Collecting and Cultivating IMOs

Protocol and Learnings

Building Community Capacity to Increase Agroforestry Tree Planting through Participatory Listening Sessions, Training, and Peer-to-Peer Networks

Wellspring Forest Farm and Mycena Agroforestry Initiative · 2026
www.MycenaTrees.org

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number LNE23-466. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

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Purpose

IMOs, or indigenous microorganisms, are the native fungi, bacteria and protozoa that live in local soil. Farmers and land stewards work with IMOs to improve soil health, and therefore plant health, by increasing the diversity and abundance of the soil's microbial community.
Working with IMOs involves collecting these microorganisms, stabilizing them, multiplying them, and applying them to growing sites. This guide lays out the four-step process we refined at Wellspring Forest Farm in 2024 and 2025, what we learned at each step, and how we applied the finished culture to tree nursery beds.

Process at a glance

Step	What happens	Key ratio	Time
IMO 1: Collect	A box of cooked white rice is half-buried under healthy trees to collect native microbes	One rice-cooker batch (12 cups dry rice)	4 to 7 days
IMO 2: Stabilize	Colonized rice is mixed with brown sugar and fermented	1 part IMO 1 to 1 part brown sugar, by weight	3 to 7 days
IMO 3: Multiply	IMO 2 is mixed with bran and spent mushroom blocks and built into a warm pile	1 part IMO 2 : 5 parts bran : 5 parts spent mushroom blocks, by volume	5 to 6 days

IMO 4: Integrate	IMO 3 is mixed with native soil and cultured again	1 part IMO 3 to 1 part native soil, by volume	Until the pile returns to ambient temperature
Apply	IMO 4 is spread on the nursery beds as a top dressing	1 inch deep, covered with straw mulch	One application

Our research trial

Our goal was to see whether an IMO culture could improve biological activity, root development and above-ground growth in nursery trees. Many organizations, governments and farms are planting trees, but the trees often struggle and die. We wanted to grow more resilient trees with strong, fibrous root systems that would have a better chance of thriving once planted out.
We began refining IMO collection in 2024. In 2025 we completed many rounds of collection, stabilization and cultivation, and after a spring and summer of refining the process, we carried the culture all the way from IMO 1 to IMO 4 and applied it to air-pruned nursery beds.
The trial used 9 air-pruned beds, 3 for each target species (willow, black locust and chestnut), with one bed per species in each treatment:

Treatment	**What we did**
Control	Weeded and mulched the bed only
Commercial inoculant	Drenched the bed with BioOrganics Mycorrhizal Inoculant Plus+: 2/3 cup of powder mixed into 2 gallons of water
Home-grown IMO	Weeded the bed, applied IMO 4 one inch thick, mulched with straw and watered it in

IMO 1: Collecting Indigenous Microorganisms

Goal

Collect native fungi and bacteria from a healthy environment. Cook rice, put it in a cedar box, and partially bury the box under the canopy of a healthy tree. After 4 to 7 days, retrieve the box and harvest the local microbes living on the rice.

Materials checklist

☐ **Uncooked white rice** (brown rice also works but is less common; avoid enriched rice)
☐ **Wooden or bamboo box**, or a plastic container with many holes (about shoebox size). We used cedar.

☐ **Chicken wire** stapled over the top to keep out animals
☐ **Staple gun or nails** to attach the chicken wire
☐ **Unbleached paper towel, cloth or tarp** to cover the box
☐ **Rubber band, twine, string or rocks** to hold the cover in place
☐ **Shovel** to prepare the collection site
☐ **Rice cooker**
☐ Optional: **mesh** to keep out insects, and **rubber gloves**

Step 1: Prepare the rice

Cook the rice a little harder and drier than rice for eating, like al dente pasta: nearly fully cooked, firm and fluffy, not mushy.

1. Add 12 cups of rice to the rice cooker.
2. Rinse the rice 5 times in the cooker pot: fill with water, swirl, and pour off. By the fifth rinse the water ran almost clear. Removing the extra starch helped us avoid mushy rice.
3. After the final rinse, fill the cooker with water to the 10-cup line, then add one more cup.

Step 2: Cook the rice

1. Cook on the white rice setting and remove it as soon as it finishes (about 1 hour).
2. Empty the rice into a large bowl and stir to stop it cooking or steaming further.
3. Let it cool completely, stirring every 5 to 10 minutes. Move rice up the sides of the bowl so it cools faster and can breathe.

Step 3: Fill and cover the box

1. Spread the cooled rice evenly in the box. Don't pack it tightly; the microbes need space to breathe.
2. Cover the box with breathable material. We stapled chicken wire over the top, which kept out animals and large insects. A cloth, paper towel or natural paper held with a rubber band or string also works, as does a loose wooden or mesh lid.



Step 4: Choose a collection site and bury the box

1. Half-bury the box under established trees. We collected under the same species we were growing (willow, chestnut and black locust) to see whether nursery trees benefited from IMOs cultivated under their own kind. For a general collection, try a forest edge, bamboo grove, hedgerow, or an undisturbed shady spot with visible fungal activity such as leaf litter, white threads or rich soil.
2. Cover the box with a plastic tarp weighted with a stone to keep rain out. Some sources also cover the box with leaf litter or straw to mimic natural conditions and regulate temperature; we did not.



