



4-H Member's Guide

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Growing

Button Mushrooms

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Contents

- Getting Started
 - Equipment
 - Trays
 - Compost
- Growing Mushrooms
 - Spawning
 - Casing
 - Growth
- Harvesting Mushrooms
- Glossary
- For More Information
- Sources of Mushroom-growing Kits and Spawn

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Getting Started

The cultivated button mushroom *Agaricus bisporus* (*A. brunnescens*) can be grown at home with the proper equipment and care. Growing mushrooms is considerably different from growing plants because mushrooms do not require sunlight. They can be grown in any dark corner or unused shelter where temperatures are cool and ventilation is adequate. A mild even temperature is essential, so the best times for growing mushrooms are spring and fall.

Equipment

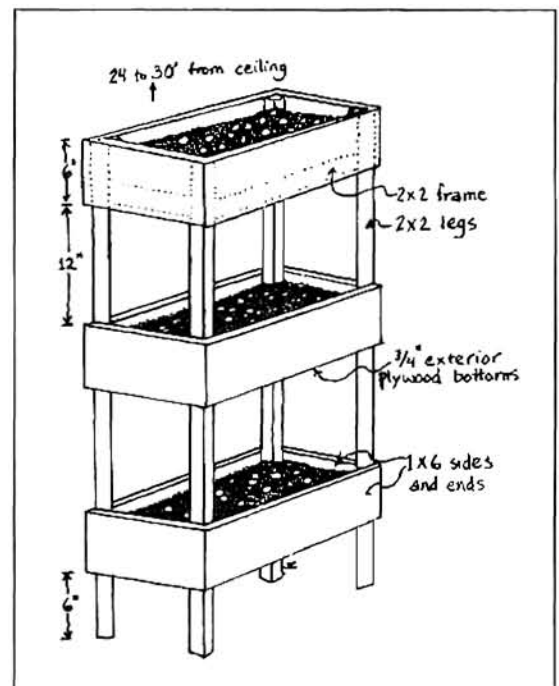
The following equipment is needed to grow button mushrooms:

- trays
- a pitchfork
- a watering can or hose
- straw
- manure
- gypsum
- a thermometer
- spawn (ordered when compost is ready)
- a pump mist sprayer
- peat or sterile soil
- a sieve

Trays

Mushrooms are usually grown in wooden trays. These may be any size as long as they are 6 to 12 inches deep. Trays 2 by 3 feet wide are commonly used because they are easy to carry when empty. They can be made from scrap lumber and should be held together with screws, rather than nails, for durability. Provide ventilation, beneficial for mushroom growth, by placing the trays on bricks or pieces of two-by-four lumber. For adequate air circulation, stacked trays should have 12 to 18 inches between each tier and be 24 to 30 inches from the ceiling.

Place the trays in a cellar or shed, under a table, or in a cool room. Apartment superintendents may allow you to keep trays in a boiler room or similar location. Placing some trays in different locations limits the spread of insects and diseases to only parts of the crop. Wherever the trays are placed, keep the area free of rats and mice and screen any windows to keep out insects.



Stacking trays to grow mushrooms

Compost

Compost preparation should begin about 5 weeks ahead of the desired spawning time. A pitchfork, a watering can or hose, straw, manure, gypsum, and a thermometer are needed to prepare the compost. About 1/2 ton of compost will fill 60 square feet (ten 2-by-3-foot trays) and yield from 100 to 150 pounds of mushrooms. Each 2-by-3-foot tray will use about 100 pounds of compost and yield 10 to 15 pounds of mushrooms.

The most important component of the compost is manure. The "hotter" (more rich in nitrogen) and fresher it is, the better. The best manure is that obtained from horses. Chicken, turkey, rabbit, sheep, goat, and even elephant manures can also be used. Cow and hog manures are very low in nitrogen and therefore undesirable. Check with local farmers and zoos for manure and straw. They may be glad to supply you with ample amounts! The circus or county and state fairs are also possible sources of manure and straw. Do not use manure from a veterinarian's

stable, or any other manure that may have medicines in it, because it can harm the mushroom spawn.

Thoroughly saturate the manure with water, if necessary, just to the point of runoff. Using a pitchfork, mix an equal volume of straw, which has been soaked in water for a day, with the manure. As you toss the manure and wet straw together, sprinkle the mixture with gypsum (hydrous calcium sulfate). Gypsum gives the compost good consistency by helping to avoid a sticky texture. For 1/2 ton of compost, add 20 pounds of gypsum (2 pounds gypsum for each 2-by-3-foot tray). Gypsum is available from local building supply companies at a low cost.

