UMass Extension

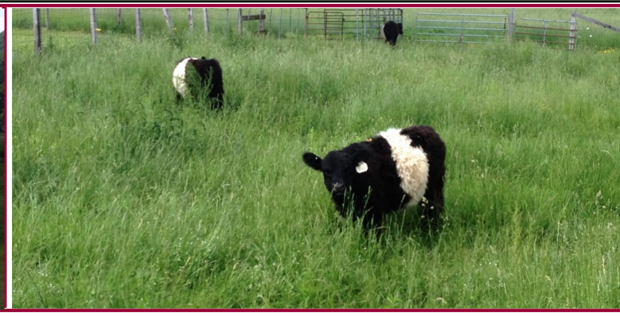
CENTER FOR AGRICULTURE

Crops, Dairy, Livestock & Equine

Newsletter

SPRING 2014

VOL. 17:2



Inside this issue:

Editor,

Masoud Hashemi

Masoud Hashemi

Upcoming Events:

July 12th: Open House at Blue Star Equilculture. Visit: www.equiculture.org for more info.

August 1st-3rd: MA 4-H Dairy Show. Franklin County Fairgrounds

August 12th: Central MA Dairy Producers Twilight Meeting, Coopers Hilltop Farm

September 12th: Green Pasture Dairy

UMass Agricultural Field Day

Come see the research projects you have been reading about!

Tuesday, July 29th
10:00am-4:00pm
UMass research farm
89-91 North River Road
South Deerfield MA

For more information on upcoming events visit: https://extension.umass.edu/cdle/upcoming-events

Biochar Field Research at UMass

By Emily Cole

In the last newsletter you were introduced to a relatively new soil amendment being studied here at UMass - Biochar. We currently have a research project underway at the South Deerfield Research Farm that is focused on quantifying the long term effects of amending soil with biochar to find how it might contribute to the practice of sustainable agriculture.

I am a graduate student in the Plant and Soil Science department and am beginning the third year of what will be a ten-year study on the long-term effects of biochar. In this project we are assessing the effect biochar has on native field soil quality and its contribution to sweet corn growth. The biochar being used in this study was made from sugar maple and is the small unsellable residue leftover from a hardwood charcoal briquette production facility. It was applied to a silt loam soil as small, rice-sized, pellets in July of 2012. Field plots were amended with a single application of biochar at the rates of 0, 18, 36, 54 or 72 tons per acre. After a short incubation period, a short season sweet corn was planted. In this initial year, no fertilizer was applied to the field. Although the application of biochar had no significant effect on the yield or quality of the sweet corn in the first growing season, soil analysis at the time of harvest showed greater nitrate-nitrogen concentrations with higher biochar application rates.

Biochar Field Research at UMass continued...

In the second growing season, sweet corn was planted in the same research plots and half of each plot was fertilized with calcium ammonium nitrate at a rate of 50 lbs./acre. Continued soil analysis showed significant changes to the soil characteristics. The cation exchange capacity (CEC) increased with higher biochar rates, as did the pH (See table 1 for more information); however, there was no significant difference in the yield or quality of sweet corn amongst the biochar plots, both fertilized and unfertilized.

Initial Sample & char%	Density (g/cc)	Soil pH	CEC (Meq/cg)
July 2012	0.92	5.6	8.4
July 2013 0%	0.89	6.2	9.3
2%	0.84	6.6	9.1
4%	0.84	6.9	9.2
6%	0.79	7.1	9.6
8%	0.83	7.1	9.7

Table 1: changes to field soil one year after biochar application

We are now in our third year of research and the biochar has been in the soil for two full years. This season, we will begin to look at the long-term effects of amending a soil with biochar. Sweet corn will be planted again in May, soil characteristics will continue to be analyzed, and we will begin to look for changes in the bacterial community of the soil.

