



LSP *Myth Buster* #64

An ongoing Land Stewardship Project series on ag myths and ways of deflating them.

Updated: December 2023

→ **Myth:** Nitrogen Fertilizer & High Yields are Inextricably Linked

→ **Fact:**

When German chemists Fritz Haber and Carl Bosch developed a way to manufacture nitrogen fertilizer in the early part of the 20th century, they truly revolutionized the way agriculture is undertaken on the planet. Nitrogen makes the biological world go ‘round. Just about every ecosystem in the world — from pristine wilderness to a Midwestern cornfield — has its productivity limited by the amount of nitrogen available to it. There’s always been plenty of nitrogen present in the atmosphere, but it needs to be converted to ammonia before it is accessible to plants. In fact, for most of the world’s history, only lightning or specialized bacteria had the ability to convert atmospheric nitrogen into biologically usable forms. Animals can also produce ammonia by eating plants and excreting manure.

The Haber-Bosch process changed all that: for the first time, humans had the ability to bypass natural sources of nitrogen-based fertility and crank it out on a massive, industrial scale. Humans have taken over a once natural cycle, and as a result there is roughly double the rate of nitrogen input into the terrestrial nitrogen cycle. A huge chunk of that increased input is the result of crop farming’s reliance on nitrogen fertilizer. Corn, in particular, is a nitrogen hungry plant. High corn yields are so closely tied to the amount of nitrogen available that farmers are often tempted to over apply fertilizer as insurance. This is a problem: annual crops take up only about half of the nitrogen applied to a field, according to studies done in agricultural regions around the world. As we report on pages 22-26 of the No. 2, 2023, *Land Stewardship Letter*, lost nitrogen makes its way through the soil profile and into our water, where it becomes a pollutant in

the form of nitrate.

That’s one reason why, in April 2023, the Land Stewardship Project joined 10 other groups in filing a petition calling on the Environmental Protection Agency to use its emergency authority under the Safe Drinking Water Act to address nitrate pollution in the karst region of southeastern Minnesota.

How Much is Enough?

In recent years, due to more accurate soil tests, advances in precision application technology, and general awareness of the economic and ecological costs of applying too much fertilizer, land grant universities have reduced their recommendations for how much nitrogen corn farmers need to apply. However, take a look at any extension service bulletin on corn production, and it’s clear the same narrative rules: more nitrogen fertilizer equals higher yields, and thus higher profits.

However, a recent field trial by, of all places, the seed giant Dupont Pioneer, is throwing a wrench into that equation. A 17-year study experimented with varying how much nitrogen was applied to corn. The rates ranged from the full land grant university recommendation to zero. Both continuous corn and corn rotated with soybeans (soybeans in the rotation can add nitrogen to the soil naturally) were tested.

Not surprisingly, corn yields on the zero nitrogen plots took a major hit the first several years. Even when rotated with soybeans, not applying nitrogen to corn caused yields to plummet by 40%. However, in a turn of events that surprised Pioneer agronomists, after the tenth year of the study rotated corn that received no nitrogen fertilizer had virtually *no difference in yield*

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Pioneer is quick to not draw too many conclusions from this study, and it admits that this is a non-replicated trial. However, in a written update on the study, company researchers took great pains to make it clear it was carefully done. “This outcome is unusual and the reason for it is unknown,” they reported, adding that, “Further investigation is warranted. This study remains ongoing.”

Let’s be clear: studies like this do not discount the idea that plants need nitrogen to thrive. But they help highlight the fact that rotating crops provides huge benefits and sometimes we don’t give soil and natural processes in general enough credit for generating fertility. That’s not surprising, given how, historically, purchased fertilizer has been relatively affordable, as well as easy to obtain and apply.

One clue to Pioneer’s surprising results may have emerged from a set of four University of Illinois studies showing that, on average, 67% of nitrogen-based

fertility corn gets is sourced naturally from soil, not fertilizer. This has major economic implications: one of the reasons an increasing number of “conventional” crop farmers have been showing up at soil health workshops put on by LSP and other groups is that they are looking to cut their reliance on nitrogen fertilizer, which, because it is derived from fossil fuels, has experienced sharp price spikes in recent years.

As the “Soil Health” section on pages 16-26 of the No. 2, 2023, *Land Stewardship Letter* shows, the farmers who belong to LSP’s Soil Builders’ Network have been utilizing cover cropping, rotational grazing, no-till, diverse rotations, and cutting-edge composting methods to build soil’s innate ability to create its own fertility. They are also utilizing biologically-based soil tests that go beyond conventional nitrogen-phosphorous-potassium (NPK) monitoring to determine exactly what life is present in their fields and what role it can play in growing healthy, productive plants.

In other words, we may have taken over the nitrogen cycle, but that doesn’t mean we can’t give back some control.

More Information

- “How Much Nitrogen Fertilizer Does Corn Need?” Aaron Smith, University of California-Davis, <https://bit.ly/47gqFyG>
- “How much nitrogen does corn get from fertilizer? Less than farmers think,” University of Illinois, <https://phys.org/news/2023-05-nitrogen-corn-fertilizer-farmers.html>
- “A Long, Hot Summer,” *Land Stewardship Letter* report on farmers building soil health, <https://landstewardshipproject.org/wp-content/uploads/Long-Hot-Summer.pdf>
- “Rooting Out Nitrates,” *Land Stewardship Letter* report on Olmsted County Groundwater Protection & Soil Health Program, <https://landstewardshipproject.org/wp-content/uploads/Rooting-Out-Nitrates.pdf>

More Myth Busters

Other *Myth Busters* can be found at <https://landstewardshipproject.org/myth-busters>. For paper copies, contact Brian DeVore at 612-816-9342 or bdevore@landstewardshipproject.org.

LSP Fact Sheets

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