Step 5: Wait and observe (4 to 7 days)

☐ Look for rice colonized with white, fluffy growth. Yellow, orange or light gray growth is also a sign of beneficial microbes.
☐ Avoid black, blue or green mold, which are likely contaminants. Discard the batch if they dominate.
We got the most consistent, clean-looking cultures in moderately dry weather between 65 and 80°F (18 to 27°C). Very rainy, cold or hot weather was not ideal.

Step 6: Harvest

When the rice is well colonized and smells sweet, earthy and fungal, bring it in for processing.

Step 7: Use or store

Either move straight on to IMO 2, or store the culture in the fridge in a breathable container for no more than one week.

IMO 2: Stabilizing Indigenous Microorganisms

Goal

Slow the rapid microbial growth of IMO 1 and preserve the collected microbes by fermenting them with an equal weight of brown sugar.

Materials checklist

☐ **IMO 1** (colonized rice from the box)
☐ **Brown sugar**, ideally unrefined such as muscovado or panela
☐ **Mixing bowl or tray** and a **scale**
☐ **Storage container**: wide-mouth jar, plastic container or clay pot. We used terra cotta pots.
☐ **Breathable cover**: cloth, paper towel, coffee filter or a loose lid
☐ Optional: **gloves** for clean handling

Steps

1. **Harvest IMO 1.** Keep rice that has turned white, gray or lightly fuzzy. Discard any black mold or parts with an off smell, and gently crumble clumps.
2. **Weigh it.** From one box, take the healthiest parts of the culture, about 2.5 to 3 pounds.
3. **Mix with brown sugar at 1:1 by weight** (for example, 2.5 to 3 lb of sugar). Mix until the grains are well coated and the sugar starts to draw out moisture. The mix should feel moist and sticky but not overly wet.
4. **Fill the container** loosely, leaving about one third of it empty for airflow.
5. **Cover and store.** Use a breathable cover; we used coffee filters on small jars and brown paper on terra cotta pots. Keep it in a cool, shaded spot out of direct sun and heavy rain. Never seal it airtight.



Fermentation and storage

Let it sit 3 to 7 days. When it smells pleasantly sweet-sour, it is stable and ready to use.
Once fermented, IMO 2 can be kept at room temperature in a breathable container for months. Refrigeration is optional except in very hot, humid climates.
Open question: how long does IMO 2 stay viable? If it keeps for 6 to 12 months, farms could collect and stabilize IMO 2 one summer, store it over winter, and move it to IMO 3 and IMO 4 in time to inoculate beds early the next season.

IMO 3: Multiplying with Bran and Spent Mushroom Blocks

Goal

Multiply the IMO 2 culture by mixing 1 part IMO 2 with 10 parts organic material. We split the 10 parts evenly between bran and spent mushroom blocks, for a final ratio of 1:5:5.

Recipe (by volume)

Ingredient	Parts
IMO 2 culture	1
Grain or bran	5
Spent mushroom blocks, broken up	5

Steps

1. Break the spent mushroom blocks into small pieces.
2. Mix the IMO 2 thoroughly into the bran.
3. Add the mushroom block pieces gradually and mix to spread them evenly.
4. **Get the moisture right.** Too little water limits microbial growth; too much can overheat the pile or turn it anaerobic. Aim for 60 to 65% moisture, like a squeezed-out sponge. With a hand test, a tight squeeze should barely produce one drop of water. If drops come out easily, the pile is too wet: flatten it and let it dry. Reduce added water if the blocks are wet; pre-wet dry bran or blocks while mixing.
5. **Build the pile** about 3 to 5 cubic feet and 18 inches high. A pile that is too small won't heat up.
6. **Cover** with breathable material such as rice straw, burlap or shade cloth.
7. **Monitor temperature and moisture daily.** The pile should rise to 110 to 120°F, mostly in the first 3 days, and should not go above 120°F. If it does, aerate or flatten it with a rake or spading fork to avoid overheating (above 130°F). If it dries out, add a little water at a time and mix it in.
8. **Finish.** In our trials the pile returned to ambient temperature in 5 to 6 days. When the temperature is stable and it smells earthy, IMO 3 is ready for IMO 4.



What we learned

Don't turn the pile. With our first (willow) batch we turned the pile several times. The temperature kept spiking and falling, which likely harmed or killed some microbes. With black locust we only aerated and slightly flattened the pile when it passed 120°F, which worked better.
Trust your hands over a moisture meter. During the chestnut batch our moisture reader gave false readings and we added too much water. We flattened the pile to about one inch overnight to dry it before finishing. From then on we used the squeeze test: at the right moisture the material clumps easily, and a very hard squeeze releases one drop. Don't squeeze extremely hard to force water out, which would likely harm the microbes.
One batch of rice is enough. For the chestnut batch we used a single rice-cooker batch and built the smaller pile as high as we could without changing the ratios. It still heated properly and carried through the whole process, which simplifies things.

