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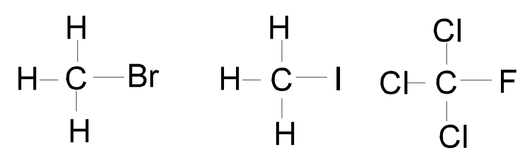
Soil Fungus Conference and Turfgrass Symposium, Reno:
Methyl bromide alternative and soil amendments
by Larry Stowell, Ph.D.

The 1995 Soil Fungus Conference was held in Reno at the Sands Regency Hotel on March 23rd and 24th. It was the 41st gathering of this group of microbiologists and plant pathologists. The mission of the meeting is to provide a casual environment for lively discussion of applied soil microbiological discoveries and ongoing research. Methyl bromide alternatives, amendments for control of soil borne plant pathogens, myorrhizal fungi and reports from Holland and Taiwan were a few of the topics that were discussed. Unfortunately, I missed an entire day of the conference because all flights from San Diego were canceled due to a severe snow storm in the Reno area. I made it to the meeting in time to catch the Local and Global Developments and Potpourri section and to make an invited presentation on Stress Reduction that featured PACE Turfgrass Research Institute results. You will be surprised at some of the information that is presented at these small focused groups of researchers. This issue of Insights will report on methyl bromide alternatives and soil amendments from Taiwan.

METHYL BROMIDE ALTERNATIVES

Alternatives to methyl bromide is a hot topic worldwide. Dr. Ole Becker, UCR nematologist, presented for the first time in public a new potential replacement for methyl bromide (MeBr). The new compound is methyl iodide (MeI). Methyl iodide provided similar control of fungi, nematodes and weeds compared to MeBr. The UC has submitted a use patent on this compound for soil fumigation. The new technology sounds interesting, but...

Background: Production of methyl bromide (MeBr) will be banned in the future and will therefore be unavailable by the early part of the next century. Although methyl bromide is an excellent fumigant, it is a gas that contributes to the destruction of the ozone layer in the earth's upper atmosphere (6-50 miles altitude). Ozone (O3) is a gas that absorbs ultraviolet (UV) light. This feature of ozone is important because ultraviolet light is known to damage a variety of cell components, including DNA, the genetic material of all living things. Human exposure to UV radiation is tightly associated with skin cancer. With reductions in ozone content in the upper atmosphere, we would expect to see dramatic increases in skin cancers and other radiation related illnesses.
Methyl bromide belongs to a group of chemicals called halogenated hydrocarbons. In general, the halogenated hydrocarbons are dangerous to the ozone layer. What makes a halogenated hydrocarbon? First, you need a halogen. Halogens are a group of elements that are similar in their reaction with other elements and include: **fluorine** (F, used in toothpaste and fluorinated water), **chlorine** (Cl, used to disinfect swimming pool water, a component of table salt [sodium chloride] and muriate of potash [potassium chloride]), **bromine** (Br, used in making antiknock compounds for leaded gasoline, fumigants such as MeBr, and water purification compounds), **iodine** (I, lack of iodine causes goiter, used in medicinal products, less reactive than the other halogens). Hydrocarbons are molecules that contain, you guessed it, hydrogen and carbon. Methyl bromide and methyl iodide are represented in the molecular drawings below:



Methyl Bromide | Methyl Iodide | Freon 11

So what are the advantages of MeI compared to MeBr? First, MeI does not deplete ozone as rapidly as MeBr. The measure used to evaluate potential hazard to the ozone layer is termed the ozone depletion potential (ODP). The most rapid ozone depleting compounds are the chloroflorocarbons, such as the Freons. Freon 11 has arbitrarily been given an ODP value of 1 and all of the other chemicals are some proportion of this value based upon their rates of ozone depletion. The Clean Air Act restricts chemicals that have a ODP of 0.2 or higher. Methyl bromide is rated at 0.6, too high to allow use in the future. Methyl iodide has an ODP of only 0.02, 1/10th of the Clean Air Act limit. A big improvement over MeBr and this low ODP does not trigger the Clean Air Act regulations. Second, MeI is liquid up to 109° F. This means the material does not have to be handled as a compressed gas such as MeBr (the boiling point of MeBr is 38° F). This is a big advantage from a worker protection perspective.

