Agri-Gro and Plant Nutrient Interactions

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Introduction

Plants require sixteen essential nutrients. Thirteen of these are provided by the soil or growing media. Agri-Gro is a product sold to reduce fertilizer usage by increasing nutrient availability in the soil by microbial and enzymatic activity and as a supplemental micronutrient fertilizer. This study is an initial step in understanding the mechanism whereby Agri-Gro is able to increase yields with crops.

Procedures

In 1999, a greenhouse study was conducted at Lincoln University in Jefferson City, Missouri using tomato plants grown in pot culture. Growing media was a clay loam soil taken from a Central Missouri site and mixed with washed pure quartz sand. The treatments included Agri-Gro applied according to manufacture recommendations for tomato plants, and fertilizer treatments of complete Hoagland fertilizer solution, macronutrients alone, and micronutrients alone. The plants were harvested on three separate dates with soil and tissue analyzed for nutrient composition and dry weights of tissues determined. The first harvest was during vegetative stage, the second during flower initiation and the last harvest was conducted shortly after initial fruit maturation. A randomized complete block design was used with 10 replications.

Results and Discussion

The key findings of this study include:

Agri-Gro significantly increased the availability of boron, iron and zinc in the growing media (soil mixture), the concentration of boron and iron in the vegetative tissues was increased by Agri-Gro, but the total quantity of these nutrients taken up by the plant on a whole plant basis was not affected. The soil used for this study already had adequate levels of these nutrients for the plants' needs and thus the additional amounts were not used by the plant, but primarily accumulated in the soil. Consequently, the other observed effects of Agri-Gro cannot be attributed to the application of these fertilizer nutrients, but to other active components of Agri-Gro.

The vegetative component of the plants (as measured by dry weights) was slightly smaller with Agri-Gro than the control. Possible explanations include-

A) Reduced nutrient availability at the very early growth stages of plant growth when Agri-Gro was applied. Since Agri-Gro stimulates microbial populations, these organisms tie up plant nutrients causing reduced nutrient availability. The greatest effects occur upon initial application and stimulation of microbial growth. As the microbes die, these nutrients again become available to the plant at a later stage of development.

B) Growth regulating compounds within Agri-Gro itself or by the stimulation of production of these compounds by soil microbes by Agri-Gro.

The smaller size of the plant was not reflected in the fruit yield with Agri-Gro; in fact, **yield was significantly increased with Agri-Gro** on the initial harvest. The concentration of nutrients in the fruit was significantly higher with Agri-Gro, but Na was significantly reduced. The quantity of several nutrients which had moved into the fruit was significantly higher with Agri-Gro treatment. These included N, S, B, Ca, Cu, K, Mg, P and Zn. The soil concentration of nutrients with Agri-Gro greatly dropped during the third harvest, but the quantity of nutrients in the vegetative tissues were not greatly increased indicating that the nutrients taken up from the growing media were translocated to the growing fruit. The limitation in this data is that the plants did not complete their normal productive life cycle to be able to compare the total yield production from the crop.

In addition to boron, iron and zinc, Agri-Gro resulted in significantly higher soil concentrations of N, Ca, Cu, K, Mg, Mn and P in the growing media than untreated plants and soil. And with the exception of Mn, these same nutrients had similar or significantly greater concentrations of nutrients in the vegetative tissues with the use of Agri-Gro. Possible explanations for these results are:

A. Agri-Gro enzymes or microbes stimulated by Agri-Gro are "mining" the soil by making more nutrients available from the exchange sites on the soil, especially calcium, potassium and magnesium. This is supported by the nutrient treatment that received no macronutrients (N, P, K, Ca, Mg and S). Agri-Gro resulted in an increase in available macronutrients in the soil indicating a "mining" effect of Agri-Gro for the cations NH, K, Ca and Mg. The presumed effect here is to stimulate cation exchange or release of the soil particles. Additionally, the concentration of available P increased with Agri-Gro treatment over the three harvest dates, but decreased over the same harvest periods without Agri-Gro. It would be expected that the P levels would decrease over the harvest dates as the plants grew, but the increase in P levels indicate that Agri-Gro is making P more available possibly by enzymatic action or promotion of microbes with enzymatic activity for P.

