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Manganese deficiency in soybeans? Experts advise foliar application

Manganese deficiency in soybeans
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WEST LAFAYETTE, Ind. - A Purdue University agronomist said that many farmers over the last several years have observed a mid-season yellowing of their soybeans, commonly called "yellow flash," which is caused by a manganese deficiency.

Tony Vyn, Purdue Extension cropping systems specialist, spent the last two years studying the causes of manganese deficiency and various treatments.

"We found that manganese deficiency is much more likely to occur in soil where there is low inherent availability of manganese, relatively high pH levels and relatively dry soil conditions," Vyn said. "All three of these factors have an impact on the amount of plant-available manganese."

The worst possible combination, he said, is to have low soil manganese concentrations and a high pH, and low moisture levels only exacerbate the problem. Moisture affects the form that manganese is in and its availability to plants. Dry soils tend to have more manganese in a form that is unavailable to plants, and wet soils result in a chemical change of a portion of total soil manganese -- to a plant-available form, Vyn explained.

"This is partly why manganese deficiency is called 'yellow flash' because the symptoms can disappear quickly after a rain or after soybean roots grow into a soil zone with more plant-available manganese," he said.

Vyn's research team, which included Jim Camberato, Purdue Extension soil fertility specialist, and graduate student Yanbing Xia, looked primarily at two treatment methods. One method was to add manganese like a traditional starter fertilizer and position it 2 inches beside and 2 inches below the seed at the time of planting. The second method was foliar application 7-10 days after a post-emerge glyphosate application.

Vyn said they are not completely satisfied with their research because of the amount of soil spatial variability they encountered even within their 4-acre trials.

"There has been very little yield improvement that we could prove statistically from the banded application of manganese at the time of planting," Vyn said.

The foliar application of manganese proved to be more beneficial in increasing leaf manganese concentration immediately, but the results

were short-lived—one to two weeks. Vyn said that they are beginning to learn more about the critical level of manganese needed in the soybean leaves at the top of the soybean canopy during its vegetative and reproductive growth in order to obtain optimum yields.

"The traditional thought has been that we need to have approximately 20 parts per million of manganese in the top fully expanded trifoliate leaves during vegetative production," Vyn said. "We are learning that the actual manganese concentration in soybean plants can range widely, and producers will definitely see more in the way of manganese deficiency symptoms when there are only 10 parts per million.

"But we have also observed yield responses when leaf concentrations of manganese increase to 30-35 parts per million."

Prior research done at Purdue shows that soybean fields with too little available manganese can result in a yield loss up to 12 bushels an acre. Vyn said that additional research is needed to find just how much of a yield increase is possible by maintaining higher manganese levels, especially during the reproductive stage of soybean development.

To help prevent manganese deficiency from occurring this year, Vyn recommended careful liming to keep soil pH from getting too high. Manganese availability to the soybean plant is reduced as soon as soil pH climbs above 6.6 or 6.8, he said.

"So as farmers deal with low soil pH problems by applying lime, they should consider using variable rate lime applications to avoid raising soil pH above 6.7 in any area of the field," he said. "Variable rate technology has already improved the soybean plant's access to micronutrients."

Because measuring micronutrient concentrations is an additional cost when submitting a soil test, most farmers opt not to have them measured, Vyn explained. Although there is very little change in soil micronutrient concentrations from year to year, he said, they should be tested at least every five years.

Soybean farmers should also keep a close eye on their fields for visible symptoms of manganese deficiency following a glyphosate application to make sure the soybean leaves maintain manganese concentrations above 20 parts per million.

"The 20 parts per million critical level is based on old research, and critical levels for manganese may have changed because of modern, higher-yielding cultivars, as well as the dominant use of foliar applied glyphosate," Vyn pointed out.

If a field is suspected of being manganese deficient, farmers should randomly collect 30-40 top, most fully-expanded, trifoliate leaves in the suspected area and send them to a commercial lab for analysis, Vyn said.

If a manganese deficiency is present, Vyn recommends a foliar application 7-10 days after the glyphosate application.

He said that farmers should not tank mix manganese with glyphosate because, when mixed, the efficacy of both -- the glyphosate on weeds, as well as the manganese for the soybean plants -- is reduced.

This year, Vyn and his team will look at manganese availability in glyphosate-resistant corn and glyphosate-resistant soybeans that are in rotation with and without glyphosate applications. They will also test two foliar applications versus one application and no application. Manganese by itself and in different combinations with other trace minerals such as zinc will also be evaluated.

This research has been funded by the Indiana Soybean Alliance.

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Yellowing between the leaf veins shows manganese deficiency in soybeans.

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