Manganese Toxicity in Cantaloupes

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Growers may already be seeing leaf symptoms on their cantaloupe plants that are often misdiagnosed as a foliar disease. However, these leaf symptoms described below indicate **manganese (Mn) toxicity** which is related to low soil pH.

Symptoms: Symptoms of manganese toxicity usually appear on older leaves of cantaloupe when fruit begin to net or when fruit are the size of billiard balls and there have been heavy rains. The worse symptoms appear shortly before harvest and in lower areas of the field. The best way to determine whether you have Mn toxicity is to take an affected leaf and hold it up to the sun. Tiny pin-hole sized lesions with yellow halos clustered between the veins will be visible (Fig. 1). As the lesions mature, they will coalesce, and turn brown (Fig. 2). Some cantaloupe rows often seem to be worse than adjacent rows. Affected plants frequently appear as clusters in the field. Moderately to severely affected cantaloupe plants will demonstrate poor vegetative growth and reduced or incomplete fruit maturation. The combination of all these symptoms often can be confused with several infectious diseases. Because of the symptoms growers will at times increase their fungicide sprays, which may lead to phytotoxic problems.

Cause: Manganese toxicity is caused by soil pH levels that are at or below 5.8. Excess soil acidity allows manganese that is normally bound to soil particles to be released and taken up by the plant in very high concentrations, i.e., toxic levels. Manganese levels of 800-900 ppm and above in foliar tissue is usually toxic. Losses to manganese toxicity can be severe. The apparent "spread of the disease" is due to plants in the field where pH is lower developing symptoms first and plants in areas where the pH is not as low developing symptoms days or even weeks later. Growers may have had their soil tested and had spread lime in the fall but still have this problem—low pH in some parts of the field.

One of the reasons for the drop in pH even though lime has been applied is the use of pH lowering fertilizers such as ammonium and urea. These acidifying fertilizers can have a long-term effect on soil that is cumulative and leads to lower pH levels. Ammonium sulfate, $(NH_4)_2\,SO_4$, can significantly lower pH, while ammonium nitrate (NH_4NO_3) and dried blood make soil moderately more acid, and urea makes soil only slightly more acid. Ammonium is made up of nitrogen and hydrogen and over time is converted to nitrate by soil bacteria, the warmer the soil, the faster the conversion. During the conversion to nitrate, nitrogen loses hydrogen and adds oxygen. The hydrogen ions are free in the water solution between soil particles to react with various substances. Plants have difficulty obtaining the nutrients they need in the proper amounts when the soil water solution has too many hydrogen ions (low pH).

Symptoms of Mn toxicity are worse when there are heavy rains because of the lack of soil oxygen, which results in changes in the availability of some nutrients like manganese. Under saturated soil conditions manganese is made more readily available to plants and in low pH soils the likelihood of manganese toxicity increases.

Magnesium (Mg) deficiency is also a possibility when pH levels drop below 5.8. In this case plants do not take up enough of the nutrient. Deficient plants exhibit interveinal chlorosis (yellowing or scorching of leaf tissue between veins) with the veins remaining green (fig. 3). If soils are acidic and low in Mg, dolomitic lime can be used in the fall or to help right now magnesium fertilizers can be used.

Prevention: Soil acidity levels should be maintained above a pH of 6.3. Soil tests on sandy soils need to be done every year, at least for pH levels. The pH levels can change even after one year on sandy, low organic matter soils. Lime should be mixed into the soil at least several months before planting. While many plants do not grow well in acidic soils, cantaloupe is especially sensitive to the lower pH levels. Watermelon will rarely show signs of Mn toxicity even at a low pH. There is little that can be done to correct for manganese toxicity during the

season. However, using fertilizers with a nitrogen source of nitrate-nitrogen (calcium nitrate and potassium nitrate) instead of ammonium-nitrogen may help increase soil pH. Potassium carbonate also can raise soil pH. It is water soluble and can be applied through drip systems. However, correcting soil pH can be an arduous and lengthy process and it's probably too late to see a yield response in the current season if the symptoms have already been observed.

Fig. 1 Pin-head lesions surrounded by a halo of yellow or clear tissue.

Fig. 2 Younger leaves with pin-hole lesions (red) and older leaves with pin-hole lesions coalescing to form larger necrotic areas (black).

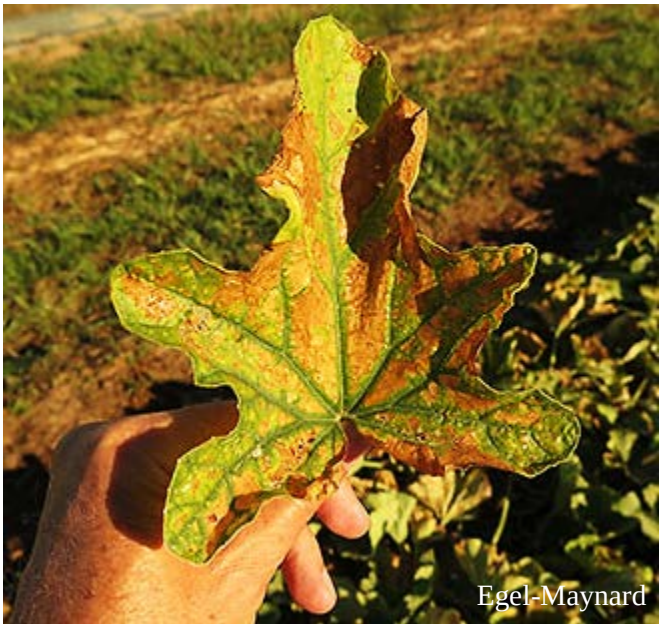

Fig. 3 Magnesium deficiency in cantaloupe with interveinal scorching and veins that remain green.