2008 Vermont Forage Conference

American Legion, Post 27

Middlebury, VT
March 12, 2008

Sponsored by
UVM Extension and USDA – Risk Management

Agenda

9:25	**Welcome** Sid Bosworth, UVM
9:30	**What's New In Forage Equipment** Dan Undersander, Extension Forage Specialist, Un. Of Wisconsin
10:20	**Managing Corn for Silage from Seed to Silo** Ev Thomas, Vice President of Agricultural Programs, Miner Institute
11:10	**Innovations in Manure Nutrient Utilization of Forage Crops** Doug Beegle, Extension Soil Specialist, Penn State University
11:45	**The Latest in Crop Insurance** Shantel Thomas
Noon	**Lunch**
1:00	**Profitable Forage Production** Dan Undersander
1:35	**Strategies to Reduce the Costs of Fertilizer** Doug Beegle
2:45	**Copper Sulfate Footbath Research** Sally Flis, Graduate Student and Research Assistant, UVM and Miner Institute
3:10	**Update on Corn and Small Grain Silage Research** Heather Darby, Extension Agronomist, UVM Extension

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What's new in forage equipment for making hay

Dr. Dan Undersander
University of Wisconsin

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Harvesting Forage

- Wide swath
- Conditioning
- Tedding, Raking, Merging
- Baling

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Wide swath benefits

- Faster drying
- Higher forage quality

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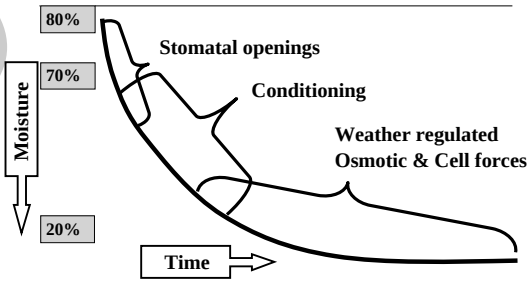
Sequence of Drying Forages



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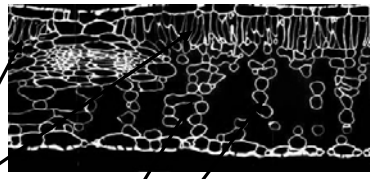
Leaf Structure

Legumes have 10 times more stomata than grasses



Upper and lower **epidermis** is heavily coated with waxy cutin, conserves water and protects

Palisade parenchyma neatly, tightly packed cells with high chlorophyll content, site of photosynthesis "light reaction"

Spongy mesophyll loosely packed cells site of energy conversion to sugar and respiration

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Stomata Openings

- Sunlight – more they get, the more they stay open
- Shading closes Stomata
- 20 – 30% of water removed before stomata close

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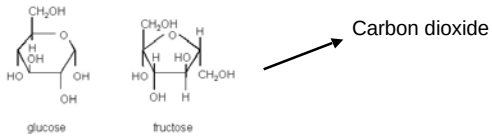
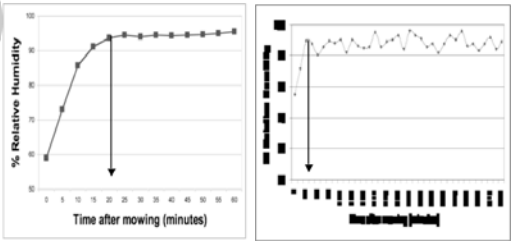
Respiration continues after cutting until lose some water

