Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

Virginia No-Till Fact Sheet Series Number Two:

Nitrogen Fertilizer Injection in No-Till Systems

Authored by Timothy Woodward, Research Specialist, Crop and Soil Environmental Sciences; Mark Alley, W.G. Wysor Professor of Agriculture and Extension Soil Fertility Specialist, Crop and Soil Environmental Sciences; and Wade Thomason, Assistant Professor and Extension Grain Crops Specialist, Crop and Soil Environmental Sciences, Virginia Tech

What does nitrogen fertilizer injection mean?

Liquid nitrogen fertilizers have typically been surface applied. This method of application places the fertilizer where the urea nitrogen component of the solution is susceptible to volatilization losses.

Previously, these losses were reduced by incorporating the fertilizer into the soil with tillage, but this is not possible in no-till production systems.

Technologies are now available to inject liquid nitrogen fertilizers below the soil surface. Typical injection units use no-till opening coulters to create a trench into which the nitrogen solution is applied in a narrow band with a knife behind the coulter (Figure 1). Other types of injectors are also available.

Injection of nitrogen is not a new method of applying nitrogen; however, units now available to producers are capable of incorporating new technology, such as variable rate applications, as well as being able to operate at higher field speeds, increased widths, and greater fertilizer carrying capacities.

Figure 1. No-till opening coulter

Why would you want to inject nitrogen?

Benefits

The agronomic benefits of injecting liquid nitrogen are decreased potential for nitrogen to be lost through volatilization, reduced potential for nitrogen immobilization by microbes, reduced potential for runoff, and improved placement relative to plant roots. Surface application of liquid nitrogen fertilizers can result in losses of nitrogen as ammonia through volatilization, because the fertilizer is placed on the surface residue with direct exposure to the atmosphere and high levels of urease which converts urea to ammonia. Placing nitrogen below surface residues limits these losses.

Immobilization of applied nitrogen by microbes decomposing surface residues, such as rye cover crop, is also reduced by injection because the nitrogen is placed below the surface residue layer. Runoff losses are also reduced by injection because the nitrogen fertilizer is not exposed to heavy rainfall events that might occur after application. Finally, injection also places the nitrogen fertilizer into the mineral soil where root activity is highest. Overall, side-dress injection of nitrogen fertilizer maximizes the potential for N uptake by plants.

Drawbacks

The main drawbacks of injecting nitrogen are increased application costs and time. Injection applicators are typically not as wide as boom sprayers utilizing drop nozzles to surface apply liquid nitrogen fertilizers, and thus extra time is required to make the side-dress nitrogen applications. Also, the injector is another piece of equipment. The extra costs must be compared to fertilizer saved and/or potential yield increases obtained with injection.

Current studies on nitrogen injection have varying results. In many cases, injecting liquid nitrogen is superior to surface banding, but in certain situations surface banding and injection have yielded the same results. The variation of results is primarily due to the weather around the time the fertilizer was applied. For example, if adequate rain occurred to move surface applied nitrogen fertilizer below the surface residue, no benefit to injection is expected. But, if warm, dry, windy conditions occur after surface application, volatilization losses can be expected to be high and injection can produce much higher yields. Also, if surface residues have a high carbon to nitrogen ratio, i.e. rye straw, immobilization of nitrogen by microbes decomposing the residue can be expected to be high resulting in decreased availability to plants. It is obvious that results from injecting will vary year to year, and even field to field, but injecting nitrogen reduces risk by placing nitrogen below the surface residue in a position to maximize plant uptake and minimize losses.

Is nitrogen injection always consistent with no-till?

Most injection units only slightly disturb the residue surface, as seen below, and are compatible with no-till. However, the precise definition of no-till varies in several agencies providing cost-share programs for increasing no- till crop production. Implement characteristics and amount of soil disturbance vary with machines and operating techniques. If you are considering fertilizer injection equipment and receive cost share for no-till, check with the agency providing the cost share to be certain that the equipment you are considering is covered*aureus* and *E. coli* bacteria.

Figure 2: Urea Ammonium-Nitrate (UAN) injection into rye residue.

Visit Virginia Cooperative Extension: ext.vt.edu

2020 3011-1516 (SPES-265NP)