Due to the fairly healthy state of the field soil in this study, effects of biochar on physiochemical properties and soil biota will likely be more nuanced than in highly degraded soils. Since we do not expect to see drastic changes this research is providing a unique opportunity to look closely at subtle changes over time. This long-term research is important to undertake, due to the long-lasting properties of biochar.

Figure 1: Fresh biochar application, July 2012

Figure 2: Biochar incorporated into the soil

Feasibility of Growing Fava Beans in Massachusetts

Fatemeh Etemadi, Masoud Hashemi, Francis Mangan

The Fava bean is a cool season legume crop with a high nutritional value and it has the potential to be grown as a new cash crop in Northeastern United States. Fava beans can be seeded as early as mid-March and harvested in time to plant an additional crop within one growing season. Once marketable pods are harvested in late June, the plant residues which are rich in nitrogen can be incorporated into soil. Fava beans can also be grown after harvesting a spring planted cash crop and be used as a cover crop through the winter. Fava beans have the ability to fix atmospheric nitrogen under various environmental conditions, act as a break crop in crop rotation, and provide feed to pollinators and beneficial insects. We are demonstrating the feasibility of growing fava beans in Massachusetts while determining basic information on its management practices suitable to the conditions of Massachusetts. These practices include but are not limited to, planting different varieties, time of planting, seeding rate, fertility requirement and the feasibility of transplanting Fava Beans.

Feasibility of growing Fava Beans in Massachusetts continued…

Figure 1: fava bean pods

The University of Massachusetts has received funding from Massachusetts Department of Agricultural Resources (MDAR) through specialty crops block grants to study the feasibility of planting fava beans in New England.

In a preliminary trial at the UMass Research Farm in 2012, we found that planting fava beans as early as March 15th can significantly reduce the incidence of chocolate bacteria disease which usually infects the plants during high temperatures in July and August. In recent years, weather conditions in Massachusetts, more specifically in Pioneer Valley has not allowed direct seeding this early in the season. In order to work around these unpredicted conditions, the possibility of transplanting has been studied. In the first year of experimentation we were looking at various aspects of fava bean cultivation, including: methods of planting (direct seeding vs transplanting), optimum date of planting, and nitrogen contribution of fava beans to sweet corn. This study consisted of three dates of planting including transplanting on the 16th of April, the 23rd of April and First of May as well as direct seeding on 1st of April. We found that the best time of transplanting is early April. Transplanting on the 16th of April resulted in a 42% and 43.7% higher yield compared with planting on the 23rd of April and the 1st of May, respectively (Table 1). We also found that seedlings height at the time of transplanting should not exceed five inches to ensure optimum establishment. We also found that transplanted fava beans out yielded direct seeding by 26.1%.

Planting method	DOP	Pod fresh wt. (lb/ac)	Seed fresh wt. (lb/ac)
Direct	4/1/13	6094 ab	1969 ab
Transplant	4/16/13	6792 a	2484 a
Transplant	4/23/13	4759 b*	1741 b
Transplant	5/1/13	4330 b	1728 b

*Means with the same letters in each column are not significantly different at odds of 1 out of 20

Table 1. Yield comparison of Fava beans planted as direct seeding and transplanting at different dates.

Figure 2: fava bean harvest July 2013

Cover Crop and Nitrogen Management for Sustainable Potato Production

Emad Jahanzad, Allen V. Barker, Masoud Hashemi, Amir Sadeghpour, Touria Eaton

Cover crop mixtures for sustainable potato production

The need for more food and economic pressures have forced potato growers to move toward more intense potato production systems with extensive use of nitrogen fertilizer. Research has shown that nitrate losses of the applied fertilizer can be up to 50% resulting in higher costs of production and environmental concerns. This study focuses on the efficiency of cover crop mixtures and tailors appropriate N application rate for a sustainable potato production system. Cover crop mixtures in this study consisted of oat/peas, oat/daikon, rye/daikon, daikon/peas, rye/peas, along with no cover crop plots. Nutrient density of potato tubers along with tuber yield will be measured in this study.