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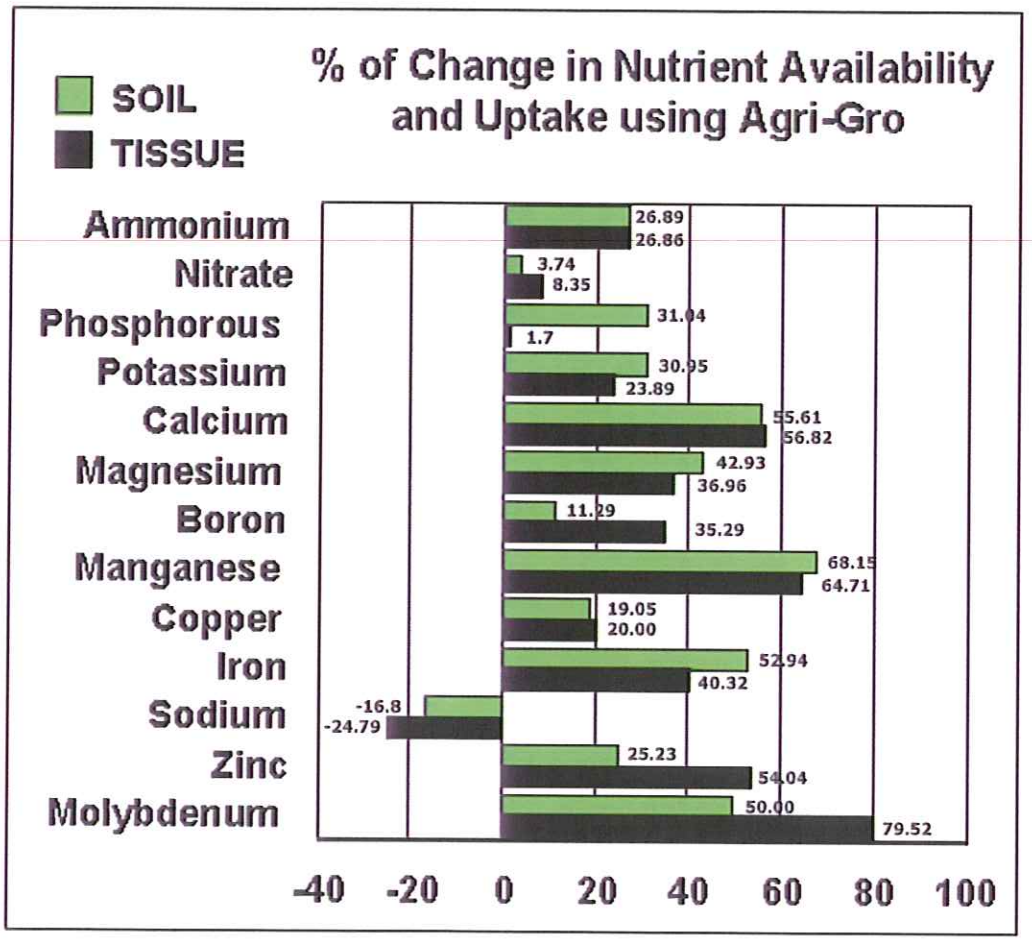
B. Agri-Gro is interacting with the applied fertilizers to retain them in the soil in a more available form. Similar processes as above may be able to keep applied nutrients more available to plants, e.g. keep from being bound to soil particles or converted to unavailable chemical Compounds.

C. The nutrients tied up by the increased number of soil microbes are released by the dying microbes causing more available nutrients over time.

Another interesting observation was that while Agri-Gro promotes increases in cations, **Na was consistently lower in Agri-Gro treated soils and plants.** This may be worthy of further investigation with saline soils since high Na competes with K for uptake by plants.

Conclusions

This study indicates that Agri-Gro has potential to reduce fertilizer application to crops, and that the effects of Agri-Gro go far beyond its micronutrient content. With soils having adequate or near adequate micronutrient content, the greatest benefit is the increased availability of both mactonutrients and micronutrients. Maintaining high levels of micronutrients and macronutrients, especially K, in the growing media until the plant needs them for fruit and seed development may play a critical role in the value of Agri-Gro to these crops. Agri-Gro also has potential to reduce environmental pollution by more efficient utilization of fertilizer nutrients and thus the potential reduction of applied fertilizers. Traditionally, fertilizers have been applied in large quantities early in the season (e.g. preplant), only to have a high percentage of the fertilizers lost to leaching, volatilization, and being tied up by biotic and chemical reactions. The use of micronutrients, enzymes and microbes such as provided by Agri-Gro may offer a real opportunity to reduce the environmental impact of crop production while at the same time increasing the efficiency and profitability of crop production. Further research is needed to better understand the mechanism whereby Agri-Gro is able to accomplish this, as well as how to maximize the benefit of Agri-Gro to get the most efficient use of all fertilizer nutrients.



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