CONTROLLED ENVIRONMENT CHAMBER

Center drive lane + two fruiting chambers - approximately 600 sq. ft.
Used for stacking mushroom logs during forced fruiting.

CONTROLLED ENVIRONMENT CHAMBER
by Mitch Gilbert.

The Laird, Norton Foundation of Seattle, Washington has made a challenge/match grant to the Forest Resource Center to build a controlled environment chamber for force-fruiting Shiitake mushrooms. Matching contributions have been pledged by: Rochester Materials Co. (ROMAC) of Rochester, MN; Spancrete Midwest Co. of Osseo, MN; Garn, Inc. of St. Paul, MN; Tuohy Furniture of Chatfield, MN; Controlled Environment Growing of Ottertail, MN; and Hurt Architecture of Dakota, MN. Upon receipt of further contributions completing the Laird, Norton match, construction will begin this summer.

Because fresh Shiitake mushroom prices vary dramatically with the season of the year ($4 to $20 per pound retail) and because the quality and volume of yield are dependant on environmental conditions, a logical extension of the Forest Resource Center's educational efforts is to demonstrate the possibilities of indoor cultivation. In an environment with controlled temperature and humidity, logs may be artificially forced to fruit 3 to 4 times per year. Thus, the duration of an investment in Shiitake growing can be shortened accordingly and growers can produce mushrooms during the season of optimum prices, rather than strictly as weather permits. An added advantage of controlled environment fruiting is the ability to produce more consistant volumes and higher quality mushrooms.

For demonstration purposes, a structure for controlled environment should be of a size and type that is applicable to small commercial ventures. Cost and difficulty of construction, heating and cooling, and
long term maintenance must be minimal. Space must be very efficiently utilized. Provisions must be made for grading, packing, refrigeration and drying. Subterranean or bermed construction (essentially a basement with a roof) would require the least winter heat or summer cooling. A Carn wood heating system would consume spent Shiitake logs to heat a large reservoir of water to meet heating requirements for extended periods of time. The humidity control equipment as well as the electrical and plumbing systems will use current, energy efficient, greenhouse construction methods. The drawing above is our conception of such a building. Note that this is not a blue print. An architect (Robert Hurt) is being engaged to design a working print.

Many potential growers have expressed an interest in converting existing agricultural buildings for controlled environment Shiitake culture. A demonstration building should have environmental controls adequate to manipulate and observe the effects of varying temperature, humidity, air flow and lighting. Our observations should contribute to efficient operation and recommendations for low cost building construction or conversion. This information will help us help others make Shiitake mushrooms a profitable, locally grown forest crop.

Comments or suggestions on design from readers would be appreciated, as well as any contributions (we still need $4,000) towards matching the Laird Norton Foundation’s grant. We look forward to being able to answer more of your questions on indoor cultivation of Shiitake in the near future.

Figure 1. Stereum spp. on pin oak log (bottom log). Stereum is a common white rot fungus which attacks wood which is sound of little damaged, such as bed logs. This fungus was once a major threat to the structural timbers in boats.

WEED FUNGI AND WOOD DECAY by Mary Ellen Kozak and Joe Krawczyk.

One primary concern to the Shiitake farmer is the prevention of contamination of bed logs by fungi other than the Shiitake fungus. Weed fungi can wreak havoc with bed logs and quickly turn your money and efforts into a mass of rotting unprofitable wood.

The original intent of this article was to describe to Shiitake farmers the weed fungi commonly encountered on logs in the laying yard. However we felt that what might be of significant help is a brief description of the mechanics of wood decay. This may give the grower a greater understanding of what's happening chemically inside the log. In future articles we will deal with specific contaminant fungi.

Lentinus edodes (the Shiitake fungus) is a rather unique organism because it does what many creatures cannot - it can make a feast out of wood. Many organisms utilize plants as their food source - but wood is generally not a preferred item to slice up and sautee in the frying pan.

(Continued on Page 3)
White rot fungi can do what most fungi cannot; they can degrade the lignin molecule. This means that when the Shiitake fungus is introduced into a bed log all that will remain after the Shiitake fungus has utilized all the food it can will largely be cellulose and some hemicelluloses. The first visible evidence of the fungal attack is the appearance of a whitish stain in the woody tissue as a result of delignification. This decomposition is not discernable in early stages, eventually the wood becomes bleached and brittle because the fungus is actually thinning the cell walls. Because white rot fungi are good degraders of hardwoods, there are other white rot fungi which are weed fungi on bed logs. Stereum sp. is one of these. This white rot fungus becomes established quickly and can outcompete the Shiitake fungus. Logs infected with Stereum should be removed from the laying yard promptly. (See Fig. 1.)

