UMass Extension

CENTER FOR AGRICULTURE

Crops, Dairy, Livestock & Equine

# Newsletter

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*Inside this issue:*



Editor,

Masoud Hashemi

## Upcoming Events:

**Cost Reducing Strategies for Dairy and Livestock Operations**
Tuesday, March 18th: 10:30am-3:30pm
https://extension.umass.edu/cdle/upcoming-events

**SNESA Cattleman's Conference**
Saturday, March 22nd: 9:00am-2:00pm
http://www.snesa.org/

**UMass Agricultural Field Day**
July 29th
UMass Animal and Crop Research Center

**Our Agriculture program was ranked #11 in the world by the Quacquarelli Symonds World University Rankings!**

## Annual Dairy Farmer Twilight Meeting Recap

*By Madeline Magin*

The annual twilight meeting brought dairy farmers together from throughout the state. This year's meeting was graciously hosted by Carter and Stevens Farm in Barre, Massachusetts. After the afternoon milking hours were complete everyone gathered and watched as the cows filed into the paddock and made themselves comfortable entirely impartial to the forty-odd visitors.

The comfort level of the cows was undeniably the result of the unique double bedded paddock design. The owner of Carter and Stevens, Phil Steven's, explained how he has used this system to his advantage. Two round bales of hay are shredded and added as bedding every day. The continual addition of dry matter provides a media to absorb the manure and creates a comfortable surface that the cows enjoy resting on *(figure 1)*.

*Annual Dairy Farmer Twilight Meeting Recap continued...*

The entire concrete surface of the paddock is sloped which allows for the easy removal of the bedding and manure which can be scraped to the opposite end of the paddock which only needs to be emptied occasionally (*figure 2*).


*Figure 1: Cows comfortably resting*

In the eight month period of having this system in place it has only been emptied out three times. The concrete surface is also the source of ambient heat throughout the colder winter months. Phil openly admitted that this system is quite large relative to the size of his dairy farm. He was allowed this opportunity because he purchased used resources. Had this opportunity not arisen, the scale of this facility would not have been feasible for his farm.


*Figure 2: Manure collection area*

Phil went on to talk about other opportunities he has been able to take advantage of. The energy costs of the farm are offset by the renewable energy harvesting technologies that the family has been able to implement on the farm that grants have helped to support. As we gathered to begin our tour of the farm, a wind turbine was revolving in the background. Additionally, the southern facing rooftop of one of their barns hosts a series of solar panels (*figure 3*). The energy harvested by these technologies feeds directly into the grid and they receive a check every month for their contribution.


*Figure 3: Barn with solar panels on the roof*

Beyond talking about the innovative technologies that have been implemented on the farm, Phil was proud to speak on behalf of the familial values of the farm. His daughter Molly attended the Stockbridge School of Agriculture and serves an integral role on the farm, as well as his son and son-in-law. His take away message to having a successful farm is to diversify your operation. The Stevens family has done this by selling hay and firewood, operating a farm store, and running an outdoor wood-fired barbecue to supplement the ever changing profits from their dairy farm.


*Audience at the meeting*

# Massachusetts Corn Hybrid Evaluation of 2013

*Masoud Hashemi, Sarah Weis, Madeline Magin*

Twenty corn hybrids were evaluated for silage and grain yield at the University of Massachusetts Crops Research and Education Center Farm, in South Deerfield, in 2013. Each entry hybrid was assigned to one of three groups based on its relative maturity (RM) provided by the seed companies; Group I, shorter-season group (88-94 days), group II, mid-maturity group (95-100 days), and group III, full-season group (101-114 days). All hybrids were planted on May 7, 2013. A cone type distributor mounted on a double disc opening corn planter was used in a conventionally prepared seed bed. Plots were planted at the rate of 37,000 seeds per acre in 30 inch rows. Weeds were controlled using glyphosate.

Plots consisted of 3 rows, 25 feet long and 2.5 feet wide, and replicated 4 times. Silage and grain plots were separate but in adjacent fields at the same site. The experimental sites had no manure application history and soil organic matter was 1%. Research plots received 600 lb/acre of 15-8-12 fertilizer and 4000 lb/acre of lime prior to planting. Pre-sidedress soil nitrate test (PSNT) taken in early July indicated insufficient available nitrogen so 400 lb/acre calcium ammonium nitrate (27% N) was applied as sidedress .

