

Indigenous Microorganism Cultures at Tobacco Road Farm

by Bryan O'Hara

As part of efforts to improve the soils and quality and yield of produce at Tobacco Road Farm we have been utilizing a biological inoculant made from locally sourced microorganisms. This inoculants material is referred to as IMO (Indigenous Microorganisms). The techniques for IMO culturing come from the principles of Korean Natural Farming (KNF), an agricultural methodology developed by Han-Kyu Cho.

KNF is based on traditional Korean use of local materials, fermentations of fertilizing materials and modern concepts in plant nutrition from Japanese agricultural thought.

The IMO process involves setting a box of partially cooked grain into an appropriate place in the local environment in order to collect a culture of that biology. This culture is then brought back to the farm and put through various processes until a substantial pile of highly active local biology is produced. This material is then introduced into the farm system through various methods such as irrigation, foliars, potting soils, livestock water, mulch piles and, as solids, directly onto the fields. The culture is full of diverse, well-adapted organisms able to continue to thrive under field conditions if treated carefully. The mycelium of fungal organisms is obvious in the culture, and when introduced into the fields the mycelium can be observed proliferating along with potential mushroom development.

This method is very timely considering the current state of our soil biology. The use of inappropriate chemicals and tillage and the impact of pollution, combined with climate disturbance and tampering worldwide have left our soils in trouble. In terms of our farms' soils where vegetables are raised using intensive methods, IMO have aided in the extensive development of soil aggregation and improved soil structure. There is improved nutrient release of elements such as Ca, Mg, P as well as micro and trace elements, likely due to enhanced fungal activity. This has helped to balance our relatively high N and K levels with all this being observed through physical assessment and tissue analysis.

There have also been dramatic improvements in the soil structure and its impact on soil air and water balancing — air and water being the most important of fertilizers, the balance of which is critical for proper biological functioning. With the care being given to these soil organisms it became clear that tillage would be detrimental to our efforts so a no-till system was developed on the farm described in an article in the October 2016 issue of *Acres U.S.A.* No-Till has proven to go hand in hand with IMO, and all the improvements in soil and produce have much to do with both of these techniques.

IMO #1

In terms of the production of the IMO culture, the first step is to partially cook a grain media. This is usually organically grown brown rice, though we have used other pesticide-free grains as well. The rice/grain is cooked with water at a 1:1 ratio by volume for about 20 to 30 minutes, resulting in a firmer, dryer rice than would be served for a meal. The rice is then placed in a container such as a wooden box or basket. We have a box made of cedar (9 x 16 x 6 inches interior) with a lid. Cedar is the preferable material, but we have used pine boxes. The cedar box is filled about two-thirds full with

rice, leaving space for air. It is important for the box or container to have a lid or other covering in order to keep out excessive rain while it sits in the culturing environment.

The box is then taken into nearby forest where an appropriate culture site is located. Here is a time to fully use our senses in order to locate a site. The signs for a site often come from the smells of the forest area as well as using our sight and other senses. Often this is under a large deciduous tree which has shown its strength and fed a strong biology at its roots. The forest duff is then moved aside and the box is set down into this site. Duff is piled atop the box until it is buried.

Sometimes we place exceptionally vigorous looking/smelling duff directly on top of the rice in the box, but this is not necessary. The box is left for approximately one week — longer in cold weather, shorter in summer's heat. After this time the box is unearthed and the contents examined. There should be primarily a rich white fungal growth on the grain with perhaps a few other colored growths. This is perfect, however if there is less white fungal growth than blues, red, greens, etc. the option is to either take what part is mostly white or start again. We have never had a completely failed box. This culture is called IMO #1.

IMO #2

The IMO #1 is taken back to the farm and mixed with an organic brown sugar at a 1:1 ratio by weight in a clay crock, leaving about one-third of the volume of the crock for air. The crock is then covered with a porous paper material secured by a large rubber band. The crock sits for approximately one week at a warm room temperature after which it is ready for use. This material is IMO #2. It may also be stored at this stage by placing the crock in a root cellar, and alternatively some people store this material in their refrigerator.

IMO #3

The next stage is the making of IMO #3. For this step, some IMO #2 is liquefied and mixed into a pile of bran. The bran is piled on the earth in partial shade underneath deciduous trees. The bran pile is hydrated to about 65 percent moisture, or until water can barely be squeezed out of a ball of the bran, using a dilution of IMO #2 at 1:500 water or so. Other KNF herbal extracts are also often added at this point, such as garlic, ginger, angelica, licorice and cinnamon extracts at 1:1,000 dilution, and sugar extracted plant juices as well as vinegar at 1:500 dilutions. These extract materials are very useful components of the KNF farming system, however their making is beyond the scope of this article, and IMO #3 can be made without their use. The bran is piled on the earth; the height is often only a few inches, and hydration is accomplished with turning for consistency of moisture. The height of the pile is determined by how high the temperature will be in the next few days. Lower piles tend to heat less; higher tend to overheat. The optimum temperature range is about 100-120°F. If the pile starts to heat much over 120°F turning in order to cool may be required.

