

mushroom

news

February 2011



Specialty Mushrooms

21st NAMC Schedule

Cultural Practices to Enhance Mushroom Yield & Concentration of the Antioxidants Selenium and Ergothioneine

– Alma Rodriguez Estrada & Daniel J. Royse

10 Commandments of Agari-Culture Management

– Ray Samp

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US DOL Officials Meet with AMI Growers

Officials from the U.S. Department of Labor met with Chester County growers to discuss the Migrant and Seasonal Agricultural Worker Protection Act (MSPA), Farm Labor Contractors and requirements for growers and service providers. Jim Mooney, Regional Coordinator and Joe McKeefery, Wage and Hour Investigator based in West Chester, PA were

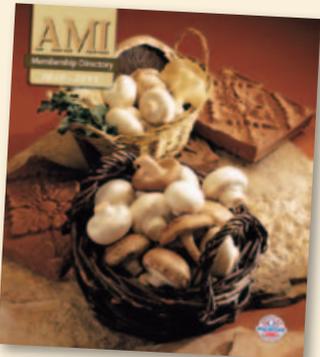
the principal presenters. Other DOL participants included Wage & Hour Assistant District Director Ivette Vigano, Wage & Hour Investigators Mike Freeman, Francia Yops and Rachel Dinetz. The meeting was held at the Hilton Garden Inn in Kennett Square on Dec. 14. More than 20 companies were represented. **nf**



DOL regional representatives at the meeting included Jim Mooney, Rachel Dinetz, Joe McKeefery, Francia Yops, Mike Freeman and Ivette Vigano.

AMI Directory Correction

There is a mistake in the Topterra Holland B.V. listing in the new directory. The fax number should be +31 478532246. Make a note of the change in your directory. **nf**



Promotion Announced

Mike Manion was promoted recently to Vice President, All Seasons Mushrooms Inc., according to company President, Frank Moscone. The promotion was made in recognition and appreciation for Manion's continued diligence, performance and focus on both the short and long term best interests of All Seasons. Manion has been an instrumental leader at All Seasons since July 2008 and was commended for his commitment and loyalty to the company. **nf**



Mushroom Import Report Compiled from Department of Commerce Trade Data Services Washington, D.C. – Reporting Month **October 2010**

	Oct 2010 KILOGRAMS	2010 YTD KILOGRAMS	Oct 2009 KILOGRAMS	2009 YTD KILOGRAMS
Fresh, <i>Agaricus</i>	2,870,996	29,705,872	2,076,584	22,206,665
Fresh, NESOI*	327,036	4,093,774	393,230	3,891,160
Whole < 225 g	90,894	865,790	164,379	919,683
Sliced < 225g	299,370	3,049,909	311,053	2,358,925
NESOI* < 225g	1,155,061	14,307,575	1,259,910	10,902,006
Whole > 225g	2,040	321,469	57,879	630,024
Sliced > 225g	94,235	2,047,718	106,941	3,517,360
NESOI* > 225g	1,160,796	20,994,556	1,610,988	22,310,373

Total Classified by Container Weight:

< 225g	1,545,325	18,223,274	1,735,342	14,180,614
> 225g	1,257,071	23,363,743	1,775,808	26,457,757
Total by Container Weight:	2,802,396	41,587,017	3,511,150	40,638,371

* Not Elsewhere Specified or Indicated



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Cultivation of Companies, Crops & Profits – Sara Manning, *Mushroom News* Editor

It's time to *Unmask the Possibilities* at the 21st North American Mushroom Conference in New Orleans this month. We are very excited about our group of speakers from the research, business and produce industry fields. Check out our topics and schedule in this issue. We look forward to seeing many of you later this month for a great conference and a fun winter break. If you can't make it, we'll be sure to feature the presentations, news and events in upcoming issues.

A specialty topic we share this month is *Cultural Practices to Enhance Mushroom (Pleurotus eryngii) Yield and Concentration of the Antioxidants Selenium and Ergothioneine* by Drs. Alma E. Rodriguez Estrada and Daniel J. Roysse. The King Oyster study shows that the same species may adapt to different methods of cultivation. Most growers understand that different methods have diverse economic and practical advantages and disadvantages. Cultural practices may influence nutritional properties, quality of mushrooms and disease susceptibility.

Ray Samp adds the sixth installment to his *10 Commandments of Agari-Culture Management* series with

"Thou shalt not make significant changes to a system that is performing well." If operations are running smoothly, sometimes a manager will try to save money on supplies, man-hours or fuel only to realize that production suffers in the end. When a farm experiences a superior growing streak, it's best not to make changes without a good reason.

When the release of the Institute of Medicine's (IOM) research led to a Recommended Dietary Allowance (RDA) for vitamin D, the Mushroom Council issued a news release indentifying fresh mushrooms as a natural source of the nutrient to help consumers meet the new recommendation. *IOM Report on Vitamin D* by Mary Jo Feeney and Heidi Gengler highlights the details and implications from the study. In other Council news, survey results from *Taste of Home* magazine and AllRecipes.com show that 62 percent of consumers purchase mushrooms more than once a month, with 26 percent purchasing mushrooms more than once a week.

Keith Silfee shares information that banks will require in the future in the *Financial Issues* column. He suggests

that companies pay for good financial reporting since these statements will help owners make good decisions. Lenders study these reports so they can ascertain the profitability of the business. He suggests that companies clean up and strengthen balance sheets to show that profits are invested in the business and not distributed to owners or partners. He also says to build up cash reserve, improve equity, liquidity and working capital.

The Penn State Lines by Drs. David M. Beyer and John A. Pecchia discusses casing management and the pinning process. There are many important steps for growers to review before, during and after casing to anticipate mushroom growth, requirements for water and making the correct compromises to achieve maximum yield, fresh quality and desired size. The article discusses staggering pin set, aggregates within the casing layer and methods to create two or more waves of mushrooms.

Finally, the *AMI Update* notifies growers of changes to the labels and Material Safety Data Sheets for insecticides that are registered for use in *Agaricus* and specialty production. **mn**

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View of side board attachment



Vinyl instruction label



Protective yellow endcap



Plastic hook & clamp



114" Approximate overall length

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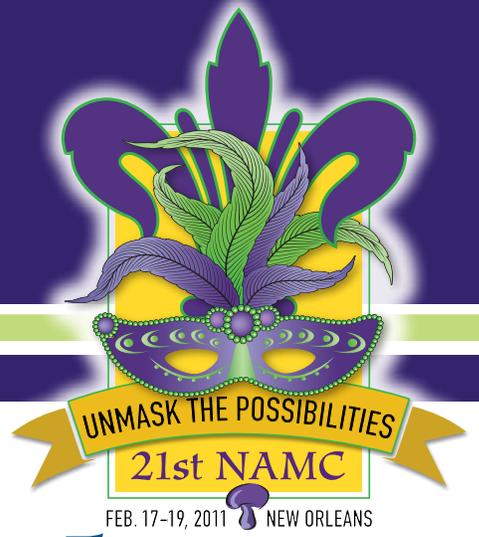
TENTATIVE SCHEDULE