The Effect of the Decomposition Rate of Cover Crops on Potato Growth and Development

The cover crops used in this study are from different plant families and have different C:N ratios. It is important to monitor the rate of decomposition of cover crop residues to find if there is a synchronicity between the nutrient release of cover crop residues and nutrient uptake of the potatoes. This study is conducted in the same field as my potato research to assess the decomposition rate of cover crops. For this experiment we are leaving a group of samples above the soil while burying the rest to imitate both no-till and conventional tillage scenarios. Comparing these samples through the decomposing process will provide valuable information on the efficiency of cover crops in providing nutrients for the following potatoes

Effect of cover crops on nitrate leaching reduction, weed suppression, and nematode population of the soil

Potato growers often use an excess of nitrogen fertilizer to ensure against the loss of yield and quality. Excess use of nitrogen in potato fields along with the high risk of nitrate leaching results in nitrate contamination of water supplies. According to The USDA, about one-third of United States assessed surface waters do not meet designated uses, and agriculture is the source of 60 percent of this impairment which is largely from N runoff and leaching. This study evaluates the efficiency of cover crops in nitrate leaching reduction. As Lysimeter studies are costly and require expensive equipment, we employed an innovative method to solve this obstacle by burying nitrate-monitoring capsules below the cover crop root zone which provides valuable data on nitrate leaching. We will take weed biomass samples to evaluate the effect of cover crops on weed suppression. We will also collect soil samples in order to study the population of parasitic and free living nematodes that are

Fertilizer Materials and Soil Nutrient Amendment

By Solomon Kariuki, Katie-Campbell Nelson, and Masoud Hashemi

Plant nutrients are available through root absorption of ions from soil solution. Molecules in solution also can be absorbed by roots in some cases. Thus, a fertilizer must first be dissolved to be used by plants. Fertilizers are categorized as organic or inorganic. Inorganic fertilizers are generally composed of simple, mostly water-soluble nutrient salts in granular, slow release or liquid formulations. A fertilizer qualifies as naturally organic if derived from plant or animal materials or naturally occurring rocks and minerals containing one or more mineral elements that are essential for plant growth.

The relative content of the chemical elements nitrogen (N), phosphorus (P), and potassium (K) commonly used in fertilizers is labeled using NPK rating and any additional chemical element labeling follows after that. The N value is the percentage of elemental nitrogen by weight in the fertilizer. The values for P and K represent an expression of these elements as oxides in the form of P_2O_5 and K_2O. This usage derives from the traditional practices of reporting elements as oxides.

Materials may be used alone or blended with other fertilizers to form a multiple-nutrient fertilizer. Generally there is no measurable difference in crop response to multiple-nutrient or single- nutrient fertilizers, as long as they supply the same amount of soluble nutrients. The advantage of multiple-nutrient fertilizers over single-nutrient fertilizers is that only one fertilizer would be needed to supply several elements, rather than having to purchase several fertilizers. The following tables are a quick reference guides to various fertilizer materials that could be used to address soil nutrient deficiencies. The actual nutrient content may vary from this list depending on the manufacturer and other materials blended with the product. Most values are for the fertilizer- grade product and not the pure chemical. The chemical formulas given are the primary active compound.

Also included is the fertilizer liming and soil acidifying effect. Pure calcium carbonate ($CaCO_3$) is considered as the most commonly used liming material (lime) and is assigned a100% neutralizing effect index also known as *calcium carbonate equivalency* (CCE). The effectiveness of a liming material is based CCE scale where if greater than 100, the material is considered capable of neutralizing more acidity on a weight basis than pure $CaCO_3$.
At the end of these tables is an explanation with examples on how to calculate the amount of fertilizer to apply to meet agronomic nutrient requirements.