The pile is covered with wet leaves, straw or cardboard and needs to be protected from excessive rain. We often use a black plastic tarp suspended on hoops to keep off rain and provide more humidity. The most common bran used in the United States is organically grown wheat bran; in Korea rice bran is utilized. Rice bran being the by-product of white rice production is probably quite plentiful and inexpensive in Korea. In the United States organic brans are in great demand in the organic feed industry and their price reflects this.

We often make several piles of 200 pounds of bran a year, at a cost of up to \$100-\$150 per pile (this is for about 3 acres of vegetable crops). We have used rice, wheat and oat bran and have had success with all of them, however right now oat bran is primarily used. Many people are looking for less expensive appropriate substitutes for bran, and we have experimented with many. None of them have given us the consistent results of bran though we often do incorporate up to 25 percent coconut coir into the mixture.

The pile of bran quickly begins to heat and develops quite fragrant odors. Within days, the pile is covered with a white fungal growth very similar to the IMO #1 culture. In dryer times of year, or if the pile overheats and requires turning, we add some water to rehydrate the pile. The explosive growth of the biology does quickly consume moisture. Once the fungal mycelium has thoroughly grown into the bran, often after only 4-5 days in the summer but longer in the cooler periods, it is time for the incorporation of soil and the assembly of IMO #4.

IMO #4

For IMO #4, soil is mixed into the highly biologically active bran pile (IMO #3) at a ratio of 1:1 by volume. The soil comes from a variety of places and diversity is probably of benefit, though it seems likely that soil from the area to be farmed is best. We use a mixture of topsoil from the field, topsoil from the field edges and field subsoil from the various digging projects. The soil helps to cool the bran pile if it is still heating excessively, so the material can now be piled higher, usually a foot or two high.

The highly activated biology of the IMO #3 now has a chance to incorporate into a soil condition and continues to remain highly active, though at generally lower temperatures than the straight bran. The clumps of bran formed during the IMO #3 process are best left somewhat whole during this mixing process, usually about the size of golf balls (1-2 inches). The pile is rehydrated to a similar level of hydration of IMO #3 using herbal and plant extract dilutions if available, as well as seawater at a 1:30 dilution (also if available). After about a week this material is ready to be utilized in the farming system.

It is most active for a few weeks after final assembly, but we store this material by simply leaving it under its tarp for up to several months and apply it as needed.

The primary use of IMO #4 for us is to apply it directly to the vegetable bed surface before seeding or transplanting. This is done at a rate of about 5 gallons to 250 sq. ft., more or less depending upon availability. IMO #4 is capable of expanding itself in field conditions and is really more like a catalyst so exact volumes may not be critical. Under gentle treatment the biology may persist for extended periods so field treatment with IMO #4 may only need to be intermittent depending on individual conditions. We do not treat every bed every year this way, but most beds at least every other year.

As mentioned earlier, one of the reasons we switched to a no-till system was for the preservation of the IMO in the field. When applying IMO it is best to do so in the morning or evening, cover it with mulch, and water it in. The IMO can be readily seen expanding into mulch materials (straw, leaf, woodchip) following this process. At the rate that we apply this material we can immediately seed or transplant, however with higher applications a few days of cooling down may be appropriate.

Another useful application of IMO #4 is foliar application. For this process approximately 2 gallons of IMO #4 are vigorously stirred into about 5 gallons of water, then strained and added to 25 gallons of water containing other microbe-friendly foliar ingredients and is then immediately applied. IMO can also be applied using the irrigation system with a

similar approach of stirring and straining. We have also used IMO to reduce odors in animal bedding areas, and livestock particularly enjoy consuming it, so it needs a fenced in area during culturing of IMO #3-4 to keep animals at bay. It is useful in animal water as well. For the orchard IMO is added to the mulch which is applied under the trees as well as utilizing the trees' shade for the actual culture area of IMO #3 and #4. It is also a useful ingredient in potting soil formulations.

Much experimentation can be done with the IMO process, and the material has many uses. Often multiple cultures of IMO #2 are mixed into the water to hydrate the IMO #3. Taking IMO #1 from various sites and at various times of the year aids in the diversity of organisms. The use of various materials in the culture step of IMO #3 can also yield dominance of various organisms, so it could be mixed with various aims in mind. IMO #4 can also be used in the preparation of various side dressing of fertilizers, liquid or solid.

People have also experimented with culturing virgin forest land and bringing back that biology to their farms. Another common approach to save on expense is simply to utilize IMO #2 directly in foliar and irrigation, thus eliminating the bran culture. We have not tried this, preferring to fully develop the culture on bran and soil. IMO can also be cultured in greenhouses during the winter. The methods put forth here are certainly not the only way, but hopefully will prove a valuable guideline for your operation.