Ten foot sections of the central rows were harvested by hand for evaluation of silage yield. Shorter and mid-season hybrids were harvested on August 30, and full-season hybrids were harvested by replication on September 12, 13, and 17. Harvested hybrids were evaluated for silage and ear yield, percentage ears, and moisture content. Silage yield was adjusted to 70% moisture and earcorn yield to 25% moisture.

The grain plots were harvested on November 21 - 25. Ten foot sections of ears were hand harvested and shelled to determine moisture content and yield. Moisture was measured using a DICKEY-John® mini GAC® moisture tester.

Climate data for the evaluation site is presented in Table 1 and Table 2. Overall, in 2013 the corn crop experienced a favorable growing season. Temperatures were above the norm for this location. Rainfall was a bit below average, but was plentiful later in the season.

**Table 1:** Temperature Data for 2013 in South Deerfield, MA.

GDD[1]

| | 2013 | Norm | Deviation |
|---|---|---|---|
| May | 301 | 185 | 116 |
| Jun | 529 | 483 | 46 |
| Jul | 790 | 645 | 145 |
| Aug | 591 | 595 | -4 |
| **Total** | **2211** | **1908** | **303** |

[1] Growing Degree Days was calculated as: GDD = $\Sigma(T_{max} + T_{min})/2 - 50$

**Table 2:** Rainfall Data for 2013 South Deerfield, MA.

Rainfall (inches)

| | 2013 | Norm | Deviation |
|---|---|---|---|
| May | 2.01 | 3.79 | -1.78 |
| Jun | 3.10 | 3.75 | -0.65 |
| Jul | 4.87 | 3.91 | 0.96 |
| Aug | 4.10 | 4.10 | 0 |
| **Total** | **14.08** | **15.55** | **-1.47** |

Results for corn silage yields are given in Table 1. Hybrids are arranged according to their reported days to maturity. Average yields for the three maturity groups are shown in bold. Silage yield ranged from 24.2 ton/ac to 37.1 ton/ac, with the full-season hybrids significantly outperforming the short and mid-season hybrids. However, shorter season and mid-season hybrids yield similarly. Earcorn yielded significantly more on the full season hybrids than the others. Percent ear is sometimes given as an indicator of silage quality, with a higher ear percentage indicating higher energy content of the silage. The shorter- season hybrids had higher ear percentages than the mid- and full- season hybrids. Plant population is given as a matter of interest. Significant differences in plant population among hybrids were not observed.

*Corn hybrid evaluation continued:*

**Table 3: Corn silage yield in 2013**

| Hybrid | Days to maturity | Plants/ac (000's)[z] | Silage ton/ac[y] | Earcorn ton/ac[x] | %ears |
|---|---|---|---|---|---|
| TA 333-22DPRIB | 91 | 29 | 24.7 | 6.5 | 66.0 |
| DKC 43-10RIB | 93 | 31 | 27.6 | 7.4 | 66.8 |
| DKC 43-48RIB | 93 | 34 | 27.7 | 7.4 | 66.4 |
| P9917AMX | 93 | 29 | 24.2 | 6.4 | 66.5 |
| **Shorter- Season (<95 days)** | | | **26.0b[v]** | **6.9b** | **66.4a** |
| DKC46-20RIB | 96 | 33 | 24.6 | 6.1 | 62.6 |
| TA 477-31 | 97 | 30 | 27.7 | 6.5 | 58.2 |
| TA 484-28 | 98 | 33 | 30.1 | 7.5 | 62.7 |
| P0533AM1 | 98 | 33 | 27.0 | 7.0 | 65.1 |
| DKC 49-29RIB | 99 | 31 | 26.8 | 6.6 | 62.2 |
| **Mid-Season (95-100 days)** | | | **27.2b** | **6.8b** | **62.2b** |
| DKC 52-04 | 102 | 34 | 30.8 | 8.2 | 66.6 |
| DKC 53-56RIB | 103 | 31 | 32.3 | 8.6 | 67.1 |
| DKC 57-50 | 107 | 34 | 33.3 | 8.5 | 64.1 |
| DKC 57-75RIB | 107 | 31 | 32.5 | 8.5 | 65.7 |
| TA5 83-22DP | 108 | 34 | 37.0 | 9.4 | 63.7 |
| DKC 61-21RIB | 111 | 35 | 37.1 | 8.9 | 60.0 |
| DKC 61-88RIB | 111 | 32 | 35.9 | 9.2 | 64.2 |
| DKC 62-08RIB | 112 | 31 | 32.7 | 8.4 | 64.2 |
| DKC 62-97RIB | 112 | 30 | 32.0 | 8.2 | 63.6 |
| TA 683-13DP | 112 | 35 | 35.8 | 8.9 | 62.4 |
| P1449XR | 114 | 32 | 35.9 | 8.3 | 57.5 |
| **Full Season (>100 days)** | | | **34.1a** | **8.7a** | **63.6b** |