IMO 4: Integrating with Native Soil

Goal

Introduce the cultured microbes to local soil by mixing IMO 3 with equal parts native soil and culturing it again.

Recipe (by volume)

Ingredient	Parts
IMO 3 culture	1
Native soil	1

Steps

1. Mix IMO 3 and native soil until well combined, adding water slowly until moist but not wet.
2. Check moisture: the same 60 to 65% target as IMO 3, wet enough that you could almost

squeeze out a drop.
3. Build the pile and cover it with the same cloth or fabric used for IMO 3.
4. Monitor temperature and moisture as for IMO 3. Aerate or flatten if it passes 120°F; add water a little at a time if it dries out.
5. When the pile returns to ambient temperature, it is ready to apply.

Applying IMO 4 to Nursery Beds

☐ Weed each bed so the only plants above ground are the target tree species.
☐ **IMO bed:** spread IMO 4 one inch deep as a top dressing, cover with straw mulch, and water it in.
☐ **Commercial inoculant bed** (same day): mix 2/3 cup of BioOrganics Mycorrhizal Inoculant Plus+ into 2 gallons of water and drench the bed.
☐ **Control bed:** weed only.

Assessing the Biology

To get a picture of the soil biology in the beds, we worked with Joshua Pezet of Web of Life Regenerative Land Care, who assessed samples from the beds in late October 2025 using soil food web microscopy. We were looking at the amount of bacteria, fungi and protozoa in each sample, and whether fungal growth differed between the commercial and home-grown treatments.
Not seeing a clear difference does not mean the IMO inoculation didn't work. The cultures may need more time in the beds, or the differences may be hard to detect with a small number of samples.

What we learned about on-farm observation

We planned to observe cultures ourselves with a digital microscope at each stage: the rice, freshly harvested IMO 1, the sugar ferment, the IMO 3 and IMO 4 piles, and the beds at intervals after application. In practice this was harder than expected:

- We didn't know exactly what to look for or what our observations would mean, so it was hard to judge whether a culture was healthy, diverse or vital.
- Thin samples worked best; picking out single grains gave a clearer view than thick samples.
- The camera software failed, so we couldn't keep a photo record.
- Microscope work pulled time away from other farm work and from moving the cultures

through the process.

Now that the process itself is reliable, sending samples to a soil biology lab or trained assessor is likely the more practical route. Open questions remain: what observations are realistic for a farm, and what is a simple process for taking, preparing and reviewing samples?

Open question: what are the biological effects of overwintering on the young trees and their soil?

Time and Materials

Time

Most of the process is waiting. Active time is a few hours per batch.

Task	Active time	Waiting time
Rinse, cook and cool rice	About 1.5 hours	
Fill and bury the box	[add]	4 to 7 days (IMO 1)
Harvest IMO 1 and mix with sugar	[add]	3 to 7 days (IMO 2)
Build the IMO 3 pile and check it daily	[add]	5 to 6 days
Build the IMO 4 pile and check it daily	[add]	Until ambient temperature
Apply to beds	[add]	

Timing tips: start the rice in the morning. IMO 2 is forgiving, but don't let IMO 1 or IMO 3 go too long.

Materials and costs

Item	Cost
Cedar box (fencing boards from a local box store)	[add]
Chicken wire	[add]
White rice (12 cups per batch)	[add]
Brown sugar (2.5 to 3 lb per batch)	[add]
Bran	[add]
Spent mushroom blocks	On-farm
Tarp, cover cloth, compost thermometer	Usually on hand

Optional KNF Additions

Korean Natural Farming practitioners sometimes add other inputs at the IMO 3 stage, including fermented plant juice (FPJ), oriental herbal nutrient (OHN), brown rice vinegar (BRV), sea water, non-chlorinated water, humic acid and IMO 4 tea. We did not test these.
Fermented plant juice (FPJ) supplies plant-derived hormones, amino acids, soluble nutrients and the microbes carried on the plant material. It is used to stimulate vegetative growth and help seedlings and plants resist stress.
Oriental herbal nutrient (OHN) is a fermented herbal extract, typically of garlic, ginger, cinnamon, licorice and angelica. It is used as a plant tonic to support resilience and discourage pathogens, diluted for foliar sprays, soil applications or seed treatments.
Brown rice vinegar (BRV) adds acidity, acting as a preservative, pH buffer and penetration aid. It helps stabilize ferments and offsets the sweetness of sugar so mixes attract fewer insects.

Overall Reflections

The cultures looked good and smelled good at every stage. Whether the process is worth it is harder to answer: do the trees grow noticeably faster, and can you see more life in the soil? Farmers adopt many practices because they see results over time, and IMOs may be the same. Making IMOs took relatively little active time. Assessing them with sampling and microscopy took a lot more. Because the process itself takes only a few hours of active work and inexpensive materials, it is a low-risk investment for a farm nursery looking to increase soil vitality and diversity.

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