The ins and outs of mold©

An interview by Michael Fallarino with Jessie Micales
Supervisory Plant Pathologist
US Forest Products Laboratory
Center for Forest Mycology Research

Jessie, you are schooled as a biologist, right?

Yes, I'm a mycologist and plant pathologist by training. I work with fungi — everything from chestnut blight to downy mildews of sugar cane, to corn and decay fungi, and now mold. I've been around the fungal kingdom a little bit. I used to work almost exclusively with wood decay fungi, but over the course of the past five years the interest in mold has gotten so much stronger that ninety percent of the calls I'm getting are mold related. They used to be almost entirely wood decay related.

Now the poor wood decay fungi don't get a chance to grow very much because people are so sensitized about mold due to all the media and internet coverage, that as soon as they see some mold growing they're beginning to take care of the situation. The wood decay fungi grow much more slowly, and people become aware of moisture problems when they see the mold growing, so they get the problem taken care of before they can break down the wood too much.

Because of the way that we are building today — houses are tighter and the nature of the construction materials is changing — should we be making an allowance for organisms such as mold?

Yes. The main concern regarding mold is moisture. Whenever you have a major moisture build up — such as a plumbing leak or some sort of disaster due to flooding, or even persistent condensation coupled with air movement within the structure —for example a subtle factor like cool air from an air conditioner colliding with the warm air it's displacing — all these events may cause mold and its disbursement.

It needn't be the case that the house is too tight. Pressure differences, as well as differences between interior and exterior materials can also be a causative factor.

Why is it important to understand mold and its dynamics?

There are a couple of answers to that. Molds have been here forever but people are becoming more aware of them lately. There can be serious health implications for asthmatics and people with allergies.

There was a lot of publicity surrounding a case in Ohio where approximately ten infant mortalities were linked to moisture problems in low income housing. Many of the rooms had a particular fungus called *stachybotrys,* which is a black fungus found in very moist conditions. That's when the "toxic mold" hysteria began.

Subsequently, upon examining the method of data collection the Center for Disease Control determined that it wasn't statistically valid to say that the mold caused the death of the babies. There were other factors involved that suggested other correlates. However, the ultimate effect of the mold remains unknown. This has launched a lot of research in the medical community about the effects of mold on human health. Many grants were disbursed and a lot of studies are currently in progress. Within the next two years we'll begin to see the results of the research.

Some molds make *mycotoxins.* We originally associated mycotoxins with molds growing in foodstuffs like grain. It's a big question as to whether these same fungi, or even closely related fungi, will produce these same toxins while growing on building materials and then release them into the air. The mycological research is tending to show that they make them in such small quantities — which may or may not become airborne — that we can't assume that they are harming people. The situation is a lot more dubious than that. Some strains of the fungus will produce a mycotoxin while others won't. This is even true of the different species of *stachybotrys.* So the question becomes: are the toxins generated only under certain environmental conditions? And the answer to this question appears to be *yes.* A lot of the mycotoxins are only on the cell walls of the spores of the fungi. It's really much more complicated than people first thought.

With *stachybotrys* in particular the spores tend to be held in clumps of liquid, which reduces their ability to become airborne, especially compared to some other fungi. For example, the basic survival mechanism of some fungi, like *penicillium* and *aspergillus,* is to make lots of very dry spores that can be released and transported by *any* air movement. Air currents generated by humans walking around a room can cause the spores to release from the structures on which they're formed and become airborne. And the release can be in massive quantities. One colony can produce millions and millions of spores. And these spores are survival structures: they're resistant to cold and to dehydration. They're very light and capable of remaining airborne. Once airborne they can become enmeshed with ambient air currents and float for very long periods of time, spreading everywhere.

By "long periods of time" give me a frame of reference.

I don't know if that has been studied specifically. It involves complex Bernoulli principles of air movement involving differences in materials. But they're so light and tiny — they're only a couple of microns wide — that they could easily stay airborne for weeks at the very least.

With some plant pathogens, such as corn or wheat rusts, we've found that they can ascend into the upper atmosphere such as the jet stream and become disbursed across states. For example spores that are forming in Mexico can end up in Colorado. I would assume that most spores can do the same thing.

These mold spores are everywhere. I once cultured my desktop for a seminar I was giving and the results were pretty disgusting. I immediately went out and bought some Endust and dusted my whole office.

The key with spores is moisture. Normally, they don't exist in large enough populations to bother people with allergies — so long as you're making a reasonable effort to keep a hygienic environment. But once there's moisture on wood, or a wall —such as drywall — or anything from which they can derive nutrients, the spores will start growing. They put out a structure called a germ tube — the vegetative structure is called a hyphae — and they begin growing. These are thread-like structures growing outward from the spores seeking sources of nutrition. They can grow very rapidly.

One of my sons doing graduate work showed that if there is flood damage in a structure spores will begin germinating within two days. So in a case such as that, if there was going to be a remediation process it would have to be started almost immediately succeeding the wetting. Otherwise the newly growing organisms can begin forming new spores within two days. After that you can have an exponential spore growth occurring in the building and at that point the situation can slip out of control.