namc update

Thursday, February 17		
12 pm – 5 pm	Registration open	Conti Room
1 pm – 4 pm	Expo Set up	Crescent City Ballroom
6 pm – 8 pm	Expo Opening & Reception	Crescent City Ballroom
Friday, February 18		
7:30 am	Registration open	Conti Room
7:30 – 8:30 am	Breakfast in Expo	Crescent City Ballroom
8:15 – 8:30 am	Welcome & Announcements	Waldorf Astoria Ballroom
8:30 – 9:30 am	<i>A. O'Neil Memorial Lecture: Solutions from the Underground: How Mushrooms Can Help Save the World</i> Speaker: Paul Stamets, Fungi Perfecti	Waldorf Astoria Ballroom
9:30 – 10:00 am	<i>How Do You Know When It's Time to Spray a Little Febreze in Your Boots?</i> Speaker: John Blanchfield, American Bankers Association	Waldorf Astoria Ballroom
9:30 am	Partners' program departure for New Orleans city tour, lunch, Mardi Gras World tour	Hotel Lobby
10:00 – 10:30 am	Break in Expo	Crescent City Ballroom
10:30 – 11:30 am	<i>Harvesting More Profit</i> Moderator: Carla McKinney Speakers: Ray Samp, Doug Schirippa, Lawrence Zimmerman	Waldorf Astoria Ballroom
11:30 – noon	<i>Leveraging Data into Sales</i> Speaker: Roger Soman, Encore & Associates	Waldorf Astoria Ballroom
Noon – 1:30 pm	Lunch in Expo	Crescent City Ballroom
1:30 – 2:15 pm	<i>Studying Produce Trends for Solutions & Strategies</i> Speaker: Lorna Christie, PMA	Waldorf Astoria Ballroom
2:15 – 3:00 pm	<i>Mega-Trends in American Foodservice: Of Mushroom Flavors & Health</i> Speaker: Greg Drescher, CIA	Waldorf Astoria Ballroom
3 pm – 5 pm	EXPO OPEN – NO SESSIONS, Refreshment Break in Expo	Crescent City Ballroom
Saturday, February 19		
7:30 am	Registration open	Conti Room
7:30 – 8:30 am	Breakfast in Expo	Crescent City Ballroom
8:30 – 9:30 am	<i>Unmasking the Future of Spawn: Four North American Perspectives</i> Moderator: Bill Barber Panelists: Stephen Anania, Monir Elzalaki, John Kidder, Scott McIntyre	Waldorf Astoria Ballroom
9:30 – 10 am	<i>The Four R's of Food Safety</i> Speaker: Drew McDonald, Taylor Farms	Waldorf Astoria Ballroom
10:00 – 10:30 am	Break in Expo	Crescent City Ballroom
10:30 am – noon	<i>Moving Forward: What Are the Possibilities?</i> Moderator: Dr. David Beyer Panelists: Jim Angelucci, Ed Leo, Burton Loveday, Artie Needham, Jim Rothwell, Keith Silfee	Waldorf Astoria Ballroom
Noon – 1:30 pm	Lunch in Expo	Crescent City Ballroom
1:30 – 2:30 pm	<i>The People and the Process of Farm Business Succession Planning</i> Speaker: Dennis Hall, PA Center for Farm Transitions	Waldorf Astoria Ballroom
2:00 – 6:00 pm	Expo tear down	Crescent City Ballroom
2:30 – 3:00 pm	<i>Sustainability Opportunities</i> Speakers: Joe DiNorscia, Murray Good	Waldorf Astoria Ballroom
3:00 – 4:00 pm	<i>Marketing in an Up-and-Down Market</i> Speakers: Ken Wong	Waldorf Astoria Ballroom
6:00 pm	Cocktail party on pool deck	Garden Terrace Pool Deck
7:00 – 10:00 pm	Dinner/Dancing	Blue Room

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Cultural Practices to Enhance Mushroom (*Pleurotus eryngii*) Yield & Concentration of the Antioxidants Selenium & Ergothioneine



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Green-Bay
Dept. of Natural and
Applied Sciences



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Penn State
Dept. of Plant Pathology

A summary of our work on enhancing mushroom yield and concentration of the antioxidants selenium and ergothioneine in the King Oyster mushroom is presented here. Improved yield was achieved by supplementation of substrate with a commercial delayed-release nutrient and the use of a casing layer. Yield was increased by 141 percent from cased substrates vs. non-cased substrates and yield was further enhanced by the addition of delayed-release supplement at time of casing (179 percent total increase). Mushrooms were darker in color and lower in solids content when produced on cased substrates compared to non-cased substrates.

Concentrations of the antioxidant selenium were enhanced in mushrooms by supplementing the substrates (to levels of 5 and 10 $\mu\text{g/g}$) with sodium selenite. Mushrooms accumulated selenium to levels that would supply 70 and 116 percent of the daily value (DV) of selenium in a serving size of 85 g of fresh mushrooms. Since selenium-enriched mushrooms would supply more than 20 percent of the DV, they could be considered an excellent source of selenium. To enhance ergothioneine concentration, mushrooms were grown on low-moisture (55 percent) substrate as compared to the commonly used 60 percent (high-moisture) in commercial cultivation. Mushrooms produced on low-moisture substrate had ergothioneine concentrations of 2.6 mg/g, while mushrooms produced on high-moisture substrate contained 2.2 mg/g or less.

Introduction

Although different species of mushrooms have different nutritional and environmental requirements, the same species may easily be adapted to different methods of cultivation. For example, *Pleurotus eryngii* could be cultivated successfully on substrate contained in bags, bottles or trays with or without a casing layer (Tan *et al.* 2005). Cultivation methods with slight variations have economic and practical advantages and disadvantages that are recognized easily by mushroom growers. What is perhaps more difficult to quantify is the effect that cultural practices have on the nutritional properties, quality of the mushrooms and disease susceptibility (Rodriguez Estrada *et al.* 2009a, b). In the following report, we describe cultural practices such as casing layer application, substrate supplementation, fragmentation

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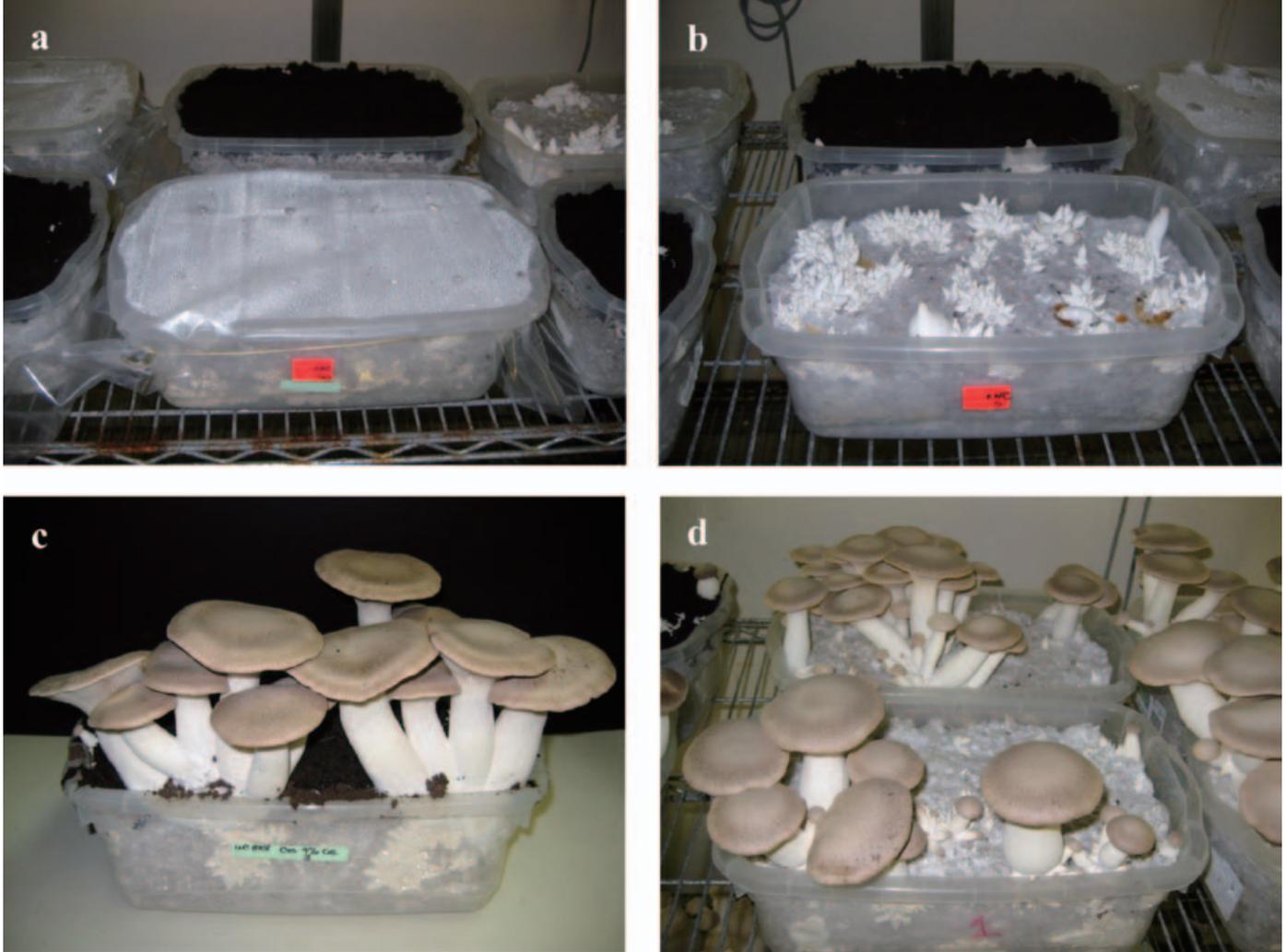


