



MUSHROOM CULTIVATION AND MARKETING

HORTICULTURE PRODUCTION GUIDE

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Abstract: *The market for mushrooms continues to grow due to interest in their nutritional and health benefits. Their potential to serve in waste management has yet to be fully explored. As fungi, mushrooms have life cycles very different from those of green plants. The choice of species to raise depends on what growth media are available and on market considerations. Oyster mushrooms grow on many substrates and are easiest for a beginner. Shiitake already has earned considerable consumer demand. Mycorrhizal types of mushrooms, such as chanterelles and matsutake have not been successfully cultivated. Commercial cultivation of morels is limited to a single facility which uses a patented process. Truffle production requires a significant investment of time before production begins. The evaluation of a commercial mushroom enterprise should include a careful analysis of potential markets. Many information resources are referenced for further research.*

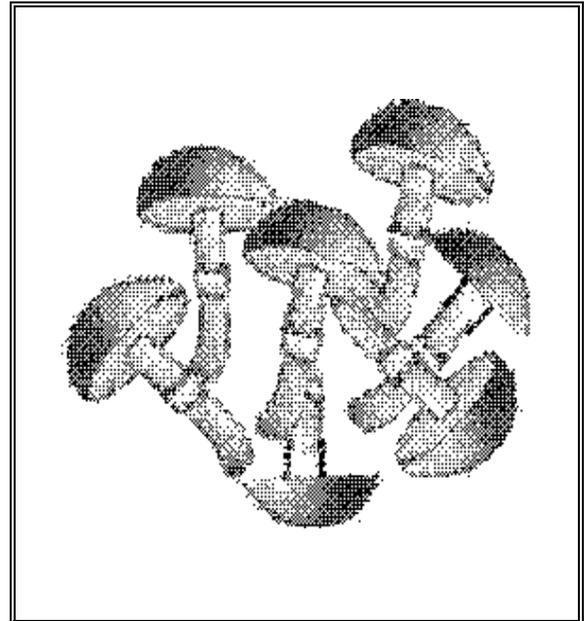
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Introduction

The market for mushrooms has been expanding in recent years. The trend is away from the canned product toward fresh and dried mushroom sales. Recently *The Packer*, a produce industry weekly, reported that, according to a recent marketing survey, of the families that purchased mushrooms in the previous year, 86% purchased button mushrooms and 70% purchased specialty species (1). The American Mushroom Institute, however, reported that the 1997-98 season saw a decline in the specialty mushroom segment of the market after a decade of steadily increasing sales.

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Many people are interested in the nutritional and medicinal aspects of mushrooms. Mushrooms contain many essential amino acids and can be a valuable food source. White button mushrooms contain more protein than kidney beans but less than milk. Shiitake mushrooms are less nutritious, but still are important as a potential protein source (2). Low in fat, mushrooms also provide vitamins (B₁, B₂, C) and minerals.

Asian traditions maintain that some of the specialty mushrooms provide health benefits. Chinese doctors use at least 50 species.

Recent scientific evidence suggests that many mushroom species do indeed contain substances which may prevent or alleviate cancer, heart disease or viral infections. Two recent titles detail existing research on the benefits of mushrooms. See the **Resources** section at the end of this guide for more information.

The production of mushrooms can play an important role in managing organic wastes which have become problematic as landfills reach capacity. Many by-products from agricultural production and food processing can be used as growing media in mushroom production. The materials remaining after harvest can be composted and applied directly to the soil as an organic amendment.

As a result of all of these factors, interest in cultivating the edible fungi has grown. Mushroom production may offer opportunity to those willing to develop a commercial operation as an additional enterprise for the farm or rural community, or for farmers without large acreages. The following material is offered to those considering this option as a new enterprise. An attempt has also been made to include resources for entrepreneurs who wish to do further research.

It should be made clear at the outset that mushroom production is labor- and management-intensive. Specialty mushrooms have very frequently been promoted as being a "get rich quick" kind of enterprise. On the contrary, it takes a considerable amount of knowledge, research time, planning, and capital investment to set up a commercial production system. Once in production, sporadic fruiting, invasion of "weed" fungi, and unreliable market prices are problems which producers must be prepared to handle.

Mushroom Growth

Production of mushrooms is completely different from growing green plants. A person considering mushroom production should become thoroughly familiar with the life cycles

of fungi. A plant pathology text is a good resource for this initial research task.

Mushrooms do not contain chlorophyll and therefore depend on other plant material (the "substrate") for their food. Commonly cultured mushrooms are saprophytes—plants that feed on dead plant material. The part of the organism that we see and call a mushroom is really just the fruiting body. Unseen is the mycelium—tiny threads that grow throughout the substrate collecting nutrients by breaking down the organic material. For different species of mushrooms, the preferred growing medium varies. Some species can grow on a wide range of materials and others can't. After the mycelium has grown throughout the substrate, and when its specific requirements are met, the mushroom will fruit. Humidity, light, temperature, and carbon dioxide-to-oxygen ratio are conditions which typically determine when a mushroom will fruit.

