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>>When it comes to growing mushrooms, some folks imagine it to be nothing but a smelly, dirty mess! But there are others who say “that ain’t so!” In fact, home cultivation of mushrooms is a growing trend. And on this episode of HomeGrown, we’ll learn from a mycologist just how fun and economical and clean it really is! Hi, I’m Rebecca Cressman, and you’re watching HomeGrown!

>>Welcome to HomeGrown, the show that brings you all the dirt on vegetable gardening. Today we’ll learn how to grow mushrooms at home. Paul Stamets is the author of two seminal books on mushroom cultivation. And he’s the founder of a family owned gourmet and medicinal mushroom business in Shelton, Washington. Our very own James Greaves traveled to Washington to learn firsthand from Paul all the basics of mushroom cultivation. Let’s take a look!

>>We mentioned mushrooms to be like fruit. Well, what do you mean?

>>Well, the common analogy that is used is that mushrooms are to mycelium what apples are to an apple tree. Or more specifically, what apples are to the *roots* of an apple tree. The mycelium is a root-like structure growing underground. Anybody can see it, they can go to a log that’s on the ground for a few months, knock it over, and you’ll see the white fuzzy stuff. All gardeners are tuned into mycelium. What people don’t realize is that much of this fuzzy group is actually mushroom mycelium. And the mushrooms may not form for months and decades. So they may lay dormant for hundreds of years, and then sprout—so to speak—and then produce a fruit. A mushroom. So picking the mushroom does not harm the mycelium mat in most cases. So the mushrooms come up just for a few days, emerge very quickly, but the resident mushroom mycelium is really 99% of the life cycle or more.

>>What’s the difference between a plant and a fungus?

>>Okay, they’re in different kingdoms entirely. And so a fungi contain no chlorophyll. And they expire, or respire, carbon dioxide...fungi do. And plants absorb carbon dioxide and respire oxygen.

>>Now what’s the difference between a fungus and a mushroom?

>>Well, mushrooms are a subset of fungi. There’s 1-2 million species of fungi in the kingdom of fungi. Around 10 percent are mushrooms. About 150,000 species are estimated to be mushrooms. But we’ve only identified 14,000, approximately. Which means our ignorance exceeds our knowledge by at least one order of magnitude, which is probably not uncommon with humans at this point in time!

>>Mushrooms also have a lot nutritional value, don’t they?

>>Yes, they do. And that takes people by surprise because there is a myth that mushrooms are not nutritious. But when you take the fact...

>>Well they seem so light.

>>Well they're 90 percent water. And so usually analyze, like grains, you analyze it by dry weight, not by moist weight. Let me say what mushrooms do not have. They have no cholesterol; they have no vitamin A and no vitamin C. They're very high in complex carbohydrates, which are very important for your immune system. They're very high in an assortment of vitamins B, Niacin, thymine, etc. they also are the best source of vitamin D of any land-based organism. Mushrooms generate vitamin D upon exposure to the sunlight.

>>Are you a huge proponent also of home growing? Where do you grow mushrooms on?

>>Well mushrooms are as perishable as fish. And so, when you buy mushrooms, often times they're like five-day-old fish. Mushrooms aren't frozen, they're kept fresh. Fish are easily frozen. But imagine catching a fish and then eating it five days from the time you caught it. So mushrooms, being so perishable. The advantage of growing mushrooms at home is we can take mushrooms in 20 minutes from the time of cutting them, off of a mushroom kit, we can be eating them. So the freshness of mushrooms is really important. The other thing about growing mushrooms at home is that you can be assured that they're clean. Of not using dangerous fertilizers or chemical compounds, pesticides in particular.

>>What are some misconceptions that a lot of us have about mushrooms?