Build the compost pile preferably under cover and on a hard surface, such as a cement floor, to discourage insects from laying eggs in it. Once the compost is made, let the pile rest. Cover small amounts of compost with wet burlap and water the burlap to keep the pile moist. Use a stick thermometer or dairy thermometer to judge when the pile should be turned.

When the temperature reaches 160° to 170°F, a chemical change called caramelization has taken place. Turn the pile literally inside out, sprinkling water on dry or white parts. Cover the pile if necessary to keep it moist and allow it to rest, checking the temperature every other day. When the temperature again reaches 160° to 170°F—the caramelization level—turn the pile as before, cover it, and let it rest. Repeat this procedure two or three more times or until the odor of ammonia cannot be detected. This ensures even caramelization throughout the mixture.

The compost is ready for spawning when the manure no longer gives off the smell of ammonia, the straw is broken down into pieces about 3 to 5 inches long, and the texture of the mixture is fairly fluffy, not sticky and clumped. When turning the compost, always check for these conditions. Once the compost is ready, allow it to rest one more week and keep it moist or covered. Then add the spawn.

Growing Mushrooms

Spawning

Dry spawn is a pure culture of the mushroom mycelium in a dormant state. The mycelium is the body of the fungus—its "roots," "stems," and "leaves"—which grows throughout the compost and gives rise to the mushrooms, or the "flowers" of the fungus. The easiest spawn to use is dry flake spawn; dry brick spawn can also be used. Suppliers of spawn are listed below. Try to order from the nearest source.

Mix dry flake spawn into the compost at a rate of about 1 quart per 15 square feet of growing surface area (1 to 2 cups for each 2-by-3-foot tray). Pile the spawned compost into the wooden trays in heaps. It is easiest to fill the trays where they are to stay, because

once filled they are heavy and difficult to move. After 24 hours, press the piles flat into the trays using a brick or a piece of wood. Leave about 2 inches of space at the top of each tray.

If dry brick spawn is used, pile the compost into the trays and place walnut- to egg-sized pieces of the brick spawn into the compost about 1 to 2 inches deep and 6 inches apart. Cover the pieces of spawn with compost and press the spawned compost down flat as previously described.

In 2 to 3 weeks, the compost should be covered with fine white webs of mushroom mycelium. During the first weeks, increase the temperature to between 65° and 70°F (18° to 21°C) if possible. In addition, it is important to keep the compost

moist by misting it twice a day with water. Do not water the compost by sprinkling or pouring water onto it; this not only disrupts the delicate mycelium but also may make the compost too wet for proper mycelium growth and development.

Casing

To stimulate the formation of mushrooms, apply a layer of peat, peat mixed with soil, or loamy soil over the mycelial growth on the compost. This layer is called the casing. To prepare the casing material, use a sieve to remove any sticks, stones, or large clumps. Moisten dry peat or soil until it stays together when you squeeze a clump in your hand.

Harvesting Mushrooms

When the compost is covered with white mycelium, apply a blanket of casing about 1 to 1 1/2 inches thick and reduce the temperature to about 55°F. Saturate the casing with water so it is thoroughly moist but not dripping wet.

The moisture content of the casing is critical to the development of the mushrooms. The proper moisture content can be maintained by covering the trays with several layers of wet newspaper and lightly watering them twice daily. In about 10 days remove the newspaper and mist the trays twice daily as before. In very dry areas, it may be necessary to keep the newspaper cover on or cover the trays loosely with plastic to maintain adequate moisture.

Growth

In a few days, tiny white pinheads should appear. These will develop into delicious mushrooms in about a week. The temperature of the area in which the trays are located determines how quickly the mushrooms develop. In cool temperatures (50° to 55°F, 10° to 13°C), the crop develops slowly over a long time. In warm temperatures (65° to 70°F, 18° to 21°C), the crop develops quickly over a short time. The yields of both crops, however, will be similar. Therefore, to prevent being overwhelmed with too many mushrooms all at once, it is more practical to grow mushrooms at cooler temperatures.

