Progress Report

Title: Preliminary Test for Developing an Outdoor Aging Method for Mushroom Compost.

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Objective:

The purpose of this field investigation was to test a method to control weed infestation when mushroom compost is placed in an outdoor environment to passively age the material for future use as an agricultural soil amendment.

Justification:

Mushroom compost (MC), which was formerly referred to as "spent mushroom compost", is a by-product of the commercial mushroom industry in Pennsylvania. At mushroom farms in Southeastern Pennsylvania (i.e., Berks, Chester, and Delaware counties), MC is often placed outdoors in fields to "passively age" for future use as a very beneficial agricultural soil amendment. The major problem with outdoor placement is weed infestation. Although MC is steam pasteurized prior to removal from the mushroom production facility, and therefore destroying any potential viable weed seeds, leaving MC outdoors in "piles" results in weed seeds transported to the material primarily by wind and birds. Thus, outdoor aged MC often becomes infested with many weed species associated with farms and pastures, and these weeds are difficult and expensive to manage. Also, the quality of the MC can be compromised when infested with the various weeds often found in agricultural fields in Pennsylvania.

Methods:

Fresh MC (i.e., MC recently removed from a production facility) from Giorgi Mushroom Company (Reading, PA) was delivered to the test location in a pasture field at the Penn State Berks Campus, in Reading, PA. The test site was treated with glyphosate (Roundup 4L herbicide) at 2 quarts product per acre to control and eliminate any weeds prior at the start of the experiment. The herbicide was applied with a backpack sprayer calibrated to deliver 50 gallons water-carrier per acre from a flat-fan spray nozzle discharged at 40 psi.

At the test site, posts and 'chicken-wire' fencing was installed around the perimeter of each individual test plot to contain the MC (Figure 1). The entire plot area or whole plot measured 20 ft x 30 ft. The whole plot was divided into two sub-plots of 10 ft x 30 ft. MC was

placed in one sub-plot at a height of 36 inches, and MC was placed in the other sub-plot at a height of 18 inches. Each sub-plot was further divided into three sub-sub-plots measuring 10 ft x 10 ft. These sub-sub-plots served as the 3 (three) treatments: (1) untreated MC, left undisturbed, (2) MC treated with Roundup only when weeds emerged (i.e., postemergence weed control), and (3) MC seeded with annual ryegrass (*Lolium multiflorum*) at 100 lbs per acre, in hopes that the annual ryegrass "cover crop" will prevent or out-compete any weeds from infesting the plot.

The test site was established on March 12, 2012, with plots erected, fresh MC placed into the test plots and annual ryegrass was seeded. The herbicide was applied once on June 2, 2012, due to the visual appearance of an excessive amount of weeds present in the test plots.

Results:

Refer to Tables 1 and 2 for results from this preliminary investigation. Overall, the results were similar with MC stored outdoors at either the 36-inch or 18-inch height. Therefore, initial storage height would be a preference by each individual mushroom farm. Weed infestation was observed in untreated MC plots. These weed species consisted of lambsquarters, foxtails, and a few other species. Weed infestation was also observed in Roundup-treated plots, however, when weeds appeared, those plots were treated with Roundup to control with weeds. No weeds were observed in plots seeded with annual ryegrass. The annual ryegrass emerged and provided a thick, dense cover, and therefore may have prevented weed seeds from establishing or perhaps out-competed the weeds. In conclusion, seeding MC into annual ryegrass would be an economical solution to preventing or minimizing weed infestation in outdoor-aged MC, since treating with Roundup has an expense of both materials and labor.

Future Direction for Research:

The experimental design for research planned with outdoor-aging of fresh MC will be similar to the preliminary test (Figure 1). Overall, MC will be placed in outdoor plots at the Penn State Berks Campus (Reading, PA) using the same treatment structure as this preliminary test (refer to the 'Methods' section). However, MC tests will be established each month on March, April, May, June, July, August, September, and October 2013 to determine how placement time effects weed infestation and control, as well as annual ryegrass cover. Overall plot size for each establishment time (i.e., month) would be 10 ft x 15 ft, which will be divided into two sub-plots 5 ft x 15 ft, with MC placed at 36-inch height and 18-inch height. Each sub-plot will be further divided into three, 5 ft x 5 ft plots, representing the three treatments of (1) not seeded - untreated, (2) not seeded, but treated with glyphosate, and (3) seeded with annual ryegrass.