Nearly all of the common button mushrooms (*Agaricus* spp.) produced commercially in the United States are grown in expensive, high-tech structures designed to minimize pest pressures and to control the growing environment. Managers control not only temperature, humidity, and light, but also ratios of gases in the atmosphere. The production systems are highly developed and very efficient. The goal is always to decrease the time it takes to proceed from prepared substrate to fruiting and harvest. When cycles are shortened, production per year increases and potential profits rise.

Typically, the mushroom farmer manipulates the atmospheric conditions first to favor mycelium growth until it fully occupies the substrate. Later the atmospheric conditions are changed to those necessary to initiate and complete fruiting (usually different from those ideal for mycelial growth).

There are alternative methods of producing mushrooms. Paul Stamets of *Fungi Perfecti* (3) has spent most of his life studying their growth and cultivation. His book *Growing Gourmet & Medicinal Mushrooms* (see **Resources** section for

more information) is an invaluable resource for anyone considering the cultivation of any mushroom. He suggests methods of growing outside on logs, on stumps, and in the garden, as well as indoor cultivation in bags and on columns. Whether these methods can be developed into competitive commercial schemes depends upon the abilities of the entrepreneur adapting them. Peter Oei, in *Manual on Mushroom Cultivation*, describes in some detail alternative mushroom production systems successfully used in developing countries. Many ideas for low-input systems are included. In practice, however, it is unlikely that the beginner can successfully compete with existing highly capitalized and efficient mushroom companies in the wholesale market. Only by developing a market niche for a high-quality fresh product or by producing a mushroom-based food item can a small-scale beginner hope to compete.

How to Begin

The choice of which species to grow should be thoroughly researched. The beginner should be completely familiar with the various fungi life cycles and should know the parameters of growth required by each. Two basic references are: *The Mushroom Cultivator* by Stamets and Chilton and the aforementioned *Growing Gourmet and Medicinal Mushrooms* by Stamets. See the **Resources** section for more information.

A mushroom cultivation kit (check with suppliers listed below) is often a good way to learn how to grow a particular species before beginning commercial production. Accurate technical and financial records can be used to realistically gauge whether or not commercial production will be profitable. At the same time, a system for creating conditions favorable to the various stages of growth can be designed and tested.

For a commercial operation, the producer must first collect the substrate material into which the chosen species will grow. Mushroom species are often very particular about their substrates. The substrate is fermented, pasteurized, or

sterilized in order to prevent or reduce competition from fungi other than the chosen species. The growing medium is then inoculated with spawn. See the **Suppliers** section for spawn sources.

Choosing a Mushroom Species

Having access to an economical growing medium suitable to the species chosen is an important factor in deciding which species to grow. The amount of processing necessary to prepare the substrate for the spawn is another consideration. The chart below lists common species and the materials upon which they are commercially cultivated (4, 5).

Species for Beginners

The final choice of a species to grow depends upon the waste materials available for use as substrate, an appropriate facility, cost of necessary equipment, the level of skill required to manage the life cycle of the fungus, and the market already established for that species. Considering these criteria, oyster (*Pleurotus* spp.) and shiitake (*Lentinus edodes*) mushrooms are probably best for most novices. They are relatively easy to grow and there is a growing market, thanks mostly to efforts of large commercial producers of white button (*Agaricus*) mushrooms who have been diversifying into other specialty mushrooms.

Although these experienced and highly capitalized operators create stiff competition, there may still be a place in the market for the small but efficient producer. Excellent service, top quality, and consistent supply might substitute for the lowest wholesale price with some local customers, particularly gourmet chefs. In addition, shiitakes grown on logs may develop into a separate niche market, because they are considered to be of higher quality and may have a longer shelf life than shiitakes grown on sawdust substrates (the most common mass-produced method). Oyster mushrooms, with limited shelf life, may also have an advantage in nearby markets.