>>There are a lot of misconceptions. One is that you cannot be poisoned by a mushroom by touching that poisonous mushroom. The other one is that mushroom experts have died from mushrooms and therefore, mushrooms are dangerous, even from mushroom experts. Well, I'm sorry, but I just don't buy that. The poisonous mushrooms that are well known are the first mushrooms one learns to avoid. So your good edibles, you know the bad poisonous mushrooms, "bad" just because they can cause us reactions. But there are mushrooms in between. There are several different types of poisonous mushrooms. And the classic amonedias the destroying angel is one. There are other mushrooms, like the jack-o-lantern mushroom which glows in the dark, but it can give you some severe cramping. It's not deadly, per se. It can be causing illness. So the other myths about mushroom are that they're good for you if you eat them raw. Not true. All mushrooms should be cooked. The cell wall structures are made of a citreous-like sugar. It's extremely difficult for you to digest unless they're cooked. Now they can be also tempered in acid, like in vinegar, for instance. And that can make them more digestible.

>>You would soak them in vinegar or cook them in vinegar?

>>Pickled mushrooms. You can cook the mushrooms and you can also pickle them, and that would make them more readily absorbable. But if you eat a raw shiitake mushroom, then swallow it. It will pass through you whole. All you have to do is look in the toilet bowl the next morning and you'll prove that theory, you know? So mushrooms should be cooked.

>>Now can you eat them raw for flavor?

>>You can eat them raw for flavor and for texture. And that is not for nutritional purposes. But some mushrooms are fantastic in that regard alone.

>>What are some barriers to stop people from growing mushrooms in their home?

>>I suppose that some people living in apartments feel like they don't have enough room. And I like to say that if you have enough space for a dinner plate, you have enough space for growing mushrooms. So it doesn't take a lot of space. Some people think "oh they take too much care." But all you do is you squirt them four times with a mister, with your hand in the morning, four squirts. Four squirts in the evening. I calculate that to be about fifteen seconds. So limited amount of space, small amount of effort, great reward. I think the greatest barrier is the inability of some people to get over the hurdle of what we call microphobia, the fear of fungi, or the fear of the unknown.

>>So what's the first thing we need to do to grow mushrooms at home?

>>Well the best way is to first get a mushroom kit. And the mushroom kits are already inoculated, they're fully mature and grown out and they're ready to produce. So basically, all you have to do is water them and take care of them on a daily basis, and soon thereafter, within a week or so, they'll burst with mushrooms.

>>So tell me, when you do get a kit, we've got some kits here. What comes? What is a kit?

>>Well, a kit comes in a cardboard box, and in the cardboard box, if you were buying oyster mushroom kits, which these three are here. And they come with an instruction booklet and a plastic bag, which is what we call a humidity tent. Now, in the instruction booklet are step-by-step instructions. And this one mushroom oyster booklet covers four different types of oyster mushrooms. White, yellows, pinks and blues. We have a white oyster mushroom kit here. And after you receive the mushroom kit in the mail, you set it up vertically or horizontally. And this is what we call a humidity tent. It's just a plastic bag that has holes punched because the mushrooms outgas carbon dioxide, just like we do. But we are actually more closely related to mushrooms than we are to any other kingdom. So we respire carbon dioxide and absorb oxygen, and so do mushrooms. So we need to keep the humidity high so they need to "breathe" through the holes, and then having the plastic bag keeps the humidity high. You put the bag over the mushroom kit, just prior to that, you spray it with a mister every day and put the bag over top. Some people put it on a pie plate or a dinner plate. You can actually put it into a white plastic

bucket. A lot of people have plastic buckets, etc. And then you put the humidity tent over top. As soon as the bag comes, even though the bag will have no mushrooms on it, but it's fully white from the white mycelium—this is on straw. The straw's brown, but as the culture grows, which is white, fuzzy cobweb mycelium, the whole bag here will turn white, and then you start spraying the surface of the bag (which we've done here) and now there are little holes in the bag, and they start coming out of these little holes as bouquets.

>>And how old are these mushrooms here?

>>Well these have now been forming for about two days. So about two days ago there weren't any mushrooms at all, it was a smooth surface. So they start erupting. And as they progress in a daily fashion, the next day and then the next day.

>>So these are four days old?

>>Those are four days from the time of the first signs of baby mushrooms appearing. But it's approximately 7-10 days from the time that you actually receive the mushroom kit in the mail.

>>How can you tell if you're applying too much or too little water?