Breakdown of starch and sugars

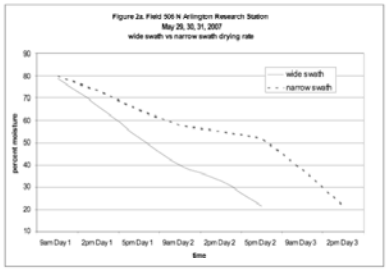


2 – 8% of Dry Matter loss

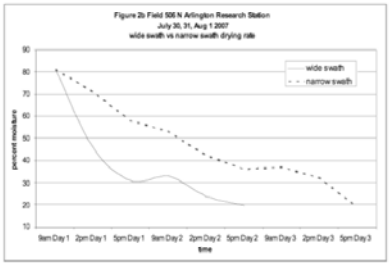
Relative humidity inside windrow



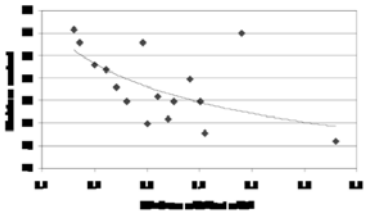
Effect of wide swath on drying rate



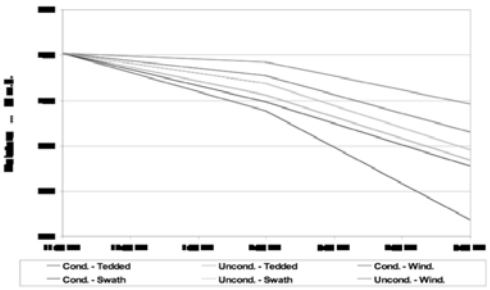
Effect of wide swath on drying rate



Moisture content of alfalfa 5.5 hours after cutting with various windrow width to cut width ratios, WI Farm Technology Days, 2002



Mower-conditioner Swath Width Study
(Windrow 33% and Swath 65% of Cutting Width)



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Put hay into wide swath
Keep off of ground

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Change in Alfalfa/grass Silage Composition due to swath width (8 Trials, Wisconsin, 2005 to 2007)

Component	Change (wide – narrow) (% of Dry matter)	
	Average	Maximum
CP	-0.2^{ns}	2.0
NDF	-1.0	-4.1
NFC	1.7	4.0
Ash	-0.2^{ns}	-1.6
Lactic acid	0.77	4.52
RFQ	11	24

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Mowing without conditioning

- Less expensive
- Less energy to operate
- Faster mowing

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Conditioning to break stems

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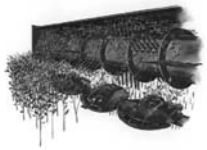
Conditioner types

Flail/impellers



Rubber Rolls

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Roll and Impeller Comparison

- Roll creates a crushing action
- Impeller creates a stripping action
- Impeller tends to have higher losses
- Roll with rotary mower may leave strips in light crops due to limited air through rear of machine

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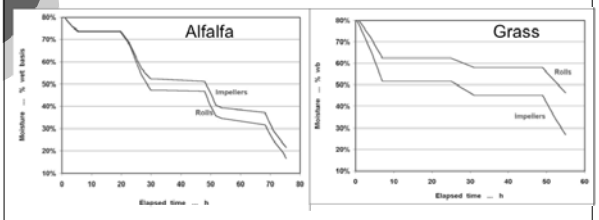
Conditioner drying rates



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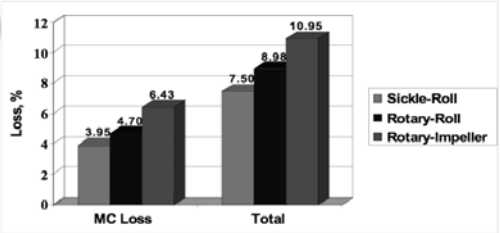
Comparison of Losses(%)

Wisconsin Study



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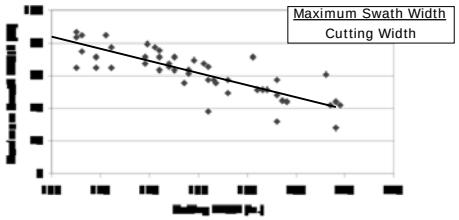
Maximum swath width versus cutting width



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Adjust roll conditioner properly

- Tension on rollers
- Spacing of rollers

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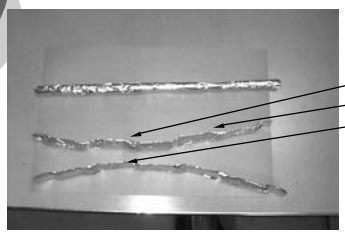
Adjust conditioner roller spacing



Measure clearance where "Crimp" or smallest clearance occurs

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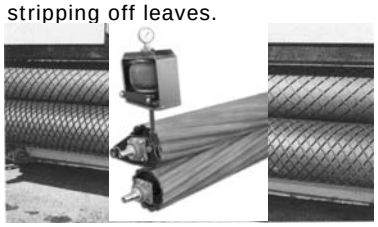
Superconditioner

completely crushes alfalfa stems without stripping off leaves.