Mushroom Cultivation Media	
<u>Growing Medium</u>	<u>Mushroom Species</u>
Ricestraw	Straw (<i>Volvariella</i>) Oyster (<i>Pleurotus</i>) Common (<i>Agaricus</i>)
Wheatstraw	Oyster (<i>Pleurotus</i>) Common (<i>Agaricus</i>) <i>Stropharia</i> Straw (<i>Volvariella</i>)
Coffee pulp	Oyster (<i>Pleurotus</i>) Shiitake (<i>Lentinus</i>)
Sawdust	Shiitake (<i>Lentinus</i>) Oyster (<i>Pleurotus</i>) <i>Hericium</i> Ear (<i>Auricularis</i>) Ganoderma (<i>Reishi</i>) Winter (<i>Flammulina</i>)
Sawdust-straw	Oyster (<i>Pleurotus</i>) <i>Stropharia</i>
Cotton waste from textile industry	Oyster (<i>Pleurotus</i>) Straw (<i>Volvariella</i>)
Cotton seed hulls	Oyster (<i>Pleurotus</i>) Shiitake (<i>Lentinus</i>)
Logs	Nameko (<i>Pholiota</i>) Shiitake (<i>Lentinus</i>) White jelly (<i>Tremella</i>)
Sawdust-rice bran	Nameko (<i>Pholiota</i>) Ear (<i>Auricularis</i>) <i>Coprinus</i> Winter (<i>Flammulina</i>) Shiitake (<i>Lentinus</i>)
Corncoobs	Oyster (<i>Pleurotus</i>) <i>Hericium</i> Shiitake (<i>Lentinus</i>)
Paper	Oyster (<i>Pleurotus</i>) <i>Stropharia</i>
Horse manure (fresh or composted)	Common (<i>Agaricus</i>)
Crushed bagasse and molasses wastes from sugar industry	Oyster (<i>Pleurotus</i>)
Water hyacinth/Water lily	Oyster (<i>Pleurotus</i>) Straw (<i>Volvariella</i>)
Oil palm pericarp waste	Straw (<i>Volvariella</i>)
Bean straw	Oyster (<i>Pleurotus</i>)
Cotton straw	Oyster (<i>Pleurotus</i>)
Cocoa shell waste	Oyster (<i>Pleurotus</i>)
Coir	Oyster (<i>Pleurotus</i>)
Banana leaves	Straw (<i>Volvariella</i>)
Distillers grain waste	<i>Hericium</i>

Oyster mushrooms

Oyster mushrooms (*Pleurotus* spp.) are often recommended as a good choice for beginning mushroom cultivators because they are easier to grow than many of the other species, and they can be grown on a small scale with moderate initial investment. Although commonly grown on sterile straw from wheat or rice, they can be produced from a wide variety of high-cellulose waste materials. Some of these materials do not require sterilization, only pasteurization, which is less expensive. Another advantage of growing oyster mushrooms is that a high percentage of the substrate is converted to fruiting bodies, increasing potential profitability.

Oyster mushrooms have great potential as an integral part of a sustainable agriculture system. Many types of organic wastes generated in production or by the food processing industry are added to the waste stream annually. These materials could support oyster mushroom production, if systematically collected and processed.

Although there are no books devoted entirely to oyster mushroom production, Stamets' books provide basic information. There has been research into using various agricultural and forest wastes as substrates, some of which is reported in the recently published *Mushroom Biology and Mushroom Products*, edited by D.J. Royce (6). Peter Oei (5) documents a number of commercial production systems for some strains grown in developing countries. Lawrence Weingarten describes his production process on his website, complete with photos: <http://sorex.tvi.cc.nm.us/nama/cult/i-grow-2.htm>

Oyster mushroom cultivation has one significant drawback: some people are allergic to the spores. In these cases, air-cleaning equipment or respirators are necessary in order to work in the production facility.

The consumer market for oyster mushrooms is being developed by the larger mushroom

companies as they diversify their operations. However, because of the short shelf life of many oyster mushroom varieties, this species may offer a special advantage to the local grower who markets directly and can consistently deliver a fresh, high-quality product.

Shiitake mushrooms

Shiitakes (*Lentinus edodes*) are well suited as a low-input alternative enterprise because they, like oyster mushrooms, can be grown on a small-scale with a moderate initial investment. Shiitake mushroom production is the most developed specialty mushroom option. Its cultivation has been well investigated and a commercial market already exists. Shiitake mushrooms are grown on logs outside or are produced inside on synthesized sawdust logs or on sawdust in bags. See the brief description of these production systems below. Several excellent books are also listed below.

Log Production

Hardwood logs approximately 4–6" in diameter of a length easily handled (commonly 4') are cut during their dormant season. Oaks, sweetgum, cottonwood, beech, birch, willow and other non-aromatic hardwoods are appropriate species. The denser woods produce up to twice as long as the softer ones. Smaller diameter logs produce sooner than bigger ones, but for a shorter time. Logs are handled so that there is as little loss of bark and contact with soil as is possible. They are inoculated with spawn, using a strain selected for the temperature and fruiting regime appropriate to the production system. There is a wide variety of spawn from which to choose.

