THE USE OF NATURAL NITRATE FOR ORGANIC CORN PRODUCTION, 2009

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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. According to the USDA National Organic Program (NOP) (USDA-AMS, 2009), this rapidly mobile source of natural nitrogen can be used 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 2009. 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).

The experimental design and layout consisted of 48 contiguous 30-inch rows, 1100 feet long, with a total trial width of 120 feet. Manure (chicken manure) was applied on 1 November 2008, at a rate of 3 tons/acre to the entire experimental area. Corn was planted on 5 May 2009 at 34,000 seeds/acre.

Natural Nitrate was applied on 20 June 2009. 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 21 July 2009, 3 plants per plot and a Minolta SPAD reading was taken as an estimate of N content in leaves. 3 plants in each plot were also checked for

European Corn Bore presence.

An additional SPAD reading was taken on 13 August 2009, along with height measurements. Corn stalk nitrate sampling occurred on 7 October by collecting corn stalk samples from 3 random plants per plot.

Each plot was harvested on 27 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 the late spring nitrate test 24 days after planting (DAP), soils showed a pH of 7.0, 0.1848% N, 307.3 ppm K, and 103.5 ppm B-P. Soils showed an average of 9.25 NO_3-N in all plots.

On July 21, SPAD readings were significantly greater in the NN leaves compared to the check: 43.2 in the check vs. 50.5 in the NN plots (Table 1).

Corn borer damage was detected in one plot, with no significant differences between treatments. On 13 August, SPAD readings were again significantly greater in the NN plots (46.6) compared to check plots (37.4). Plant height was also greater in the NN plots, averaging 10.4 ft., compared to 9.6 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 134.7 bu/acre in the NN plots compared to 65.8 bu/acre in the check plots (Table 1). Corn moisture content was 1.2% higher in the NN plots, averaging 25.5% at harvest.

Corn protein content averaged 6.6% in the NN plots compared to 5.9% in the check plots. Oil content was not different between treatments, averaging 3.8%. Starch content was also similar at 61.7%.

SUMMARY

The use of NN on the Shriver Farm in 2009 proved extremely beneficial, in terms of enhancing plant growth, N content in leaves, and yield. There was an average 69 bu/acre increase in plots fertilized with the NN. This amounted to a $414/acre increase in income. Natural nitrate can be particularly important after heavy rains, as were experienced in 2008, when pre-plant manure applications may have suffered from leaching and/or run-off. We will repeat the experiment with NN in 2010 based on the success of two years of this trial.

Table 1. Yield and growth measurements, Shriver Farm 2009

Treatment		Corn	21 July 2009	13 August 2009		7 October 2009
	Yield (bu/acre)	borer presence	SPAD N	Height (ft.)	SPAD N (%)	Stalk NO3-N (ppm)
Control	65.8	0.00	43.18b	9.5b	37.38b	<20
Natural Nitrate	134.7	0.08	50.50a	10.4a	46.62a	<20
$LSD_{0.05}$	13.5	NS	2.981	0.4	3.72	NS

Table 2. Grain Quality, Shriver Farm 2009

Treatment	Density (g/cc)	Starch (%)	Oil (%)	Protein (%)	Moisture (%)
Control	1.218	61.25	3.75	5.92b	24.23b
Natural Nitrate	1.232	62.08	3.80	6.58a	25.45a
$LSD_{0.05}$	NS	NS	NS	0.83	0.697