Figure 1: *Pleurotus eryngii* cultivation in plastic bins. Substrate was bagged in polypropylene bags, sterilized, inoculated and incubated for 25 days. After complete colonization, substrate was manually fragmented and placed in plastic bins. **a.** Non-cased substrate was covered with a plastic sheet (front) while cased substrate (back) was covered with a casing layer (peat moss and calcium carbonate, 78.7% moisture). **b.** Primordia formation on non-cased (front) and cased substrate (back). **c.** Mushrooms growing on cased substrate. **d.** Mushrooms growing on non-cased substrate.

and moisture content, and their effects on *P. eryngii* yield (fresh mushroom weight), biological efficiency (BE, ratio of mushrooms fresh weight to dry substrate weight expressed as a percentage), pilei color (brightness), antioxidants (selenium and ergothioneine) concentration, solids and number of mushrooms. Materials and methods used for the experiments reported herein may be found in Rodriguez Estrada *et al.* (2009a, b).

Cultural Practices to Increase Yield

The crop cycle of many cultivated edible mushrooms (e.g. *Agaricus bisporus*, *P. ostreatus*, etc.) consists of multiple breaks or flushes. However, *P. eryngii* produced on substrate that is contained in bags or bottles normally yields only one flush before the substrate is discarded. If a casing layer is used, two or more flushes may be obtained (Tan *et al.* 2005). Furthermore, where mushroom farms have limited control of environmental conditions or during outdoor cultivation, the use of a casing overlay minimizes the loss of substrate moisture (Oei 2006; Rodriguez Estrada and

Royse 2008). In controlled environments, where the relative humidity can be maintained around 85-90 percent, the use of a casing layer to grow *P. eryngii* is not necessary but, as mentioned previously, only one flush is commonly obtained.

Rodriguez Estrada *et al.* (2009a) explored the effects of applying a casing layer to substrate that had been fragmented and supplemented (applied at different times during the production cycle) on *P. eryngii* yield, number of mushrooms, solids content and pilei color. A commercial strain of *P. eryngii* was grown on a substrate composed of cottonseed hulls (56 percent), sawdust (27 percent), corn distillers (4 percent), ground soybean (12 percent) and calcium sulfate (1 percent). Substrate was packed in plastic bags, sterilized and inoculated with *P. eryngii* (rye spawn). Substrate supplementation with Remo's (delayed-release corn gluten and soybean-based supplement) was completed at two different stages of the cropping cycle. In one set of experiments, one third of the substrate was supplemented at spawning, one-third after colonization and

the remaining was not supplemented. For all treatments, the substrate was first incubated in plastic bags. Then, the colonized substrate was manually fragmented and placed in plastic bins for primordial initiation and mushroom production (Figure 1).

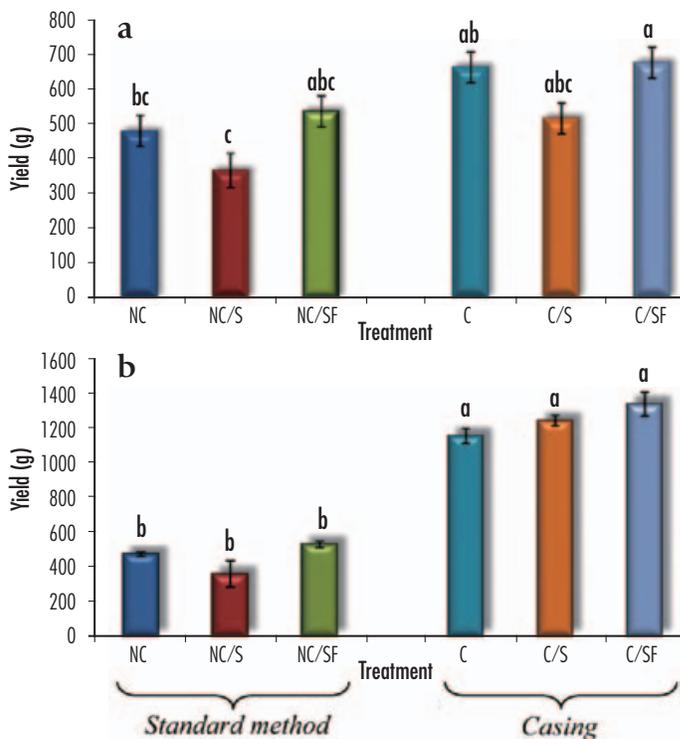
Supplementation at spawning had negative effects on yield and number of mushrooms. On the other hand, supplementation at time of substrate fragmentation resulted in the highest yield although not statistically different from non-supplemented substrates (Figure 2a). Casing layer application dramatically increased yield and biological efficiency (Figure 2a). Solids contents of the fruiting bodies were higher from non-cased substrates. Mushrooms harvested from non-cased substrates had an average of 11.3 percent solids while mushrooms from cased substrates contained 8.2 percent solids. Pilei brightness, measured with a chromameter, was lower from mushrooms harvested from cased substrates (Figure 3).

The effects of the casing layer and substrate supplementation after the first flush also were evaluated. Non-cased substrate was fragmented, re-supplemented and cased or "only cased" (without fragmentation or supplementation). Together, second and third flushes for the "only cased" substrate yielded 396 g (39 percent BE). In contrast, second

and third flushes for the fragmented, re-supplemented and cased substrate yielded 607 g (59.7 percent BE) representing 53 percent more biomass than the "only cased" substrate. In that experiment, substrate supplementation and fragmentation were applied together and therefore it is not possible to elucidate the contribution of each effect (fragmentation vs. supplementation). However, it is assumed that a depleted substrate will require both an additional source of nutrients and fragmentation to promote vigorous mycelia re-growth, primordial formation and mushroom development.

Substrate that was not cased produced only one flush, while cased substrate produced up to three flushes and therefore, yields in the latter case were considerably higher (Figure 2b). Increases in yield were mainly due to the extended production cycle that occurred whenever a casing layer was applied. Potentially, a casing layer might be applied before or after first flush. Regardless, casing layer

Figure 2: Yields (g/bin) obtained from six different substrate treatments: NC: non-cased substrate; NC/S: non-cased substrate supplemented at spawning; NC/SF: non-cased substrate supplemented during substrate fragmentation (after complete colonization of the substrate); C: cased substrate; C/S: cased substrate supplemented at spawning; C/SF: cased substrate supplemented during substrate fragmentation (after complete colonization of the substrate). "Standard method" refers to non-cased substrate. "Casing" refers to substrate that was covered with a casing layer. a. Yield from first flush since in non-cased substrates only one break is obtained. b. Yield obtained from three flushes for the cased substrate (C, C/S and C/SF) and one flush for the non-cased substrate (NC, NC/S, NC/SF). Means represented by different letters are significantly different according to the Tukey-Kramer HSD test ($P < 0.05$).



