On-Farm Research Report

2017-36

Nitrogen Management in Corn 2014-2016 Review

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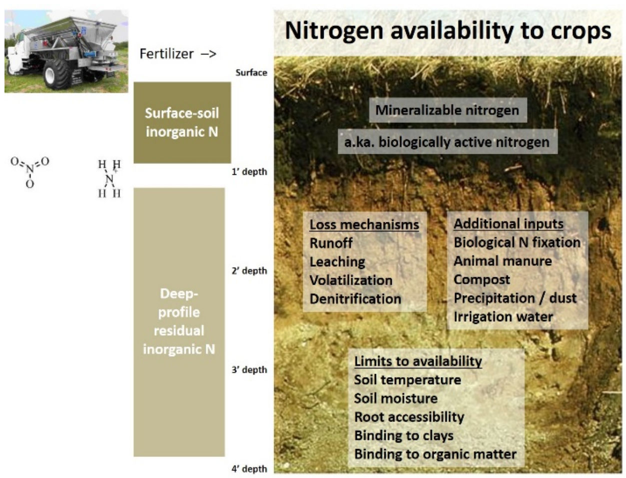
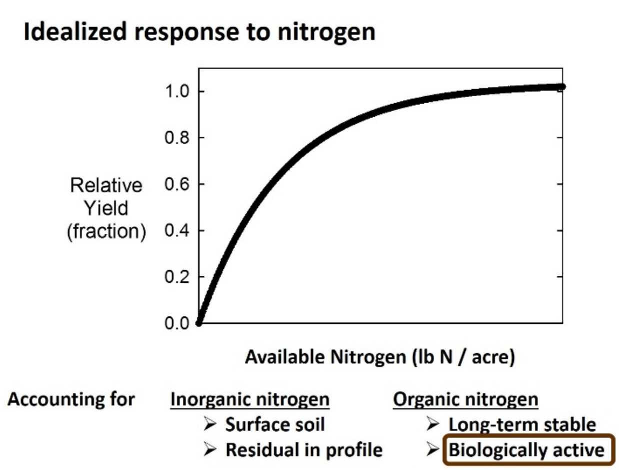
https://sites.google.com/a/ncsu.edu/ars-ncsu-soil-ecology/

Nitrogen (N) is the most limiting plant nutrient, so recommendations to apply the exact amount of N should be simple. However, this is not the case, as N is mobile and readily lost through runoff, leaching, volatilization, denitrification, and immobilization.

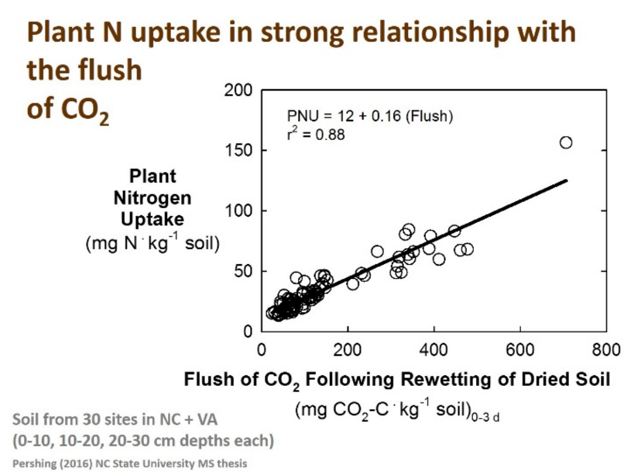


Currently, N recommendations for corn and other crops are made without soil testing. However, we know that inorganic N sources in surface and deep layers and organic N sources from stable and biologically active fractions of soil organic matter are the primary contributors to crop yield in the absence of N fertilizer. Accounting for these sources will make better N fertilizer recommendations so that farmers make wise investments for profitability and protecting the environment.



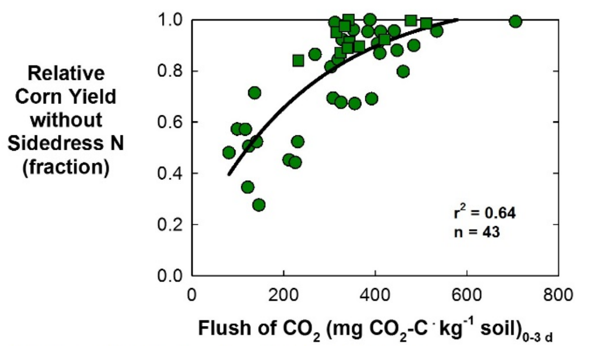
Soil is living! Just like carbon (C) is a part of all living things, so too is N. If enough C accumulates, soil organisms will cycle sufficient N from decaying organic materials into plant-available form. Soil is healthy when the microorganisms contained within it are working and not exhausted from lack of food – soil needs continual C inputs to be healthy.

