IMPACT OF ETHANEDINITRILE APPLICATION ON SOIL NITROGEN CONCENTRATION

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Ethanedinitrile (EDN) is being investigated for its potential as a pre-plant soil fumigant to be used in vegetables and other specialty crops. Its chemical properties such as vapor pressure and boiling point are more favorable than methyl bromide which could make it an excellent soil fumigant if it provides reliable efficacy on key soil-borne pests. Preliminary data also suggest that it has a very short soil residence time and therefore should not have a lengthy plant-back period associated with other current soil fumigants. EDN has been shown to degrade in the soil with some of the degradation products being NH^3, CO^2, HCO^{2-}, and NH^{4+}. One of these bi-products of concern is NH^{4+} (ammonium). Ammonium is a cation that is commonly used a source of nitrogen in fertilizer blends. The deposition of ammonium by EDN could be beneficial because it would be a source of nitrogen which needs to be added in nearly all specialty crop production systems. However, excess ammonium could be detrimental because of its potential toxicity to certain specialty crops such as tomato and lettuce. In soil, ammonium is eventually converted to nitrate by soil-borne bacteria. Nitrate is an anion that is highly leachable through the soil profile which is of concern for groundwater contamination. These experiments were designed to be preliminary assessment of ammonium deposition in soil after EDN application.

Materials and Methods

Two experiments were conducted in which EDN was applied through shank or the hot gas method at various rates. Experiments were conducted at the North Florida Research and Education Center (NFREC) in Quincy, Florida and the Gulf Coast Research and Extension Center (GCREC) in Balm, Florida. Soil type at NFREC is Dothan loamy fine sand. Soil type at GCREC is Myakka fine sand. Pre-plant fertilizer was applied prior to fumigant based on soil test results and Cooperative Extension recommendations. Shank applied EDN was deployed with a single row combination bed press with three mole shanks. EDN was delivered 12 inches below the surface of the bed at rates of 300, 400, 500, and 600 lb/a. Beds were immediately covered with Guardian totally impermeable film (TIF).

Hot gas treatments were injected directly into 7/8 inch drip tape buried one inch below the soil surface with emitters every 12 inches at rates of 400, 500, and 600 lb/a of EDN. A non-treated control and 250 lb/a of a 39:60 mixture of 1,3-dichloropropene and chloropicrin (Pic-60) were also included under TIF. Prior to implementing a crop in experimental plots, soil samples were taken to a depth of six inches in each plot and a composite sample combined over all four reps. Soil was analyzed by commercial lab for ammonium and nitrate concentration.

Another experiment was conducted at NFREC in which EDN was compared to methyl bromide (MB). Soil type at this site is Orangeburg loamy sand. This experiment was conducted in the same manner as the aforementioned studies, with exceptions being fumigant was applied using two mole shanks and no hot gas treatments were included. Rates of EDN were 300, 400, 500, and 600 lb/a. Methyl bromide was applied at 300 lb/a through three back-swept shanks and delivered 8 inches under Berry Total Blockade TIF. A non-treated control was also included. Prior to implementing a crop in experimental plots, soil samples were taken to a depth of six inches in each plot and a composite sample combined over all four reps. Soil was analyzed by a commercial lab for ammonium and nitrate concentration.

An experiment was established in Levy County, Florida. Soil type in Levy County is Otela fine sand. At this location, 300, 400, 500, and 600 lb/a of EDN was shank applied with two mole shanks with fumigant delivered 12 inches below the bed surface. A non-treated control and 250 lb/a of Pic-60 were included and all treatments were covered with Guardian TIF. Prior to implementing a crop in experimental plots, soil samples were taken to a depth of six inches in each plot and a composite sample combined over all four reps. Soil was analyzed by a commercial lab for ammonium and nitrate concentration.

Results

In three of the four experiments conducted, ammonium concentration in EDN treated plots were greater than the non-treated control. In some cases 50 times higher than the control. It must be noted that these experiments were not designed to determine the fate of EDN in treated soil. Pre-plant nitrogen application rates and sources were different in each of these experiments. This was meant to gain preliminary data on which to base further experimentation. It is clear that a significant quantity of ammonium is deposited in the soil through EDN application which will most certainly necessitate the alteration of pre-plant fertilization practices for specialty crops. Pre-plant nitrogen application could possibly be eliminated when EDN is used for soil fumigation. Further experimentation will be needed to determine if EDN fumigation alters the rate of nitrification.

