NEW JERSEY

Greensand as a Soil Amendment

By J.R. Heckman and J.C.F. Tedrow

The benefits in plant growth sometimes observed following greensand application are likely not due to nutritional benefits, but from changes in soil physical properties.

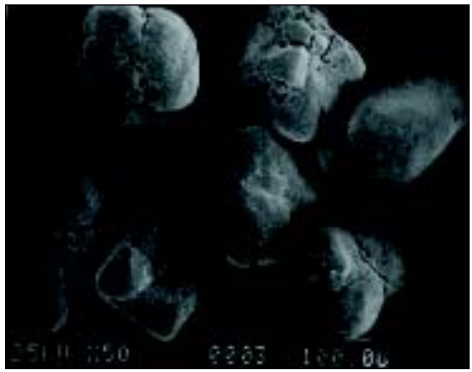
Greensand is composed largely of glauconite, a unique mineral that occurs as a natural geologic deposit that stretches as a belt across New Jersey from Monmouth County to Salem County. Greensand also occurs in parts of Delaware, Maryland, and Virginia. Although there are several theories of origin, greensand is generally thought to have formed in shallow marine seas near the interface of water and land.

Since the late 1800s, millions of tons of greensand have been spread over soils in New Jersey and other parts of the U.S. For this reason, greensand may occur today in many soils where it was not originally present. The presence of greensand may still be benefiting crops by improving the soil's ability to hold water and store nutrients. In the early part of the 20th century, there were about 80 open pit mines in New Jersey where greensand was mined. There are only a few of these mines operating today. The photo at left shows a view of a modern mine.

Modern greensand mining operation in Gloucester County, New Jersey.

The olive green-colored glauconite mineral in greensand is unusual. Unlike most types of clay, which are very fine, glauconite often exists as sand-sized pellets, as shown in the photo below. Glauconite does not behave like typical sand, since it is a mica-like complex composed mostly of muscovite- and illite-like clay minerals, containing many micro-pores. Also, unlike a true sand, the micro-pores in greensand contribute to soil water-holding capacity. In this way, it differs from true sands, which are composed of minerals such as quartz and feldspars. Greensands typically have a high cation exchange capacity (ranging from 20 to 30 cmol/kg). Addition of greensand to sandy soils enhances the ability of the soil to store exchangeable nutrients such as calcium (Ca), magnesium (Mg), potassium (K), and micronutrients. These desirable physical and chemical properties may explain how greensand can be useful as a soil amendment.

Pure glauconite generally contains up to 8% K_2O and small amounts of phosphorus (P), Ca, and trace elements. However, since greensand contains other non-



Glauconite pellets from the Hornerstown formation (photo by R. Holzer).

beneficial constituents as well as glauconite, the K content of commercial products generally falls well below this value (from 0.1 to 7% K_2O).

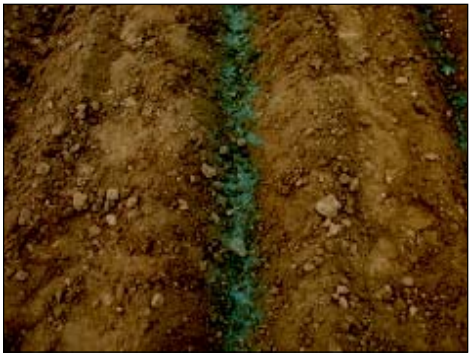
The issue of K availability from greensand has been studied since the 19th century, when positive crop responses were occasionally observed following application. Almost all investigators have concluded that greensand has very little value as a nutrient source. Greensand is sometimes recommended as a natural K source for organic agriculture. Recent research suggests that greensand benefits may be a result of changes in soil physical properties and not improved plant nutrition.

A field trial near New Brunswick, New Jersey, evaluated the response of potatoes to various rates of greensand applied in the row at time of planting with the seed pieces (**see photo)**. The study was conducted on a Sassafras sandy loam soil that had relatively low organic matter content and poor physical condition as a result of many years of continuous cropping to vegetables. Thus, this field site afforded the opportunity for greensand to express soil-conditioning attributes. Potato tuber yields were on average 16% higher where the greensand treatments were applied (**Table 1**). The crop was uniformly fertilized with 108, 7, and 134 lb/A of nitrogen (N), P_2O_5, and K_2O, respectively. Tissue analysis revealed no differences in nutrient concentrations in the potato leaves. Thus, the positive yield response was not likely related to an influence of greensand on plant nutrition, but improved soil properties.

Table 1. Yukon Gold potato tuber yield and specific gravity in response to greensand application in the seed furrow prior to planting in 2003.

Greensand rate, lb/A	Tuber yield, cwt/A	Tuber specific gravity
0	91	1.063
125	105	1.061
250	107	1.063
500	105	1.063
Significance* (check vs. others)	0.04	NS

*The check was significantly different than the treatments @ p=0.04.



Greensand applied in the seed furrow before planting potatoes.

Conclusion

In general, greensand should be considered more valuable as a soil conditioner than as a fertilizer. Micro-pore spaces within glauconite can enable greensand-amended soils to have improved water-holding capacity and increased ability to store and retain nutrients. These changes may or may not result in a positive plant response, depending on the specific soil. Although organic matter additions may also improve soil water holding capacity and nutrient retention, the changes resulting from adding greensand to soil are permanent. BC

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Additional information regarding greensand is available from: J.C.F. Tedrow, 2002. Greensand and Greensand Soils of New Jersey: A Review. Rutgers Cooperative Extension, Bulletin E279. Website: >www.rce.rutgers.edu/pubs/pdfs/e279<.