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Figure 3: *Pleurotus eryngii* mushrooms harvested from non-cased and cased substrate. Pilei color from non-cased substrates is notably brighter than mushrooms grown on cased substrates.



application before the first flush resulted in the largest increases in yield (Rodriguez Estrada *et al.* 2009a).

It is worth noting that mushrooms harvested from cased substrates had higher moisture content. So increases in yields were partially due to extra water absorbed by the mushrooms. Yield and quality are important indicators of production success and the trade off between such factors should not be ignored. Additionally, higher moisture content in the mushroom context might facilitate the development of undesired outcomes such as occurrence of certain molds or bacteria and deformities in the basidiocarp (Rana *et al.* 2000). Until now, a comprehensive assessment of different cultural methods and how they influence both yield and quality of *P. eryngii* mushrooms had not been performed. Such information will contribute to our understanding of the potential for rational use of a casing layer and delayed-release nutrient supplementation in commercial cultivation of *P. eryngii*.

Cultural Practices to Increase Selenium

Mushrooms have antioxidant properties that are provided by various compounds such as phenolics, ergothioneine (ERGO) and selenium (Werner and Beelman 2002, Beelman and Royse 2006, Dubost *et al.* 2007). Selenium content in mushrooms is species specific. For example, *Boletus edulis*, *Agaricus* spp. and *P. cornucopiae* have selenium concentrations of approximately 17 mg/kg, 2.7 mg/kg and less than 0.5 mg/kg (d.w.), respectively (Piepponen *et al.* 1983, Beelman and Royse 2006).

Supplementation of the substrate with sodium selenite (Na_2SeO_3) results in increased selenium content in mycelia and basidiocarps (Werner and Beelman 2002, Stajic *et al.* 2005, Beelman and Royse 2006). Rodriguez Estrada *et al.* (2009b) supplemented substrate (cottonseed hulls/

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sawdust) with various levels of sodium selenite and demonstrated that selenium accumulation in *P. eryngii* mushrooms was roughly linear in relation to the levels of added sodium selenite. For example, additions of 5 and 10 µg/g resulted in mushrooms with selenium concentrations of 4.6 and 9.3 µg/g (d.w.), respectively.

The Food and Drug Administration (FDA) recommends a selenium daily intake of 70 µg. A serving size (85 g) of mushrooms enriched with selenium would provide 81.4 µg of selenium when the substrate is supplemented with 10 µg/g of sodium selenite, therefore providing more than 20 percent of the recommended daily values (DV) (Rodriguez Estrada *et al.* 2009b). Selenium-enriched mushrooms may be used as a component in functional foods or as a starting material to produce selenium supplements (Werner and Beelman 2002).

Cultural Practices to Increase Ergothioneine

Another important antioxidant found in mushrooms is ergothioneine (ERGO). ERGO provides several physiological benefits such as a cytoprotectant, enhancement of metabolic energy, protection against formation of cataracts, molecular regulation of anti-inflammatory mechanisms in lungs, etc. (Shukla *et al.* 1981, Kawano *et al.* 1982, Paul and Snyder 2009). More recently, ERGO has found use as a color stabilizer in processed fresh fish (Bao *et al.* 2010).

Dubost *et al.* (2007) evaluated variations of ERGO concentrations in *A. bisporus* mushrooms in response to compost supplementation and cultural practices. They found that ERGO concentration was higher in mushrooms harvested during second and third flushes from compost supplemented with the amino acid histidine (5, 10 and 20 mM). In addition, cultural practices such as fragmentation of the colonized compost at casing and lower moisture content of the substrate enhanced ERGO content in mushrooms (Dubost *et al.* 2007).

ERGO concentration in *P. eryngii* mushrooms responded significantly to substrate moisture content but not to substrate fragmentation or histidine supplementation (Rodriguez Estrada *et al.* 2009b). Substrate adjusted to 55 percent moisture yielded mushrooms with 2.57 mg/g (d.w.) of ERGO. On the other hand, mushrooms grown on 60 percent moisture content substrates had 2.21 mg/g (d.w.) (Figure 4a). It is not clear if ERGO concentration was a result of water stress or accumulation.

Dubost *et al.* (2007) suggested that ERGO might be a stress-induced metabolite that is enhanced when fungi are exposed to low substrate moisture and fragmentation

of the substrate. Rodriguez Estrada *et al.* (2009b) also observed that ERGO concentration in mushrooms only responds to moisture content of the substrate and therefore, higher concentration of this compound might be an accumulation effect. In low content moisture substrates, mushroom yield and number of mushrooms were significantly lower than in high-moisture content substrates (Figure 4b and c). It is expected that “drier mushrooms” will have more solids and as a consequence higher concentration of ERGO (Figure 4d).

If a casing layer is applied, yields will increase; solid contents will decrease and ERGO will slightly decrease. Still, ERGO concentration will be higher than mushrooms grown on high moisture content substrates. Since both casing layer and moisture content of the substrate significantly influence ERGO concentration in *P. eryngii*, it might be feasible to grow this species on cased/low-moisture content substrates. By doing so, mushrooms will have high ERGO concentration with no significant losses in yield.

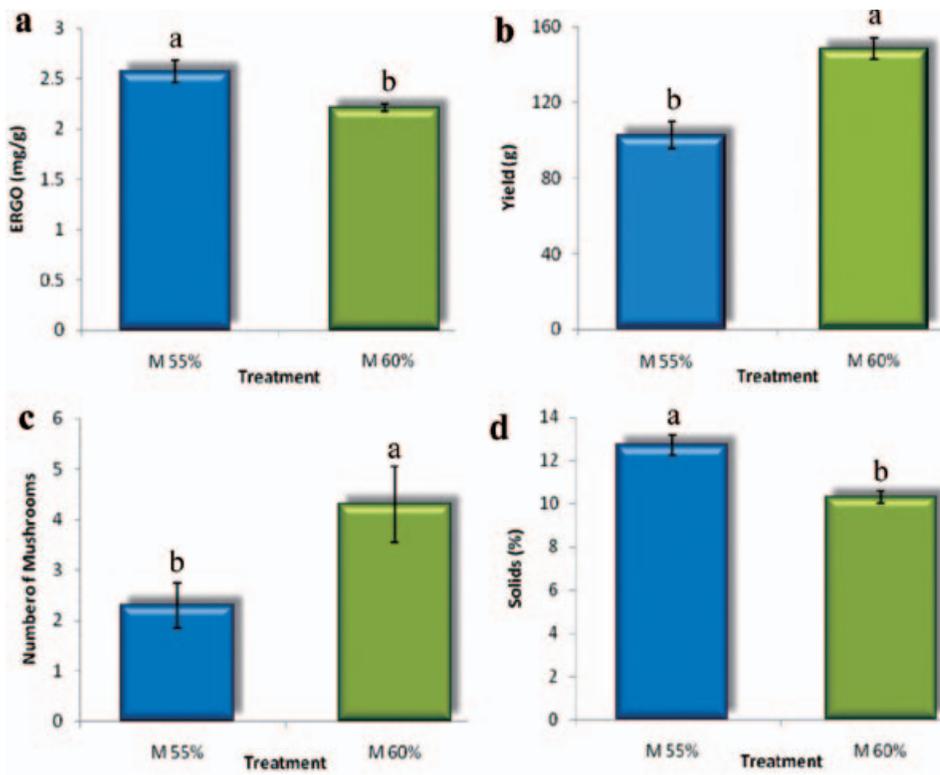
Conclusions

Our results indicate that yield and the presence of the antioxidants selenium and ergothioneine in the basidiocarps may be enhanced through selected cultural practices. Supplementation of substrate with sodium selenite and use of moderately low moisture content in the substrate are cultural practices that are relatively easy to implement on a commercial scale. Potential yield reduction by lower moisture content in the substrate may be overcome and even enhanced by the use of a casing layer.