>>Very good question. It's sort of like an overripe tomato, in that you get little blemishes that are forming, and little brown spots on the mushroom. On the surface of the mushrooms. The babies really can't overwater, but as they mature, the potential of overwatering can be an issue. But usually customers don't water enough. So when in doubt, water more.

>>What are some things that can go wrong?

>>With oyster mushrooms, there's very little that can go wrong. They're the easiest mushroom in the world to grow.

>>So you'll have more than one flush. How many flushes will you get out of a kit like this.

>>Well oyster mushrooms are notorious for producing 5-6, 7 flushes or crops. Usually about one week apart. And the course of this, the straw is being digested. Mushrooms are formed, carbon dioxide is being outcast, and so the substrate, the straw, shrinks in its mass. This is in a sense why compost piles shrink also. They are being digested by fungi. And so carbon dioxide is leaching out.

>>Okay, so these mushrooms have grown. How do we know when they're ready to pick?

>>Well this is a three day sequence. These are little babies, we call them primordial. And they're little families that are coming out as bouquets. And then the next day they start expanding. And as they expand, they become lighter in color. And then the next day, they fully mature. And here's one here that's ready to be harvested. And squeeze them, they're quite fleshy, they're quite...

>>Oh wow, this is beautiful! Now, it has something to do as well with...you can't tell by size when they're ready, right? Because different sizes can all be ready?

>>You're asking really great questions. Some oyster mushrooms will mature when they're small, and some will mature when they're much larger. But the real indication here is the formation of the gills. These are where the spores come from. And when these gills extend like this, and the caps plain becomes flattened, that's the best time to pick them, or just before that time. Ideally it's best to pick the mushrooms before this stage. You have better flavor, and the flesh is thicker. When they sporulate, the flesh actually goes from a fairly thick, white marshmallow looking flesh, to something that's very thin. Because the energy and the nutrition goes to spore formation. So it's best to pick the mushrooms when they're young.

>>So you can eat them at any stage, but this is the best stage?

>>Approximately, this is the best stage.

>>So that was white pearls, why don't you tell me about some of these other mushrooms here?

>>Well, our most popular mushroom kit is the shiitake mushroom kit. These are the Japanese black forest mushroom.

>>Are these out on the front?

>>That's correct. We have a little stamp on here that they must be opened within 30 days of the time that you receive it. Now this is very different from the oyster mushrooms. Oyster mushrooms you should open immediately. But with the shiitake, you can let it, you know...

>>They're not quite as eager?

>>Yes. They're asleep in the box. They've, in a sense, been put to bed. And then it comes to you. And this is the white, fuzzy mycelium again. This is all sawdust; the oyster mushroom was on straw. So this is one that actually grows better on sawdust. Then we open the bag. It's very similar to the other one. So with this now, again we put it on a pie plate. Or we can leave it on the bag. And you spray the outside of it. Then we simply put the humidity tent after we spray over. And then if you suspend this with a paper clip or a clasp or whatnot, and then the mushrooms start forming in a matter of a few days. Usually about 5-7 days, then baby mushrooms start popping out. The white

mycelium turns brown. That's good. The browning of the mycelium from white to brown is an indication that the kit is maturing. And then from this stage to this stage, which is fully mature now, is about one week. And in colder climates, it can be up to two weeks, and in warmer climates, it can be up to 4-5 days. But all these kits require water and indirect natural light. Otherwise they are broadly tolerant of temperature fluctuations. If no mushrooms form in two weeks, then we have an alternative strategy. And we use water, you see, this is full of regular tap water. We prefer non-chlorinated water. You can get water off of your rooftop if you want to, with a downspout. Or regular water, not distilled water. It should be mineralized water, or well water.

>>So we just put this block...

>>If it has not produced any mushrooms, into the water. We submerge it. You'll see it kind of floats. And so that's why we usually put a brick on it or some weight. If you let it sit overnight, then the next morning we pull this out, we'll put it back on to the plastic bag or onto a dinner dish or a pie plate. And then we begin our regimen of spraying—usually twice a day. Then the humidity tent goes back on top of the shiitake mushroom kit. And then mushrooms start forming within about 3-4 days.

>>Now you also do this between flushes, is that correct?