After inoculation, the mycelium grows throughout the log. During this time, the producer may need to move the logs, protect them from sun and wind, and spray or mist them to maintain the necessary humidity for eventual fruiting. When the substrate (log) is fully occupied and conditions are right, the log is soaked and/or shocked to begin fruiting.

Harvesting at the proper stage of development also requires close attention from the mushroom farmer. Shiitakes must be picked at the correct time to ensure premium prices. Post-harvest storage, packaging, and shipping can be costly.

Many shiitakes are raised organically, but there are "weed" fungi as well as other pests such as slugs and flies which can reduce production or quality. The producer must be prepared to control these pests or lose some of the crop. It is, however, easier to organically produce shiitake mushrooms than some of the other mushrooms. In order to label a product "organic," the production process must undergo a process called certification. Several organizations and some states currently certify organic production. Federal regulations will soon be the law. For further information, call and request the ATTRA publication *Organic Certification*.

Studies have shown that log production of shiitakes is only marginally profitable if labor and management costs are taken into consideration. It is possible that as a part of an integrated farming system, such an enterprise could become a profit center to utilize off-season labor or to enhance overall profitability. If the farm includes agroforestry practices such as riparian buffers or windbreaks, a shiitake area might be incorporated there.

Growing on sawdust

Now, most shiitakes are raised on a sterilized sawdust substrate. This method, although it allows for a much faster fruiting cycle and a high level of return (110% or more of initial dry weight), demands a greater capital investment and more skillful management than log production. In order to achieve fruiting as quickly as possible, the producer must provide a building in which temperature and moisture can be manipulated. The building must be kept clean to avoid contamination.

Equipment to pasteurize or sterilize and mix the medium may be needed and can represent a

significant initial investment. At current prices, these costs may be difficult for a beginning producer to recover. Growing mushrooms on sawdust requires attention to detail – especially careful monitoring – and timely processing of the blocks or bags. Several books listed below, including Stamets (1993) and Przybylowicz and Donoghue (1990) offer more details of this production method.

Marketing shiitakes

It is possible to find U.S.-produced fresh or dried shiitake mushrooms in specialty food stores and many large supermarkets throughout the country. Some analysts suggest that the market may have less potential for expansion now than was predicted in the 1980s. Other specialty mushrooms may capture some of this market if the overall demand for mushrooms does not increase.

It is therefore very important to plan a marketing strategy carefully before committing to a shiitake mushroom venture.

Possibilities include:

- Direct marketing of the fresh or dried product (farmers markets, gourmet chefs, internet or mail order offerings)
- value-added products (mushroom sauces, dried entrée mixes, teas)
- wholesale system set up for fresh produce (contract or to wholesaler).

Local grocery stores may be interested in buying this specialty product directly. A grower in eastern Arkansas stated that local grocery chains were only interested in her shiitake mushrooms after she could assure them of a year-round supply. She decided that she had to add either indoor log or substrate in order to meet this requirement. Natural foods stores are another potential market which may be more tolerant of a seasonal supply situation.

The price for shiitake mushrooms fluctuates throughout the season. Prices are highest in the winter when supply is low, and lowest in summer when production peaks. Except in very

mild climate areas, the only logs which fruit in winter are those maintained indoors. Using strains selected to fruit at cooler temperatures can lengthen the harvest season to capture more favorable prices.

There are several methods shiitake growers can use to preserve their crop during times when prices are low. Persimmon Hill Berry Farm (7) tackled the challenges of marketing their own value-added product by building a commercial kitchen and developing a special shiitake mushroom sauce.

Operations that make value-added products may be able to provide a market for small shiitake producers in their areas. The Persimmon Hill Berry Farm in Missouri is a good example. Area growers can freeze their surplus mushrooms until enough have accumulated to make sale and delivery to the facility worthwhile. Likewise, during heavy production in warm weather, mushrooms can be held frozen until there is time to process them. Growers get a better price and Persimmon Hill can increase its product sales.

Another way to avoid the depressed prices of high supply periods is to dry the product. Hardscrabble Enterprises (8) buys several grades of dried shiitakes. Growers supplying this company ship the dried product directly to West Virginia. Contact Paul Goland for further details for specifications on drying the mushrooms, shipping requirements, and prices for various grades.

Sources of further information on shiitakes

Several states, including Pennsylvania, California, and Oregon, support university research and may have Extension specialists to provide information to growers in their state. Others have Extension publications with information specific to the area. Some of these resources are available electronically on the Worldwide Web.

In states without these resources, one of the best ways to trouble-shoot and learn about

production is to share information with other growers. There are a number of local grower organizations, many of which publish newsletters. State Extension horticultural specialists should be aware of local organizations or you can contact the North American Mycological Association (see **Resources** below).

There are also several books that have been published on shiitake production. See **Resources: (shiitakes)** for more information.