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Figure 4: Effects of substrate moisture content on ergothioneine (ERGO) concentration in mushrooms (a), yield (b), number of mushrooms (c), and solids (d). Means represented by different letters are significantly different according to the t-test ($P < 0.05$).



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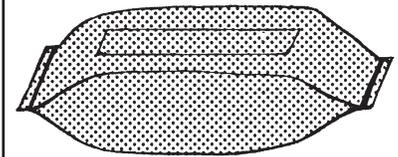
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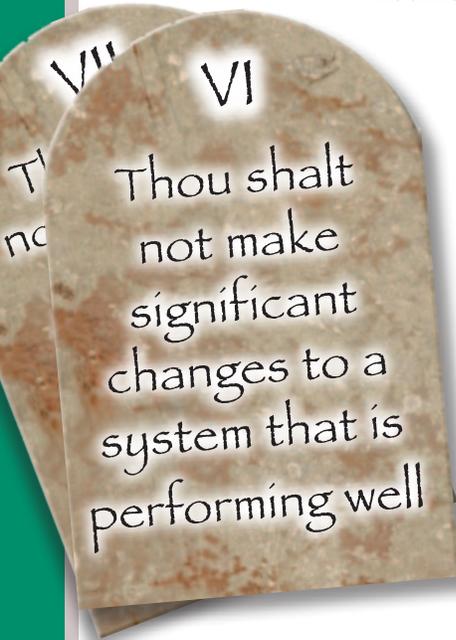
10 Commandments

A mushroom farm that is producing and hitting on all cylinders is a beautiful thing. When yields are high for an extended period of time the logic, the flow, the complete meshing of so many variables becomes so simple that the superior results seem effortless. When I see a farm in this “groove,” I personally enjoy taking a step back and watching the extreme complexity of the business just flow easily by as a lazy, slow moving stream would in deep, rural Georgia.

At times I’ve heard growers make the comment that, “you just can’t seem to do anything wrong! Whatever you do the mushrooms just keep coming!” And indeed it seems that way so that one wonders what all the talk is about that the mushroom business being a tough business. Operations go well, timing of harvesting is exact, growers and managers go home early. What an idyllic place a mushroom farm can be.

That is until the impending storm is seen on the horizon. Someone thinks that operation can do better! A noble goal indeed, but be careful here. Much

frustration and gnashing of teeth can come from the casual and righteous desire to make an excellent performing operation better. At times I’ve cringed when I’ve been associated with high flying operations and then heard someone say something like: Maybe costs can be lowered if we change the composting raw material. There is a cheaper peat moss available if we commit to change over this month! We can reduce odor if we reduce the sour core on the compost piles by making the compost drier! I think the airflow patterns in the rooms need changing! We can reduce composting man-hours and fuel usage if we don’t turn the piles so frequently! These are the kind of things that numb the mind when they are proposed because it’s a sign that the end is in sight.



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I've never been the kind of consultant that says, "Do Not Change Anything" – and leaves. Every operation can be improved and there are always challenges to be addressed on any mushroom farm. Various things such as safety issues, mechanical improvements, preparation for the next seasonal change and even minor cultural adjustments can be made when cultural urgency is not an issue. However, when you've got a full wind in your sails, do not change course on a whim. There must be good reason and the change must be at least culturally neutral so as not to upset the continuity of a good run. Jerry Manuel, former major league baseball manager, doesn't tinker with the rotation when the team has won 10 of 11. Likewise the cultural integrity of a mushroom farm should not be changed without reason in the middle of a winning streak.

Several times in my career I've seen aggressive operations over-reach in the quest for more even when there was little to gain. The comments I referred to above are actual and they have been the demise of several "good runs" of production in order to squeeze that little bit more out. I've visited farms where the run had ended, equilibrium lost and another wandering in the wilderness had commenced. We all know how fleeting mushroom production success can be, and in these cases it was truly lost for a questionable pursuit for improvement. Sometimes it was weeks of lower yields, occasionally quarters, and even cases of a year or two drifting in the cultural abyss trying to regain "Paradise Lost."

So the lesson of this commandment is this: When things are going real well, any change should be deeply considered and entered into slowly with the full knowledge that with any significant change probably there is a lot more to lose if you guess wrong, than you would gain if you guess right! **mn**

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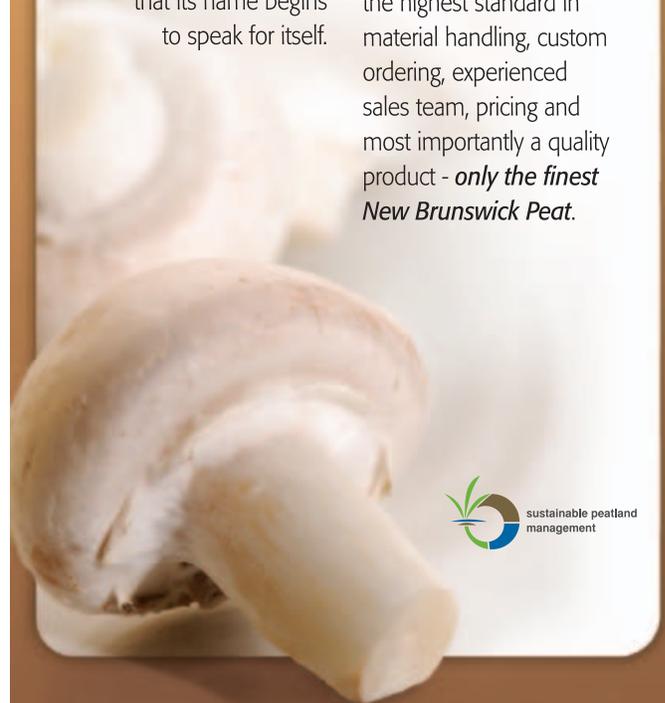
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IOM Report on Vitamin D

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Mary Jo Feeney
Mushroom Council Nutrition
Research Coordinator



Heidi Gengler
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Current Facts:

- For the first time, a Recommended Dietary Allowance (RDA) was established for vitamin D.
- The RDA is 600 IU – three times the previous 200 IU Adequate Intake (AI) value.
- The RDA at the 600 IU level is achievable through food sources.
- The Daily Value for vitamin D for Nutrition Facts labeling – regulated by the Food and Drug Administration – did not change and remains at 400 IU per serving at this time.

The Details

On Nov. 30, 2010, the IOM updated the Dietary Reference Intakes (DRIs) for calcium and vitamin D (<http://www.iom.edu/Reports/2010/Dietary-Reference-Intakes-for-Calcium-and-Vitamin-D.aspx>.) Both the IOM Report and

the Office of Dietary Supplements Fact Sheet on Vitamin D (<http://ods.od.nih.gov/factsheets/list-all/VitaminD/>) updated upon release of the IOM report, identified mushrooms among food sources of vitamin D.

To understand the significance of establishing an RDA for vitamin D – here is a bit of background. The Dietary Reference Intakes (DRI) are reference values that quantify estimates for nutrient intakes – and are used by health professionals to counsel individuals about dietary intake, by government agencies in setting standards for federal food programs and national dietary guidance. There are four types of reference values: RDA, AI, UL and EAR.

- **Recommended Dietary Allowance (RDA)** – is the average daily intake level sufficient to meet nutrient requirements of almost all healthy individuals. The 600 IU RDA is for those

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between ages 1 and 70; 800 IUs are recommended for those 71 and over.

- **Adequate Intake (AI)** – is based on approximations of nutrient intake that are assumed to be adequate and used when an RDA cannot be determined. Previously, the DRI for vitamin D was an AI of 200 IU.
- **Tolerable Upper Intake Level (UL)** – is the highest average daily intake level likely to pose no risk of adverse health effects. Previously, the UL for vitamin D was 2,000 IU.
- **Estimated Average Requirement (EAR)** – is the average daily intake level estimated to meet the requirement of about half of the healthy individuals.

