Moly Shortfall Hard on Plants

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OMAHA (DTN) -- Micronutrients often are neglected in most soil tests, as they focus on major nutrients or the few micros known to be a problem in a specific area.

Even professional agronomists and scientists tend to forget the more obscure micronutrients. Yet each of these nutrients is absolutely essential for crops to grow normally and produce good yields.

When a nutrient deficiency occurs, the crop typically has telltale visual symptoms -- at least to the skilled eye. That's not the case for the micronutrient molybdenum (Mo), said crop consultant Matt Hagny, who recently discovered a fairly widespread deficiency of that micronutrient in clients' fields from central Kansas to Nebraska. His investigation into mysterious wheat and soybean symptoms may have implications as far as Iowa and central Illinois.

Hagny found a little molybdenum added to fertilizer or herbicide applications returned more than five bushels per acre of soybeans in a replicated trial.

"Testing for molybdenum was a bit of a shot in the dark," Hagny said from his Wichita, Kan., office. "We had a number of wheat fields exhibiting what looked vaguely like nitrogen or sulfur deficiency: pale green plants that were slow to get good color after topdressing with nitrogen."

Numerous plant tests comparing poorer with more healthy samples showed no common threads, until Hagny remembered a discussion about molybdenum deficiency he had had with an Australian agronomist.

Hagny called Ward Laboratories of Kearney, Neb., where previous tissue testing had been conducted, to request molybdenum tests be run on some of the samples. Although no one in the region had been looking at molybdenum for crops, the lab had the ability to run the analysis because of testing done for feed. High levels of molybdenum can pose problems for livestock.

Soil tests for molybdenum are unreliable, due to testing procedures and because the mineral is found in such low quantities in the soil. Healthy plants should have 0.07 to 0.4 parts per million depending on the crop species, Hagny said.

Some of his plant samples tests showed molybdenum below the test's detectable limits of 0.01 parts per million. Retesting confirmed the results.

Hagny began testing other crops in 2007, and found similar deficiencies in soybeans, sunflowers, and field peas.

Micronutrient deficiencies in crops are sometimes due to crop stress or nutrient imbalances, which limit the plant's ability to take in the nutrient or to properly use it.

In this case, the missing molybdenum simply was not there.

"We probably have soils that are fairly low in molybdenum to begin with, and we've been exporting it in crops for decades," the consultant said. "We never discovered (the problem) before because we basically haven't looked for it. Prior to this, all the crop nutrition experts said there were no molybdenum deficiencies in Kansas or Nebraska." Many of his clients also are long-term no-tillers, and that may have exacerbated the deficiency.

“We have a lot of microbial activity going on in those no-till fields, and have increased the organic matter, which may dilute the available molybdenum. However, I think I’ve been seeing molybdenum deficiencies for many years, even in tilled fields, and simply not known what it was.” Nor did anyone else, he added.

Hagny and his clients secured sources of sodium molybdate from fertilizer suppliers in California and Ohio. They applied the product, at about 0.02 to 0.04 pounds (about one-third to two-thirds ounce) of actual Mo per acre, in a variety of ways: adding it to starter and other fertilizers, applying directly on the seed, tankmixed with preplant herbicides, and in foliar applications along with post-emergence herbicides.

Molybdenum can be supplied to the crop as sodium molybdate or ammonium molybdate, both of which are highly soluble in the soil and easily absorbed and translocated by plants.

“You don’t need a lot, because the plants don’t need much, they just need some,” Hagny said. He found the most cost-effective treatment was in preplant or burndown herbicide applications or with post applications of glyphosate on Roundup Ready soybeans.

In soybean trials, using randomized, replicated treatments, Hagny found that $1.50 worth of sodium molybdate per acre added 5.7 bushels to soybeans that were deficient. He said that in extremely deficient fields, soybeans visibly turned a darker green within a few days of foliar applications.

Hagny said molybdenum is unique in that the quantities needed by a plant are so small that seeds grown under adequate molybdenum conditions can supply most of what the adult plant will need.

Plants from seeds grown under marginal molybdenum conditions are more dependent on what the plants can obtain from the soil.

Out of curiosity, Hagny traced the origins of a number of seed lots planted in fields where the molybdenum deficiencies occurred earliest and most severely. Those early symptoms would indicate the seeds were grown under moly-starved conditions.

Several lots of soybean seed had been grown at diverse locations in Illinois; sunflowers were produced in California and Puerto Rico.

“I’m sure there are many areas of the country where natural molybdenum levels are high enough that it may never be a concern. But the seed lot origins are telling me the low-molybdenum issue is not just a problem here in Kansas,” Hagny said.

“We’re not aware of any areas in Illinois that have molybdenum deficiencies,” said Fabian Fernandez, assistant professor of soil fertility and plant nutrition at the University of Illinois. He speculated that low pH conditions can lead to poor molybdenum uptake, “but fields used for seed production typically are good soils, with adequate pH levels.

“Molybdenum is very important to nodulation in soybeans. Perhaps the varieties we’re talking about had issues with nodulation, or perhaps the variety itself has low molybdenum levels,” Fernandez said.

Hagny is not sure how long foliar and soil-applied treatments will be needed to rebuild the soils’ natural levels. “We’re going to keep tracking the deficient fields until the tissue samples tell us we no longer need to make applications,” he said.

The agronomist said farmers concerned about molybdenum should collect plant samples from their individual fields or soil types, being careful to protect the leaves from contamination, including from sweaty hands. “You also need to check with your lab, to make sure they have the equipment to test for molybdenum down to 0.01 ppm.”

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Correction/Update by Hagny: Since these articles were written, Hagny has discovered that soil applications of Mo are totally ineffective on the types of clays found in Kansas soils, except where the Mo is applied in a band with P fertilizer. Apparently in some parts of the world, soil Mo applications (with water as a carrier) are effective, as stated by several authorities on the subject.