Stacked Functionality greenhouse Use of Mushroom Production: Utilizing space under transplant tables to diversify crops and income

Questions? Contact
laurenkuzeee@gmail.com &
asicko@umich.edu

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BY: ANABEL SILKO & LAUREN KUZEE

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Introduction

Let's do it! But How?

Knowing we wanted to work on a project growing mushrooms at the Campus Farm, we pitched doing a Sustainable Agriculture Research & Education (SARE) project to the program manager at the University of Michigan Campus Farm, Jeremy Moghtader.

Jeremy was enthusiastic to support our project, but suggested that to emphasize sustainability in our SARE application by maximizing use of space and resources: growing mushrooms beneath transplant production tables inside of our farm's greenhouse.

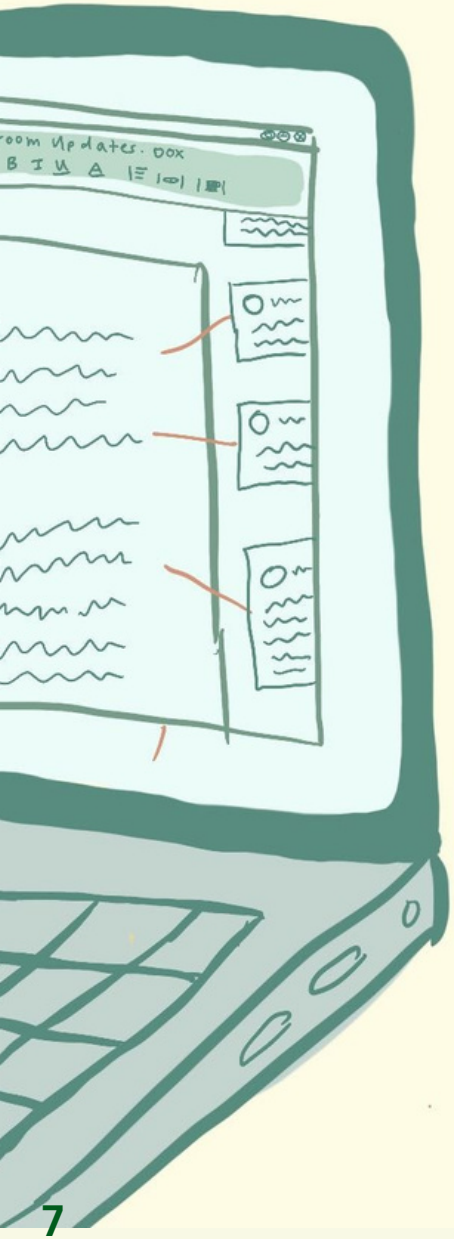
Most farms have limited revenue in the winter season, so this could potentially offer small farms another source of revenue during the colder months; using greenhouses that are already heated and capturing water falling through transplant tables (from watering seed starts) augments resource use during this period of the year.

So, we submitted an application with hopes that the SARE grant would allow us to evaluate the feasibility of mushroom production as a stacked use function with transplant production.

APPLICATION TIMELINE

OCT 2020

We began the grant writing process with little experience but lots of excitement! We divided up sections and got lots of editing help from Jeremy. After submission, there were 4 long months of waiting until we found out that we received the grant!



NOV 2020

- October 2020: Research and proposal writing
- November 2020: Proposal deadline
- March 2021: Proposal is accepted!

MARCH 2021

WE GOT IT!

- April 2021: Initial inoculations
- September 2021: First fruits

Materials

- Warm-weather mushroom spawn from Field and Forest Products
- Wine cap spawn in sawdust (5.5 pound bag per 16 square feet, $22/5.5 lb bag)
- Oyster spawn in sawdust (24 oz of spawn per each log stack of 18" diameter biscuits, $24/154 oz. bag)
- Oyster spawn on plugs (100 plugs per 10 linear feet of logs, $12/100 plugs)
- Shiitake spawn on plugs (100 plugs per 10 linear feet of logs, $12/100 plugs)

Left: Plug spawn, Right: Grain spawn, Field and Forest Products

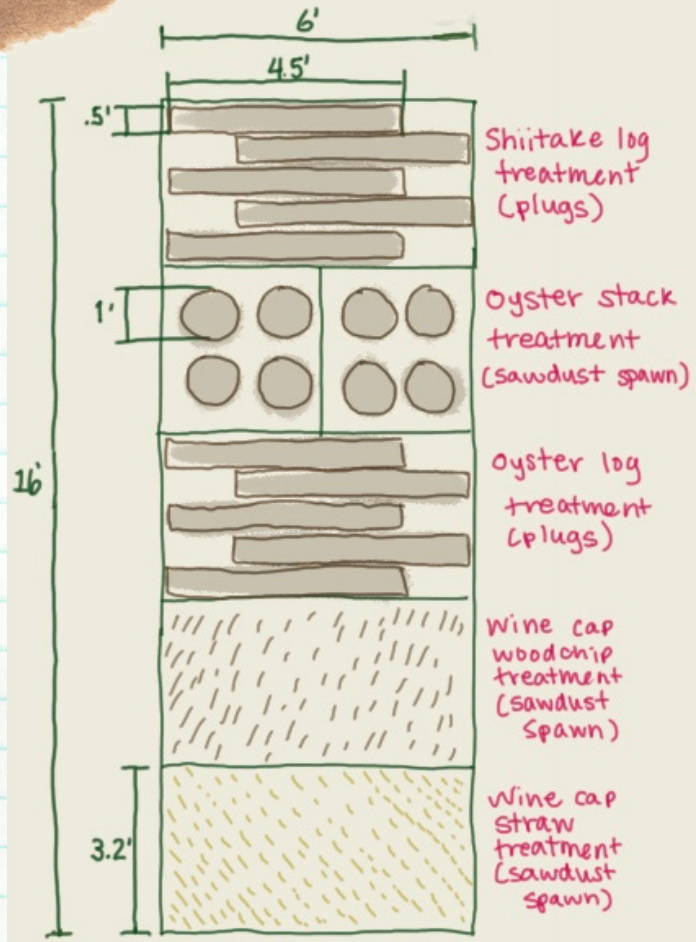
- Soy wax to seal plugs into logs from Field and Forest Products (5 lbs for 30 4.5 ft logs, $10/1 lb wax)
- Specialized drill bit to create holes for plugs from Field and Forest Products ($16.00)
- Invasive buckthorn wood chips (sourced from the botanical gardens)
- Straw/hay (1/2 bale per 18 square feet, sourced from local farm supply at around $5/bale)
- 4.5-5 foot long logs
- 1-foot diameter logs for stacking