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Superconditioner

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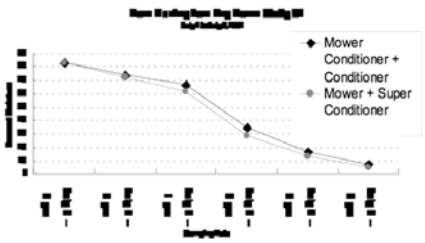
Superconditioner



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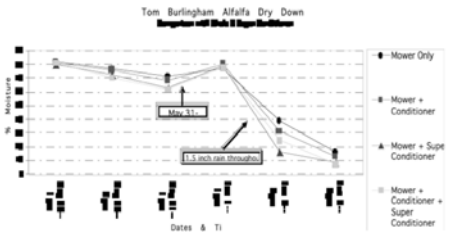
Superconditioner



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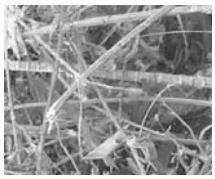
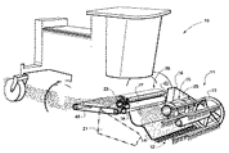
Macerator

- A first rotating crushing roller cooperates with a second rotatable crushing roller





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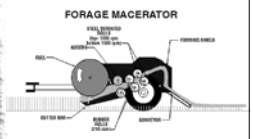
Macerator

1. Feed cut forage into the rubber rolls
2. Then into a set of steel, serrated rolls which macerate.
3. Aggressiveness of the maceration is determined by the air pressure settings on the machine.



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Why should ash content be a concern?

- Ash provides minerals to the diet, but no calories (i.e. energy).
- Takes the place of nutrients on almost a 1:1 basis.
- Ash content above that contained in plant is dirt contamination

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Ash Content of Forage Samples

Forage Ash Content
UW Marshfield Lab, 2007

Type	Statistic	% Ash
Haylage	Average	12.3
	Max	18.0
	Min	5.7
Hay	Average	10.3
	Max	17.6
	Min	8.8

Elevated Ash reduces TDN

"Cows don't produce milk eating dirt"

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What about research looking directly at the effect of % ash in the forage in milk production?

"While there have been few dairy research trials in this area, it is highly likely that cows do not milk well when fed dirt."

Pat Hoffman, Dairy Scientist, Marshfield ARS, 2002

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Possible Causes of Higher Levels of Ash in Forages

Disk Cutterbar Cutting height

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Mower knife type

Those knives that "pick up hay" better, also pick up more ash.

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Possible Causes of Higher Levels of Ash in Forages

Picking up soil when harvesting

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Possible Causes of Higher Levels of Ash in Forages

Hay and Silage bags on the ground

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Forage Cutting height

- Lower cutting results in more yield
  - 0.5 t/a per year for each inch of alfalfa
- Lower cutting height shortens stand life of grasses
  - Especially smooth bromegrass, orchardgrass, timothy
- Lower cutting height reduces forage quality
  - 5 points RFV per inch cutting height
- Lower cutting height increases ash with disc mowers
- Best compromise is generally 2.5 to 3 inches cutting height

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Possible Causes of Higher Levels of Ash in Forages

- Rake so tines do not touch ground
- Move hay as little across ground as possible

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Rake properly

- Keep forage on top of stubble
- Rake so tines do not touch ground
- Move horizontally across ground with rake as little as possible
  - i.e. move two swaths on top of third in middle rather than rake all to one side as shown in previous slide.
- Merger will result in less as on forage than rake.

