# Inovative Media Amendments: Zeolite and Actinovate©

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**The purpose of my presentation is to highlight amendments currently used by growers in the Pacific Northwest. The first being a mineral and the second being a naturally occurring, beneficial organism.**

The term zeolite is actually a group of minerals of volcanic origin. These minerals have a wide range of uses; cat litter, feed additive, water purification, odor control sponge, bio-remediation, and our area of interest, horticultural applications. The mineral type used by many researchers and our company is clinoptilolite.

Our reason and need for this as an amendment was because of the increased cation exchange capacity (CEC) it would provide when incorporated into a soilless medium. The mineral has the ability to exchange cations from its sites with cations in a solution around them without a physical change in the structure of the mineral itself. It also has a large amount of pore space, is resistant to high temperatures, and is chemically neutral. Zeolites are quite selective in the area of attached nutrients, the sequence for clinoptilolite is K, $NH_4$, Na, Ca, Fe, Al, Mg (Ames, 1960).

Some of the first work with Zeolite occurred during the late 1960s in Japan. Clinoptilolite was added with N fertilizer used in rice production to increase the availability in the soil (Minato, 1968). Other work has also been focused on the addition of clinoptilolite to sandy soils for increased water and nutrient retention. This possibly led to the incorporation of clinoptilolite into the sand substrate for putting greens. Simulated sand-based studies, with 10% clinoptilolite, showed an 86% to 99% reduction in leaching of $NO_3$ and $NH_4$ (Huang and Petrovic, 1994). Greenhouse moisture studies of bentgrass showed a 26% to 60% increase of shot growth in sand amended with 10% clinoptilolite (Huang and Petrovic, 1996).

It has also been found in Australia that incorporation of 5%, by volume, of zeolite can "eliminate" any possibility of ammonium toxicity in soilless media. Some types of slow-release fertilizer used in our area increase the potential for this to occur. So an added benefit, is that the uptake of ammonium by zeolite helps to reduce the possibility of ammonium toxicity during the winter. But we currently know of no one here in the Pacific Northwest using the amount indicated by the Australian work.

A grower and a horticultural consultant who had been looking into increasing the CEC of growing media sparked our interest. Many grower's in this area use uncomposted Douglas fir bark as the main component of the medium, it naturally has a low CEC (compared to peat moss or other composted media components). After looking at all of the options that could fit their production methods, zeolite appeared to be the amendment they had been looking for.

The consultant approached us about creating a custom blended medium amendment (premix), containing zeolite. The combination of ingredients was created to work together in a "synergistic" type of relationship, with no one ingredient being more important than the other. The type of zeolite currently in use by us is clinoptilolite, a hydrated sodium potassium aluminum silicate. This zeolite is mined here in the state of Oregon and ground to a $20 \times 50$ mesh. The mineral in its raw state is charged with Fe, Ca, and K oxides. It has inherently lower levels of Na than other sources we have looked at (not all clinoptilolite's are created equal, review an analysis of the product before use). This is then added to a custom premix (called Premix 2000) that we have created to be incorporated into a soilless medium.

Some interesting work was done a couple of years ago by a local grower and one of our field representatives. The trial was set up partially to see if it was possible to extend the shelf life of plants grown without or with limited use of slow-release/controlled-release fertilizer in an ebb and flood system. The trial showed that anions (for instance phosphorus and nitrate) could also attach to the exchange sites. It was theorized that the reason was because of the form of nutrient used. The trial plants were fertilized with a custom liquid formulation containing ammonium polyphosphate and urea ammonium nitrate as part of the N source, so possibly the phosphorus and nitrate "hitched a ride" with the ammonium. But the trial also showed a lower than expected retention of potassium. With the theory of the phosphorus and nitrate attachment in mind, the form of potassium (potassium thiosulfate) did not appear to have as strong of an attachment as would be hoped, based on the known affinity of K to the zeolite used.

There are still areas of interest to be explored using zeolites as amendments in soilless media. While it is not our market area to further the research into this amendment, we are constantly looking for improvements that can benefit the grower by maximizing nutrients used and reducing nutrient runoff from container nurseries.

In 1947, Selman A. Waksman and Albert Schatz isolated an antibiotic produced by soil bacteria of the genus *Streptomyces*. This antibiotic, Streptomycin, demonstrated activity against bacteria that had shown resistance to antibiotics that were used at that time. The activity of this antibiotic was to inhibit protein synthesis and damage cell walls in susceptible organisms. There are over 50 antibiotics that were originally isolated from a *Streptomyces* bacteria.

*Streptomyces* are a type of bacterium that resemble fungi in structure. They are unique in that they can reproduce by spores and produce several different types of antibiotics. There are over 500 known species and only a few of them are pathogenic towards plants and animals. Streptomyces are found all over the world and play an important role in soil microflora. The rich, earthy smell often found in soils and forest areas comes from chemicals (geosmens) given off by these bacteria. They also have quite a varied diet, such as sugars, alcohols, amino acids, organic acids, and aromatic compounds. There also appears to be a lot of interest in using these organisms in bioremediation.

In the early 1990s, University of Idaho microbiologist Don Crawford collected isolates from the roots of linseed plants being grown in an area of England. From this group of isolates, two were selected that showed promise as natural fungicides. One of these was patented by the Idaho Research Foundation, Inc., and licensed to Natural Industries, Inc. of Houston, Texas. The organism, *Streptomyces lydicus* WYEC 108 (Actinovate), was used in the University of Idaho's potato trials and performed well in comparison to synthetic fungicides.