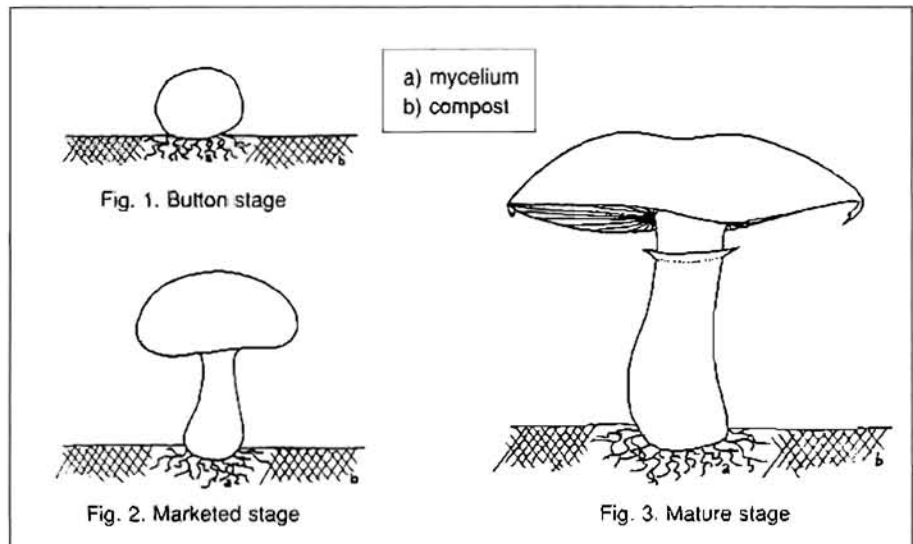
After the first mushrooms appear and are harvested, they will emerge in flushes, every 10 to 13 days for 3 to 6 months, until the compost is exhausted. Continue to mist the trays twice daily between flushes. Do not apply water to developing mushrooms because they may turn brown and stop growing.

Pick mushrooms by grasping them over the cap and around the stem and gently twisting. The mushroom will separate from the compost, leaving a white mycelial mass behind. Remove these masses from the casing with a knife and fill the holes left by the picked mushroom with the casing material to maintain a uniform surface. This ensures the continued productivity of the tray.

Pick mushrooms to be eaten raw in salads or with dips in the button stage (fig. 1). Mushrooms also can be picked in the stage that is

typically found in supermarkets, when the unruptured veil covers the gills under the cap (fig. 2). These store well and can be used in cooking. One advantage of growing mushrooms is being able to pick fully mature mushrooms, which have opened gills (fig. 3). Mature button mushrooms do not store well and for this reason are never seen in supermarkets. Yet they have the best flavor and are delicious in sauces or special dishes.

After the trays cease bearing, the compost is perfect for adding to vegetable or flower gardens or using as mulch around trees and shrubs. The trays and the areas where compost was mixed and mushrooms grew should be thoroughly scrubbed and air-dried. Cleaning and removing all organic debris will discourage diseases and insects. Discard trays that have decayed while in use.



Growth stages of *Agaricus bisporus*, the button mushroom

Glossary

Button stage—The whole immature mushroom, resembling a small round white body.

Cap—The top part of the mushroom which supports the gills, also called the pileus.

Caramelization—A chemical change that helps bacteria in compost to reproduce, forcing the temperature to go as high as 160° to 170°F; the compost turns a rich brown color and the straw in it breaks into small pieces.

Casing—A layer of peat, peat mixed with soil, or loamy soil 1 to 1½ inches thick, which is applied over the mycelial growth on the compost.

Compost—A mixture consisting of decayed organic matter that supports mushroom growth.

Fungus—An organism that grows in living or dead organic matter, varying in size from microscopic to very large; includes molds, mildews, rusts, smuts, and mushrooms.

Gill(s)—The radiating plates forming the undersurface of the mushroom cap; also called the lamella (plural: lamellae).

Gypsum—A mineral used to amend soil and make plaster of paris; also called hydrous calcium sulfate.

Mature stage—The fully developed mushroom: the cap has expanded and the gills are actively producing spores.

Mycelium—The mass of interwoven filaments that forms the vegetative portion of a fungus, often growing in soil or organic matter.

Organic matter—Material that is produced by the growth of animals or plants.

Spawn—Pure cultures of mycelium prepared especially for starting mushroom growth in compost.

Spore—A cell produced upon mushroom gills from which new mushrooms develop.

Stem—The stalk of a mushroom upon which the cap sits, also called the stipe.

Two-by-four lumber—Pieces of wood of variable length that are 2 inches thick and 4 inches wide.