Mushroom Species Not Commonly Cultivated

Some species of mushrooms are not commercially cultivated. Many of these are mycorrhizal types, that is, they grow only in conjunction with the roots of higher plant species. Morels, matsutakes, and chanterelles are familiar examples of such mushrooms.

This type of mushroom is the hardest kind to grow commercially since the needs of both the fungus and the host plant must be met in order to produce a commercial crop. Also, the host plant typically must reach a certain physiological maturity before the fungus will fruit. For trees, this maturity may be measured in decades. Nevertheless, both truffles and morels are now being grown commercially in this country.

Morels

Commercial small-scale production of morels is not currently a practical option. At this time, morels are being grown at a production facility in Alabama using a patented process. The patent is owned by Terry Farms and is the only known successful commercial process for fruiting these highly valued mushrooms out of season.

Spawn is available to establish a morel patch from several suppliers. If successful, these mushrooms fruit in the Spring at the same time that wild morels do. Market prices are, understandably, the lowest of the year during

this natural fruiting season. Drying the product for year around sales might have potential, if commercial quantities are produced from the patch.

Truffles

In the future, truffles (*Tuber* spp.) may hold potential for beginning cultivators. Because these fungi grow underground on tree roots, the producer can concentrate on caring for the trees and may not need extensive knowledge of the fungus itself. The requirements of the *Tuber* spp. are met by choosing an appropriate host plant (oak or hazelnut), inoculating its roots with the spawn, and planting it.

Correct soil and environmental conditions must be maintained until the tree reaches maturity and fruiting begins. Production of truffles is still experimental. Frank Garland, who raised the first truffles in the U.S., has written a growers' guide based on his experience (9).

Other Mycorrhizal Species

Mushroom researchers continue to investigate the growth of other species so that they can be cultivated for the commercial market. Until such production systems are developed, chanterelles, boletes, and matsutake (pine) mushrooms will continue to be collected from the wild for sale to the specialty mushroom market.

In some parts of the country, foraging for wild mushrooms is a viable commercial venture. ATTRA's mandate excludes us from providing information on species that are not cultivated commercially; therefore we cannot offer information on commonly collected species. However, *Mushroom, The Journal of Wild Mushrooming* (see **Resources** below) is an excellent source on foraging for wild mushrooms. There are numerous local mycological societies as well. Often these groups schedule "forays"—trips to known mushroom habitats—where the inexperienced can learn about and identify various species from more knowledgeable mushroomers.

It is critical that anyone foraging for wild mushrooms be absolutely certain about identifying characteristics. There are many books available on the subject, but if at all possible, it is a good idea to learn from someone who has field experience as well. There have been some well-publicized instances of mistaken identity recently. Even very knowledgeable people have made fatal mistakes. If the mushroom is to be sold, issues of liability must be addressed. Since foraging is regulated in some areas, a call to the state Department of Agriculture is another prerequisite before heading to the woods.

With proper management, foraging can be sustainable and environmentally unobtrusive. It is important to disturb as little of the natural environment as possible when foraging. Wild mushrooms require a very specific set of environmental conditions to grow and spread. If the area in which they are growing becomes too disturbed, the entire mushroom stand may die. It is also good to leave some mushrooms to mature spores so that they will repopulate and produce more mushrooms in the future.

Pest Management

The best strategy for managing any pest is provided by integrated pest management (IPM). IPM views pests as a natural part of the farm environment and considers various options to alter the agroecosystem to decrease its carrying capacity for the pest.

The producer must first be able to identify pests and must then determine at what level they become an economic threat to the crop. Because specialty mushroom production is so new in the United States, pest complexes are just beginning to be identified. Local agents or state Extension specialists can assist with identification of pests and determining economic thresholds.

The second step in IPM is monitoring. Traps or baits are used to determine whether pests are present and to estimate how many. If numbers increase, control measures can be implemented quickly, before populations explode. The

numbers and types identified by monitoring are used to determine whether or not to take action, and what type of action to take.

Knowing the life history of each pest makes it possible to design a strategy to attack it at a "weak link" in its life cycle. Extensive knowledge about the pest's predator complex and its function in the local ecology are also necessary ingredients for a successful IPM program. Check local or land grant university libraries for references on specific insects.

As an example, mushroom flies, a common pest of various cultivated mushrooms, are attracted to the smell of decaying vegetation such as mushroom media. Screening the mushroom house ventilation system keeps adult flies out. Good screening, double doors and, ideally, a positive atmospheric pressure within the mushroom structure will help prevent the entry of flies or airborne contaminants. Adult fungus flies are also drawn to standing pools of water on solid benches, on walks, or under benches. Therefore, further prevention of pest problems is accomplished by eliminating places where water can accumulate.

