Ionized Copper as an Effective Control of Proplematic Pathogens©

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Copper has been used for years in various compounds as well as a Bordeaux mixture to control disease. It is the backbone of many products to control organisms such as anthracnose.

Over the past few years nurseries were being asked and required to retain and re-use the irrigation water that they apply to their crops. The Department of Environmental Protection (DEP) in Connecticut asks that no run-off be allowed to leave the property to ensure that any contaminants remain within the nursery and not affect waterways down stream. Prides Corner Farms has effectively accomplished the goal of retaining 100% of its irrigation water and re-using it within its irrigation system.

By re-using the irrigation water a substantial increase in water-born pathogens has also occurred. Organisms such as *Phytophthora* and anthracnose have become a greater problem in spite of rigorous cultural practices and increased fungicide applications. These control methods can only go so far. A system had to be found to treat the water at the source before the organisms actually reached the plants.

Many forms of water treatment were looked at. Simple methods, as nonturbulent aerators, were installed in one irrigation pond with some limited success. Algae build-up was significantly decreased and with higher oxygen content in the water this provided a better habitat for beneficial organisms. This, however, did not go far enough to eliminating or preventing an outbreak of certain diseases.

Liquid and gaseous chlorine were given consideration but then dismissed as health and environmental concerns raised too many questions. Ozone purification systems were also looked at but cost and maintenance of the equipment as well as the need to have low solid particulates in the water made this method too risky.

Finally using copper (Cu) as a possible answer was brought to our attention. Ionized Cu was being used extensively in Florida's fruit region to wash crops after they were harvested. Some greenhouses were also using copper. Finally there were sprayers in use that used charged copper ions as a way to make fungicide as well as insecticide applications more efficient. Unfortunately there was very little information regarding the use of ionized copper on a large scale such as in a nursery setting with overhead irrigation. The concept was simple and sound and although the initial expense was high the maintenance of the system was quite low and very simple to operate. Prides Corner Farms decided to try it and see if it could be practically applied to our nursery conditions.

The principal of using electolytically generated copper ions was simple. By applying a direct current across copper electrodes and controlling the dose you would be sending positively charged ions into the water, which attracts and bonds with negatively charged sites on the microorganisms causing a disruption of the cell membrane. A minimum of 0.5 ppm is required for adequate disease disruption. Achieving this on a large scale required a great deal of thought. This is how we accomplished this. The copper is incased in what is called a 2-inch flowcell. The gallons pumper per minute (gpm) will determine how many flow cells are needed. A minimum of 600 gpm are needed in our irrigation zones therefore 24 flowcells were engineered in series to accomplish our needs. We also needed a stock tank to store the ionized water, as we needed to “supercharge” the water with concentrated copper ionized particles. The concentrated stock tank needed to be maintained at 20 to 25 ppm Cu so that when the stock is injected into the irrigation system we achieve the 0.5 ppm level required.

Being the only system of its kind in the Northeast required us to make adjustments as we went. One problem we immediately ran into was water quality. For this system the dirtier the water the better the system actually works. We needed to generate approximately 3 to 5 amps of current in order to be able to adequately ionize the copper. The more particles in the water the better the conductivity. Our water was too clean. In order to get around this we added 3 to 4 lb of salt to our 1000-gal stock tank. This raised the conductivity of the water allowing for better amperage. Another perplexing problem is the calcium carbonates in our water. They were very high and caused the ionized copper to precipitate out of solution in our stock tank if it was held for more than 24 h. We solved this by adding approximately 20 ounces of muriatic acid, which is 30% hydrochloric acid. Once we overcame these two obstacles the system ran smoothly.

OBSERVATIONS AND CONCLUSIONS

Plants grown under this system were small-leaf and large-leaf *Rhododendron* taxa as well as *Euonymus fortunei* cultivars. They were selected because of their inherently high disease risk. Beginning in May whenever these plants required irrigation the copper system was used to inject the ions into the main line. Twice during the summer tissue samples were taken to monitor levels within the plant. During one particular visit Dr. Harry Hoitink, plant pathologist at Ohio State University, warned us to the dangers of excess copper and the potential problems it can have on a crop. We therefore monitored the levels closely. During the first year the plants were exposed to the Cu ionization, 21 and 23 ppm, respectively, were observed. Plants not receiving the Cu had levels normally around 6 to 8 ppm. The second year the plants were exposed, the levels rose to 25 and then 40 ppm. This last reading gave us cause for concern as, according to Scotts testing laboratories, Cu levels between 5 and 25 ppm were considered to be in the normal range. A level of 40 ppm was obviously beyond the normal range. There were no obvious toxicity systems showing in the plants however. In the Sept. 2001 issue of NMpro an article was written pertaining to the use of Cu (Ledford, 2001). The article discussed the use of copper-treated containers and the article alluded to mention that levels much higher were needed to adversely affect the overall health of the plants.

Results were amazing. In the fields where ionized copper was injected into the water the incidence of *Phytophthora* and anthracnose were virtually eliminated. Another possible benefit is the decrease in use of fungicides that are used to control these pathogens. Next year we will begin treating blocks of plants with reduced levels of fungicides to see if the copper will give us the control we are looking for with less chemicals. If we could cut our use of pesticides in half that would be a significant savings. The one question we still haven’t been able to answer are what, if any, long-term effects the copper will have on crops. We did see elevated levels after 2 years. Since most of our crops are on 2-year cycles it is our hope that these levels will not become excessive and cause potential toxicity problems. It is our conclusion that ionized copper, as a tool to treat irrigation water is a viable and effective means of water treatment. Our system has been installed for 2 years and we feel we have enough confidence to expand beyond the one area we are treating now. It is safer to the surrounding environment with virtually no health risk compared to chlorine. The overall system is simple to run and is virtually maintenance free. It may or may not be right for everyone but it could play a role in the treatment of irrigation water under the right conditions.

LITERATURE CITED

Ledford, D. 2001. No excess copper. NMpro, September.

Growth of Herbaceous and Woody Perennials in Spent Mushroom Substrate Composted by Aerated and Static Methods©

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INTRODUCTION

Spent mushroom substrate (SMS) is defined as the material that remains after a mushroom production cycle. The substrate for the bulk of commercially produced mushrooms (*Agaricus bisporus*) is generally composed of horse and chicken manure, hay and wheat straw, as well as supplements such as cottonseed meal, husks and hulls, corn cobs, limestone chips, gypsum, urea, and minerals that is first composted then used for mushroom production. Large quantities of SMS are being produced every year and in concentrated areas, so its disposal poses an issue. One of the major problems with storing or holding SMS is that it continues to compost and goes anaerobic producing of an offensive odor. Other problems include nutrient leaching from the SMS into the ground water and unsightly appearance when piled on farmland. Currently the SMS that is used by the nursery and greenhouse industry is aged 1 or more years. To reduce the time and space needed to store SMS, Young, 2000 demonstrated that fresh SMS could with special handling be used for greenhouse and nursery crops with out aging. If fresh SMS is not used immediately but has to be stored, the pile of SMS will go anaerobic and the odor will be offensive to the surrounding community. To over come this problem we are evaluating if a 30-days aerobic composting period will create a fairly stable type of SMS that then can be used by the nursery and greenhouse industry. The objective of this research was to determine the response of plant species to aerated and static SMS and five mix concentrations.