Figure 1: sulfur deficient pea.

Plant Nutrient Deficiency Symptoms

Clain Jones discusses tools to identify nutrient deficiencies in plants.

There are three basic tools to diagnose which nutrients may be lacking and causing poor plant growth: soil testing, plant tissue testing, and visual observation of the plants for nutrient deficiency symptoms. Soil and tissue testing compare values measured by laboratory analyses to amounts considered sufficient based on research, while visual assessment is qualitative.

Soil testing helps determine whether a specific nutrient should be added to the soil before the crop shows signs of deficiency. Given the time and expense of soil sampling and analysis, typically one sample is sent in for a field, garden, or lawn, thus providing an average value of soil nutrients over a large area. For example, a farmer may have separate samples for upper vs lower parts of a field, or a gardener might submit separate samples for the hoop house and the outdoor garden plot.

Tissue testing and visual assessment can pinpoint specific areas where problems are observed. Tissue testing is limited because nutrient concentrations vary among

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species and varieties, by the plant growth stage, plant part, even the time of day the sample is collected, and how the tissue is handled after collection. Unfortunately, there aren't always published nutrient sufficiency ranges for many nutrients and crops in Montana.

Looking at leaves is quick and easy. The limitation of visual assessment is that once deficiencies are strongly visible, plant production may have already been hurt. Before applying fertilizer on a large scale based on visual symptoms, plant tissue analysis should be used to confirm the nutrient deficiency. This is important because many growth issues can cause symptoms that look like nutrient deficiencies. These include stress caused by underwatering, overwatering, disease, insects, or herbicide damage. In a garden environment there are more options, with smaller economic consequences, to correct plant nutrients mid-season, than for large scale farms.

The earlier a deficiency is detected and corrected the better. However, a challenge in this region is that our cool spring weather may cause nutrient deficiency in the short term. Specifically, nutrient release from organic matter and movement of nutrients like phosphorus (P) and iron (Fe) are slow in cold soils. Even if the soil contains sufficient available nutrients, the plants might be unable to take them up. If, additionally, the soil is waterlogged, root rot can further stress the plants and decrease nutrient uptake. This exacerbates nitrogen (N) and iron deficiencies. If deficiency is due to cold, nutrient deficiency symptoms should go away once soils warm, and applying more nutrients is a waste and won't help.

MSU Extension provides an online nutrient deficiency flow chart and the Extension bulletin Plant Nutrient Functions and Deficiency and Toxicity Symptoms to guide visual plant assessment. The flow chart quickly guides the user to a specific nutrient that is likely deficient based on which leaves are affected (old and near the base of the plant, or young and at top), the leaf color, whether the symptoms are spotted/striped or affect the whole leaf, and more.

Nitrogen, sulfur (S), phosphorus, and iron are nutrients commonly deficient in Montana. Uniform yellow and light green leaves on crops are likely due to

Figure 2, left: nitrogen deficient wheat. Figure 3, right: nitrogen deficient bean.

(left) MSU Extension, (right) Kathrin Olson-Rutz

nitrogen and possibly sulfur deficiency. Nitrogen deficiency is first seen on older, lower leaves, whereas sulfur deficiency shows up first on upper, younger leaves (Fig. 1). In cereals nitrogen deficiency commonly shows as discoloration from the leaf tip backward in the form of a 'V' (Fig. 2). Yellowing due to disease, and some nutrients other than nitrogen and sulfur, is usually non-uniform, striped or spotty. Even legumes (beans, peas) which supply their own nitrogen through specialized bacteria on their roots (rhizobia), can be nitrogen deficient if they got off to a slow start and didn't build healthy rhizobia nodules early on (Fig. 3).

Phosphorus deficiency is seen on lower, older leaves first. The leaves and stems are dark green with purple on the leaves (Fig. 4), sometimes seen more on the underside of the leaf.

Iron deficiency is common early in the year and in basic (high pH) soils. Corn, raspberry, rose, Amur maple, aspen, strawberry, and mountain ash are plants highly susceptible to iron deficiency, which shows up as interveinal chlorosis, a sharp distinction between green leaf veins and yellow tissue between the veins (Fig. 5).

Even if nutrient deficiency is identified too late to correct for a bumper crop this year, note where in the field or garden symptoms showed up. Soil sample those affected areas to determine how much fertilizer or amendment is needed for the next growing season.

Visit the MSU Extension Soil Fertility website for regionally appropriate information about soil nutrients, or contact Clain Jones directly at clainj@montana.edu, 406-994-6076.

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Figure 4, left: phosphorous deficient corn.
Figure 5, right: iron deficient sweet pepper.

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