Table 1. Primary and Secondary Nutrient Sources

E (Percentage)

Nitrogen Sources

Material	N	P_2O_5	K_2O	Ca	Mg	S	†CCE/100 lbs
Ammonium nitrate	34	0	0	0	0	0	-61
Anhydrous ammonium	82	0	0	0	0	0	-148
Ammonium nitrate sulfate	30	0	0	0	0	5	-71
Calcium ammonium nitrate	27	0	0	6	0	0	0
Ammonium nitrate limestone	20	0	0	6	4	0	0
Ammonium sulfate	21	0	0	0	0	24	-110
Aqua ammonium	16-25	0	0	0	0	0	-45
Calcium nitrate/urea (Calurea)	34	0	0	10	0	0	-36
Calcium nitrate	15	0	0	21	0	0	+20
Crotonylidene diurea	32	0	0	0	0	0	none
Isobutylidene diurea	31	0	0	0	0	0	none
Nitrogen solutions (N-SOL or UAN solutions) (urea/ammonium nitrate):							
32% UAN (35% urea + 45% A.N.)	32	0	0	0	0	0	-55
30% UAN (33% urea + 42% A.N.)	30	0	0	0	0	0	-52
28% UAN (30% urea + 40% A.N.)	28	0	0	0	0	0	-49
21% AN (60% A.N. + 40% water)	21	0	0	0	0	0	-37
19% AN (54% A.N. + 46% water)	19	0	0	0	0	0	-33
Potassium nitrate	13	0	44	0	0	0	+26
Sodium nitrate (nitrate of soda)	16	0	0	0	0	0	+29
Urea (sulfur coated)	36-38	0	0	0	0	0	-118
Urea	45	0	0	0	0	0	-81
Ureaform	38	0	0	0	0	0	-68

Phosphorus Sources

Material	N	P_2O_5	K_2O	Ca	Mg	S	CCE/100 lbs
Ammoniated superphosphate	12-17	22-35	0	0	0	0	-7
Ammonium polyphosphate	10	34	0	0	0	0	
Diammonium phosphate (DAP)	18	46	0	0	0	0	-70
Ammonium phosphate nitrate	30	10	0	0	0	0	-54
Monoammonium phosphate (MAP)	11	48	0	1	0	0	-65
Ammonium phosphate sulfate	16	20	0	0	0	15	-80
Basic Slag	0	0-6	0	3-29	0	0	+70
Bone meal	0-2	10-20	0	19-25	0	0	+20
Concentrated superphosphate	0	46	0	14	0	2	0
Nitric phosphate	12-17	22-35	0	0	0	0	-20
Phosphate rock	0	2-35	0	0	0	0	+10
Normal superphosphate	0	20	0	21	0	11	0
Phosphoric acid	0	2-35	0	0	0	0	
Conc. Wet-process acid	0	40-54	0	0	0	0	-90
Wet-process acid	0	30	0	0	0	0	-63
Superphosphoric acid	0	76	0	0	0	0	-110
Urea-ammonium phosphate	25	35	0	0	0	0	
Urea phosphate	17	44	0	0	0	0	-82

Table 1 Continued….

