Most of the rest ends up in the drainage water as nitrate, with a small amount converted into the gas that makes up 70% of the air we breathe. When we track the nitrogen applied to turf, we find that about half of it ends up in the plant (like corn), but almost none in the drainage water (unlike corn), and a small amount converted to nitrogen gas. The missing portion ends up in the soil as organic matter. This organic matter accumulation can go on for a long period of time, but eventually will taper off because there is a limit to the amount of organic matter a soil can store. At this point, the nitrogen cycle changes, and the nitrogen that used to accumulate in the soil as organic matter will now begin to end up in the drainage water.

Researchers at Colorado State University published a paper that used a computer model to describe what is happening to soil organic matter over time in fertilized turf (Figure 2). If we just focus on the upper most line in the figure, which represents a lawn fertilized at 3 lbs N/M/yr with the clippings mulched, you can see that soil organic matter accumulates rapidly for about 30 years, then starts to stabilize. It is at this point in time when we would expect leaching to start to become an important process. During the accumulation phase, the extra nitrogen in the system is stored in the organic matter, but afterwards it has nowhere else to go. Figure 3 is a graph from the same computer simulation shown in Figure 2, but now shows the expected nitrogen leaching associated with the various management systems. You can see that after about 30 years, the 3 lbs N/M/yr plot begins to show significant nitrogen leaching. None of the other management scenarios do because they are still in the accumulation phase.

So what does this mean? First, this is a major departure from the way we normally talk about nitrogen leaching. Under this new system, nitrogen

leaching is predicted to occur when the soil becomes saturated with organic matter, regardless of the rainfall or the timing of the fertilizer application.