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Tedders

- To spread swath or windrow for faster drying

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Wheel Rakes

- Least Expensive
- High ash potential
  - Adjust wheel float to minimum needed to pick up hay.

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Parallel Bar Rake

- Powered
- High maintenance
- Rigid across uneven ground

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Rotary Rakes

- Powered
- High maintenance
- Can ted/rake/merge windrows
- Most expensive

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Windrow Merger

- Picks up hay to move across ground
- Expensive

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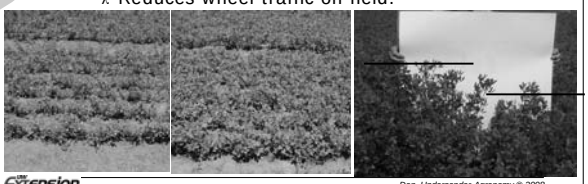
Merge windrows into optimum size for harvesting equipment

- Harvesting twice as big windrow:
  - Requires 10 to15% more energy
  - Reduces harvesting time
  - Reduces wheel traffic on field.



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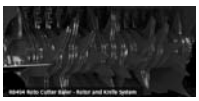
Baling

- Cutting forage for hay/hayage - bales that break apart easily for feeding
  - Higher initial machinery cost
  - Higher energy requirement
  - Stones cause knife damage



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Baling

- Cutting forage for hay/hayage - bales that break apart easily for feeding
  - Fermentation in plastic wrapped bales not changed
  - Higher feeding efficiency
  - Improved stocker cattle gain

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Managing Corn Silage from Seed To Silo

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In the U.S. only about 7% of the corn acreage is harvested as whole-plant corn silage. And some of that acreage is planted with the intention of grain harvest but is harvested for silage because something went wrong: Drought, pest damage, etc. With the increased corn acreage due to the ethanol boom, it's likely that the actual percentage harvested as silage may be closer to 5%. Therefore, it's not surprising that until recently there has been little effort by plant breeders to improve corn silage digestibility. This doesn't mean that there hasn't been any improvement in the digestibility of corn silage; corn silage digestibility has been increasing for at least fifty years, *but this has been due to increases in the grain-to-stover ratio*. Plant breeders have succeeded in putting more grain on each corn plant, with resulting improvements in whole-plant digestibility. But for most of the past 100 years there has been no improvement in the digestibility of corn stalks and leaves. In fact, if there's been any trend at all it's been a slight decline in stover digestibility. This in spite of research showing that increasing corn silage fiber digestibility by one percentage point increases milk production by about 0.5 lbs.

The seed corn industry began to change in the 1990s with the growing popularity of leafy hybrids and with the commercialization of brown midrib (BMR) corn hybrids. Following are the advantages and disadvantages of each of these hybrid types.

Brown Midrib Hybrids

Brown midrib hybrids are silage-only hybrids. Although the Bm3 gene isn't patented, almost all BMR hybrids are currently sold by Mycogen Seeds. The midrib on the leaves of BMR hybrids has a reddish-brown color, thus the name. The nodes on BMR corn stalks are also reddish-brown. A naturally occurring genetic mutation causes incomplete lignin formation, resulting in increased dry matter intake (almost always) and higher milk production (usually). BMR silage yields are typically 5 to 20% lower than that of non-BMR hybrids of comparable maturity, and seed costs at least twice as much. The lower lignin concentration can result in poor standability, especially if left in the field past ideal silage maturity. Some BMR hybrids also have poor disease resistance. It's therefore not surprising that BMR hybrids represent a very small percentage of the corn harvested for silage each year.