[z] Plots were seeded at 37,000 seeds per acre assuming 90% germination and survival to achieve density of 33,000 plants per acre.
[y] Silage yield is reported as tons per acre of 70% moisture and
[x] Earcorn is reported at 25% moisture.
[v] Means with the same letter within each column are not significantly different at $P \leq 0.05$.

Results of grain harvest yields are shown in Table 2. As was the case for the silage yields full season hybrids yielded better than short season hybrids however, the yield difference between mid-maturity and full-season hybrids were not significant. Even with a late November harvest, the grain moisture content was greater as the days to maturity of the hybrid increased.

If cost of drying is a factor, then cost of drying may offset slightly lower yield (probably not 37 bu per acre lower yield, though).

**Table 4: Grain yield in 2013**

| Hybrid | Days to maturity | Plants/ac (000's)[z] | Grain bu/ac[y] | Grain % moisture[x] |
|---|---|---|---|---|
| TA 333-22DPRIB | 91 | 37 | 226 | 15.3 |
| DKC 43-10RIB | 93 | 34 | 223 | 15.1 |
| DKC 43-48RIB | 93 | 36 | 265 | 15.2 |
| P9917AMX | 93 | 34 | 211 | 15.7 |
| **Short Season (<95 days)** | | **36** | **231 b** | **15.3 a** |
| DKC 46-20RIB | 96 | 34 | 244 | 15.9 |
| TA 477-31 | 97 | 37 | 284 | 15.9 |
| TA 484-28 | 98 | 37 | 257 | 15.6 |
| P0533AM1 | 98 | 37 | 273 | 17.3 |
| DKC 49-29RIB | 99 | 32 | 226 | 15.9 |
| **Mid-Season (95-100 days)** | | **36** | **257 a** | **16.1 b** |
| DKC 52-04 | 102 | 33 | 255 | 16.0 |
| DKC 53-56RIB | 103 | 34 | 224 | 16.1 |
| DKC 57-50 | 107 | 33 | 261 | 17.0 |
| DKC 57-75RIB | 107 | 33 | 240 | 17.0 |
| TA583-22DP | 108 | 35 | 309 | 16.3 |
| DKC 61-21RIB | 111 | 35 | 292 | 18.2 |
| DKC 61-88RIB | 111 | 36 | 295 | 16.5 |
| DKC 62-08RIB | 112 | 35 | 296 | 17.5 |
| DKC 62-97RIB | 112 | 32 | 274 | 17.9 |
| TA 683-13DP | 112 | 31 | 269 | 18.0 |
| P1449XR | 114 | 32 | 241 | 20.1 |
| **Full Season (>100 days)** | | **34** | **269 a** | **17.2 c** |

[z] Plots were seeded at 37,000 seeds per acre assuming 90% germination and survival to achieve density of 33,000 plants per acre.
[y] Grain yield is reported as bushels ( 56 lb) per acre at 15.5% moisture.
[x] Percent moisture is measured at harvest using a DICKEY-John® mini GAC® moisture tester.
[w] Means with the same letter within each column are not significantly different at $P \leq 0.05$.

# BIOCHAR: A Brief Introduction

*By Emily Cole and Madeline Magin*

The term biochar references the charred product of a low oxygen burn (pyrolysis) of organic biomass that can be added to agricultural soils as an amendment. As the surge in research on biochar has been very recent, the long-term effects of applying biochar to soil are not fully understood; however, studies have shown that biochar amended soils have increased nutrient and water retention as well as increased cation exchange capacities.

Additionally, it is believed that amending soil with biochar can greatly influence the amount of carbon that soil can sequester, which could significantly reduce the amount of carbon in our atmosphere, thereby mitigating the effects of climate change.