The second group are brown rot fungi. These fungi are different from the white rot fungi because they cannot degrade lignin but can very effectively degrade cellulose. Brown rots are very important in the conifer forest as they help decay much of the biomass of downed timber. They "pick the bones", utilizing cellulose and leaving a skeleton of lignin behind. These fungi cause the wood cells to shrink and crack, Daedalea is a good example of a brown rot fungus. The fruiting body in Figure 2 is only an expression of the undesirable competitive decomposition processes going on inside the log. Now that we know what happens inside the log as it decays we will be able to investigate specific white and brown rot "weed fungi", their hosts, and how to manage bed logs to reduce the chance of "weed fungi" establishment.

MARY ELLEN KOZAK and JOE KRAWCZYK

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Bob Burchett - Chairman of Geode Wonderland R.C. & D. discussed Shiitake mushroom's economic development potential at three seminars held in Iowa.

Two thousand plus individuals attended Shiitake seminars sponsored by three R.C. & D.'s in three states; Iowa, Illinois and Wisconsin. R.C. & D. stands for Resource, Conservation and Development. It is a program of people helping people improve their economy and environment through conservation, development and better utilization of natural and human resources. All U.S.D.A. agencies provide technical assistance to the R.C. & D. Council. The Soil Conservation Service provides leadership for the program. If you are interested in having an educational shiitake seminar in your area or would like assistance in establishing a Shiitake growers association, contact your local R.C. & D. Coordinator.

Concerning Spawn by Bob Harris

On receipt of spawn, it should be refrigerated unless used in a week or so. Allow to sit at room temperature for two days prior to use, if removed from refrigeration. Usually it will last 6 months in refrigeration. Viability can be checked by removing two or three plugs from the bag. Clear off the large white mycelial growth and incubate at 70-75°F for two days in a plastic bag with a damp paper towel inside for humidity. If the white mycelial growth reappears, the plugs are viable.

There are many characteristics of a strain which make it desirable or not depending on the climate, type of wood used, quality of mushrooms produced, etc. Mycelial growth can vary with temperature. Some strains require more warmth, others grow well at lower temperatures. Some of these are more aggressive and resistant to contaminants. The fruiting of strains will vary according to temperature. Some tolerate higher temperatures to initiate fruit. Production will also vary in yield of first and later flushes as well as overall yield. Some produce more yield, but with smaller mushrooms, other yield fewer and larger mushrooms. The quality of the mushrooms will vary too. Some have thicker flesh, better form, etc. In general the strains with fast growing mycelium at lower temperatures will produce fewer mushrooms, but of high quality. They are usually large, darker, the margins tend to remain unrolled longer, and have thicker flesh, thus are better for drying. The strains requiring warmer temperatures for good spawn run are

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usually less resistant to contaminants, will produce more mushrooms, and are more tolerant of higher temperatures when initiating fruiting. The mushrooms tend to be smaller, with thinner flesh, and tend to flatten out when fully mature. These strains may even fruit earlier after the spawn run if the proper temperature is maintained during the spawn run. So called year around strains are a result of hybridization of the two basic types. Selection has created certain year around types that if properly managed can give the highest overall yield, as each fruiting will be good although the first may not be as high as the warmer strains. The year around strains can be very disease resistant and tolerant of a wide range of temperatures for fruiting - depending more on the cycle of wet and dry conditions. Much of the current strain research is involved with combining the aggressive mycelial growth, disease resistance characters with high yield, temperature tolerance, fast fruiting ones while retaining good quality mushrooms. In addition to these basic growth patterns of course will be the adaptation of these strains to moisture conditions, thus multiplying the variance factor of the strains.

As a result of the complexity involved with strain selection, strains should really be tested for several years by a spawn manufacturer prior to release for sale. In this way they can best tell you about the profile of the strains they sell. Merely isolating a strain from a mushroom that fruited one time in Minnesota, and calling it a Minnesota type is no guarantee of the overall yield and performance. Remember all Shiitake strains originated in the Orient, not the U.S. At Mushroompeople all of the strains sold have been tested for at least two or more years prior to sale in our modern labs using the latest accelerated growing procedures. In this way the qualities of a particular strain can be best evaluated. I have been using two of the currently sold strains since 1978.

I recommend that people try different strains themselves to see which work the

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Inexpensive, home made fruiting chamber. Logs are enclosed in a plastic structure to hold humidity provided by a household humidifier. Photo by: Grand Rapids Shiitake Project.

best under the conditions employed. Using the Box Method with short logs and accelerated growth can be most helpful for testing strains without lots of work. Normally spawn is inoculated with ten inch spacing and one row of plugs per inch of diameter of log, and offsetting each row so plug sites intersect the space of the previous row. If the plug number is doubled or tripled the time until fruiting can be shortened to 7-8 months, and Shiitake can then outcompete many contaminants. This increases initial labor, but can be useful with problem wood types such as aspen.

BOB HARRIS and Jennifer Snyder own and operate Mushroompeople in Inverness, California.