So what is the problem with MeI? Both MeBr and MeI are known or suspected carcinogens. The testing to determine whether MeI will pass all of the toxicological and environmental impact evaluations will be expensive may take 10-20 years. This is the first true alternative to MeBr that has been discovered. Further research will determine whether it will have value as an environmentally safe and effective fumigant. Although MeI meets some reduced risk criteria by not damaging the ozone layer, methyl iodide is a highly toxic chemical.

SOIL AMENDMENTS

Soil amendments from Taiwan that have disease suppressing characteristics were also discussed. Even though the information was published in a refereed journal, the audience was not very receptive to the technologies. This group of amendments are based upon organic waste products and synthetic fertilizers. They are a dramatic contrast in technology compared to the fumigation information presented above.

Background: Biological control of soil borne diseases has primarily evolved down two different paths. One path followed results that have been known for years--that complex mixtures of microorganisms found in composted manures and green waste suppress soil borne diseases. The second path is more recent and depends upon a "silver bullet" biological control approach. A silver bullet is a specific biological control organism that is targeted at one or a few plant pathogens. An example of a silver bullet is *Trichoderma*, a fungus that attacks other fungi. With the first path, if some of the microorganisms in the complex mixture are not adapted to the environment in which they are applied, other microorganisms in the complex mixture will take their place. In the case of the silver bullet, if the biological control organism is not adapted to the environment, the application will be a total waste. The silver bullet approach has been generally unsuccessful. The complex mixture strategies have proven successful in a variety of applications. Why don't we see more complex mixtures on the market? Because they are difficult to produce and they offer limited commercial potential. In short, they are hard to make money on so no one is developing them as products.

A third path has emerged as biological control interests have increased in recent years. In this case, organic materials are added to the soil which results in a soil environment that favors groups of antagonistic biocontrol organisms. The technology appears to be working in Taiwan (Huang, H.C., and Huang, J.W. 1993. Prospects for control of soil borne plant pathogens by soil amendment. Current Topics in Bot. Research. 1:223-235). In the case of composts, the microorganisms and a food base are introduced into the soil. In most of the Taiwan examples, no microorganisms are introduced. Instead, the raw manure or green waste product and fertilizers are applied to the soil. One of Huang and Huang's mixtures contains a byproduct of the sugar cane industry called bagasse and rice hulls, oyster shell powder, urea, potassium nitrate, calcium superphosphate and mineral ash and has been given the name S-H mixture (named after the original inventors Sun and Huang). The S-H product controls *Pythium, Fusarium*, *Sclerotium*, and *Rhizoctonia*. What more could you want? Is this technology new? Yes and No. Organic amendments have been used to suppress diseases since the 1920's (Fellows, H. 1929. Studies of certain soil phases of the wheat take-all problem. Phytopathology. 19:103), but amendments are usually poorly defined. Huang and Huang have taken some time to define their process and publish it.

Organic amendments are promoted for use in turfgrasses by a variety of businesses. Unfortunately, it is very expensive for a business to provide sufficient research to convince you, the end user, and key influencers at universities that the technologies work. This problem allows some less than honest businesses to promote suppression of diseases with their organic products with little fear that their product claims will be challenged. Until further research is conducted on these difficult to study products, you should use caution and test these products on split greens or using other conditions that will allow you to determine if the product works. If you don't see a disease in the treated area using one of these complex products, this may be due to lack of sufficient pathogen populations and conducive environmental conditions and not the product. You need to have a side-by-side non-treated area to compare results. The Huang and Huang ideas are not unique and I would like to encourage you to test similar, less popular methods of disease control on small areas at your course. Use three different areas of the course and leave non-treated areas for comparison. If you find positive or negative results, send in the information and it will be included in a future issues of PACE Insights.

LETTERS:

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