Interestingly, the study of biochar evolved from the discovery of 500-2,000 year old carbon rich soils known as *terra preta (black earth)* along the banks of the Amazon River. *It* wasn't until the twentieth century that specific sites of terra preta were discovered which helped support claims of the presence of civilizations there in the past. Upon the discovery of this nutrient rich soil amidst a landscape of heavily leached soils, scientists realized that the terra preta soils might hold the answer of how to effectively amend soils for long term use. Retaining soil nutrition could play a large role in decreasing rates of deforestation and desertification as well as ensuring food security on a global scale.

Upon closer inspection, it was found that there was a regular occurrence of high levels of charcoal in the soils from different terra preta sites. The soils from these sites had 70 times more black carbon than surrounding soils. Most scientists are in agreement that these soils are the product of old dumping grounds where people poured ash from fires and cooking stoves, bones (fish and game), feces, urine, turtle shells and broken pottery. The slow burning of wood and other materials that took place in these cultures as they cooked their food and tended their fires throughout the night produced a solid carbon rich material which we know as charcoal. Char is made up of extremely small particles which lends itself to having increased pore space and surface area. These characteristics allows substances treated with biochar to retain more nutrients and water.

Discovering that the nutrient poor soils of the Amazon Basin could be amended to sustain an agriculturally based civilization gave scientists hope that reproducing the terra preta soils in other locations could greatly influence soil management practices throughout the world. Today, in order to replicate the effects seen in terra preta, large amounts of biochar must be produced, and it must be produced efficiently. The way in which this is done is pyrolysis. Pyrolysis is defined as the thermal decomposition of organic material in the absence of oxygen. The absence of oxygen prevents combustion which would result in ash, not biochar. In order to produce biochar, organic materials must be heated to a temperature of at least 300 degrees Celsius. At this temperature, organic material thermally decomposes, releasing a liquid by-product and the residual solid biochar. The optimum temperature for producing biochar depends on the type of biomass that is fed into the system and the specific characteristics you desire in the resulting biochar. In the natural carbon cycle, 100% of the carbon from a living plant would eventually return to the atmosphere as carbon dioxide through the processes of decomposition (*figure 1*) . However, pyrolysis of that same starting material will result in a stable biochar product that has lost almost all of it's other components except the carbon. This changes the chemical structure into a stable product that will resist decomposition in the soil and persist in the soil for many years continually helping to maintain soil health.

Pyrolysis temperature and procedure as well as the biomass feedstock influence the characteristics of the biochar produced. To generalize characteristics across all biochars produced would be wildly inaccurate and would mask the many nuances involved in determining whether a biochar application would benefit a specific soil.

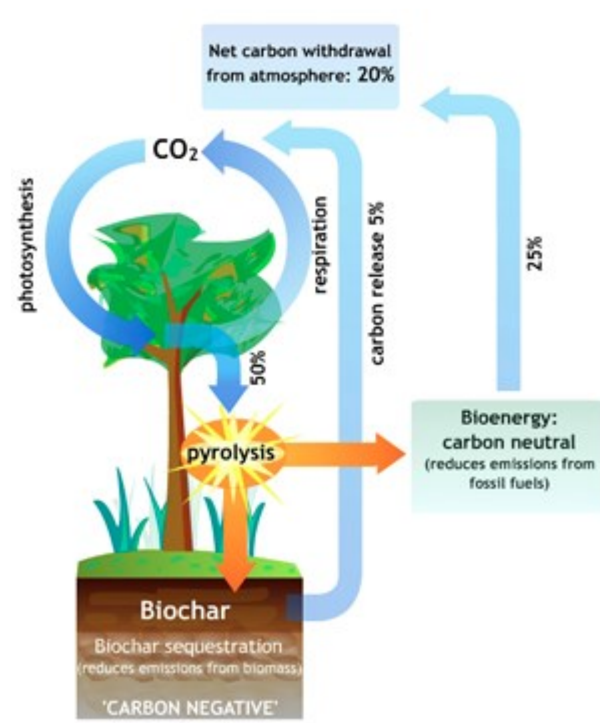


*Figure 1: Diagram of carbon cycle*
http://cuaes.cornell.edu/ag-operations/curbi/biochar.cfm

The work of Dr. Jeffrey Novak and others highlights the vast differences amongst biochars produced through different circumstances and using various starting materials. Feedstocks such as peanut hulls, pecan shells, poultry litter, and switchgrass can all result in biochar using the slow pyrolysis process. The temperature of pyrolysis plays a significant role in the final biochar structure. The organic starting material is composed of a variety of compounds, primarily cellulose, hemicellulose, and lignin compounds. These compounds begin to degrade at different temperatures and all play a part in the characteristics of a biochar.

