

RESEARCH UPDATE: GYPSUM TRIALS LEAD TO INCREASED SULFUR UPTAKE BUT NOT YIELD

By Kristin Williams, Agronomy Outreach Professional

We are in the midst of the final year of research and demonstration for our gypsum grant funded through a state Conservation Innovation Grant (CIG) from the Natural Resource Conservation Service (NRCS). Our main focus has been looking at how gypsum can be used as a soil amendment both for soil health and to measure potential changes to soil test phosphorus (P) levels.

To explore this concept we've used mined gypsum, flue gas gypsum and black gypsum (which also contains humates). Gypsum is essentially calcium sulfate, and it is the calcium that interacts in clay soils by displacing magnesium and encouraging "flocculation" where clay particles are coagulated into micro-aggregates. Theoretically, this can improve soil structure and decrease soil crusting, thereby increasing water infiltration and decreasing runoff. The sulfur can bind with aluminum (toxic in large quantities as our clay soils tend to be higher in aluminum), thereby making the aluminum less reactive in the soil profile. Humates, complex organic molecules, also provide potential soil health properties.

Our final soil health tests will be conducted this fall, so we plan on providing a final update this coming winter on this project. Meanwhile, we have had multiple field seasons to look at soil and crop responses. Unfortunately the vast majority of our results did not suggest any significant differences ($\alpha=0.1$) between any of our treatments. We did not see any changes in soil test P (either positive or negative) based on

treatment, nor did we see any yield changes in corn silage or alfalfa/hay trials. We have seen some stratification of nutrients and slightly lower pH at the surface of the soil, irrespective of treatment (see our Summer 2018 Newsletter).

One result worth noting is that in 2018 we did find greater uptake of sulfur in corn silage samples. Specifically, flue gas gypsum was significantly greater than the control and all the other treatments (see below). It should be noted that the treatment types were not the same in terms of rate (lbs/ac) because the rate was based on industry recommendations, and flue gas gypsum had the greatest application rate in our study. The average soil test for sulfur was significantly greater at the surface for flue gas gypsum as compared to the control at both Farm Two, where amendments had been applied for two years, and Farm Three, where amendments had been applied for one year. (Yield and uptake results at Farm Two were not measured since a microburst hail storm ruined the crop).

It is not surprising that the addition of gypsum would lead to increased sulfur in the soil or crop, at least when applied at almost 2 tons/acre (3,750 lb/ac). We know that sulfur is an essential nutrient for chlorophyll growth and protein production, as well as being required by rhizobia bacteria in legume nitrogen fixation. However, in Vermont we are lack-

ing recommended rates based on soil test levels. You will notice your soil test only lists average state values, not a recommendation.

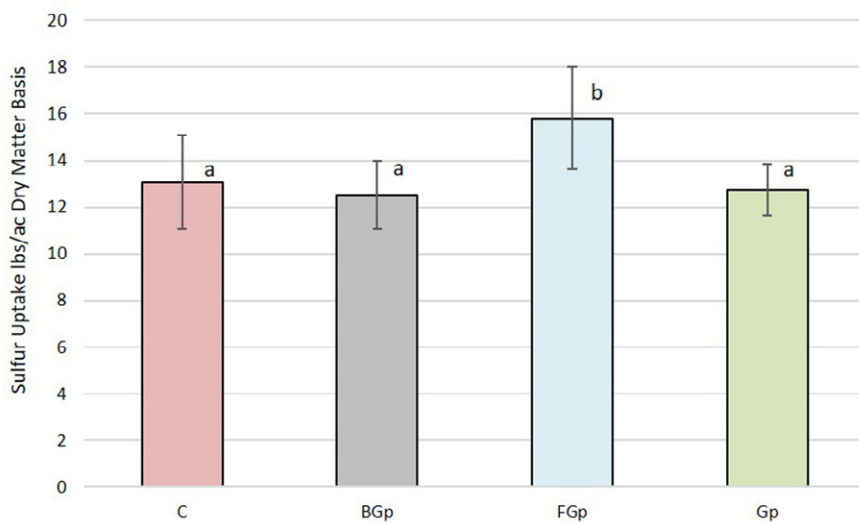
In this case, the greater uptake of sulfur did not relate to any greater yield or nitrogen lb/ac in the corn silage, so that would suggest the sulfur was already sufficient in the field for crop purposes. (Not long ago increased acid rain did lead to increase sulfur precipitation; however, in this form sulfur acts a pollutant that also acidifies the soil.)



EFFECTS ON CORN GROWN IN SOIL AMENDED WITH GYPSUM?

ALTHOUGH PRELIMINARY RESULTS FOUND NO SIGNIFICANT DIFFERENCES IN SOIL PHOSPHOROUS OR CROP YIELD, WE FOUND A GREATER UPTAKE OF SULFUR.

While gypsum is a relatively common amendment in other parts of the country, it is not used as commonly here. We are hoping that our final year results will shed more light on its potential in this area. Look for those updates in the upcoming winter/spring.



Corn Silage Treated with Flue Gas Gypsum Had Higher Sulphur Uptake

Average estimated uptake on dry matter basis of sulfur (S lb/ac) in corn silage samples at Farm Three of our gypsum trials in 2018. N=4 replicates per treatment.

C – Control, BGp- Black Ag Gypsum, FGp – flue gas gypsum, Gp – mined gypsum.

Error bars represent ± 1 standard deviation. Letters that do not overlap indicate significant difference based on Tukey post-hoc test.