Potassium Sources

Material	N	P_2O_5	K_2O	Ca	Mg	S	CCE/100 lbs
Greensand	0	1	6	0	0	0	
Potassium Carbonate							
Solid	0	0	48	0	0	0	+70
Liquid	0	0	34	0	0	0	+50
Potassium chloride	0	0	60	0	0	0	0
Potassium magnesium sulfate	0	0	21	0	11	23	0
Potassium metaphosphate	0	0	59	39	0	0	
Potassium nitrate	13	0	44	0	11	23	+26
Potassium sulfate	0	0	52	0	0	16	0
Calcium Sources							
Calcium chloride	0	0	0	36	0	0	0
Calcitic limestone (ground)	0	0	0	36	0	0	+98
Burned Lime	0	0	0	70	0	0	+178
Dolomitic limestone (ground)	0	0	0	24-30	6-12	0	+100
Gypsum	0	0	0	22	0	18	0
Selma chalk	0	0	0	32	0	0	+80
Hydrated lime	0	0	0	50	0	0	+134
Magnesium Sources							
Dolomotic limestone (ground)	0	0	0	24-30	6-12	0	+100
Magnesium oxide	0	0	0	0	45	0	+250
Magnesium ammonium phosphate	8	40	0	0	15	0	
Magnesium sulfate (Kieserite)	0	0	0	0	17	23	0
Magnesium sulfate (Epsom salt)	0	0	0	0	10	13	0
Potassium Magnesium sulfate	0	0	21	0	11	23	0
Sulfur Sources							
Ammonium thiosulfate	12	0	0	0	0	26	
Ammonium sulfate	21	0	0	0	0	24	-110
Elemental sulfur							
Wettable S	0	0	0	0	0	95	-312
Flowable S	0	0	0	0	0	60	-218
Flowers of S	0	0	0	0	0	95	-312
Potassium sulfate	0	0	52	0	0	16	0
Potassium Magnesium sulfate	0	0	21	0	11	23	0
Gypsum	0	0	0	22	0	18	0
Magnesium sulfate (Epsom)	0	0	0	0	10	13	0
Sulfuric acid	0	0	0	0	0	20-26	-70

† CCE = Approximate calcium carbonate equivalence; Negative value indicates net acidifying effect on soil; positive value indicates net basic reaction in soil (AOAC).

Symbol k ey: N = Nitrogen; P2O5 = Phosphate; K2O = Potash; Ca = Calcium; Mg = Magnesium; S = Sulfur; CaCO3 = Calcitic Limestone

Table 2. Micronutrients Sources

Materials	Nutrient Content
Copper (CU)	
Chelated Cu	
Cu EDTA	13% Cu
Cu HEDTA	9% Cu
Cupric ammonium phosphate	30% Cu
Cupric oxide	60-80% Cu
Copper sulfate	35% Cu
Boron (B)	
Fertilizer borate	
Borate granular	14% B
Borate 48 (i.e., 48 % B_203)	15% B
Borax	11% B
Boric acid	17% B
Sodium borosilicate	6% B
Calcium borate	10% B
Solubor	20% B
Magnesium borate (boracite)	21% B
Iron (Fe)	
Basic slag	10-13% Fe
Ferric sulfate	20% Fe
Ferrous ammonium phosphate	29% Fe
Ferrous ammonium sulfate	14% Fe
Ferrous carbonate	42% Fe
Ferrous sulfate	20% Fe
Ferrous oxalate	30% Fe
Magnesium borate (boracite)	21% B
Zinc (Zn)	
Chelated Zn	9-14% Zn
Zinc sulfate	22-36% Zn
Zinc ammonium phosphate	34% Zn
Zinc oxide	78-80%
Zinc sulfide	61% Zn
Zinc polyflavonoid	7-10%

Table 2 continued...

Materials	Nutrient Content
Manganese (Mn)	
Manganese oxide	68-70% Mn
Basic slag	1-3% Mn
Manganese carbonate	31% Mn
Manganese sulfate	24% Mn
Manganese chloride	17% Mn
Manganese ammonium phosphate	28% Mn
Molybddenum (Mo)	
Sodium Molybdate	38-46% Mo
Impurities in Superphosphate	trace

TABLE 3. ORGANIC[2] FERTILIZER MATERIALS

(Approximate Percent Values)