Biologically active soil has high N mineralization, i.e. the conversion of organic matter into inorganic N. Inorganic N is ammonium and nitrate that can be taken up by plants. The goal of this project has been to characterize soil biological activity through N mineralization and a simple index – the flush of CO_2 following rewetting of dried soil. A strong, direct correlation exists between the flush of CO_2 and net N mineralization. We've found a strong relationship between the flush of CO_2 and plant N uptake under greenhouse conditions.



In a series of field trials from 2014 to 2016, corn yield response to N fertilizer inputs was evaluated from a diversity of farms throughout North Carolina and Virginia, along with characterizing soil biological activity at the beginning of the growing season. Corn grain and silage yields were determined by harvesting small sections within each treatment and calculating yield (grain - bu/a @15% moisture and silage - ton/a @ 35% moisture).

Corn yield with no N fertilizer applied at sidedress varied from 25 to 100% of maximum yield achieved with fertilizer at sidedress. As expected, many sites had low yield without sidedress N fertilizer. However, only those sites with low soil biological activity had the lowest relative yield. In contrast, sites that had high soil biological activity achieved near maximum yield even without sidedress N fertilizer.



Total of 32 grain fields in NC + VA and 11 silage fields in VA

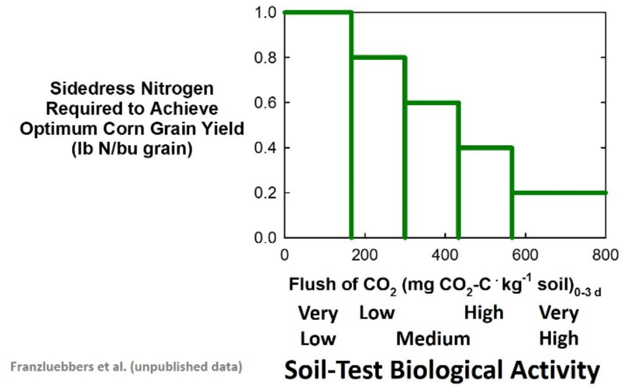
Franzluebbers et al. (unpublished data)

The implication of these results is that a simple soil test to determine soil biological activity is possible to predict potential N availability to corn! The relationship is not perfect, but the soil test is used pre-plant or at planting and so many variables can modify plant N responses, such as irregular precipitation, cold nighttime temperatures, hot daytime temperatures, weed competition, insect pressures, etc. Our results are highly encouraging that a simple soil test can be used to modify how N fertilizer is recommended for different soil conditions in the Mid-Atlantic and southeastern US region.

We also calculated N fertilizer needed to achieve optimum yield and scaled the results to actual yield achieved, resulting in estimates of lb N / bu grain. Optimum yield was assumed at a threshold of 5 lb grain / lb N, which was calculated from $0.50 / lb N and $5.60 / bu grain. [Note: This recommendation system should only be considered preliminary, as results have not been published and no entity has endorsed the approach].

This study was part of a USDA-NIFA-AFRI funded grant (2013-67019-21369)

Preliminary analysis for recommendation domain



Those sites having very low soil-test biological activity would require a full application of sidedress N, i.e. 1 lb N / bu grain. For example, a 200 bu/acre corn crop on soil having very low soil-test biological activity would require 200 lb N/acre at sidedress. In contrast, a site having medium soil-test biological activity would require 0.6 lb N / bu grain. For a 200 bu/acre yield goal, sidedress N application of 120 lb N/acre would be needed. The net difference between a site having very low soil-test biological activity and a site with medium soil-test biological activity would be 80 lb N/acre. At a cost of $0.50/lb N, this would be a difference of $40/acre.

Since conservation agricultural management approaches such as no-tillage and cover cropping often contribute to rising soil-test biological activity, one could quickly see that extra costs for these conservation measures could be recouped with lower N fertilizer requirements. Keeping more N in a biologically active organic form that can be released during the growing season would be an investment strategy for continuous long-term gains. The key is to keep the soil energized with enough C to immobilize and mineralize a large pool of recycling N. Further research and experiences will allow us to refine recommendations of N – an element that is greatly needed for food production, but that is so easily lost with large inorganic N applications.