Biocontrol options exist for certain mushroom pests, among them the sciarid fly. A predatory nematode attacks this pest in its larval form in the composting substrate. Many toxic pesticides have been replaced by this beneficial nematode.

Sanitation is essential to least-toxic mushroom production systems. This means the production structures and equipment must be kept free from contamination. Preparing a growing medium with no pest nematode larvae, or eggs should also be a basic part of the sanitation program. If the substrate is composted, it should be done in an area distant from the growing facility. Spent media should be marketed to landscapers and nurseries, if there is no on-farm use for it. Disposal should take place away from the mushroom production facility. Otherwise, it will attract pests and the problem will become worse. If natural logs or stumps are used, inoculation with spawn soon after cutting and minimal contact with soil will reduce contamination by pathogens.

Markets for Mushrooms

Since the 1950s, per capita demand in the U.S. for the white button mushroom as well as specialty varieties has increased dramatically (10). The mushroom industry in the United States is currently dominated by large, well-established companies. Most are located in Pennsylvania and California. The production houses are constantly full of mushrooms in every stage of production. Mushrooms raised in these systems can be sold on the wholesale market and still earn a profit. It is very difficult, however, for a beginning grower to compete with these companies in wholesale markets.

The small-scale commercial production of white button mushrooms and other *Agaricus* mushrooms such as portobellas and creminis may not be economically viable and is not recommended for the beginner. A significant capital outlay and a high level of management skills are required to begin production and, at current prices, recovery of the initial investment may not be possible. Marketing is extremely competitive. More information about the button mushroom business is available from The American Mushroom Institute (see **Resources**).

Although many mushrooms have been investigated and can be cultivated, the market for specialty mushrooms is still limited. The potential mushroom producer would be wise to thoroughly investigate demand for each species before committing large amounts of time and capital to the production stage of the enterprise development.

Direct marketing at local farmers' markets, restaurants, or supermarkets may be an opportunity in some locations. Most wholesale customers will require assurances of consistent supply and quality before they will commit to purchasing from unknown or less convenient sources.

Market Research

Perhaps the most challenging problem in developing new enterprises is assessing the

market. Nevertheless, growers are strongly encouraged to assess market opportunities before beginning. The following section is adapted from a resource sheet entitled “Doing Your Own Market Research” by Cornell Extension Specialist Judy Green (11).

When considering growing mushrooms as a diversification strategy, farmers must first ask themselves the following questions:

- Is there a market for this? Will I be able to sell enough mushrooms at a price above my cost of production?
- Will growing and selling mushrooms be consistent with my family’s goals and my farm business goals?
- Do I have the resources needed to be successful? (A complete inventory should include skills, labor and management time, sources of information, assistance and credit, input suppliers, processors and distributors.)
- Will it be profitable? (Use projected income and expenses for an “average future year” to determine whether revenues will be higher than estimated costs of production.)
- Can I afford to produce mushrooms? (A new enterprise may take several years to become profitable.)

The goals in market assessment are: 1) to project the volume of sales and the price to reasonably expect to achieve with a new enterprise, (needed to analyze profitability and cash flow potential); and 2) to gather information about potential buyers and competitors (helps in developing a market strategy).

This next set questions of can be answered through market research:

- What is the total market size at present for this product within a given area?
- How many competitors are there for this market? What are their strengths and

weaknesses? What type of buyers are they targeting?

- What prices can buyers expect to receive for a given level of quality?
- What trends are there in consumption, competition, and pricing?
- What are the characteristics of buyers of this product or service? Age? Income level? Lifestyle? What are they looking for? Where are they looking for it? How can I do a better job than my competitors in meeting their needs?
- What proportion or share of the market might I expect to capture?

Research is especially important when you are considering an innovative enterprise or a new market. Some common methods for conducting primary research include: observation, written surveys, personal interviews, and test marketing (offering your product on a limited basis in order to evaluate potential sales).

Another aspect of market research includes evaluating the competition. This will help you determine the market as it already is, and will assist you in determining niches your product could fill. To find out more about your competitors, use their products. Talk to them. You may be surprised how much information they will share.

Further business assistance is available through local Small Business Administration offices. In addition, the ATTRA publication *Evaluating a Rural Enterprise* is available upon request.

Further Resources

Two mushroom publications that include production information are *The Mushroom Growers Newsletter*, and *Mushroom, The Journal of Wild Mushrooming*. Subscription information is included with citations for several key books under **Publications** in the **Resources** section

below. A list of mushroom websites is also included.

Conclusion

The commercial cultivation of mushrooms is not for everyone. It requires someone who is familiar with fungus life cycles and is willing to commit resources to research, to designing a system, and to business development. The mushroom cultivator must be able to carry out operations on time, be attentive to details, and be vigilant about pest invasions. In many cases, marketing requires excellent public relations skills.