Material	N	P2O5	K2O	Ca	Mg	S	Micro-nutrients
Manure: (dried)							
Horse	0.4	0.2	0.3	*	*	*	*
Cattle	1.5	1.5	1.2	1.1	0.3	*	*
Poultry							
Broiler litter	3.0	3.0	2.0	1.8	0.4	0.3	*
Hen-caged layers	1.5	1.3	0.5	6	0.4	0.3	*
Hen-litter	1.8	2.8	1.4	*	*	*	*
Swine	0.6	0.4	0.1	*	*	*	*
Sheep	0.6	0.3	0.2	*	*	*	*
Blood (dried)	12-15	3.0	1.0	*	*	*	*
Bone meal (steamed)	0-2	10-20	0	19-25	0	0	
Blood meal	15	1.0	1.0	*	*	*	
Compost (garden) §	1	1	1				
Cottonseed hull ash	0	27	*	*	*	*	*
Cottonseed meal	6-7	2.5	1.5	*	*	*	
Cotton motes (composted gin wastes)	2	0.5	3	4	0.7	0.6	*
Fish scrap							
(acidulated)	7-10	1-2	0	*	*	2	*
(dried fish meal)	9	3	6	*	*	*	*
Hay:							
Legume	3.0	1.0	2.4	1.2	0.2	0.3	*
Peat/Muck	2.3	0.5	0.7	*	*	*	*
Sawdust	0.2	0	0.2	*	*	*	*
Seaweed (dried)	0.7	0.8	5.0	*	*	*	*
Sewage sludge (dried, municipal)	5	6	0.5	3	1	1	*
Tankage	7	10	7	*	*	*	*
[3]**Wood ashes**	0	2	6	20	1	*	*

Symbols: N = Nitrogen; P2O5 = Phosphorus; K2O = Potassium; Ca = Calcium; Mg = Magnesium; S = Sulfur

*Unknown amounts

§Depends on raw materials and amendments composition

[2] Note: Organically Certified fertilizers are different from "naturally organic" http://www.omri.org/simple-opl-search/results/fertilizer

Contains > 70% CaCO3 equivalent

Appendix

Appendix 1. Fertilizer Rates Calculations

Before using any fertilizers, it is important to understand how to read a fertilizer label. All fertilizers are labeled with %N - % P_2O_5 - %K_2O by weight.

Example: 80 pounds of Potassium nitrate (13-0-44) would contain 10.4 pounds of N (80 X 0.13), 0 pounds of P2O5 (80 X 0), and 35.2 pounds of K2O (80 X 0.44).

Appendix 2. Amount of solid fertilizer to apply for a specific amount of nutrient

The basic formula for calculating how much fertilizer to apply to a given area for a specific amount of nutrient is:

$$\text{Pounds of Fertilizer} = \frac{\text{(Pounds of nutrient needed)}}{\text{(\% nutrient in the fertilizer)}}$$

Examples:

How much Potassium nitrate (13-0-44) is needed to apply 80 pounds of potassium (K)?

It would take 182 pounds (80 ÷ 0.44) of Potassium nitrate to apply 80 pounds of K_2O.

What if Potassium chloride (0-0-60) was used instead?

It would take 133 pounds (80 ÷ 0.60) of Potassium chloride to apply 80 pounds of K_2O.

Appendix 3. Amount of liquid fertilizer to apply for a specific amount of nutrient

The basic calculation formula for liquid fertilizers is similar to solids, but the density of the liquid fertilizer must be known before calculating the amount of fertilizer to apply.

Example:

How much N, P2O5, and K2O is in a 5 gallon jug of a 9-18-6 liquid fertilizer weighing 11.1 pounds per gallon?

Steps: 1. How much fertilizer is present in the 5 gallons?

There would be 55.5 pounds of fertilizer (11.1 lb/gal X 5 gal).

2. What is the amount of each of N, P2O5, and K2O in the jug?

There would be:

5 pounds of N (55.5 X 0.09),

10 pounds of P2O5 (55.5 X 0.18),

and 3.3 pounds of K2O (55.5 X 0.06).

Prepared by Solomon Kariuki,UMass Soil and Plant Tissue Testing Laboratory Programs Coordinator, Katie-Campbell Nelson, Extension Educator; Masoud Hashemi, Extension Associate Professor Stockbridge School of Agriculture.

For other fact sheets visit:: https://extension.umass.edu/cdle/fact-sheets