Greenhouse trials in peas showed it could possibly control Aphanomyces root rot, an extremely devastating disease that restricts the planting of peas in Idaho. It was also shown in other work that the bacterium influenced root nodulation frequency. The colonization of these nodules, by the *Streptomyces*, increased them in average size and also stimulated the vigor of the bacterium within the nodule. It was hypothesized that root and nodule colonization was one of the ways the *Streptomyces* acted as a growth-promoting bacterium in legumes (AEM, 2002).

*Streptomyces* is known to be a rhizospere-colonizing bacterium. It is thought that one of the reasons for growth promotion in some plants is the ability of the bacterium to produce hormones and siderophores (siderophores reduce minerals to a form easily absorbed by plants or biologically chelates them) in the rhizosphere of the host plant. The bacteria also are able to produce chitinases, glucanases, peroxidases, and other enzymes, which increase its antagonistic potential towards a pathogen (AEM 2002).

There are a wide variety of operations using this organism in the Pacific Northwest, product lines ranging from bedding plants to woody ornamental trees and shrubs. This past winter a bedding plant producer was having a problem with the spring *Primula* crop. There was no known pathogens present, just a lack of vigor and visible appeal of the plants. Preventive fungicides were being applied and did provide some visible change, but the problem would return. The grower discontinued the use of one fungicide (Subdue MAXX) and replaced it with Actinovate soluble. Within 3 to 4 weeks a change could be noticed in the crop, with increased color and vigor on the entire crop. The spring crop of violas and pelargoniums had also been treated, the mass of root system and color intensity of the flowers was very evident.

Several years ago a trial was undertaken using one of the other products inoculated with the Actinovate organism. The product, Actino-Iron, is a live bacterium applied to an iron humate carrier. This carrier acts as food for the bacteria and a long-term iron source for a plant when this is incorporated into the medium. The results on pansies showed the greatest dry weight and bloom count on the plants treated with the recommended label rate (5 lb per $yd^3$). They also showed increased N uptake compared to the control and plants receiving supplemental liquid iron (based on the results, it appeared that the supplemental liquid iron suppressed the growth response in the plants treated, at least based on the dry weight). The primulas also showed the greatest dry weight when treated with the recommended label rate. All of the treatments with Actino-Iron showed darker green foliage and broader leaves. There was no increased N uptake as noted in the pansy trial. Plants treated with the recommended rate showed better root development by the end of the trial and were less susceptible to decline. In the area of woody ornamentals, this is the most popular form of the product used. Most growers have found that Pacific Northwest natives and Ericaceous plants show the most positive responses to this product. These range from superior root systems, fewer problems associated with the root system, increased color of flowers and foliage, and overall plant vigor.

The Actinovate product is packaged as a 100% water-soluble inoculant (the spores are attached to a whey carrier). There is also a granular for turf and as seed inoculant. It is currently in the registration process as a biological fungicide and hopefully will have EPA approval in the spring of 2004.

## LITERATURE CITED

**Ames, L.L.** 1960. The cation sieve properties of clinoptilolite Amer. Mineral 45:689-700.

**Huang, Z.T.** and **A.M. Petrovic.** 1994. Clinoptilolite zeolites influence on nitrate leaching and nitrogen use efficiency in simulated sand based golf greens. J. Enviro. Qual. 23: 1190-1194.

**Huang, Z.T.** and **A.M. Petrovic.** 1996. Clinoptilolite zeolite effect on evapotranspiration rate and shoot growth rate of creeping bentgrass on sand-based greens. J. Turfgrass Manag. 1:1-9.

**Minato, H.** 1968. Characteristics and uses of natural zeolites. Koatsugasu 5:536-547.
**Tokala, R, J. Strap, C. Jung, D. Crawford, M. Salove, L. Deobald, J.F. Bailey,** and **M.J. Morra**. 2002. Novel plant-microbe rhizoshere interaction involving *Streptomyces lydicus* WYEC108 and the pea plant (*Pisum sativum*) Applied Environ. Microbiol. 68:2161-2171.

# Liverwort Control in Propagation: Challenges and Opportunities©

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## INTRODUCTION

The primary limitation for weed control in propagation is lack of chemical options. Weed management programs in nursery crop production rely heavily on herbicides. This reliance on chemical weed control becomes a liability in propagation because most herbicides are not labeled for greenhouse use. Several postemergence herbicides can be used including Roundup, Diquat, and Scythe. Roundup can only be used in empty greenhouses (without plants). And while Diquat and Scythe can be used in greenhouses with plants, none of these postemergence herbicides can be applied within propagation flats where weed control is most critical.

Preemergence herbicides cannot be used inside closed structures. This includes glass houses, poly-covered hoop houses, gutter-connected houses, etc. Since most propagation occurs inside closed structures, preemergence herbicides are generally not an option.

The primary fear of labeling preemergence herbicides for use in propagation is volatilization and co-distillation of the herbicide. Also, many of the herbicides used in nursery crop production contain dinitroaniline (DNA) herbicides as one of its components. Dinitroaniline herbicides are a class of herbicide that function by inhibiting cell division in root meristems. The goal in propagation, by seed or cutting, is to grow roots. If DNA herbicides are applied to generally coarse and porous media used in propagation, large volumes of water applied through mist systems are likely to move herbicide through the media into proximity of the root system. If preemergence herbicides contact root tips, root initiation and/or growth would be inhibited. Research has shown that DNA-containing herbicides are generally more injurious in propagation than those that do not contain DNAs (Thetford et al., 1988).

Growers and researchers have reported trials in which herbicides were used in propagation with success (Langmaid, 1987; Thetford et al., 1988). However, every herbicide labeled for nursery crops clearly states that they may not be used in closed structures. It is illegal to recommend or use any pesticide in a manner not consistent with the label. Herbicide manufacturers are not likely to change labels for indoor use due to the reasons stated above. Therefore, regardless of how much research is conducted, currently labeled herbicides will not likely be labeled for indoor production or propagation.