Nevertheless, there is potential for an innovator who can use an existing facility, obtain a low-cost substrate, and produce a reliable supply of a high quality product. Producing a nutritious food at a profit, while using materials that would otherwise be considered “waste,” constitutes a valuable service in the self-sustaining community we might envision for the future. It is a challenge some will find worth taking.

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P.O. Box 7634
Olympia, WA 98507
(206) 426-9292
<http://www.fungi.com/culture.html>
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This publication is available for \$50 from Mushroompeople (address below in Suppliers).

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Persimmon Hill Berry Farm
RR 1 Box 220
Lampe, MO 65681
(417) 779-5443
- 8) Hardscrabble Enterprises
HC 71, Box 42
Circleville, WV 26804
(304) 358-2921
Contact: Paul Goland
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Available for \$15 from:
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(919) 732-3041
(919) 732-6037 FAX
truffleman@mindspring.com
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To order this publication, send \$20 to:
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St. Paul, MN 55108
(612) 625-5747

Hobbs, Christopher and Michael Miovic (ed.). 1995. Medicinal Mushrooms : An Exploration of Tradition Healing & Culture, Third Edition, Botanical Press. ISBN: 1884360017.

Lee, William H.R., and Joan A. Friedrich. 1997. Medicinal Benefits of Mushrooms: Healing for More Than 20 Centuries – Their Effects on Cancer, Diabetes, Heart Disease and More. Keats Publishing, 48 p. ISBN: 0879837187
Widely available for \$3.50.

National Agricultural Library (NAL) periodically publishes Quick Bibliographies (QB), results of a database search on a given topic. QB's have been published for both shiitake and oyster mushrooms. They can be downloaded from the NAL website or obtained from:

National Agricultural Library
10301 Baltimore Blvd.
Beltsville, MD 20705
(301) 504-5755

http://www.nalusda.gov/afsic/AFSIC_pubs/

Oei, Peter. 1991. Manual on Mushroom Cultivation: Techniques, Species and Opportunities for Commercial Application in Developing Countries. TOOL Publications, Amsterdam, The Netherlands. 274 p.

*This publication is available for \$50 from Mushroompeople (address below in **Suppliers**).*

Stamets, Paul and J.S. Chilton. 1983. The Mushroom Cultivator. Agarikon Press, Olympia, WA. 415 p.

Includes general growing parameters for sixteen species and covers every aspect of mushroom cultivation. Available for \$24.95 from:

Fungi Perfecti
P.O. Box 7634
Olympia, WA 98507
(800) 780-9126 or (260) 426-9292

Stamets, Paul. 1993. Growing Gourmet and Medicinal Mushrooms. Ten Speed Press. Berkeley, CA. 552 p.

Companion volume to The Mushroom

Cultivator. Updates culture and growing techniques, adds growing information on new varieties, discusses strain selection for cultivation. Available for \$50 from Fungi Perfecti (see address above).

Mushroom, the Journal of Wild Mushrooming is a quarterly periodical that primarily contains information on foraging with some information on cultivation.

Available for \$16/year from:

Mushroom, the Journal of Wild
Mushrooming
861 Harold St.
Moscow, ID 83843

The Mushroom Grower's Newsletter is a monthly newsletter containing commercial information and reporting current prices of mushrooms at San Francisco and New York markets.

Available for \$24/year from:

The Mushroom Company
5140 Lombardy Lane
Klamath Falls, OR 97603

<http://www.mushroomcompany.com/>

Associations:

The North American Mycological Association (NAMA) provides a bi-monthly newsletter, *The Mycophile*, and publishes an annual directory which provides names and address of all NAMA members and every mycology association in North America.

Annual memberships are \$15. Contact:

NAMA
3556 Oakwood
Ann Arbor, MI 48104-5213
(313) 971-2552

<http://sorex.tvi.cc.nm.us/nama/>

A source of information on the mushroom industry is the American Mushroom Institute.

Contact them at:

American Mushroom Institute
907 E. Baltimore Pike
Kennett Square, PA 19348
(215) 388-7806

<http://americanmushroominst.org/index.htm>

Websites:

Websites often make address changes. If not found at this address, a search of the Web should access current locations.

American Mushroom Institute:
<http://www.americanmushroominst.org/consumer.htm>

The American Type Culture Collection Home
<http://www.atcc.org/>

Mushroom People Books
<http://www.thefarm.org/mushroom/>

National Agricultural Statistics Services for Mushrooms
<http://usda.mannlib.cornell.edu/reports/nassr/other/zmu-bb/>

Mycologue Publications
<http://www.pacificcoast.net/~mycolog/>

Mycological Resources on the Internet
<http://www.keil.ukans.edu/~fungi/>

Mycological Resources on the Internet: Directories
<http://muse.bio.cornel.edu/~fungi/fdirect>

Penn State's Mushroom Site:
<http://MushroomSpawn.cas.psu.edu/>

Resources: (shiitake)

Rafats, Jerry. 1996. Shiitake: Cultivated Mushroom. Quick Bibliography Series B:90-4.

