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Why do I see nutrient deficiencies in my crops, even with moderate soil test levels?

Nutrient deficiencies occur regularly in Ontario and can be the cause of substantial yield loss depending on the type, severity and timing. Their presence is particularly frustrating when soil test levels show adequate levels of fertility.

The simple answer

Nutrient deficiencies can appear in soils testing moderate or high in plant nutrients given the right set of conditions. Extremes in soil temperature and moisture, soil compaction and other crop stressors (insect feeding, root diseases, weed competition and herbicide injury) can impede nutrient uptake and movement within the plant, making deficiency symptoms appear more frequently. These deficiencies are often temporary and the plants can outgrow them. However, depending on the cause, duration and severity, such deficiencies can lead to a major impact on crop yield.

A little more information

Nutrients are primarily absorbed into the plant via the roots, so healthy, active roots are critical for nutrient uptake. Knowing the nutrient availability in the soil solution, through soil testing, is important for profitable crop production and preventing nutrient deficiencies.

Environmental factors are often the difference between observing symptoms of nutrient deficiencies and not. Extremely dry conditions can prevent access of nutrients in the soil solution to roots. Saturated soil conditions can reduce root growth and nutrient absorption, while also promoting losses through the soil profile of soil-mobile nutrients such as nitrogen and sulphur.

Tillage or planting done when soil conditions are wet can cause compaction, which prevents root exploration and nutrient accessibility to the plant. The appearance of nutrient deficiencies will often occur because roots haven't been able to develop normally. (Figure 1).

Figure 1. Clumpy, hard soil conditions indicate less than ideal conditions during tillage. Root growth is inhibited leading to reduced phosphorus (P) uptake.

The full story

When a nutrient deficiency is found, identify the root cause of the deficiency first. If it's due to a shortage of plant nutrients in the soil, broadcasting granular fertilizer or foliar feeding the crop in season may offer a short-term fix. Building nutrient levels will be the long-term solution to low testing soils.

Why do deficiencies appear on soils with adequate fertility?

Symptoms may be influenced by an interruption to the nutrients supply chain from soil to plant, via impediments to root growth or nutrient mobility. In some cases, symptoms may not appear unless adverse environmental conditions are also present. Deficiencies can be triggered by these factors:

- Poor soil conditions for field operations – compaction above, below or beside emerging seedlings limits root growth
- Damage from insects or disease – corn rootworm pruning, for example, prevents proper nutrient uptake by roots
- Rotation with non-mycorrhizal crop species – corn following sugar beets or canola may exhibit P deficiency symptoms in early season
- Soil pH extremes – manganese (Mn) availability, for example, may be reduced in high pH soils (Figure 2)
- Errors in application – improper spreader setup, herbicide application overlaps, etc.

Figure 2. Mn deficiency symptoms in soybeans are more prevalent in high pH soils, especially when soil is dry.

Nutrient deficiencies can happen at any point during the season, but most often appear at certain points throughout the year:

- Early spring after planting – cool, wet soils inhibit root growth and plant uptake
- Mid-season during rapid crop growth – as vegetative growth takes off, nutrient mobility in the plant may take time to catch up
- Reproductive stages – mobile nutrients relocate from older leaves to grain and seeds, especially in dry conditions (Figure 3)

Figure 3. Potassium (K) deficiency symptoms appear in a field with moderate-high soil test levels because of dry conditions during reproductive stages. K is highly mobile in the plant, leading to deficiency symptoms starting with the oldest leaves.

How can you determine which nutrients are deficient?

Visual symptoms can give you a good indication of deficient nutrients but are most reliable when normal growth patterns occur for all but the area in question. When dealing with multiple stressors from the environment, field management issues or damage, it can be much more difficult to distinguish. And in some cases, symptoms may look like other stressors or damage to the crop, such as herbicide injury.

The best way to identify a nutrient deficiency is through plant tissue testing. Take two tests to compare an affected and non-affected area. Better still, take soil tests at the same time, in the same areas, to detect whether the issue lies with the low nutrient concentration in the soil, or whether there are other factors at play causing the deficiency to appear.