While BMR corn silage usually results in higher milk production, it may not be profitable if fed to the entire herd rather than just to transition cows and/or cows in peak production. It's generally accepted that dairy cows milking less than approximately 65 lbs milk per day won't benefit enough from BMR corn silage to justify the added cost per kg of silage. Therefore, it's necessary to segregate BMR silage in a separate silo. This fact alone eliminates BMR as an option for many small farms where all the corn silage is stored in one silo. The combination of lower yield and higher dry matter intake combines to require about 25% more acres where BMR corn is grown, having a meaningful impact on acreage requirements and perhaps on nutrient management programs. However, there is the potential to increase the forage-to-concentrate ratio when feeding BMR corn silage, thus reducing the amount of purchased grain. We've been planting BMR corn hybrids at Miner Institute for five years and have been pleased with the results. We don't like to

pay more than $200 for a unit of BMR seed nor accept 10-20% lower yields, but are pleased at the very high fiber digestibility and resulting milk production response.

How much difference is there between BMR and normal corn silage? At Miner Institute we select corn hybrids based on yield and digestibility. We also chop some of our non-BMR corn silage higher than we do BMR. Miner Institute's *non-BMR* corn silage, therefore, is several points higher than average in digestibility—about 50% NDF digestibility. Our BMR corn silage has been at least 60% NDF digestibility, similar to the BMR digestibility in a recent summary of farms in the Northeastern U.S. feeding BMR corn silage. Therefore, BMR has at least 10 percentage point advantage in NDF digestibility over non-BMR corn silage.

Leafy Hybrids

The leafy gene results in more leaves above the ear, in some cases up to twice as many leaves as normal (non-leafy) hybrids. Some leafy hybrids also have wider leaves. However, compared to corn grain, leaves aren't highly digestible, so simply increasing the number and volume of leaves doesn't result in higher whole-plant digestibility. About ten years ago I said that Miner Institute would start planting leafy hybrids on our farm when one was found in university hybrid trials to have the combination of high silage yield and superior digestibility. It took a few years, but eventually some leafy hybrids did prove to have these characteristics and this year a leafy hybrid will be one of our main two hybrids (a BMR hybrid being the other).

Leafy corn hybrids have become popular in North America for two reasons: First, seed cost is similar to that of non-leafy hybrids, and secondly, many leafy hybrids simply look great growing in the field. All those extra leaves certainly do look impressive, even though they only add modestly to yield since leaves represent only about 10% of corn plant dry matter.

Fertilizers for Corn Silage

With sky-high fertilizer prices, 2008 will certainly be the year to "cash in" on the soil fertility you may have built up by many years of manure application. A corn plant doesn't care whether the nutrients it gets are from fertilizer, just-applied manure, or nutrients applied years ago. Any field with high soil test P and K (based on a <u>recent</u> soil analysis) is a candidate for just N through the corn planter. 30-40 lbs N/acre is all you need for many of those corn fields near the barn. If you apply spring manure, incorporating it within hours of application will pay bigger dividends than ever by retaining ammonia N.

But even with high fertilizer prices, you simply cannot afford to under-fertilize corn for silage. Because you harvest the entire plant, corn sucks up a lot of nutrients. Growing corn silage without manure will be a very expensive proposition, both this year and in the years ahead.

Maturity vs. Digestibility

Corn harvested for silage is really two crops growing on the same plant: One (the kernels) is a high quality grain. The other (the rest of the plant) is a modest quality tropical grass. As the crop matures to the proper stage for silage harvest, the proportion of grain increases (that's good) while the rest of the plant matures, declining in digestibility (that's bad). However, on balance the increased grain concentration greatly outweighs the modest decrease in stover digestibility. Corn hybrid selection is one way to achieve high silage digestibility, but there's another way: Harvest corn for silage at the proper stage of maturity. This involves selecting hybrids that will be at the proper stage of maturity when harvested, and delaying harvest until at least 32% DM.

Several years ago Pioneer compared five of its corn hybrids for silage quality, harvesting them at 29% and 34% dry matter. They found at least a 10 and as much as 15 percentage point increase in whole plant digestibility when these hybrids were harvested at 34% DM rather than 29% DM. (Figure 1) These differences are almost exactly the same as the quality differences between BMR and non-BMR corn silage! However, seed price and other growing costs are the same regardless of harvest maturity, and dry matter yield is higher at 34% DM than at 29% DM.

Figure 1. Dry matter digestibility of five corn hybrids harvested at two maturities.

