THE USE OF NATURAL NITRATE FOR ORGANIC CORN PRODUCTION, 2010

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INTRODUCTION

Natural Nitrate, containing16% nitrogen (N), is also known in the trade as sodium nitrate or Chilean nitrate, and is a natural product obtained from the Caliche ore in the Atacama Desert of Chile by mechanical and hydraulic processes. The caliche ore, a "nitrogenous rock" undergoes physical processing at low temperatures similar to those of the surrounding environment. Natural Nitrate does not require transformations in the soil to become part of the soil solution and be available for plant uptake. In 2010, the USDA National Organic Program (NOP) (USDA-AMS, 2010) allowed this rapidly mobile source of natural nitrogen to provide no more than 20% of the N required by the organic crop. This fertilizer can be applied at different times during the early growing season, or at least until the last cultivation. Because of these two characteristics, Natural Nitrate can be used to synchronize available soil N with crop demand during the important early growth stages.

Working with SQM, S.A. (Atlanta, GA), we investigated the use of Natural Nitrate (NN) to complement the nitrogen supplied by organic sources (manure) to provide 20% of the N required by organic corn. This research was conducted on the Scott Shriver Farm in Jefferson, Iowa, in 2010. This product is particularly important in times of excessive spring rains that may reduce available soil nitrogen by limiting N mineralization rate and by increasing nitrate leaching, respectively.

MATERIALS AND METHODS

The Natural Nitrate (NN) was supplied by SQM, S.A., along with the Soda-Flo™ side-dress box with applicator tubes, which was attached to a tractor to apply the NN to each row. The experimental design consisted of eight plots of six rows each, with two treatments randomly assigned, and four replications:

1. Corn crop cultivated following the normal practices for organic corn (check plot) and,

2. Corn crop cultivated following the normal practices plus the application of Natural Nitrate (NN) to supply 20% of N crop demand (Natural Nitrate plot).

Prior to plot layout, soils in the field were sampled at a 6–inch depth. The experimental design consisted of a field previously in wheat in 2009 that was tilled and laid out in 48 contiguous 30-inch rows, 1100 feet long, with a total trial width of 120 feet. Manure (chicken manure) was applied on 30 September 2009, at a rate of 3 tons/acre to the entire experimental area. Corn (Pioneer 34Y02) was planted on 6 May 2010 at 34,000 seeds/acre at 2.5-inch depth. Weed management included two rotary hoeings and two row cultivations.

Natural Nitrate was applied on 16 June 2010. We assumed a target corn yield in the range of 160 to 180 bushel/acre and a total N demand of 180 lb N/acre, so the 20% N applied as Natural Nitrate corresponded to 36 lb N/acre. The equivalent application rate of Natural Nitrate (16% N) was 225 lb/acre.

On 27 July 2010, a Minolta SPAD reading was taken on 3 plants per plot as an estimate of N content in leaves. Corn plant height was determined in 3 plants per each plot, which were also checked for European corn borer presence. Corn stalk nitrate sampling occurred on 7 October by collecting corn stalk samples from 3 random plants per plot.

Each plot was harvested on 11 October with S. Shriver's combine and weighed using the yield monitor in the combine. Corn grain quality was analyzed at the ISU Dept. of Food Science Grain Quality Laboratory.

RESULTS

At pre-application, soils in plots had similar nutrients (Table 1).

On July 27, SPAD readings were significantly greater in the NN leaves compared to the check: 50.7 in the check vs. 60.0 in the NN plots (Table 2).

Corn borer damage was not detected in any plants in 2010. Plant height was numerically greater in the NN plots, averaging 9.7 ft., compared to 9.5 ft. in the check plots. Nitrate content in corn at the end of the season was equal in the check plots and the NN plots.

Corn yields were significantly greater in the NN plots, averaging 146.5 bu/acre in the NN plots compared to 133.4 bu/acre in the check plots (Table 2). Corn moisture content was equivalent (15%) in both NN plots and control plots. Corn protein content averaged 7.6% in the NN plots compared to 7.1% in the check plots. Oil content was not different between treatments, averaging 3.7%. Starch content was also similar at 61%.

SUMMARY

The use of NN on the Shriver Farm in 2010 proved extremely beneficial, in terms of enhancing plant growth, N content in leaves, and yield. There was an average 13.1 bu/acre increase in plots fertilized with the NN. This amounted to a $131/acre increase in income. Natural nitrate can be particularly important after heavy rains, as were experienced in 2010, when pre-plant manure applications may have suffered from leaching and/or run-off. We will repeat the experiment with NN in 2011 based on the success of three years of this trial.

Table 1. Pre-application soil analysis, Shriver Farm, 2010.

Treatment	K (ppm)	Na (ppm)	Mg (ppm)	Ca (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	Zn (ppm)	Al (ppm)
Control	130.7	14.7	249.3	2449.7	82.7	174.7	2.4	2.4	636.3
Natural Nitrate	148.7	14.3	239.3	2564.3	82.0	144.0	1.4	2.9	664.0
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	Bray P (ppm)	Olsen P (ppm)	NH_4-N (ppm)	NO_3-N (ppm)	Total C (ppm)	Total N (%)	OM (%)	pH
Control	45.0	25.0	1.7	7.7	1.5	0.01	2.7	7.1
Natural Nitrate	55.0	15.0	1.3	7.3	1.6	0.01	2.5	7.4
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Yield and growth measurements, Shriver Farm, 2010.

Treatment	Yield (bu/acre)	Corn borer presence	27 July SPAD N	Height (cm)	7 October Stalk NO3-N (ppm)
Control	133.4b	0.0	50.7b	288.9	122.7
Natural Nitrate	146.5a	0.0	60.0a	295.0	<20
LSD0.05	10.9	NS	7.1	NS	NS

Table 3. Grain Quality, Shriver Farm, 2010.

Treatment	Density (g/cc)	Starch (%)	Oil (%)	Protein (%)	Moisture (%)
Control	1.3	61.2	3.6	7.1	14.8
Natural Nitrate	1.3	60.7	3.7	7.6	15.1
LSD 0.05	NS	NS	NS	NS	NS