the soil moisture was ideal. Impeccable shape. I saw lots and lots of night crawler holes and I thought, 'My God, could this be what's going on here?'"

Gibbs got ahold of some dye—similar to the kind used to check for leaks in a toilet tank—dumped it into the manure lagoon and agitated the mixture. Manure was injected into the soil with a drag line*. The tile was dry when the experiment began. "We wondered how long it might take to percolate down to the tile lines. Twenty minutes? Should we go to lunch?"

There was no time for lunch, Gibbs said. The dye was there within seconds, and every time a pass was made over a lateral tile line, another pulse of colored liquid came through.

Gibbs wondered if the pressure from the applicator pump was the cause, so they next tried a gravity-feed system. Same problem. One more idea came to mind. This time they avoided the watery manure from the lagoon and loaded some of the thicker slurry from the pit under the hog barn.

"It didn't go anywhere," Gibbs said. "It behaved like manure. We dug up some areas with a back hoe and it was laying right where it was shot." He knew then not to fault the tile nor the healthy soil.

"The problem is simple. We're watering manure down to where it behaves like water. Let me repeat that. We're watering manure down to where it behaves like water. You don't need to be a rocket scientist to understand that."

Gibbs has heard the suggestion that no-till soil is at fault. Get rid of the worm holes and there's no conduit for the manure. Not true.

"Preferential flow will occur in conventional tillage through cracks and around the soil structure," he said. "We need to stop confusing the issue with tillage. The issue is that we're adding too much water."

This is a situation that needs to be addressed, Gibbs said. "We need to keep on top of this. We really do. I think some basic research could solve the problem."

Maybe the percentage of solids needs to be up to four or five percent, he said. Or, from what he learned in Europe, even higher.

The Dutch method

With so many Dutch farmers investing in this area, Gibbs decided to take a trip to the Netherlands to see how they farmed in that country. He was in for a surprise. He didn't see any of the watered down manure that the large dairies are using here. The solid content was at about eight percent.

He noticed a plastic membrane spread over a storage lagoon with rain water waiting to be pumped from an overnight storm. Gibbs figured it was to keep the water out of the lagoon, but he was wrong. It was to control odor.

Gibbs watched as a farmer loaded his applicator with manure and inserted a paper form into equipment that recorded his position by GPS. Once in the field, additional data was stamped onto the form. A sample bag of manure was collected to send for analysis by a government agency.

If manure exceeds the allowable nitrate rates, Gibbs was told, the farmer receives a bill from the government. The Dutch farmer joked about having one government official for every farmer, but it isn't the heavy regulation that's hurting agriculture in Holland, he said, it's simply a lack of space.

Gibbs returned home knowing that the practice of watering down manure didn't come from Europe. "That's our technology," he said. **"We're going to all the work of writing up Comprehensive Nutrient Management Plans and then where does it go? Into the tile.** We just need a little bit of research to figure this thing out so we don't have to scrap the whole thing."

Gibbs said he's made attempts to urge agricultural agencies to study the issue, but it's never gone far.

"Everybody's going off in other directions," he said. "We need to work together. We don't have to destroy our soils. We don't need to rip our tile out. "What we should do is look at solids. Eight percent isn't that much. I don't know why we can't tweak that."

Smoke test highlights no-till

As a long-time proponent of no-till farming, Frank Gibbs often tries to convince other farmers to give it a try.

One of his early attempts was to dig out a cubic foot of his no-till soil and place it next to a sample from his neighbor's sugar beet field that suffered from a lot of compaction due to trucks. Then he would pour a bottle of water onto each and watch it soak into his soil and run off his neighbor's.

“It was kind of hokey,” Gibbs said. “Farmers would say, ‘You’re from the government. You probably poked holes in it.’ I needed a different way to show the value of no-till.”

He remembered a blower contraption a friend created for planting beans—it never worked right—and as a fan of Red Green, Gibbs got out the duct tape to rig up a device for blowing smoke into a tile line.

“I could make smoke come out of millions of worm holes,” he thought.

The smoke test shows good soil conditions and at the same time, it shows the avenue that liquid manure takes to reach tile lines. It takes the easiest route, Gibbs said, the path of least resistance. Through worm holes and cracks in the glacial till, manure can quickly makes its way to tile.

To set up the Center of Excellence Field Day at Bakerlads Farm, Gibbs dug a hole to reach a tile line. He found two hand-laid tile lines, then a plastic line, then another older line. Tile is everywhere.

He set up his blower, dropped in a smoke bomb and watched for smoke to start rising out of a soybean field.

Smoke started to run toward the bean field, but the line made a turn and headed back into the cornfield. That’s the trouble with tile lines, he said, you never know how many there are or where they end up.

Watching smoke rise out of the soil is a great demonstration, Gibbs said, and a real attention-getter. “It’s hard for folks to deny this stuff happens when there’s smoke coming up under their feet.”

* *Liquid manure injection systems slice the soil with a disc-like attachment followed by high-pressure injector jets that pump the manure 6-8 inches into the soil, depending on the desired depth. The “drag line” is a long hose like a firehose, connected to a manure wagon or manure lagoon at one end, and a truck or tractor on the other, where the manure is applied.*