These dynamics are one of the reasons it can be very expensive to remediate severely infested buildings. In severe infestations it's necessary to remove all carpeting and drywall and get back to the studs. A case requiring extensive remediation can create a work detail that exceeds the value of the structure, necessitating destruction of the building. So this can become tragic situation. In some cases involving severe infestations homeowners are actually defaulting on their mortgage and just turning the house back over to the bank because the cost of remediation is prohibitive. Unfortunately this can become a self-perpetuating problem because sometimes the bank will merely turn around and just resell the house. People need to be more careful these days when they purchase a house. As a result many insurance companies are now refusing to cover mold infestations. But we have to be careful to not exploit emotions. For the past couple of years there has been a mold hysteria.

Is there a simple way that an average person could test to find out if there was a mold problem in his house?

Well for starters, mold-infested houses often have a musty smell. If you develop hay fever symptoms when there isn't any pollen in the air that can be a signal. Allergic reactions are often the first signal that a problem exists. Another simple diagnostic procedure is to go into the basement and look for signs of water damage or condensation on the wails or floor. For example if there is a moisture problem wood will often become stained from the moisture. If the mold is growing in large quantities it will give the wood a fuzzy appearance. The colors can vary — sometimes it's white and sometimes its black. A visual inspection should not be discounted.

Another place to look is in the attic, or any space between a ceiling and the roof. It's common for condensation to develop in these spaces. Bathrooms are another common place for mold to develop. If there are plumbing leaks — for example in the shower area — there's a good chance that mold may be developing behind the surface that encloses it. The inner wall behind toilets is another common location for mold growth. In northern climates it's common for leaks to develop from ice dams and that can be another major source for mold infestations.

Professional remediators can actually assess a house by sampling the air with a spore sampler which is a little vacuum that utilizes an air intake that runs the air past a petri plate with growth media. However, there are some reservations to this method of sampling since it only gives you a one-time snapshot of the air in the structure that might not be completely valid considering all the variables involving air movement and differences resulting from seasonal changes. These are subtle factors that influence the quantity of fungi present in a structure.

But for the average person, if you just keep your eyes open and your nose attuned, you should be able to detect if a mold problem exists. If you're looking for them you'll probably see them, and from there you'll have to determine if they actually represent a problem. Meticulous house cleaning can reveal a lot!

Is there any evidence to suggest that molds have been changing at all in recent years?

No. Biologically molds are very stable and very adapted to our environment. There may be some normal changes in their DNA, but for the most part they've remained unchanged from Egyptian times. There are a couple of references in the bible to molds and mildew.

Is there much difference between mold that would colonize inside a structure and mold that would colonize outdoors?

Yes, actually. Many molds found indoors are species related to food. We bring molds into our house on foodstuffs, and dropping crumbs — especially on carpets and rugs — can create a significant cultivation medium. The trash is another source of mold growth. Refrigerated foods that aren't used rapidly enough can be another large source of indoor mold. Compost in the house or in close proximity to the house can be yet another source.

A lot of the mold that you see on paint, for example the most common black yeast-like mold that grows in different forms, aureubasibium pullulans, is not something that you would commonly find inside with the exception of bathrooms, because it likes fairly wet conditions.

How can the average person enact good mold hygiene protocols in their environment?

Our laboratory is really beginning to focus on mold dynamics because of the level of public concern about it. We're preparing to build test structures that are wired with moisture monitors in which we have the capability to vary the moisture levels in various parts of the buildings. Recently we built an experimental house outside our lab with moisture monitoring equipment throughout the house.

It's obvious at this point that moisture movement in structures is a critical factor. We've been preaching for a long time that we need to keep wood dry. That's the key to the whole mold issue. Roofs and plumbing should be closely monitored for leaks and water intrusions. Also, interior humidity should be kept relatively low. Many people have humidifiers attached to their heaters that can raise interior humidity to as high as eighty percent. Sixty percent is a much more optimum level for interior humidity. Most molds associated with indoor problems, such as *penicillium* and *aspergillus,* need a humidity level of about eighty percent to thrive, although molds that inhabit dusts can grow at much lower humidities. The correct protocol should be to dehumidify in the summer and to be careful to not over-humidify in the winter.

In studies done in mobile and modular-type homes, the amount of interior moisture measured is directly correlated with the number of inhabitants. Aside from the moisture generated directly by individuals through respiration, the quantity of bathroom use and cooking activity will all have a cumulative effect. Composite materials themselves can also have a significant impact on mold levels.

The US Forest Products Laboratory in Madison, Wisconsin is a great national resource for research and contemporary thinking regarding

wood use and wood preservation, including the subtleties of indoor air quality. Their invaluable website can be accessed at http://www.fpl.fs.fed.us/ and contains a searchable database. This interview with Jessie Micales was conducted during the spring of 2003.