FIELD TESTED

Oyster Mushroom Production

Field Tested is a series of reports about farm tools that have been tested by Montana farmers to enhance their specialty crop production. The reports describe these farmers' findings to help others make informed decisions about their specialty crop businesses. Visit FarmLinkMontana.org/fieldtested to read more Field Tested reports. This project is administered by the Community Food & Agriculture Coalition with funding from the Montana Department of Agriculture Specialty Crop Block Grant Program.

AGAINST THE GRAIN MUSHROOMS | MISSOULA

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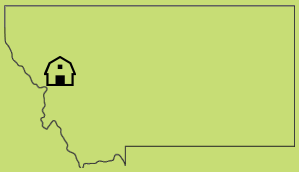
Against the Grain Snapshot

Location: Missoula, MT
Operator: Dave Victor
Acres: less than 1/10th acre
Crops: Gourmet mushrooms, primarily Oyster



INTRODUCTION

Against the Grain Mushrooms (ATG) produces gourmet mushrooms for restaurant and direct to consumer sales. Farmer Dave Victor saw an opportunity in the crowded Missoula local food scene. "Currently, there is a wide open market for fresh, local mushroom sales in Missoula but few producers with the knowledge and skill to fulfill market demand." Using a decentralized production system allows Dave to produce mushrooms in addition to his work as a vegetable farm manager in Missoula. He hopes that making his techniques publicly available will help farmers in other parts of the state add mushrooms to their crop mix.

AGAINST THE GRAIN

Against the Grain Mushrooms is a decentralized operation, operating on three sites across Missoula. Liquid culture work and grain inoculation are done at Dave's home lab, straw pasteurization and inoculation at a separate outdoor site, and mushroom fruiting is completed in a basement grow room. *Note: ATG is no longer in operation.*

OYSTER MUSHROOM PRODUCTION

Oyster Mushrooms grown on straw comprise the majority of production at Against the Grain (ATG). Dave has outlined his production system here and tracked yield, labor, and growth time. Production steps at ATG include mycelium expansion, grain inoculation, mycelium colonization, mushroom fruiting and harvest.

MATERIALS PURCHASED

- Pressure Cooker
- Impulse Sealer
- Electronic Tool Sterilizer
- Plastic Petri Dishes
- Test Tubes with autoclave rack
- Erlenmeyer Flask
- Innoculation Syringes
- Scalpel, Forceps, Innoculation Loop
- Wash Bottle
- Parafilm
- Digital Scale
- Hygrometer
- Polybags
- Sterilizable Airflow Spawn Bags
- Mushroom Cultures
    - Pleurotus eryngii - King Oyster
    - Pleurotus djamor - Pink Oyster
    - Pleurotus ostreatus - Tree Oyster
    - Pleurotus ostreatus var. columbinus - Blue Oyster

1. Mycelium Expansion

Mycelium expansion takes place in liquid culture (LC) in 2-3 weeks time. LC is made from 2 cups water, 1 Tbsp dextrose, and 1 Tbsp light malt extract. The mixture is sterilized and colonized with mushroom tissue. LC jars are stored out of direct sunlight, between 65° and 75° F.

2. Grain Inoculation

Once the liquid culture is fully grown, it is transferred to grain spawn for further growth. Rye grain is soaked for 12 hours, loaded into mason jars in a pressure cooker and sanitized for 70 minutes at 15 psi. Using an injection port, each jar is inoculated with LC and mycelium expansion takes between 10 and 14 days to complete at 75° F.

Time Progression of myceliated grain

3. Straw Pasteurization

Straw must be pasteurized to create a clean growing medium. Due to size constraints, Dave recommends hot water pasteurization rather than pressure sterilization (read more about the different techniques below). Water is heated to 175 degrees in a 55 gallon steel drum and straw is submerged in a large wire basket and held at temperature for 1 hour. At ATG, a hoist is used to lift the heavy wet straw which must be drained and cooled.

Pasteurized straw draining and cooling

4. Mycelium Colonization

Plastic bags are filled with alternating layers of 2-3 inches of straw and a handful of grain spawn. Each bag is firmly packed, tied off and a series of one inch, x-shaped slits are made 2-3 inches apart all over the bag to allow for fruiting. Bag is stored at 70 degrees until fully colonized. Humidity stays high inside the bag, therefore no additional humidity is needed as the mycelium colonizes the straw.

Uncolonized fruiting bags. Note the straw color.

Fully colonized bags at 42 days. Note the white color.

5. Mushroom Fruiting & Harvest

The emergence of baby mushrooms, called pinning, is the signal to move the bag to a fruiting space. The fruiting space should maintain 80-100% humidity, provide 12 hour on off cycle from a full spectrum light source and allow for periodic influx of oxygen. Oyster mushrooms are harvested as whole clusters when the cap of the largest mushroom in

the cluster goes from turning down to turning up. Mushrooms should be harvested before sporulation begins.

Mushrooms “pinning” or starting to fruit on sides of bag.

Freshly harvested oyster mushroom clusters.

Overripe mushrooms have visible spore production on gills.

Producer Health

According to Dave, Oyster mushrooms tend to produce lots of spores relative to other culinary mushrooms. Breathing in too many spores can lead to a condition called Mushroom Worker’s Lung, an inflammation of the alveoli within the lung. For indoor grow rooms, a ventilation system can simultaneously exhaust spore-laden if and bring in clean air. This is an important consideration when designing an indoor grow space, and should be included in a lease agreement to ensure that any necessary installations are allowed.

IMPACT: STERILIZATION VERSUS PASTEURIZATION

High quality mushroom cultivation requires sanitary conditions with minimal competition for the mycelium. To achieve these conditions, both sterilization and pasteurization are used at different times and for different substrates. Sterilization removes all potential microbial contaminants using temperatures above 250° F. At Against the Grain, small batches of liquid culture and grain are sterilized in a pressure cooker. Pasteurization removes most of the microbial contaminants using temperatures between 140 and 170 F. Remaining contaminants are out-competed by healthy and vigorous mycelium. At ATG, straw is pasteurized in a 55-gallon drum of water heated on a high BTU outdoor burner.

FARM ENHANCEMENT BY THE NUMBERS

Dave's production trial was limited by spore concerns in his leased production space (read more about this in Other Considerations). Dave tracked time and yields for his initial trials and shares what he learned in his own words:

> Producing oysters on pasteurized straw is a relatively easy way to begin growing mushrooms. The cost is low and little specialized equipment is needed. However, the labor cost is higher and the yield is lower than that seen by producers using more advanced sterilization techniques and equipment.
>
> [Mushroom] growers use biological efficiency when comparing strains and growing techniques. By definition, 100% biological efficiency occurs when 1 lb of fresh mushrooms is harvested from 1 lb of dry substrate, over multiple flushes.
>
> I produced 85 pounds of oysters per 100 hours of labor from pasteurized straw and had biological efficiency of 50%.
>
> I did not produce oysters using sterilized substrate. Growers using sterilized substrate can assume yields of 250 lb per 100 hours of labor with biological efficiencies between 100% and 200%.

ADDITIONAL RESOURCES

Montana Department of Agriculture Specialty Crop Block Grant Program: The purpose of this program is solely to enhance the competitiveness of specialty crops in Montana. Visit their website to find funding opportunities and more information. Search Montana SCBG.

Field Tested Reports and Videos: Find more reports about other projects and see videos of tools in action at the Field Tested webpage, under Resources on FarmLinkMontana.org

Farm Link Montana: A project of the Community Food and Agriculture Coalition to connect Montana's beginning farmers and ranchers with the tools they need to succeed: farmlinkmontana.org