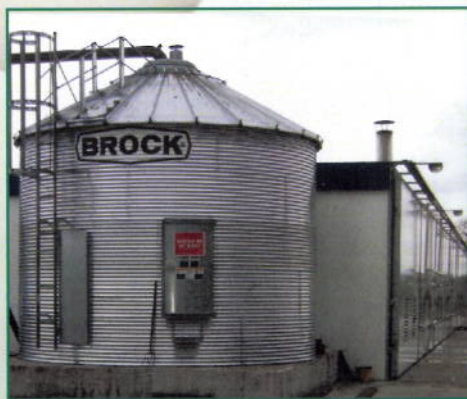


2009
All Ireland Mushroom Conference and
Trade Show

Hillgrove Hotel, Monaghan
Thursday 21st May 2009

“Survive and Thrive”



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Spent Mushroom Compost 'Fertiliser or Fuel'

Gerry Walsh

Teagasc, Showgrounds, Gorey, Co. Wexford

Email: Gerry.walsh@teagasc.ie

In 2008 on the island of Ireland, approximately 254,000 tonnes of compost was used in mushroom production. We can assume that a comparable amount of Spent Mushroom Compost (SMC) is available for use.

Part 1: SMC As Fertiliser

What Is In SMC?

Spent mushroom compost is made from wheaten straw, poultry manure and horse manure, is an excellent soil conditioner and a source of soil organic matter. It is a very effective source of major and minor soil nutrients (see Table 1). It makes a contribution to Nitrogen (N) nutrition but most of the N does not become available to the crop in the first year; research would indicate that 20% of total N is available for plant uptake in the year of application. For best results therefore, supplementary N must be applied. The Phosphorus (P) in SMC is 100% plant available for soils at soil P index 2 & 3 (50% of soils) in the year of application. Note, to ensure that crop P requirement is satisfied, that soils at P index 1 should only receive ½ of its P crop requirement from SMC and the other half from artificial fertilizer.

Table 1. *Total Nutrient Content of SMC (2003 survey)*

| | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|----|-----|
| Nutrient | N | P | K | Mg | S | Ca | Na |
| kg/t | 8.0 | 2.5 | 9.7 | 2.1 | 5.0 | 22 | 0.8 |
| Nutrient | Mn | Cu | Zn | B | | | |
| g/t | 118 | 15 | 86 | 12 | | | |

Table 2. Fertilizer value, N,P as Per SI 378

| Nutrient | N | P | K |
|---------------------------|------|------|------|
| Total Nutrient (kg/t) | 8.0 | 2.5 | 9.7 |
| Availability (%) | 40 | 100 | 90 |
| Available Nutrient (kg/t) | 3.2 | 2.5 | 8.73 |
| Value (€/t) | 2.68 | 8.75 | 9.6 |
| Total Value (€/t) | | | 21 |

Table 3. Agronomic Fertilizer value (€)

| Nutrient | N | P ² | K |
|---------------------------|------|----------------|-------|
| Total Nutrient (kg/t) | 8.0 | 2.5 | 9.7 |
| Availability (%) | 20 | 100 | 90 |
| Available Nutrient (kg/t) | 1.6 | 2.5 | 8.73 |
| Value (€/t) | 1.34 | 8.75 | 9.6 |
| Total Value (€/t) | | | 19.69 |

¹Cost of fertilizer per kg – N €0.84, P €3.5, K €1.1(April 2009)

²On P index 1 soils P availability is reduced to 60%

Farms that Could Benefit from SMC

A mixed tillage livestock farm is the best proposition. The organic manure comes from the livestock side and since the crop area has no organic loading, the livestock loading is spread over the entire farm and, thus, should be well below the 170 kg N/ha allowed. Also, the N allowed for grassland will increase the total chemical N figure for the farm.

How Much SMC can be Imported Onto a Farm?

In the Nitrates Regulations, S.I. no. 378 of 2006, the organic Nitrogen loading on the whole farm cannot exceed 170 kg N/ha. About 90% of farms are stocked at less than 170 kg/ha so that there is scope on many farms to import organic manures.

Consider table 4 as an example of the import allowed of organic manure. One dairy cow is rated at 85 kg of organic N per year while the SMC total N content is 8 kg/t.

Table 4. Organic Nitrogen budget for two stocking rates

| Whole farm stocking rate (cows/ha) | 1 | 2 |
|------------------------------------|------|-----|
| N from stock (kg/ha) | 85 | 160 |
| Maximum N allowed (kg/ha) | 170 | 170 |
| N import allowed (kg/ha) | 85 | 10 |
| SMC allowed (t/ha) | 10.6 | 1.2 |

The method of application on grassland is to graze off the grass, spread the SMC, chain harrow and then let cattle in again after 3 weeks. SMC seems to sweeten the grass.