Hybrid	29% DM	34% DM
1	61	75
2	61	75
3	64	74
4	63	75
5	65	75

Pioneer Hy-Bred International, 2001

The increasing reliance on custom silage harvest may mean that the crop will be harvested somewhat earlier than would be the case if the farmer were harvesting the crop himself. If this is the case, planting earlier-maturing corn hybrids would be much preferable to harvesting full-season hybrids at less than 30% DM. The economic value of the yield difference between hybrids 10 days apart in relative maturity would be much less than the difference in milk production potential between corn harvested at 29% and 34% DM. I have little sympathy for farmers who say that the reason their corn is harvested in the milk stage each year is because that's when the custom harvest operator is willing to chop his crop. There are two better alternatives: Change to earlier-maturing hybrids, or change custom harvesters. Although I prefer the latter, it's probably easier to change hybrids.

Chopping, filling and packing

Today's self-propelled choppers really eat corn, and with two or three trucks running the roads it's easy to exceed a filling rate of 100 tons per hour. Unfortunately, some farmers are doing this with the same weight packing tractor they were using when they were filling at half this rate. The old "Rule of 800" (tractor weight divided by 800 = maximum bunker or stack silo filling rate per hour) may be conservative, especially with processed corn silage, but even if we revise this to a "Rule of 600", for many farms this will mean having two tractors on the silage pile. That's what we do at the Institute, and even so if we're chopping close to home with our 6-row SP we have to park one of our three forage trucks to keep filling rate in line with packing ability.

Manure Nutrient Utilization of Forage Crops

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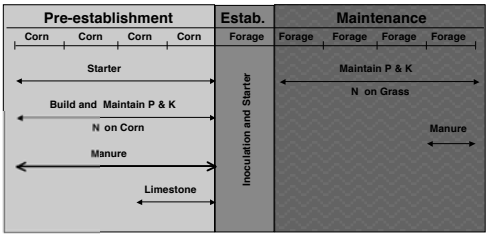
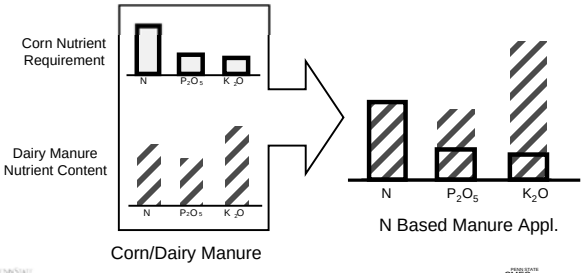
Forage Fertility Time-line



Pre-Establishment Manure Management

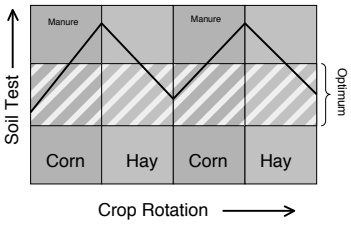
- Soil Fertility Goals:
- pH > 6.5
- P Optimum-High
- K Optimum-High

Field Nutrient Balance with Manure



Rotation Nutrient Levels

Nutrient Balance Corn/Hay Rotation with Manure applied to the corn

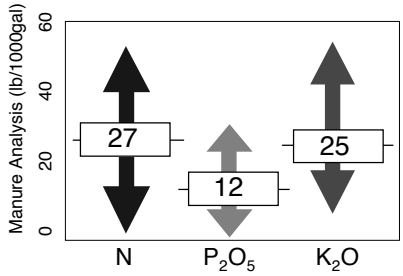


Manure Nutrient Content

Type	N	P_2O_5	K_2O
Solid Dairy (lb / ton)	10	4	8
Liquid Dairy (lb / 1000 gals)	28	13	25
Beef (lb / ton)	11	7	10
Sheep (lb / ton)	23	8	20
Horse (lb/ton)	12	5	9

PSU Agronomy Guide Table 1.2-13

Manure Analysis Variation
Dairy Manure



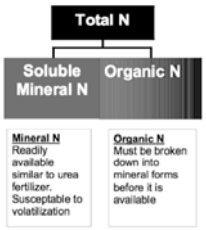
PSU AASL
n= 311

Nitrogen Availability from Manure

- Spring or summer application % Avail.

