

Introduction to Mushroom Cultivation

STOCKSCH 290M

University of Massachusetts, Amherst
Online, Spring Semester, 3 credits
Instructor: R. M Davis

Course Overview and Objectives:

The course introduces methods of growing edible mushrooms, including culture maintenance, basic mushroom substrate preparation, composting, spawn generation techniques, inoculation methods, harvesting, and pests and pest management of mushrooms. Students will understand the principles of mushroom cultivation, acquire the practical knowledge to grow several species of fungi, and will have the confidence to approach the mushroom industry for potential employment opportunities. The history of mushroom production and recent trends in the diversification of edible mushrooms will be discussed. Every step in small-scale and industrial commercialization of edible mushrooms, from spawn production to mushroom harvest, will be covered. Lessons and reading material include an overview of the importance of fungi in nutrient recycling and symbiotic associations with plants. Construction of growth chambers and greenhouses will be presented for the small grower with little capital. Small business opportunities and marketing mushrooms will also be included. Students will learn the unique vocabulary used in the industry and will be able to communicate with growers upon successful completion of the course. Three independent papers on various aspects of growing mushrooms will be required in the course. The objectives of the course are to introduce students to basic mycology as it relates to growing mushrooms, give students practical knowledge to begin growing mushrooms at home or with industry, and provide a foundation for starting a small business in mushroom cultivation.

Course Structure:

Each week students will be provided with a list of all the work to be completed during the week of class. These will include required readings from a text as well as detailed, posted, written instructor notes on every topic included in the course. There will be discussion questions to which students will post responses in the discussion forum section of Blackboard. Three papers are required (described below). Two quizzes and a final exam consist of short answers to questions on material covered in the class.

Texts: Required: Lynch, T. (2018). *Mushroom Cultivation*; Recommended: Stamets, P. (1993). *Growing Gourmet and Medicinal Mushrooms*

Grading:

Grades will be determined by the results of two quizzes (10% each), three written assignments (10% each), a comprehensive final examination (25%), and class participation via written responses on Blackboard (25% of total).

A = 93-100 total points; A - = 90-92; B+ = 87-89; B = 83-86; B- = 80-82; C+ = 77-79; C = 73-76; C- = 70-72; D+ = 67-69; D = 60-66; F = 59 or below

Accommodation Statement:

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Academic Honesty Statement:

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

Outline of Content:

Introduction to Mushroom Cultivation

Lecture 1. Introduction; History of Mushroom Production

Historical uses of mushrooms; early cultivation; domesticated mushrooms today; other domesticated fungi. Readings: Posted instructor handouts.

Lecture 2. Sterile Technique and Culture Maintenance

General sanitation (clean hands, bench, etc.); sterilizing transfer tool; working with a HEPA filter; proper storage of cultures; starting cultures from a spore print; master spawn jars; use of pressure cookers, autoclaves, and retorts. Readings: Posted instructor handouts.

Lecture 3. Fruiting substrates

Primary and secondary decomposers; wood substrates; other sources of cellulose; pasteurization; biological vacuums; selective and semi-selective substrates. Readings: Chapter 3 in Lynch, T. 2018. Mushroom Cultivation.

Lecture 4. Substrate Preparation- Straw and Sawdust Blocks

Incubation; spawn run and colonization; ventilation and humidity management; Readings: Posted instructor handouts.

Lecture 5. Mushroom discussion-Enoki , Oyster, and Shimeji

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Chapter 4 in Lynch, T. Mushroom Cultivation.

Lecture 6. Mushroom Biology and Fungal Genetics

Features of mushrooms; characteristics of mushroom-producing basidiomycetes; mycorrhizae definition; fungal genetics; mating strains and compatibility; importance of clamp connections in breeding. Readings: Chapter 1 in Lynch, T. Mushroom Cultivation and instructor posted handouts.

Lecture 7. Spawn Generation Techniques; Inoculation Methods

Cloning mushrooms from fruiting bodies or hyphae; proprietary claims; agar characteristics and uses; stock culture maintenance and storage; first and secondary spawn generations; grain and sawdust spawn substrates; inoculation techniques. Readings: Posted instructor handouts.

Lecture 8. Mushroom discussion-Shiitake and Reishi

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Posted instructor handouts.

Lecture 9. Shiitake on logs

Techniques for growing shiitake on natural logs in the backyard; optimum conditions for incubating inoculated logs; methods to stimulate fruiting. Readings: Chapter 2 in Lynch, T. Mushroom Cultivation.

Lecture 10. Mushroom discussion- Black Poplar and Button

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Posted instructor handouts.

Lecture 11. Agaricus production: Phase I Composting

History of button mushroom production; one, two, and Dutch systems of production; composting outdoors, in tunnels, or silos; horse manure compost and synthetic compost; phase I recipes; timelines for finished composts; characteristics of compost at filling; nitrogen-rich-lignin-humus-complex; calculation of carbon:nitrogen ratio in compost. Readings: Chapter 5 in Lynch, T. Mushroom Cultivation and posted instructor handouts.

