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Goji:
High pH Induced Iron Chlorosis

A group of Goji Berry plants (Lycium barbarum) were exhibiting upper leaf interveinal chlorosis. A PourThru test found the pH levels to be above 7.5, which resulted in iron being unavailable to the plant.

The goji is native to China and the Himalayas. It is a solanaceous crop which means it is in the same family as other horticultural crops such as peppers and tomatoes (Fig. 1). The goji is a perennial, and is hardy through zone 5 (Proven Winners, 2017). The goji produces many small, red ovular berries which are rich in nutrients and antioxidants. The goji plant is extremely hardy and has vigorous growth, it also has added value due to its berries. Both its vigor and edibility make the goji an ideal plant for the landscape.

Recently, we came across a group of goji berry plants (*Lycium barbarum*) exhibiting yellowing and interveinal chlorosis on the upper leaves of the plants (Fig. 2). The plants were receiving adequate irrigation, and were on a light fertilizer regiment. A PourThru test was done on four plants to determine the pH and electrical conductivity (EC) in order to more accurately diagnose the problem. The pH

Goji berry plant exhibiting upper leaf interveinal chlorosis.

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values were found to average around 7.7, with a range of 7.5 to 7.9. The high pH value coupled with the low PourThru EC values of 0.63 mS/cm means that iron was most likely limited.

Abnormal pH levels, whether high or low, can result in nutritional issues in some plants. All plants have an optimal pH range outside of which a plant will struggle to obtain the nutrients it needs. At a higher pH (alkaline) nutrients like iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) become less available to the plant. Iron is normally the limiting factor for higher pH values. Iron is an immobile element that means it cannot translocate from the lower portions of the plant to the new growth. This immobility of Fe means and that the symptoms will appear on the upper foliage. Consequently, when trying to diagnose iron chlorosis it is important to look at the location of the symptomology to help eliminate other nutritional deficiency options. In the above case with gojis, the plant's upper portion was exhibiting yellowing and interveinal chlorosis (Fig. 3). The visual symptoms, location, and pH values all point to iron deficiency due to an elevated substrate pH.

Figure 1. Two year old goji plant. Notice the vigorous growth and mounding nature.

Greenhouse Fertility Guidelines

There is limited information available about goji production in the greenhouse. Proven Winners (2017) has the most extensive online culture fact sheet. Gojis are considered to be a moderate feeder, so a fertilization rate of 150 to 200 ppm N Is recommended. For nutritional monitoring, the target electrical conductivity (EC) range is between 0.6 to 0.9 mS/cm based on the 1:2 extraction method. Thus to convert the 1:2 EC range to the corresponding SME values and PourThru values would give 1.3 to 2.0 mS/cm and 2.0 to 3.0 mS/cm, respectively.

Proven Winners recommends a substrate pH of 6.8 to 8.1. For greenhouse production in soilless substrates, a pH of 7.0 is often not recommended due to the increased basicity

Figure 2. Interveinal chlorosis and yellowing on a goji plant. Notice the upper foliage is exhibiting interveinal chlorosis while the lower foliage is still lush and dark green in coloration.

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Figure 3. Gradations of symptomology of iron deficiency in goji leaves. Here the progression of iron chlorosis can be seen. The leaf on the left is a normal, healthy leaf. From left to right the symptoms progress from mild yellowing to marginal chlorosis, to severe and complete interveinal chlorosis of the leaves.

causing issues with iron availability. The gojis we encountered were exhibiting advanced iron deficiency symptoms of the upper foliage at a pH of 7.7. Given the severity of the symptoms at this high pH, we recommend the upper limit for greenhouse production of goji berries be no greater than a pH of 7.5. This upper range means the optimal range would most likely be below this value.

Corrective Procedures

To manage this situation, the substrate pH should be monitored to ensure that it is within the acceptable range. *The corrective procedures below assume you are first working to manage excessive alkalinity with acid injection.* If the substrate pH is just beginning to increase, switching to an acidic fertilizer will help re-stabilize the pH. If corrective procedures are required, apply a 10% excessive leaching irrigation of chelated iron.

High pH Corrective Measures

•Use an Acidic Fertilizer

-20-10-20, etc

-Extremely acidic: 21-7-7

•Acid Water Drench

-Use sulfuric acid to acidify your irrigation water to pH 4.0 to 4.5.

-Apply as a substrate drench

-Rinse foliage ASAP

•Iron Drench (options)

-Iron-EDDHA: mix 5 oz in 100 gal of water

-Iron-DTPA: mix 5 oz in 100 gal of water

-Iron sulfate: mix 4-8 oz in 100 gal of water

•Apply as a substrate drench with sufficient volume to leach the pot.

•Rinse foliage ASAP

•Use with caution on iron efficient plants (geraniums)

Literature Cited

Proven Winners (2017). “Big Lifeberry®”. Proven Winners. Web. 14 April 2017.
https://www.provenwinners.com/professionals/growers/plant-culture/big-lifeberry-goji-berry-lycium