As an example of the application of SMC to a tillage farm (SI 378 compliant) growing continuous winter wheat (Soil N index 1, soil P index 3 & soil K index 3, target grain yield 9 t/ha), Table 5 shows that SMC can reduce the cost of chemical fertilizers by up to €150-180 per ha. A 9 t/ha grain crop of winter wheat will require 161 kg/ha of chemical nitrogen after receiving 9 t/ha of SMC.



Figure 1. *Spreading Spent Mushroom Compost*

Table 6. *SMC – Meeting Crop N, P & K Requirements*

| Nutrient | Winter Wheat Crop Fertilizer Req. (kg/ha) | SMC at 1 t/ha (kg/ton) | SMC at 9 t/ha Nutrient supply (kg/ha) | Value of SMC (€/ha) | Crop N Req. after SMC after SMC (kg/ha) (a – c) |
|----------------|---|------------------------|---------------------------------------|---------------------|---|
| | (a) | (b) | (c) = (b × 9) | | |
| ¹ N | 190 | 3.2 | 29 | 35 | 161 ¹ |
| ² N | 190 | 1.6 | 14.4 | 12 | 177 ² |
| P | 25 | 2.5 | 22.5 | 78.7 | 0 |
| K | 60 | 9.7 | 78.5(90%) | 86 | 0 |

¹N availability as SI 378 2008 – 09 = 40%, ²N actual availability in SMC = 20%

Records Required

All farmers have to keep records of land farmed, livestock, chemical and organic fertilizer moved onto or off the holding and of concentrates fed to livestock. The mushroom grower's obligation under the Nitrates Regulations is to record the quantity and farm destination of SMC. The record sheet for this purpose can be found in the Explanatory Handbook for Good Agricultural Practice Regulations, page 19.

Micronutrient Benefit

There are useful amounts of other major and minor nutrients in SMC for plant nutrition including Calcium and Sulphur (see table 1 above). More research is needed on the estimated soil release of these other nutrients.

Organic Matter and S. F. P. Scheme 2009

SMC is made from wheaten straw, poultry manure and horse manure. Thus SMC recycles nutrients from other farm enterprises. The dry matter content is approximately 32% and 65% of this is organic matter.

In the Single Farm Payment Scheme 2009, there is an obligation to maintain the organic matter content of soil. This is mainly of relevance on land in continuous tillage over 6 years. An organic matter test is expected to be required on every 8 hectares. SMC contains approximately 208 kg of organic matter per tonne.

On light grassland and tillage land SMC would be ideal to build up the organic content of the soil. This increases water infiltration and improves water holding capacity in the top soil. Organic matter also acts as a food or substrate for microorganisms in the soil. Their activity releases elemental nutrients to the soil solution for plant growth. The organic matter decomposes to humus particles which like clay particles, are negatively charged and act as extra sites in the soil solution to hold positively charged ions like NH_4^+ , K^+ , Ca^+ and S^+ , etc., and prevent their loss to ground water. These are all essential nutrients for plant growth and are absorbed by plant root hairs in the soil.

Research from Holland suggests that that 2% of organic matter is lost every year from soil in continuous tillage. Therefore for tillage land and light grassland deficient in organic matter, SMC is an ideal provider of organic resources.

Cereal Trial

At Teagasc, Oak Park, a field trial evaluating SMC on Spring Barley is in its second year. Early results show that 20 to 25 % of the N from SMC is available to the crop in year of application. In order to draw conclusions the trial needs to run for 3 years.

Part 2: SMC as Fuel

Background

It was established that the approximate nett heat value of 1 tonne of mushroom compost at 58% moisture is 4.7 GJ, i.e., the equivalent of 134 litres of oil.

Therefore, if all the mushroom compost could be burned in an efficient way a large excess of heat would be produced. If some of this heat is used to dry the compost before combustion, the heat used in drying should be roughly equivalent to the increase in heat value of the dried compost so the net heat output should not be greatly affected.

Early Work

Micheal Bergin, mushroom grower of Golden, County Tipperary, considered that this energy recovery had possibilities for his farm. Since 2008, he has worked with Biomass Heating Solutions, Kantogher, County Limerick, who had already successfully processed chicken litter. They also worked with the E.P.A. on changing the use of SMC to a fuel.

In the trials by the Biomass Company, the SMC is oxidised in a fluidised bed. The system was judged to be viable.

Mushroom Farm Use

The S.M.C. in this system will produce heat for growing and steam for sterilising houses.

Launch Of System

By June/July of 2009, it is planned that a boiler and steam system will be in action on the farm of Michael Bergin.