>>That's right. After one flush, or crop, is produced. Then we typically wait one week, we let it dry out, and every time it dries out, it's going to become darker brown in color. And then we re-submerge it overnight in cold water. Or room temperature water. Pull it out the next morning, spray it, then put the humidity tent back on, and mushrooms will start emerging.

>>Now everyone who has a fruit garden knows that you'll have pests in your fruit, in your vegetables. What are the problems that we can have with mushrooms?

>>Well the oyster mushrooms are attractive to fungus gnats, which are like fruit flies. But that's really only after they've heavily sporulated. All the more the reason to pick them when they're younger, then you won't have that problem.

>>How about harvesting, how do we do that?

>>Harvesting is very simple. We pull out our trusty knife, and most everyone has a knife. And these are shiitake. And we cut them flush to the surface of the block here. And the mushrooms are harvested. And then we trim off the stems and we eat the caps, and the stems are very tough but they're great for making a soup-base. So you can boil the stems in water and have a wonderful shiitake soup base.

>>So now you're going to show us another method of growing mushrooms using logs. What do we need for this?

>>Well you need spawn. IN this case we have plug spawn. These are on furniture dowels, pieces of wood. And we have inoculated it in our laboratory. And the white fuzzy mycelium has grown all over the dowels. And this is called "plug spawn." And the idea is to insert the plug spawn into the log. And then mushrooms will start producing from the log in about six months to a year. And then actually produce mushrooms twice a year for 5-10 years. And so the advantage of this is that the logs produce seasonally. Just like in your garden, you have vegetables. The logs are producing seasonally over several years. And so the indoor mushroom kits are great for people in apartments or cities. But where people have a backyard, a little bit of land, growing mushrooms on logs is a lot of fun.

>>Okay. And where did you get this log from? Is that a specific kind of wood?

>>This is an alder log. You can use oaks, poplars, willow, aspen, cottonwoods, a wide variety of wood types. Not cedar, not redwood.

>>It's too hard?

>>Well they have anti-fungal compounds that prevent them from rotting, so they're hard for the mushroom mycelium to take hold. So we like the hard woods in general. And the repairing of hard woods. Hard woods that grow near streams tend to grow very quickly. The oaks are denser, they take longer before the first flush or crop, but after the first crop, then they grow for many years. The wood should be fresh, and freshly cut. Now ideally when the sap is running in the spring, and before leaves are forming. But you do not want to use dead logs, dead trees that have been on the ground for a number of years. So it should be fresh-cut.

>>This is a pony log. We use logs often times that are three times the size. But the length of the log is totally up to your own discretion. And we use 5/16 drill. And I'll drill a series...

>>Now a 5/16 is just important because that's the size of the dowel? So it has to be exactly the same size?

>>Well...very close to the same size. The dowels actually swell a little bit with water, so they're originally 5/16 too but they swallow a little bit. So I'll do five holes, approximately, across this log. And then I'll turn it 90 degrees, and I'll do five more holes. But let me show you how the process goes.

Now I'm going to rotate the log 90 degrees, and I'm going to put the next set of holes halfway in between the previous row.

And this is a diamond pattern. We call it a diamond or alligator pattern. So we're interspersing this. And the mycelium grows out from each of these points of inoculation that eventually joins hands, so to speak. It all joins together as one solid amount of mycelium. So let's go ahead and insert the plugs. And your hands should be clean, but

you don't have to wear gloves. But I wouldn't be digging in the garden and then handling the plugs. Because you'll introduce dirt, particularly in the holes. These holes are typically one-and-a-half times, the two times the depth of the plug. So we want to make a little cave in there. So after we pound in the plug, then it goes in and it meets a little cavern. Stick it in there; kind of wiggle it a little bit. We use a dowel that has spiral grooves because if the mycelium is damaged from the concussion of inoculation, the mycelium survives in the groove and then grows into the cavity. So now we put them in now, and we use a rubber mallet. We tap. So it's flush with the surface. That's why I've got to make sure my depth is sufficient. And now I rotate.

>>Do it again.