Implications

- The ability to set an RDA rather than an AI elevates the importance of vitamin D in its established function in ensuring bone health.
- Although the committee determined that current evidence does not support other benefits for vitamin D beyond bone health, it suggested continuing targeted research in the future.
- On the Nutrition Facts panel (regulated by FDA), the amount of vitamin D in a serving is expressed as a percent of the Daily Value (400) not in International Units (IUs). If a food provided 600 IUs of vitamin D in a single serving, it would be labeled as providing 150 percent of the Daily Value.
- The committee assumed minimal sun exposure thus supporting food/diet as the primary way to meet the RDA.
- High intakes through supplements are not needed to fulfill the RDA.
- The 4,000 IU UL discourages the use of high levels of supplementation and the committee issued a caveat regarding excessive intake.

Opportunities - What's on Your Label?

In response to the IOM report, the Mushroom Council issued a news release identifying fresh mushrooms as a natural source of vitamin D to help consumers meet the new recommendation. In addition, since both the IOM Report and the Office of Dietary Supplements (ODS) Fact Sheet on Vitamin D identify mushrooms among food sources of vitamin D, consumers' awareness of mushrooms' nutrient benefits – not just vitamin D – will be heightened.

Does your label have a Nutrition Facts panel to support consumers as they look for ways to increase not only vitamin D, but also other nutrients such as potassium while controlling calories?

Your dollars invested through the Mushroom Council have supported updated nutrient analysis so a variety of mushrooms and their nutrient composition could be included in the USDA National Nutrient Database for Standard Reference (<http://www.ars.usda.gov/Main/docs.htm?docid=4451>)

If your label does not now include a Nutrition Facts panel, you may want to think again about using this communication tool. It is important to document the analytical data – particularly if you make a claim about mushrooms being a good or excellent source of a specific nutrient – because as the individual producer/packer, FDA will hold you responsible for your label's accuracy. There are resources to assist you in this effort. See the FDA Web site <http://www.fda.gov/Food/LabelingNutrition/FoodLabelingGuidance-RegulatoryInformation/default.htm> and the sample toolkit posted on the Web site of the Mushroom Council (http://mushroomcouncil.org/export/sites/default/Nutrition/Mushroom_Nutrition_toolkit_Final_080408.pdf).

It's time to showcase nature's hidden treasure's contribution not only to vitamin D, but also to an overall nutrient-dense diet. A key message of the 2010 Dietary Guidelines Advisory Committee is the urgency to stem obesity and the conditions that accompany it – such as cardiovascular disease, high blood pressure, and type 2 diabetes. A tasty, versatile, cholesterol-free, low calorie, low fat and low sodium food, mushrooms' nutrient profile can help consumer meet several nutrient and health goals simultaneously. **mn**

The healthfulness of a food item is tied with price as the second biggest influence on purchasing decisions by consumers (taste remains number one). (Source: IFIC, International Food Information Council 2010)

68 percent of Americans say they are actively using the Nutrition Facts Panel. (Source: IFIC, 2010)

Retailers also use the Nutrition Facts Panel to identify ways to better promote your product. For example, many retailers simplify the nutrition information and post it on the store shelves surrounding a product to identify it as a "healthier" food. (Source: IFT, Institute of Food Technologists 2009)

See *Mushroom News*, December 2010 for examples of successful nutrition communications and marketing campaigns.



AMI Update is a regular column that covers topics relevant to members.

Insecticide Information Updated on AMI Web Site

The Integrated Pest Management section of the Best Practices Web site has been updated to reflect changes to the labels and Material Safety Data Sheets (MSDS) for insecticides that are registered for use in mushroom production. These include:

- Dimilin® SC – new label and MSDS
- Permethrin 3.2 EC – new label
- Pyganic® Crop Protection EC 1.4 Spray – new label
- Pyganic 5.0 – new MSDS
- Armor Insect Growth Regulator – new label and MSDS
- Ecozin Plus (azadirachtin) – new label

Please visit the Web site www.americanmushroom.org/bestpractices.htm regularly for ongoing updates. Growers are reminded that Material Safety Data Sheets and chemical labels should be available for inspection by all employees and can be downloaded from the Best Practices site. mn



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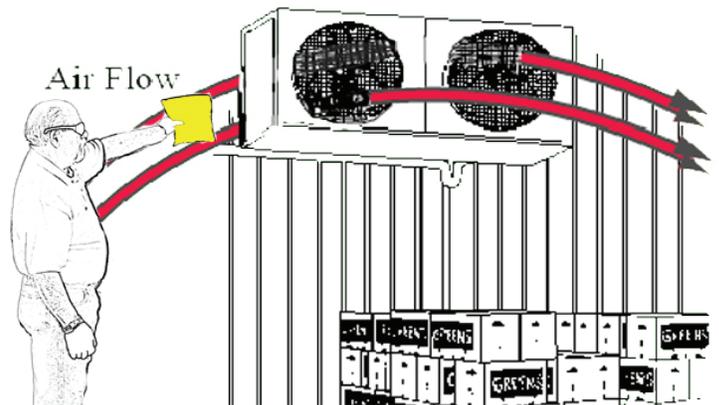
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Preparing for Banking in the Future

No doubt you have heard, "banking will never be what it used to be!" The banking world is changing. By the time you read this, the rules will have changed again. The good news is banks will be stronger. The bad is there will be fewer banks with which to deal. The ugly is the requirements to qualify for financing will be more stringent. How can you best be prepared when approaching your bank in the future?

Pay for Good Financial Reporting

The first thing you might think I would say is, "be profitable." Of course, that is a key factor, but unless you have good financial reporting that offers credibility to anyone reading the reports (including you), the question may still be, "how profitable are you, really?" Many still measure profitability by money left over in the account after the bills are all paid. If the bills are current and you have never been late on a loan payment, you must be profitable, right?

My first suggestion for being prepared would be to get accountant prepared financial statements. The size of your operation in terms of sales will determine the depth and type of accounting that will suit your needs. I would also suggest getting them quarterly, no matter what the size of your operation and learn to read them yourself.

If you make this one step alone, you will have a credible resource to give your lender, one in which they can rely with a certain degree of confidence concerning the profitability of your business. Good financial reporting will be even more important in the future.

Unfortunately, prepared statements cost money and that is why many only do the required minimum tax return. Regrettably, the tax return is not prepared with the purpose of helping you better manage your business nor for your bank to understand your true profitability. In fact, its sole purpose is to determine how much income tax you owe, thus having an inherent incentive opposite to what you would like your bank to see.

Get rid of the idea that financial reporting is a necessary evil. Prepared financial statements will help you make better decisions. You will need to impress your banker that you have an understanding of your business' finances and that you are not running the company by the seat of your pants.

Clean Up the Balance Sheet

The second most important thing in preparation for a meeting with your banker is to clean up and strengthen your balance sheet. By this I mean retaining profits in the business and not distributing them all to the owners or partners. Prepay term debt to better situate yourself down



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the road. Keep the amortization of term loans shorter than longer. Never get a loan for a term longer than the depreciated life of the asset purchased. Build up some cash reserve, improve the company's equity, liquidity and working capital.

Equity is affected by company profits or losses over time. If the company has little or no equity, it is because of the lack of profitability and/or distributions taken out. Banks will look at the capital/equity of your company just as much as cash flow and collateral. Equity is what affords a company the ability to borrow long term because it is acquired through profits used to pay down loans, build up assets and retain cash. Equity or net worth is simply the assets minus liabilities of a company or individual.

Liquidity is what is on your balance sheet that can be readily turned into currency, such as cash, inventory, accounts receivable, stock, etc. Higher liquidity provides your business more options such as the ability to come up with cash quickly if needed, and affords your company more freedom to make quick and timely decisions in the everyday routine of business.

When we talk about working capital, we are looking at the difference between current assets and current liabilities. In other words: current position. The current position of your business does not include equipment and real estate nor the term or mortgage loans used to finance them.