Veil—A thin layer of organized mycelium covering the immature gills of the mushroom.

Veterinarian—A person qualified and authorized to treat diseases and injuries of animals.

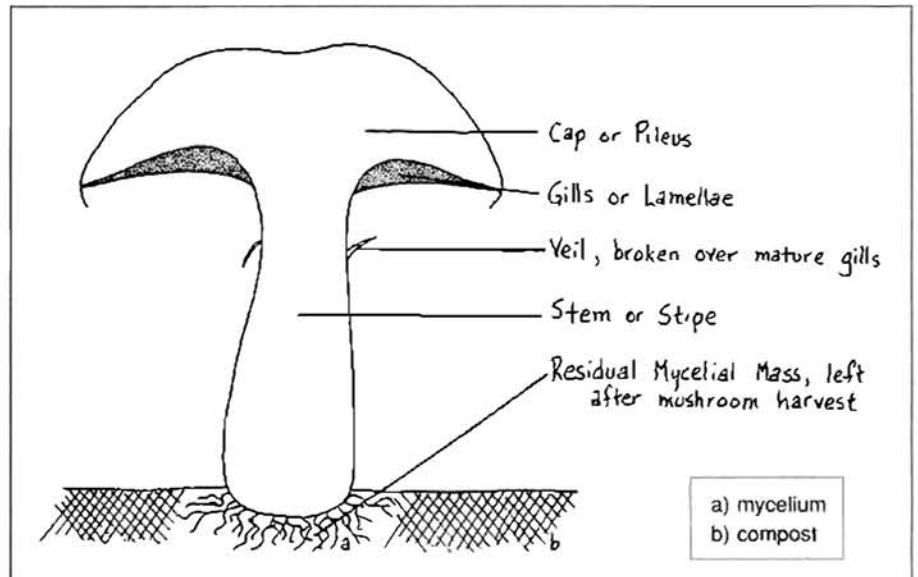
For More Information

Kaye, G. C. 1986. *Wild and Exotic Mushroom Cultivation in North America: A Growers' and Gourmets' Guide to the New Edible Species*. 2d ed. Cambridge, Mass.: Farlow Reference Library and Herbarium of Cryptogamic Botany. 59 pp.

Mueller, J. 1976. *Growing and Cooking Your Own Mushrooms*. Charlotte, Vt.: Garden Way Publishing. 174 pp.

Stamets, P., and J. S. Chilton. 1982. *The Mushroom Cultivator: A Practical Guide to Growing Mushrooms at Home*. Olympia, Wash.: Agarikon Press. 415 pp.

Wuest, P. J., and D. Bengston. 1982. *Penn State Handbook for Commercial Mushroom Growing*. University Park, Pa.: The Pennsylvania State University Press. 129 pp.



Anatomy of a mushroom

Sources of Mushroom-growing Kits and Spawn

Many types of mushroom-growing kits are available commercially. When the instructions are followed they will produce batches of mushrooms. These kits are great as gifts, as experiments for children, or as an introduction to mushroom growing. For the serious grower, however, they are impractical; the price per pound of mushrooms produced is often more than the price paid at the supermarket.

Mushroom trays with prepared compost are available from some commercial mushroom growers or nurseries. These are a practical way to produce mushrooms for those who are unable to prepare the compost themselves.

Suppliers of kits, trays, and spawn are listed below.

Kits and Trays

Carolina Biological Supply Co.
2700 York Rd.
Burlington, NC 27215
Tel. 800-334-5551

Retli-Gro
P.O. Box 124
Hamburg, PA 19526.
Tel. 215-562-7909

Spawn

APA, Inc.
473 E. South St.
Kennett Square, PA 19348
Tel. 215-444-4247

Garden Properties Supply, Inc
P.O. Box 722
Bryn Mawr, PA 19010
Tel. 215-934-2464

J. B. Swayne Spawn Co.
P.O. Box 618
Kennett Square, PA 19348
Tel. 215-444-0888

L. F. Lambert Spawn Co.
P.O. Box 407
Coatesville, PA 19324
Tel. 215-384-5031 or -7948

Mushroom Growers Association
225 Birch St.
Kennett Square, PA 19348
Tel. 215-444-3656

Mushroom Supply Co.
Newark Ave. and Pennsylvania Rd.
Toughkenomon, PA 19374
Tel. 215-268-2244

Note: Always order spawn from the nearest source. It will usually be shipped by overnight express and often only during cool weather.



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