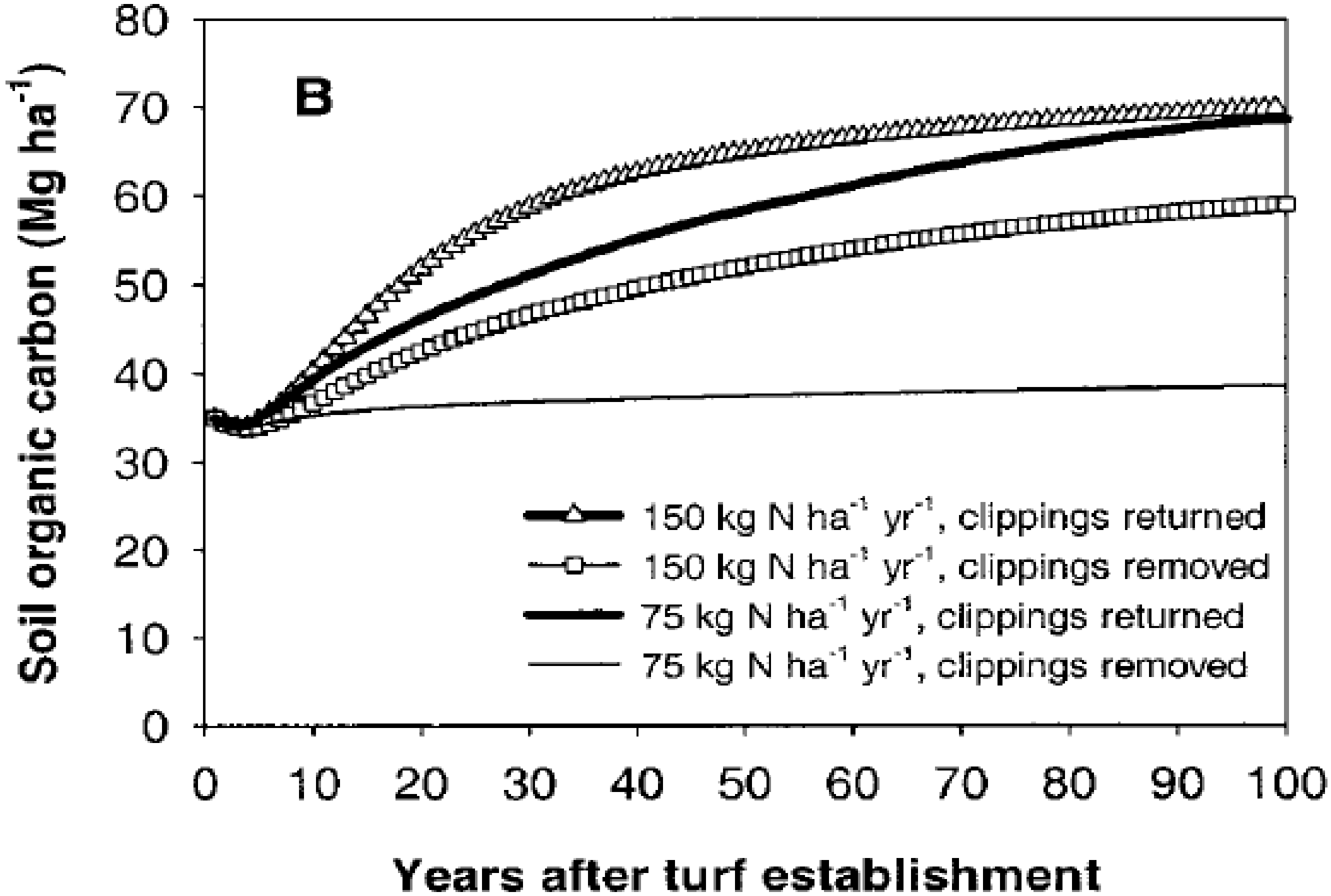

Figure 2. This computer simulation predicts how soil organic carbon (closely related to soil organic matter) changes over time under four different fertilization and clipping management programs. 150 kg N ha-1 yr-1 is approximately 3 lbs N/M. You can see that carbon (organic matter) increases most rapidly in the 3 lbs N/M program with clippings returned. However accumulation rate slows at about 30 years. Graph from Qian et al. 2006.

Second, it means that after the accumulation of organic matter levels off, nitrogen fertilizer requirements should be adjusted downward. We are still at a very early stage in understanding all this new information. Currently there is no soil test that could determine if your soil is in the saturation phase or beyond it. However, developing such a test is now a distinct possibility that I and others are working on.

In fact, this spring Soil Science graduate student Sabrina Ruis visited a number of Wisconsin golf courses to collect soil samples and inquire about fertilization and irrigation history. She is hoping to gain some insight as to how a computer model (like the one used by the Colorado State researchers) and some soil testing information (like clay content, soil organic matter, soil organic nitrogen, pH and others) might be able to predict soil nitrogen saturation and therefore improve upon fertilization recommendations.

The Soil Science Department at the UW has a long history of improving soil testing from Emil Truog who developed the first do-it-yourself test for soil pH in 1912, to O.J. Noer who established the first soil testing lab in the US, to Dr. Wayne Kussow who comprehensively calibrated the Bray and Mehlich-3 soils tests for turfgrass. The task is tall in front of us is tall, but the Badger Soil Nitrogen Test has a nice ring to it, no?

References

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Miltner, E.D. , B.E. Branham, E.A. Paul, and P.E. Rieke. 1996. Leaching and-mass balance of 15N-Labeled urea applied to a Kentucky bluegrass turf. Crop Sci. 36:1427-1433.

Qian, Y.L., W. Bandaranayake, W.J. Parton, B. Mecham, M.A. Harivandi, and A.R. Mosier. 2003. Long-term effects of clipping and nitrogen management in turfgrass on soil organic carbon and nitrogen dynamics: The CENTURY model simulation. J. Environ. Qual. 32:1694-1700.

Golf Course Regulation Compliance Program
2 of 6: *Prevent Backflow to Protect Water Sources*
by Corinne duPreez, MDA

Backflow prevention

A backflow prevention device is used to protect the water supply from potential contamination due to the unexpected flow of water in the reverse direction. Minnesota Department of Agriculture (MDA) and Minnesota Department of Health (MDH) regulations require the use of a backflow prevention device or a fixed air gap when filling pesticide or fertilizer application equipment from a municipal water supply, a private well, or from surface water.

Statutory authority

Minnesota Statute 18B.07, Subd. 5. Use of water supplies for filling application equipment. (a) A person may not fill pesticide application equipment directly from a public water supply, as defined in section 144.382, or from public waters, as defined in section 103G.005, subdivision 15, unless the equipment or water supply is equipped with a backflow prevention device that complies with the Minnesota Plumbing Code under Minnesota Rules, parts 4715.2000 to 4715.2280.

Minnesota Statute 18C.201, Subd. 2. Use of public water supplies for filling equipment. A person may not fill fertilizer application equipment directly from a public water supply, as defined in section 144.382, unless the outlet from the public water supply is equipped with a backflow prevention device that complies with Minnesota Rules, parts 4715.2000 to 4715.2280.

Feel free to cross reference them with the MDA's fact sheet, Backflow Prevention Guidelines for Filling and Rinsing Fertilizer or Pesticide Application Tanks at: http://www.mda.state.mn.us/~/media/Files/chemicals/pesticides/bfprevent.pdf

Acceptable Backflow Prevention Devices

Air Gap: Maintain a fixed and permanent physical separation from the discharge outlet to the rim of the tank, container, etc. The physical distance from the opening of the application equipment to the end of the water line must be two (2) times the diameter of the water line. An additional device for rinsing containers is required.