Also, at each establishment time, MC will be sampled in each plot and again at the conclusion of the experiment (i.e., 12 months later) to evaluate the quality of the MC (i.e., pH, organic matter content, nitrogen, phosphorous, potassium concentration, etc.).

All materials (i.e., fence posts and chicken-wire) have already been purchased and will be assembled this fall at an adjacent test site at the Penn State Berks Campus. Fresh mushroom compost will be supplied by Giorgi Mushroom Company (Reading, PA). Therefore, funding is needed to support the compost testing (i.e., laboratory analysis costs). A total of 6 plots x 8 sampling dates x 2 sampling times (at start and finish) = 96 samples x $90 per sample = $8,640 needed. Note, this field trial may be altered to accommodate the amount of funding received to support this project.

Figure 1. Diagram of test plot.

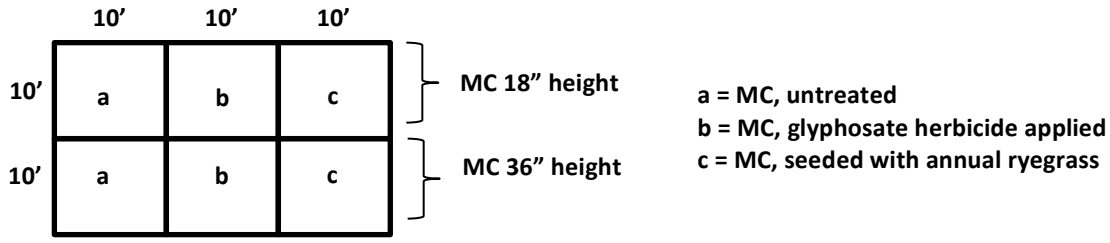

Table 1. Annual ryegrass cover[1] on the fresh mushroom compost (MC) test plots, 2012.

	3/12	3/28	4/12	4/29	5/15	6/2	6/14	6/28
36-inch Height Fresh MC	%							
Not seeded, untreated	0	0	0	0	0	0	0	0
Not seeded, Glyphosate-treated	0	0	0	0	0	0	0	0
Seeded with Annual Ryegrass[2]	0	2	15	40	80	99	99	99
18-inch Height Fresh MC	%							
Not seeded, untreated	0	0	0	0	0	0	0	0
Not seeded, Glyphosate-treated	0	0	0	0	0	0	0	0
Seeded with Annual Ryegrass[2]	0	5	15	30	75	95	99	99

[1]Annual ryegrass cover visually estimated as percent plot surface-area covered.
[2]Annual ryegrass seeded at 100 lbs/acre on 3/12/12; not irrigated (i.e., relied on natural rain for germination).

Table 2. Weed cover on fresh mushroom compost (MC) test plots. 2012.

	Plot area covered with weeds[2] 6/2	Plot area covered with weeds 6/28	Plot area covered with annual ryegrass 6/2	6/28
36-inch Height Fresh MC	%			
Not seeded, untreated	80	85	0	0
Not seeded, Glyphosate-treated	70	< 1	0	0
Seeded with Annual Ryegrass	< 1	< 1	99	99
18-inch Height Fresh MC	%			
Not seeded, untreated	90	98	0	0
Not seeded, Glyphosate-treated	75	< 1	0	0
Seeded with Annual Ryegrass	< 1	< 1	99	99

[1]Annual ryegrass seeded at 100 lbs/acre on 3/12/12; not irrigated (i.e., relied on natural rain for germination).
[2]Glyphosate (Roundup 4L) applied at 2 qts per acre on 6/2/12; weed cover, and annual ryegrass cover, visually estimated as percent plot surface-area covered.

Photos:

Compost was placed at the aging site in the spring and divided into three contiguous plots, as shown in the photos. Each plot had the same amount of compost spread the same way, but had three different treatments to compare weed seed control. These were:

- Compost with a cover crop; annual rye grass was sown into compost.
- Treatment with Glyphosate to prevent weed growth and seed production.
- Fallow, to allow natural weed propagation.

First samples will be taken in the spring of 2013 to assess changes to the mechanical, chemical and biological properties of the compost in addition to the number of weed seeds present.