Lecture 12. *Agaricus* production: Phase II Composting

Pasteurization and conditioning; characteristics of compost at spawning; spawning and spawn run. Readings: Posted instructor handouts.

Lecture 13. *Agaricus* production: Casing, Pinning, and Incubation

Options for casing layer; irrigation; rhizomorphic growth prior to pinning; optimum temperature and humidity for fruiting initiation; flushing the atmosphere in the fruiting room; harvest; postharvest cookout. Readings: Posted instructor handouts.

Lecture 14. Mushroom discussion- Lion's Mane and Maitake

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Posted instructor handouts.

Lecture 15. Fruiting Containers; Evaluating Mushroom Strains

Plastic bags, bottles, boxes; characteristics of productive strains on agar plates; senescent strains; optimum carbon dioxide levels. Readings: Posted instructor handouts.

Lecture 16. Mushroom discussion; Other Cultivated Mushrooms-Straw, Wood Ear, Nameko

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Posted instructor handouts.

Lecture 17. Mushroom discussion- Morel production

Morel life history; commercial production successes and failures; culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: Instructor posted handouts.

Lecture 18. Mushroom discussion-Wine caps and inky cap production

Backyard production; culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest. Readings: pages 63-67 in Lynch, T. 2018. Mushroom Cultivation.

Lecture 19. Pest, Disease, and Weed Control; Abnormalities

The role of microorganisms in compost; anaerobiosis; recycling; contaminants in other substrates; *Penicillium*, *Trichoderma*, *Aspergillus*, and *Rhizopus* and other molds; diseases and their control; weed molds; flies and mites and their control; abnormalities with abiotic origins. Chapter 6 in Lynch, T. 2018. Mushroom Cultivation and instructor posted handouts.

Lecture 20. Small-scale Commercialization of Edible Mushrooms

Choice of mushrooms for the small grower; minimum resources needed to start production; capital outlay; retail expectations; profit margins; small business models. Readings: Chapters 7 and 8 in Lynch, T. 2018. Mushroom Cultivation.

Lecture 21. Trouble-shooting

Diagnosing problems; causes and solutions; risk analysis of backyard production of button, oyster, shiitake, and wine caps. Readings: Instructor posted handouts.

Lecture 22. Mushroom Nutritional and Medicinal Value

Protein, carbohydrate, fat, mineral, and vitamin content of various mushrooms; medicinal mushrooms; stimulating vitamin D production in mushrooms. Readings: Instructor posted handouts.

Lecture 23. Other Edible Fungi; Biological Efficiency

Production of unusual or novel mushrooms; production of secondary mushroom products; *Cordyceps* production. Readings: Instructor posted handouts.

Lecture 24. Collecting Wild Mushrooms

Mushroom toxins; popular mushrooms collected in the wild and their value (porcini, chanterelles, truffles, and more); how to identify mushrooms. Readings: Readings: Instructor posted handouts.

First writing assignment

Approximate length one page single-spaced, 12 pt font

Hot topic! Find a current or recent article that has appeared within the past few years in the popular printed media (web, magazine, newspaper, etc.) that relates how mushroom production might provide a benefit to the environment or human health; topics might include sustainable food production, bioremediation, pest control, medicinal mushrooms, and so on. State the overall theme of the article, summarize key points, and indicate how it relates specifically to our discussions on growing mushrooms. If the author expresses an opinion (e.g., an editorial), be sure to indicate what that opinion is and provide your viewpoint.

Second writing assignment

Approximate length one to two pages single-spaced, 12 pt font

Business plan for growing mushrooms. Choose one of the mushrooms discussed in class and develop a business plan for producing that mushroom for profit. Include a) source of the culture, b) spawn production (assume you are producing your own), c) substrate type and preparation, d) spawn run (colonization) room and environmental conditions, e) pin initiation (environmental conditions), f) harvest (choose a biological efficiency based on class discussions), and g) storage and delivery. Estimate production costs, yields, price of your product, and profits (or losses!). Also include a timeline of each step from substrate inoculation to harvest.

Third writing assignment

Approximate length one to two pages single-spaced, 12 pt font

Problem solving. Each student will be assigned a yield-limiting production or pest problem. Identify the cause of the problem and provide specific methods to mitigate the problem. These methods must be realistic and available to the typical cultivator. For example, you are assigned a problem with production of the button mushroom on compost. At harvest, some of the bed is producing normally but areas of the bed are black (i.e., devoid of mushrooms). Instead, there is a powdery growth of bright green spores on the surface of the bed where mushrooms were expected. State the cause and reasons for your conclusion. Provide two methods of mitigation, in detail, such as sanitary techniques to avoid the introduction of the pathogen and methods to restrict the spread of the pathogen in the bed, such as covering the affected area on the bed with salt, which eliminates the potential of spread of the mold spores.