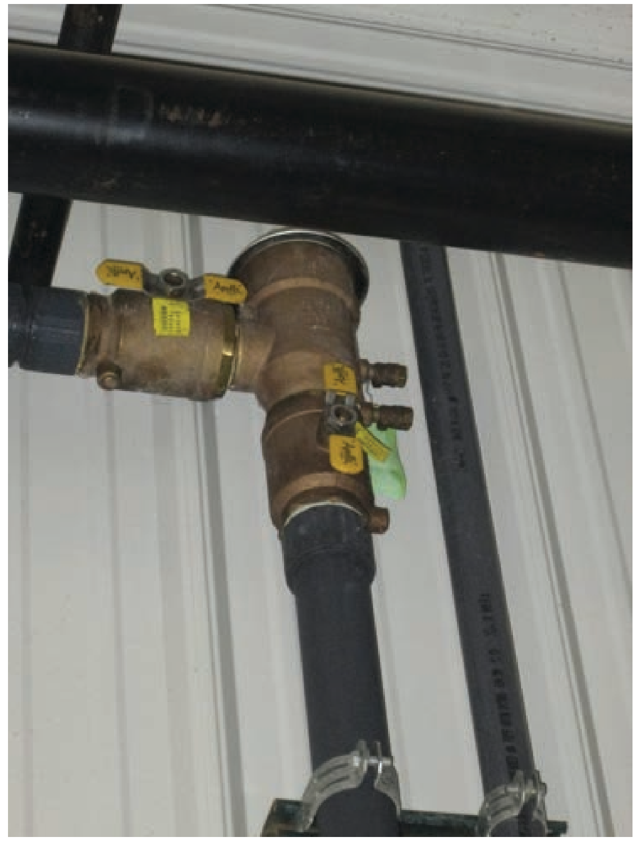
Fixed ridged air gap

Removable fixed air gap

Reduced Pressure Principle or Reduced Pressure Zone Device (RPP or RPZ): Installed, tagged, and inspected by a certified plumber.

Number One Compliance Violation
Are You Up To Code?

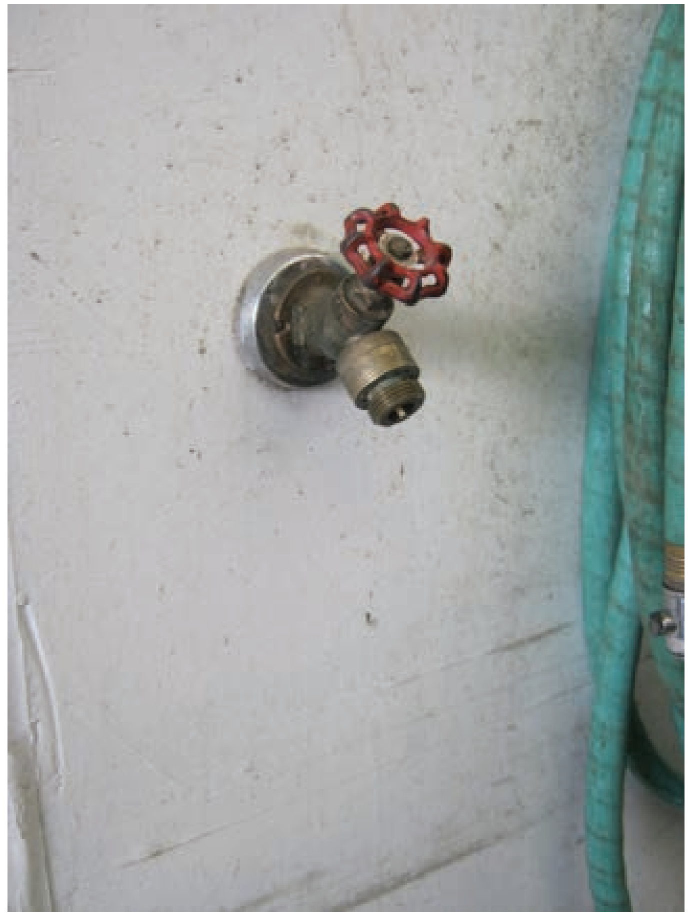
Pressurized Vacuum Breaker (PVB): Install a PVB twelve (12) inches above the overflow level of equipment that is being filled under continuous pressure with a shutoff valve downstream.



Atmospheric Vacuum Breaker (AVB): Install an AVB on a water line not subject to continuous pressure, six (6) inches above overflow level of equipment being filled, and downstream of a shutoff valve. An additional device is needed to rinse containers.