>>And we do it again. And this is so much fun for kids and for parents and for anyone involved in the PTA or the Future Farmers of America or any sort of youth groups. I don't know what it is, but there's something that is subliminally satisfying about putting a plug into a hole. People really get excited about this. And it's simple. Then we dab it with wax. And we're using a cheese wax here. You can use a beeswax. Preferably not petroleum-based waxes. And we dab the exposed part of the wooden dowel here. Mostly to prevent insects from finding it. Because insects sometimes will eat mycelium. But more importantly is that it prevents contraction and expansion to form the plugs from falling out. It preserves moisture. Now highly recommended, those of us that have been growing these for a long time... we have found that if we actually dip the ends of the log in wax. I have hot wax in this pan here. Because this is like an open wound. And by dipping the ends of the logs, we prevent infection, so to speak, of other fungi from coming in through that "wound." So now we've covered the exposed areas, we have now covered the plugs. And we're good to go.

>>And so you store this upright?

>>Actually, you don't have to store it upright initially; it can be put on a palette. That's what many of us do is keep it just off the ground, but near the ground. Because the humidity is high and temperatures tend not to fluctuate as much as higher-up in the air. On the north side of the house or in the shade in the woods, many people prefer to keep it in their gardens, because when they're in the gardens in the spring, it's raining, they're working, they can see their logs produce. But there's something that happens that's a really good indicator if a log is ready. And here is a log that is ready. In that the mycelium grows to the outside of the log here, and this white coloring here is actually the mycelium has grown all the way through the log and is now growing on the ends. And when that shows on the ends, you know that the entire log is fully permeated, or colonized with mushroom mycelium. So now we soak overnight in water. Pull the log out. And then one week later, little baby mushrooms start forming. And here is just a log that's just beginning to fruit. And these are little baby shiitake that are growing here. There are some other ones that are just breaking out.

>>And they'll just come out all over the log?

>>All over the log. See, there's a little tiny one. And that goes from there, to this stage, or this stage, in about 24 hours.

>>Wow. So we have to wait till the ends turn white?

>>Yes.

>>Soak it. And then the shiitake mushrooms will begin to grow?

>>Is there any way that they'll begin to grow naturally?

>>They actually will begin to grow naturally in response to rain. So, I mean, you have two options. Let nature guide the course by natural rainfall, or if you look at it and you say, wow, I'm having a BBQ next weekend, I want to have some fresh shiitake. You soak it the weekend before in water, underneath the surface of the water; pull it out the next day. One week later, you can have mushrooms with the BBQ in the season.

>>Great, thank you. Is there anything that can go wrong with this?

>>Well, in nature, what we say "go wrong," is maybe nature's solution to an opportunity that presents itself. So if there are things that can defeat our process here...if the logs are already colonized with other fungi, that's the number one thing that can go wrong is that if you find a dead, rotten tree and you cut a dead, rotten tree up and you inoculate it. Well there's already a fungus present. So you want to use freshly cut logs.

>>Really cool! Who knew you could grow so many types of mushrooms at home? Now, before we go, let's just review a few of the simple things we can do to make sure we're successful in growing mushrooms at home. First, remember to check that inoculation date on the package, and wait 40 days before starting the cultivation process. Also, if the mushrooms aren't growing after those 40 days, try cold shocking the log for 24 hours. But don't use distilled or chlorinated water to soak the log, only use spring, well, or rainwater. And next, be sure not to place that log in direct sunlight. And finally, remember that in order to get the greatest nutritional value from the mushrooms, you need to cook them. And that's all the time we have for today, but for more information on this and other episodes of HomeGrown, or to order a copy of the series, be sure to log onto HomeGrown at www.byubroadcasting.org. Thank you for watching, and remember, everything's better *HomeGrown*. Goodbye.

>>On an upcoming episode of HomeGrown, we'll take a look at just a few of the many stories that we'll feature on this season of HomeGrown. We've literally traveled the globe to find stories and experts that will share with us the basics of vegetable gardening. Plus we found a few "out of the ordinary" stories to share with you as well. Whether you're an avid gardener or just starting out, now and then we all need a check-up on the basics of vegetable gardening, and that's what we're here to bring you. Be sure to check it out!

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