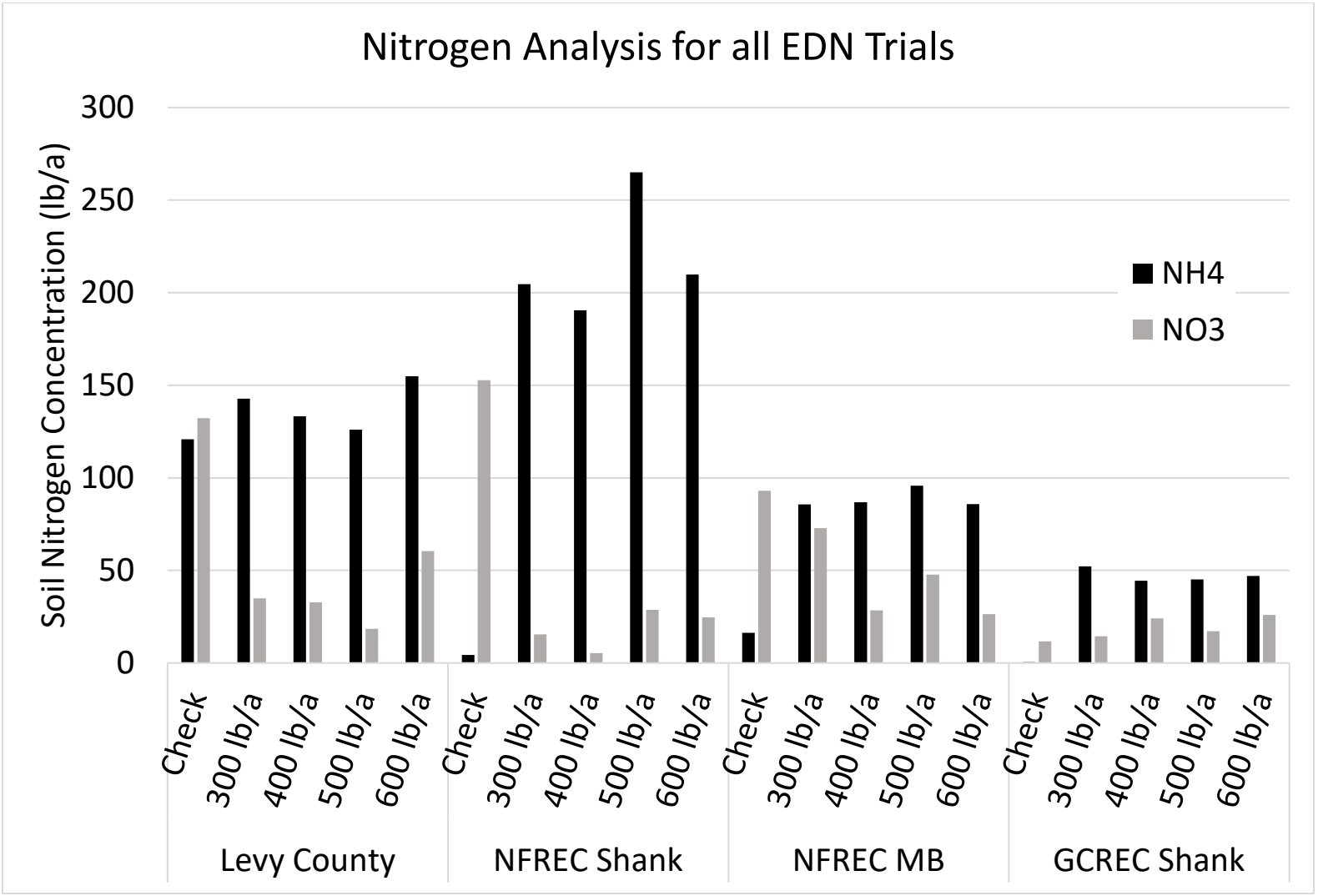

Figure 1. Deposition of ammonium (NH4) by application of the fumigant ethanedinitrile (EDN) in four trials located in Levy County, Florida, the North Florida Research and Education Center (NFREC) in Quincy, Florida, and the Gulf Coast Research and Education Center (GCREC) in Balm, Florida during spring 2017.