GENERAL SUPPORT GRANTS

The Forest Resource Center wishes to acknowledge the general support for Shiitake related activities and general services received over the past year from:

GOVERNOR'S COUNCIL - ON RURAL DEVELOPMENT
MINNESOTA DEPARTMENT - OF NATURAL RESOURCES
UNIVERSITY OF MINNESOTA - AGRICULTURAL EXTENSION SERVICE
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HELPFUL HINT by B.H. Management of contaminants may be assisted by application of Benomyl at felling, post inoculation, and spawn run in a spray dilution of 250-500 ppm.

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BOOM OR BANE OUT IN THE WOODLOT
by Mitch Gilbert.

The growing of shiitake mushrooms has noteworthy economic potential in the United States. At the Forest Resource Center we hope to see other benefits too. People obtaining shiitake logs from their woodlots should give some thought to the other values and potentials that their woodlands hold. Some deliberate management activities can dramatically increase growth and value of the timber, and improve wildlife habitat.

What is this management hocus-pocus? In a nutshell, it is controlling trees' competition for sunlight, soil and moisture, usually by cutting or occasionally by chemical application. If timber production is your objective, competition control can concentrate growth on trees of desirable species, shape or size. You can choose to grow bigger and better quality trees in less time. If wildlife habitat is your objective, you can manage to increase wild fruit and nut crops or benefit types of vegetation that are especially important to wildlife for food, breeding space or cover.

What I've just outlined is a sort of definition - not a recipe. Because the response to any management varies with the trees' species, age, history and soil conditions, there are particulars in your woodlot that need to be examined.

If the unrealized potentials in your woodlot interest you, I have two suggestions. The first is to find a good book on local tree and shrub identification. The second is to consider obtaining technical help to get started. Some good advice on assessing your situation and identifying alternatives - to fit your objectives - might save a lot of time and trouble. It might also fatten your pocket book down the road.

Some sources of assistance include your state's department of conservation or natural resources, county or university extension programs, the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, or private and industrial foresters in your area. If you're unsure about who to contact, your county extension agent is a good place to start. If you live in the Midwest, I would encourage you to stop by and visit the Forest Resource Center to see our forestry demonstration areas.

In upcoming newsletters, we will address specific forest management activities. These will include natural and artifical regeneration of oak, management plans, how to complete an inventory of your woodlot and the tax ramifications of different forest activities, to mention a few topics. Growing shiitake mushrooms can be a good way to increase your income. Depending on how you obtain your shiitake logs, it can be a boom or bane for your woodlot.

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WHAT IS THE SOUTHEASTERN MINNESOTA FOREST RESOURCE CENTER

The Southeastern Minnesota Forest Resource Center's objective is to improve the management of our hardwood resources on private land. The clientele for whom the Forest Resource Center is designed includes landowners, university students, local community education, secondary and elementary education programs, professional foresters and forest scientists. Working in cooperation with Minnesota's Department of Natural Resources, the Forest Resource Center is utilizing an existing facility that is located in the midst of 900 acres of forest land in the Richard J. Dorer Memorial Hardwood Forest near Lanesboro, Minnesota. Educational programs are being developed in conjunction with the University of Minnesota, College of Forestry, the Agricultural Extension Service and the Minnesota Department of Natural Resources. These accelerated educational/demonstration programs will increase awareness, and the level of knowledge and skills of forest landowners and other participants. Forestry specialists are convinced that demonstration sites, when coupled with personal contact, are the best method to encourage forest owners to implement necessary forest management practices. These forest management skills will help woodland owners move to optimum management on their lands. This will result in improved economic development and quality of life in the region.

Educational classes for adults offered by the Forest Resource Center include programs on black walnut, marketing timber, fuelwood management, timber taxes, woods and wildlife, the cultivation of Shiitake, the Japanese forest mushroom and a comprehensive forestry shortcourse. Ask to be placed on our mailing list if you would like to receive more information about when and where these classes will be held. Programs for elementary and secondary students and other youth groups are also available.

The Forest Resource Center offers many services for people of all ages including quality educational programs, demonstration areas, which depict woodland management techniques and provides a resident forester, who is available 7 days a week when forestry advice is needed.

Private financial support for the educational and other activities of the Forest Resource Center will ensure their continued success. You are invited to become a contributor to this important work by sending your check to the Southeastern Minnesota Forest Resource Center, Rt. 2, Box 156 A, Lanesboro, Minnesota 55949. Donors of $1,000 or more are specially recognized as Patrons of the Forest Resource Center. All gifts to the Forest Resource Center are tax deductible to the full extent of the law and the Forest Resource Center is classified by the IRS as a 501(C)3 non-profit organization.

Your financial support will help us continue to reach out and let others learn about southeastern Minnesota's greatest renewable resource, our beautiful hardwood forest.

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Calendar

April 12, 1985 - Black Walnut Mgt Seminar
April 19, 1985 - Marketing Timber Seminar
May 3, 1985 - Woods and Wildlife Seminar
October 12, 1985 - Shiitake Growers Meeting
For more information contact the F.R.C.