The complexities of producing different types of biochar can be daunting; however, producing small batches of a reasonable quality char is something that is possible to do at home. There are numerous open access designs online for kilns and stoves that range in size and investment cost. At the simplest side of the spectrum there is the 1G toucan (two can) top-lit up-draft system which is constructed out of a one gallon paint can and an industrial sized aluminum can (110 ounces). The instructions to build this stove can be found here. The 1G Toucan stove is nice to experiment with different biomass feedstock and to produce small batches of biochar for potting plants and amending the soil of small gardens; however, if you want to produce larger batches you might want to look into building a more substantial kiln. There are instructions on building a simple closed retort kiln that is insulated by firebricks and can fit a 200 liter steel barrel (Figure 2). Go here for more information on the design of this stove.

If you choose to go forward with producing your own biochar keep in mind that it does persist in the soil; therefore, apply it in small areas to test its properties before committing to a large-scale application.

Currently, research is being conducted on the effects of a biochar produced from sugar maple feedstock at the UMass Research Farm. In July 2012, biochar was incorporated into unfertilized plots at varying rates and sweet corn was planted. Soil samples are continually being analyzed for changes in nutrient retention and marketable yield is being assessed. Initial results (after 1 growing season) show that the addition of biochar had no significant effect on marketable yield, but does result in higher rates of nutrient retention in the soil. As the positive effects of biochar are often delayed, this study will continue to monitor effects in the field for years to come.

*Figure 2: Closed Retort Kiln*
http://www.biochar.info/biochar.CarbonZero-Experimental-Biochar-Kiln.cfml

# Composting at Blue Star Equiculture

*By Madeline Magin*

Blue Star Equiculture is a non-profit working horse rescue and sanctuary. At any one time there are at least thirty horses residing at Blue Star which results in the accumulation of about 600,000 lbs. of manure annually. Their past manure management strategy relied on volunteers moving the manure to one large pile that was periodically collected by a landscaper.

Although their management strategy was free of cost, it accounted for a resource loss to the operation. Every time the landscaper came to pick-up manure they were hauling away nutrients that could be recycled on the premises if Blue Star had a way to process it. In order to address this issue Blue Star needed a system that could process manure into compost at a rate that could match manure accumulation.

A Harvard extension school student and systems engineer at Adobe, Atakan Kadi, came forward with a design for a low maintenance composting system with minimal start-up costs that could process a large amount of manure into compost in a relatively short period of time. The design is based on a closed aerated compost unit that forces air into the bottom of the system to increase the rate of decomposition. A prototype of the system with a 4.7 cubic yard capacity was installed at Blue Star last June (*figures 1& 2*).

It features a strong air pump that incorporates fresh air through perforated drain pipes that run along the bottom of the manure receptacle. Additionally, the system is equipped with hoses that allow for the rehydration of the manure during the peak composting process to offset the loss of moisture.

*Figures 1 & 2: The prototype composting system and detailed view of the air pump*

Constructing this system was simple and inexpensive; however, Atakan also wanted to add features that would reduce the amount of oversight necessary to manage this system. In order to do so a micro-controller system was installed that continually measures the ambient temperature, compost temperature, and the compost humidity. The temperatures that are recorded are the basis for the frequency and duration of air being pumped into the system to ensure optimal rates of decomposition.

The records of the micro-controller are also sent back to a cloud based server that can be monitored by an operator. The benefit of this is that alerts can be sent when temperatures are recorded that are outside the normal limits or when the decomposition process is complete. This feature will reduce the amount of time that an operator would have to spend checking in on the system.

The prototype composting unit has proven to create compost efficiently and effectively; however to meet the capacity of manure that is produced at Blue Star they determined that a more open, pile based system would make it easier to unload large quantities of manure. An area was designated for this pile and perforated pipes were laid out and connected to an air pump so that the same principles of forced aeration still apply (*figure 3)*. This system produces compost efficiently and has a very low start up cost.

*Figure 3: Supplies needed for an open-pile system. Additionally, a tarp should be used to protect manure from the elements and prevent runoff.*