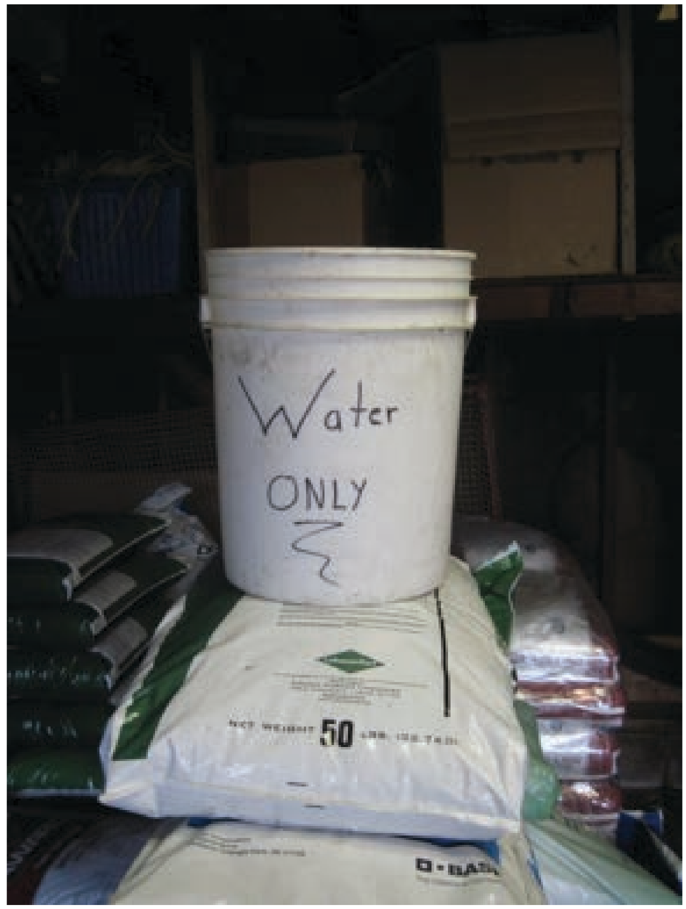
Rinsing Empty Pesticide Containers/Application Equipment Only

Hose Connection Vacuum Breaker: Attach this breaker on the discharge side of the last control valve. Do not install a hose with a spray control valve following the hose connection vacuum breaker.



Double Check Valve with Intermediate Atmospheric Vent: This valve and vent must be used together on ½ and ¾ inch water supplies for inline applications with continuous pressure. This valve is for rinsing containers/equipment only; it is not a substitute for a RPZ or RPP.

Filling hand/backpack sprayers: Fill a water-only service container and transfer the water into your sprayer.

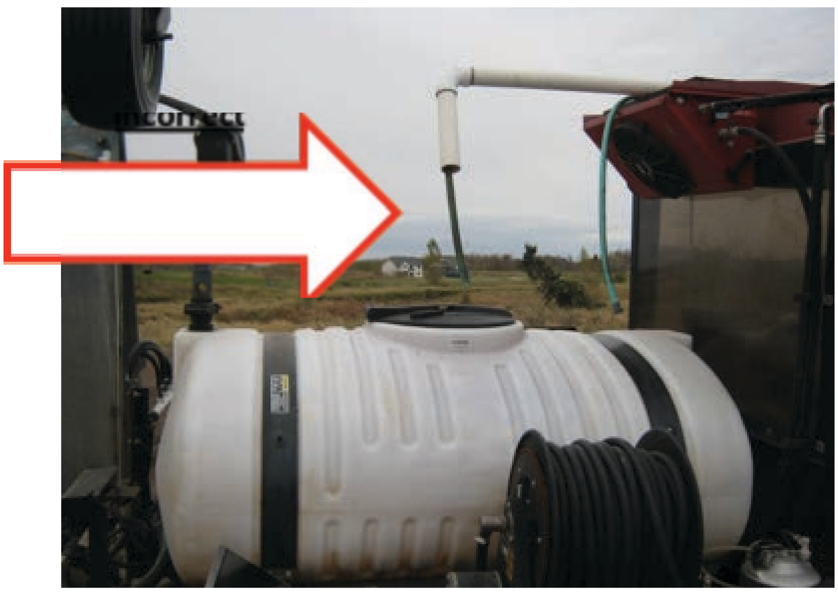


Unacceptable Backflow Prevention Practice or Devices

No backflow used
Use of check valve only
RPZ without inspection/tag
Air gap not permanenet/not fixed
Inadequate seperation of air gap (2x times the width of water line is required)
No physical gap for filling backpack sprayers
No check valve for rinsing containers
Airgap maintained by person/hand instead of fixed
No physical seperation in air gap

Number One Compliance Violation
Are You Up To Code?

No physical separation in air gap



Air gap is not permanently fixed.

Air gap is maintained by a person and not permanently fixed