National Agricultural Library, Beltsville, MD.
A bibliography of articles on shiitake mushrooms. Though somewhat dated (published in 1996), this collection still contains valuable information for shiitake producers. This publication is available free from:

National Agricultural Library
10301 Baltimore Blvd.
Beltsville, MD 20705
(301) 504-5755

<http://www.nalusda.gov/>

Harris, Bob. 1994. Growing Shiitake Commercially. 2nd ed. Science Tech Publishers, Madison, WI. 72 p.

Large scale cultivation of shiitake mushrooms using traditional oak logs. Information from many years' work, including material from recent visits to commercial farms and research facilities in Japan. Some of the most modern and cost effective methods are presented with photographs and drawings. Available

from Mushroompeople (see address in Suppliers)

Jones, Kenneth. 1995. Shiitake: The Healing Mushroom. Healing Arts Press, Rochester, VT. 120 p.

Widely available for \$8.95.

Kozak, M.E. and J. Krawczyk. 1989. Growing Shiitake Mushrooms in a Continental Climate. 2nd ed. Field & Forest Products, Peshtigo, WI. 114 p.

To order this publication, send \$12 postage paid to:

Field & Forest Products, Inc.
N 3296 Kozuzek Rd.
Peshtigo, WI 54157
(800) 792-6220

Przybylowicz, Paul and John Donoghue. 1990. Shiitake Growers Handbook. Kendall/Hunt Publishing Co. Dubuque, IA. 217 p.

An authoritative book about shiitake. It covers a wide range of topics from log cultivation to the newer capital intensive sawdust cultivation. Information varies between scientific material and practical. Emphasis is on presenting as much information as possible rather than selectively choosing the best or most advanced methods. A definite must for your shiitake cultivation library. Widely available for \$25.

Suppliers:

Allied Mushroom Products Co.
P.O. Box 4909
Tontitown, AR 72770
501-361-5938

Amycel Spawn
P.O. Box 560
Avondale, PA 19311
610-869-4041
<http://www.amycel.com/>

Field & Forest Products
N3296 Kozuzek Rd.
Peshtigo, WI 54157
800-792-6220

Fungi Perfecti
P.O. Box 7634
Olympia, WA 98507
260-426-9292
<http://www.fungi.com/culture.html>

L.F. Lambert Spawn Co.
1507 Valley Rd.
Coatesville, PA 19320
610-384-5031

Long Ridge Farms
406 Tom Cook Rd.
Sugar Grove, NC 28679
828-297-4373

Mushroompeople
P.O. Box 220
560 Farm Rd.
Summertown, TN 38483
931-964-2200
<http://www.thefarm.org/mushroom/mpframe.html>

Northwest Mycological Consultants
702 NW 4th St.
Corvallis, OR 97330
541-753-8198

Sylvan Spawn Laboratory
West Hills Industrial Park
Kittanning, PA 16201
724-543-2242

J.B. Swayne Spawn Co.
P.O. Box 618
Kennett Square, PA 19348
610-444-0888

Western Biologicals, LTD.
P.O. Box 283
Aldergrove, BC VOX 1A0
CANADA
604-856-3339

The electronic version of **Mushroom Cultivation and Marketing** is located at:
<http://www.attra.org/attra-pub/mushroom.html>

By Alice E. Beetz and Lane Greer
NCAT Agriculture Specialists

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Fungiculture is the cultivation of mushrooms and other fungi. By growing fungi, food, medicine, construction materials and other products can be attained. A mushroom farm is in the business of growing fungi. The word is also commonly used to refer to the practice of cultivating fungi by leafcutter ants, termites, ambrosia beetles, and marsh periwinkles. Mushrooms are not plants, and require different conditions for optimal growth. Plants develop through photosynthesis, a process that converts Growing Mushrooms the Easy Way: Home Mushroom Cultivation with Hydrogen Peroxide, by R. Rush Wayne. web <http://members.aol.com/PeroxyMan>. Mushrooms in the Garden, by Hellmut Steineck, Mad River Press. Some of the above can be purchased from Fungi Perfecti (www.fungi.com). All can be found online at Amazon.com (www.amazon.com). Also try searching other booksellers and the web. Unfortunately, there are a limited number of titles on mushroom cultivation, and many are out of print. Used book stores may be able to help. Amazon.com claims to be able to search successfully for books out of print. Try