

Examining lentil yield and nitrogen fixation response to inoculant and fertilizer

February 7 2023



Figure 1. Lentil at Bozeman in 2020 was noticeably greener with S (right) than without S (left).

Credit: Montana State University

Montana State University scientists and their colleagues are sharing the

results of a three-year study examining the importance of inoculant and sulfur fertilizer on lentil production.

Scientists from MSU and North Dakota State University recently completed the study, which examined seven sites across the Great Plains. Researchers aimed to determine the effects of rhizobial inoculants and certain fertilizer nutrients (potassium, [sulfur](#) and micronutrients) on lentil yield at each site and [nitrogen fixation](#) at two sites. The study was led by professor Perry Miller in the MSU Department of Land Resources and Environmental Sciences.

According to Clain Jones, MSU Extension soil fertility specialist and professor in the LRES department, the number of acres in Montana used to produce lentils has increased dramatically in the past two decades. Lentils, which are [legumes](#), form symbiotic relationships with rhizobia bacteria in nodules on their roots that can convert [nitrogen gas](#) to a form useful to plants, a process known as [nitrogen](#) fixation. Inoculating legumes with rhizobia can increase the likelihood and extent of nodulation and nitrogen fixation. This process makes lentils an attractive option for farmers who want to use less nitrogen fertilizer on their soil, Jones said.

The study showed that inoculated lentils produced greater yields in 30% of site-years—by an average of 344 pounds per acre—and fixed more nitrogen in 40% of site-years by an average of 14 pounds per acre. That's compared to non-inoculated lentils.

(A site-year is a test performed for one year at one site. That means a test conducted at one site for 10 years equals 10 site-years; conversely, a test conducted for one year at 10 sites also equals 10 site-years.)

"Lentil response to inoculation was not impacted by a history of legumes on study fields, but other research suggests it can impact nodulation

success," Miller said. "Inoculation is likely worth the cost since nodulation failure risks an insufficient nitrogen supply."

The study compared two types of inoculants: granular and a peat-powder, seed-coat formulation. According to Jones, neither type showed a consistent advantage in lentil yields or amounts of nitrogen fixed.

"Montana soils are typically sufficient in potassium, and this was true for this study, as well," Jones said. Researchers found that potassium fertilizer did not consistently increase lentil yield or the amount of nitrogen fixed. "Still, farmers should have their soils tested for exchangeable potassium to make sure levels are sufficient," he said.

The researchers found that lentil sometimes responded to sulfur fertilizer. Yield and the amount of nitrogen fixed both increased in 20% of site-years by an average of 255 and 30 pounds per acre, respectively. Low soil sulfur levels did not always result in a lentil response to sulfur fertilizer.

"However, because of several large positive yield and nitrogen fixation responses observed and the low cost of applying 5 pounds of sulfur per acre, sulfur fertilization is likely a good decision for many lentil producers," Jones said.

At one site-year, nitrogen fixation consistently increased as whole plant tissue sulfur concentration at early pod stage increased, while yield plateaued at tissue sulfur concentrations around 0.09%.

"This means that a sulfur fertilizer application may be justified, even when a seed yield response does not occur, since more fixed nitrogen is contained in lentil residue and hence producers may be able to decrease nitrogen [fertilizer](#) the following year," Jones said. "Organic producers who rely more upon legume cover crops for their nitrogen fertility could

especially benefit from increased nitrogen contained in crop residue because of increased sulfur supply. There are affordable, organic gypsum sources that producers can use to supply sulfur."

The study's summary, "Fertilizer Fact 81: Lentil Yield and Nitrogen Fixation Response to Inoculant and Fertilizer," is now available online.

More information: Study: [Lentil Yield and Nitrogen Fixation Response to Inoculant and Fertilizer](#)

Provided by Montana State University

Citation: Examining lentil yield and nitrogen fixation response to inoculant and fertilizer (2023, February 7) retrieved 25 April 2024 from <https://phys.org/news/2023-02-lentil-yield-nitrogen-fixation-response.html>

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