Current position considers your day-to-day operations such as cash, accounts receivable, inventory, savings, investment accounts, etc. on the asset side of the balance statement and accounts payable, lines of credit balances, payroll, etc. on the liability side. The term "working capital" refers to the positive difference in the current assets over the current liabilities or the equity you have in the current portion of the balance statement. The larger the difference is, the stronger the business statement.

A big issue that rears its head in a poor economy is the aging of receivables. Once receivables go more than 90 days, they begin to affect the company's ability to pay its own obligations, resulting in account payables being extended. So even if the accounts receivable number is large, if the receivables are not coming in, a static and stagnant situation develops which forces cash to be depleted and credit lines being advanced. I think everyone understands this. Just like cash is king, working capital is, too!

Planning Expansion

When planning to expand, either by purchasing another operation or building new facilities, provide your

bank with projections of expected earnings from the new operation that are detailed and clear to understand. Too often, the projections are verbal or when written are difficult to comprehend and much time is taken by the lender to translate the changes into something that will be understood by those approving the credit. Along with the projections, a clear and simple business plan would be appropriate to help answer most questions that might be asked in considering the credit.

Even though the banking landscape is changing with a new world of financial accountability before us, most would agree it is about time. The laxness in banking through the years has led to a very difficult time for all of us today. As a result, providing better financial statements, cleaning up your balance sheet and being prepared with projections will help you earn the approval of your bank. **mn**

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Mushroom size is dependent primarily on the number of pins that develop and grow per surface area. Managing the number of pins that grow is not an easy task, but can be made much easier if you prepare a casing layer that is more conducive to staggering the pin set.



David M. Beyer, Ph.D.

Professor – Mushroom
Extension Specialist
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Casing through pinning is considered by some to be the turning point in the cropping period. In a classic 1973 paper on environmental control of mushroom growing, Dr. Hans Tschierpe described the casing-pinning process as a stage when the grower must have the most precise environmental control of the mushroom crop. Therefore, it is important for growers to review procedures before, during and after casing to make sure they are attending to all of the critical details. Casing management is also a critical time to anticipate the mushroom's growth and its requirements for water and favorable environmental conditions. However, probably the most important goal of the casing and flushing/pinning process is making the correct compromises to achieve maximum yield, fresh quality and desired market mushroom size.

The biggest change we have observed recently in casing and cropping management is that growers are getting away from the hard flushing techniques that set as many pins as possible, hoping to grow the most mushroom tissue possible regardless of size and quality. This shift in pinning management started with the movement away from growing for the processing market towards growing primarily for the fresh market. However, many growers have struggled with achieving profitable yields when trying to grow medium and large product. Many also have struggled achieving a high percentage of fresh quality mushrooms and maintaining first breaks of over 3.0 lbs/sq.ft. However, changes to casing and crop management to lengthen harvesting time from the traditional 2-3 days of harvesting a first break to 5-9 days, will result in high yields with more mushrooms for the fresh market. By staggering the first break, growers are able to harvest a high percentage of medium and large mushrooms and increase the harvesting rate, which in turn reduces harvesting costs.

Casing management to stagger a pin set begins with casing materials, the mixing of these materials and then proper application. The material used to stagger a break is normally black peat or other heavy dense materials that form not only a dense casing layer, but also will create large aggregates within the casing layer. Black, deep dug peat has to be handled during the mixing in a way that maintains an open, large aggregate structure. It may be easier to achieve a lumpier (large aggregate) casing structure with the heavier peats. However with certain equipment, a sphagnum brown peat and sugar beet lime mix can be used to achieve the same density and "nugget-like" structure. These large "nugget" aggregates may have the function of maintaining good gas exchange and providing a reservoir of water for the mycelium. Large aggregates also help create the rough casing surface, which provides that diverse microclimate for the pin development. Small anaerobic areas may look like aggregates but do not quite function the same.

Casing aggregates appear to provide what some growers call "exclusion" zones, Figure 1. Exclusion zones have the physical properties to hold and give up water as needed. These aggregates may provide a larger reservoir of water for the mycelium during periods when watering the casing may promote setting too many pins at one time.

One important feature required of a staggered flush is to get more spawn growth (and more even growth) on the surface of the casing before flushing. If the casing has a large aggregate and a diverse micro-topography, i.e. microclimate, more surface growth will help stagger a flush and reduce the quantity of dirty product. How to achieve that depends on changes to casing management such as watering, temperature, casing inoculum rates and CO₂ management.



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The Penn State Lines is a regular column. Authors Beyer and Pecchia share their expertise on mushroom growing topics.

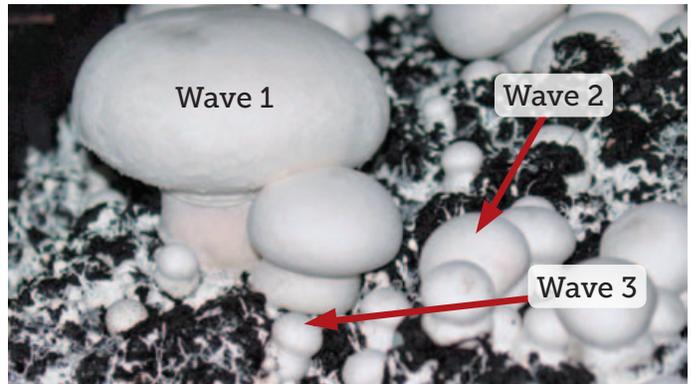
Figure 1: Exclusion zones are where the rhizomorphs grow around an aggregate of casing. The picture on the left was taken around flushing time and on the right during first break.



The objective of a staggered break is to create two or more waves of mushrooms. To achieve this stagger, a soft flush is used. Every grower will have to establish their own procedures based on the mushroom's reaction to the grower's specific control of casing materials and room environment. In general, the environmental control is designed to set a few pins a few days after casing. The hybrid strains used today pin so easily that it is not difficult to get pins to form. In fact, the challenge is to keep all of the pins from forming at one time. The first few pins are formed with not much effort or control. The management's goal is to hold back any new pins until the first wave of pins of the first break are well formed, at least 1-2 days ahead of the next wave. A low evaporation rate and high CO₂ will help hold back the pin development, but once the first wave is moving then the next wave should be allowed to move as well. This movement of the next wave may involve lowering the relative humidity to increase evaporation, and lowering CO₂ and/or temperature a little more. It may require a little watering but this irrigation may set too many pins at one time — this is another judgment call. If large aggregates have been formed properly, then there should be a good reservoir of water for the mycelium and developing pins. The management of these environmental parameters will determine how many initials begin to develop for the second and even third wave.

As the second wave begins to form and develop, the CO₂ and temperatures are very slowly lowered to encourage some evaporation and pin development. It is during this period that the grower must decide whether there are too many pins or not enough pins. If more pins are needed, the evaporation rate may be increased, casing may be irrigated and/or the CO₂ and temperatures can be lowered more quickly. However, if too many pins are moving

Figure 2: The three waves of mushrooms when a stagger is successfully accomplished.



and developing, then the grower may maintain a high RH (slower evaporation) and high CO₂, "choking" the room.

Remember, the best start for a successful stagger with larger product and high yields is a heavy, dense, lumpy casing layer. Once that is achieved, it makes a grower's job much easier trying to manipulate the environment for the desired staggered pin set. **mnn**



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IN MEMORIAM: *Robert E. Miller*

Robert E. Miller, Ph.D. died December 20, 2010 at Avow Hospice in Naples, FL surrounded by his loving family. He was born in Des Moines, IA on July 31, 1936. He graduated from Simpson College in Indianola, IA and received his Master's degree and Ph.D. in Plant Pathology from Cornell University, Ithaca, NY.