Total budget depends on the space you are working with!

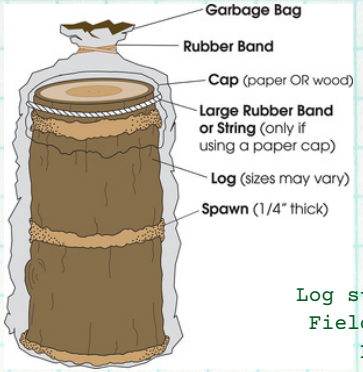
Layout

The Campus Farm at the University of Michigan is a smaller diversified vegetable farm with most production occurring between May and November. During the off-season, we have less product to generate income, but we do have a greenhouse that is heated year-round, as well as space beneath transplant production tables.

We hoped that a SARE grant would help us diversify incomes during the off season by exploring mushroom production. The drawing below shows the empty space beneath a table with example logs. We considered how that could be the ideal, shady, moist location for mushroom logs.



This diagram illustrates how we chose to break up the "treatments" under three different tables into 5 sections.



Log stack diagram: Field and Forest Products

PROCESS!

This collection of photos is from the spring of 2021, when we began the inoculation process.

We inoculated the wood chips and straw beds on 3/19 2021, the logs on 4/20 and 4/22 , and the wood discs 5/8/2021

We were lucky enough to have the team at Matthaei botanical gardens cut logs for us at the appropriate size

We began to notice mycelium growth in the beds as soon as June, but soon after the growth seemed to falter.

After about a month of waiting, we saw mycelium growth on our stacks. We let them grow over the summer and removed the bags on 8/3 to let them grow.

PROCESS Part 2

MUSHROOM GROWTH!

By the end of the summer, we had noticed new growth that had been aborted on our stacks (left). By November 2021, some of our shiitake logs had small flushes of mushrooms near the bottom. We thought that the moisture level near the bottom was better for the mushrooms. In December we soaked the logs in cold water to bring out another flush. This flush happened later in the month

Tiny Shitake

At the beginning of December 2021, we decided to make more beds of the straw wine-caps, because that is where we saw the most progress. to the left you can see the straw beds that we inoculated in January 2022.

Conclusion

In general, we have concluded that mushroom production in a greenhouse necessitates extra labor and resources specifically for the mushrooms; this type of mushroom cultivation is much less passive than we initially thought. If you are a farmer looking to diversify your income during slower seasons with mushroom cultivation in greenhouses, we would recommend growing shiitake mushroom plugs in logs or wine cap mushrooms in a bed of straw. Both of these varieties will require extra care such as ensuring they have shade and are moistened regularly.

You may also stimulate shiitake fruiting by "force fruiting," or soaking the logs a couple weeks after inoculation for between 24 and 48 hours to re-wet the log. It could also be possible that this type of mushroom production would be better suited to a farm that does not have diversified production, meaning that there is always one type of transplant on transplant tables above the mushrooms, providing more consistent shade and moisture conditions. Growing mushrooms at a farm like this could mean that the production might be less hands-on.

Tips for implementation:

- Timing is important as it greatly affects temperatures and moisture levels in the greenhouse. Inoculating logs, totems or wine cap beds should be done in October, when spawn can run during cooler greenhouse conditions and then initiate fruiting once the space is heated with the start of greenhouse operations for the season in January or February.
- Shade cloth should be used to cover tables when numbers of transplants are insufficient to keep mushroom production areas covered. This will reduce drying of the wood and or straw.
- If adding supplemental moisture to wine cap beds, careful observation should be taken to only add extra water when needed.
- Inoculated logs should likely be kept in a non-fruiting position during mycelium runs. This means they should be laid on the ground to encourage more uniform moisture content and greater ability to effectively add moisture and then shifted to fruiting positions after soaking. Having some under table greenhouse space reserved as fruiting space would likely be ideal.
- Since soaking/forcing is likely necessary for logs under greenhouse conditions choosing smaller diameter logs in the 4 inch range may be more ideally suited.

- We found that the production of mushrooms under our transplant tables required more active management than we had anticipated due in part to the variability of environmental conditions under the tables and in the greenhouse.
- In this context, the primary demands of the vegetable production operation during the height of the growing season often meant extra hands were not available to provide additional mushroom care.

- As we suggest in our tips for implementation section, further modification of the timing of inoculation may produce better results in terms of allowing spawn to run at times when greenhouse is cooler (in the fall) and then to fruit before it gets too hot in the spring as well as before farm work pulls staff in other directions.