"We sadly lost a dear friend who was respected and loved by all in the Campbell family," said Jack McDaniel, L.F. Lambert Spawn Co. Dr. Miller began his mushroom career in 1963 as a Plant Pathologist at Campbell Soup Company's Institute for Agricultural Laboratory in Cinnaminson, NJ. His research on the genetics of *Agaricus bisporus* demonstrated clear evidence of a sexual cycle, and he was instrumental in the development of subsequent mushroom breeding programs. In 1976, as Director of Mushroom Research at the Campbell Institute for Research and Technology Laboratory in Napoleon, OH, Dr. Miller led the research program that made significant advances in composting methods and developed several novel compost supplement products. The second patented formulation identified a fungicidal protective coating for supplement nutrients, which is still preferred today by the majority of mushroom farms in the United States

as an effective tool in the ongoing battle against aggressive green mold disease that continues to challenge the industry.

In 1980, Dr. Miller relocated to Reading, PA when Campbell's expanded into the fresh mushroom business. He was instrumental in bringing the first modern Dutch technology to America with the construction of a state of the art mushroom growing facility in Dublin, GA in 1982. He helped establish an on-site training classroom that benefitted hundreds of participants. Three years later, another Dutch style farm was added in Hillsboro, TX.

Under his direction, Campbell became the largest producer of fresh mushrooms in North America and indeed in the world. One of his major accomplishments was to buffer the day to day mushroom operations from a corporate structure that was unfamiliar with the imperatives of growing and marketing of perishable



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commodities. This along with his tireless work ethic and kindred human spirit endeared him to his more than 2,000 employees. Most simply referred to him as "Doc." He was a very visible leader as he maintained a rigorous travel schedule, targeting a visit to each of the eight farms every quarter.

Dr. Miller was also a significant participant in the North American mushroom industry. Campbell Soup had heretofore always been a very isolated and private producer and purchaser of mushrooms. In the mid 1980s, he removed the barriers and opened the largest of the Campbell farms to attendees of the Penn State Short Course and other outsiders. Subsequently, non-Campbell mushroom people were invited to the training center.

He fully supported the move into the spawn and supplement business, which brought the entire mushroom industry to the doorstep of Campbell. Through that aspect of the business, Campbell hosted and conducted dozens of public grower seminars throughout Canada, Mexico, the United States and Ireland.

When the devastating green mold disease first appeared in the states, Campbell used its internal resources and Irish connections to research sources of infection and control procedures to educate not only the corporate farms but also the entire North American industry. Dr. Miller made certain that Campbell joined the American Mushroom Institute and was a major sponsor of various industry initiatives, not the least of which was each of the North American Mushroom Conferences. Support was also given to several Penn State projects. He made a concerted effort to send representatives to many of the international conferences including the periodic ISMS research conferences, the annual British Mushroom Growers Association meetings and Mushroom Days in Holland.

Dr. Miller was instrumental in the formation of the Mushroom Council and was elected by his fellow Council members in 1993 as its first Chairman.

Dr. Miller retired in 1997 as Vice President and General Manager of Operations from Campbell's Fresh, Inc.; a subsidiary of Campbell Soup Company. Dr. Miller and his wife Kay moved from Reading, PA to Naples in 1998. He enjoyed golfing, fishing, reading and spending time with his family and friends. In addition to his wife

of 53 years, he is survived by three children; sons Jeffrey and Daniel Miller and daughter Stephanie Reed; a sister Gail Schee; six grandchildren and one great-grandchild.

"Bob Miller was one of the real icons of the mushroom industry. He was not only a true friend but one whose integrity, honesty and intelligence were admired by all who knew him. He also had the extremely rare combination of a top scientific mind and a keen business aptitude. He used these assets to great advantage in his management of the very complex Campbell Fresh Division. We lost an important contributor to our industry and he will be sorely missed," said Hugh McIntyre, President, L.F. Lambert Spawn Co.

A celebration of Dr. Miller's life will be held in Iowa at a later time. Donations may be made in his memory to Avow Hospice, 1095 Whippoorwill Lane, Naples, FL 34105-3847 or a charity of your choice. **mn**



AMI Offers Cookbook For Sale

The Mushroom Lovers' Cookbook contains recipes ranging from appetizers to low-calorie dishes to specialty mushrooms.

Also included in the cookbook's 196 pages are helpful hints for cooking with mushrooms, nutritional facts and a history of the mushroom industry.

The cookbook is a collection of original recipes from people involved in the mushroom business as well as recipes from international restaurants and chefs. Throughout the book are hand-drawn sketches and illustrations that create a fun, family cookbook.

The price is \$10 each. Discount prices are available for large quantity orders. Please contact the AMI Avondale office, 610/268-7483, for further information.





Survey Shows Consumers Eat Mushrooms Every Day, Every Way

For the past two years, the Mushroom Council has partnered with *Taste of Home* magazine and AllRecipes.com to host the "Every Day, Every Way" online recipe contest. Encouraged to whip up recipes for certain meal times (breakfast, appetizers/snacks and dinner), mushroom fans showcased mushrooms' versatility through 1,487 original recipe creations. Winning dishes included Stuffed Flank Steak with Mushroom Sherry Cream, Southwestern Quiche and Mushroom Panzanella. The full recipes are all available on www.mushroominfo.com

Banner advertising within the *Taste of Home* and All Recipes Web sites and newsletters helped to promote the contest and educate consumers about some of the taste and nutritional benefits of mushrooms. Upon completion of the online campaign, a survey was conducted with 4,400 TasteofHome.com and AllRecipes.com visitors to better understand consumers' knowledge, opinion and purchasing habits surrounding mushrooms; as well as the efficacy of the Council's ads. Notably, the Council's ads earned the

most interest as measured via click-through hits in advance of holidays or cooking occasions like Mother's Day and the Fourth of July. Additional findings will be used to inform future Council programming.



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Highlights include:

Ad recall is linked to increased purchases. Respondents who recalled seeing a mushroom ad on either site were more likely to have recently purchased and intend to purchase fresh mushrooms. They also buy fresh mushrooms more frequently overall.

Mushroom fans are mushroom ambassadors. Approximately 30 percent of survey respondents who recalled mushroom ads recommended fresh mushrooms to a friend (29 percent AllRecipes.com, 34 percent TasteofHome.com).

Consumers routinely use mushrooms in home cooking. On average across both sites, 62 percent of visitors said they purchase mushrooms more than once a month, with 26 percent purchasing mushrooms more than once a week.

Mushrooms enhance favorite meals. Consumers surveyed find creative ways to use mushrooms every day, every way, combining them with their favorite ingredients and dishes: pasta, beef, salads and omelets.

The economy continues to weigh on consumers' minds in their food purchases. Similar to last year, more than 40 percent of respondents noted that they would purchase fresh mushrooms in the future if they were on sale or had a coupon. This figure is in addition to the more than 30 percent who say they would purchase mushrooms if they were more affordable. **mn**

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Penn State Conference Set for Chester County

Penn State will host its 53rd Annual Mushroom Industry Conference June 19-21, 2011 at the Mendenhall Inn in Mendenhall, PA. This is only the second time the event has been held away from the University Park campus. Participants will have the opportunity to tour local mushroom facilities during the conference.

This year's conference will feature speakers of industry and academia, including graduate students. The program will highlight the latest advances, challenges and opportunities on a broad range of subjects, all with emphasis on the most critical issues facing the mushroom industry today. Topics will include up-to-date progress at the forefront of food safety, dietary health, regulatory concerns, spawn technology disease and pest management, energy use, novel substrates and cultivation practices.

A Penn State tradition since 1956, the annual conference serves to promote the growth and welfare of the North American mushroom industry. Visit the conference Web site or call 877/778-2937. **mn**

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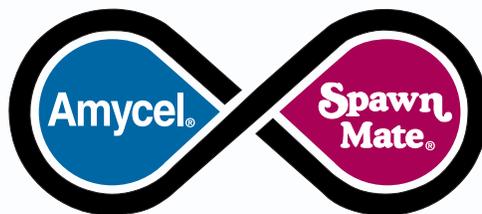
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