  Incorporation/Rain
  Same day 50 %
  2-4 days 35 %
  >7 days 20 %

- Fall or winter application
  Ground Cover
  Growing crop (Forage Crops) 40 %
  No growing crop 20 %



Manure Nitrogen Availability

- Spring or summer application % Avail.
  Incorporation
  Same day 50 %
  2-4 days 35 %
  >7 days 20 %

- Fall or winter application
  Ground Cover
  Growing crop 40 %
  No growing crop 20 %

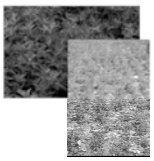
PSU Agronomy Guide Table 1.2-14

Manure P & K Management

- Similar to fertilizer P and K
- Use pound for pound as recommended on the soil test
- Remember you can't separate N, P and K in manure - N on legumes!
- Manure vs Crop Nutrients
  - Crop P:K = 1:3
  - Manure P:K = 1:2

Manure on Forages

- Nitrogen
  - Legumes
    - No Nitrogen needed but will utilize applied N
    - May stimulate grass and weed competition
      - Especially a concern with new legume seeding
    - Manage to maintain the legume
    - Mixtures >25% legume treat as a legume



  - Grasses
    - Rate - based on expected yield
    - 50 lb N/ ton / acre
    - Timing - split for each harvest based on expected yield

Manure Application on Legume Crops

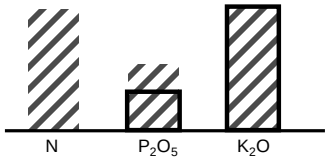
- Considerations
  - These crops provide their own nitrogen
  - Applying manure to legumes is not efficient or economical compared to applying to a non-legume
  - Stimulates grass and weed competition
  - Can physically damage the stand
  - Chemically damage the stand
    - Salt injury to new seedings

Manure Application on Legume Crops

- Management
  - Balance manure applications based on P and K
  - Apply manure to forages in late fall, winter or early spring apply
  - If applied during the growing season, apply as soon after cutting as practical
  - Apply multiple light applications rather than one big application
  - Give priority to applying manure to old stands
    - May increase productivity from grass in thinning stand
    - Should not shorten the life of the stand since it will soon be rotated anyway
  - Manage weeds carefully

Nutrient Balance with Manure on Legume

Legume does not need N but will use it.



K Based Manure Application
Dairy Manure on Grass Hay

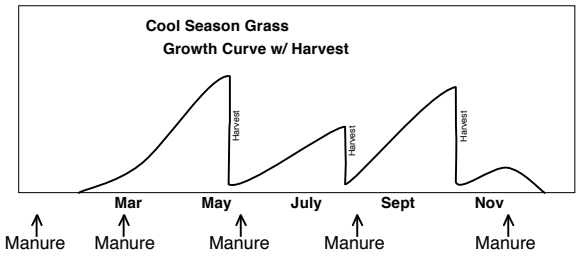
Small Excess of P

- No crop or animal concerns
- Environmental problems
  - Eutrophication
  - 51% of soil samples above optimum P

Manure Application on Grass Crops

- Considerations
  - High nitrogen requirement
  - Multiple opportunities to apply manure
    - Late fall and early spring growth
    - Between cuttings
  - Can physically damage the stand

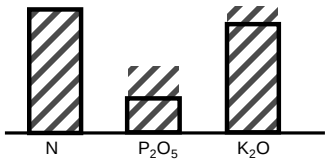
Manure Timing on Grass Hay



Manure Application on Legume Crops

- Management
  - Balance manure applications based on N
  - Be aware of P and K imbalance
  - Split apply based on N requirement of the next harvest
    - Opportunity to apply manure to forages in late fall, winter or early spring
  - If applied during the growing season, apply as soon after cutting as practical

Nutrient Balance with Manure on Grass



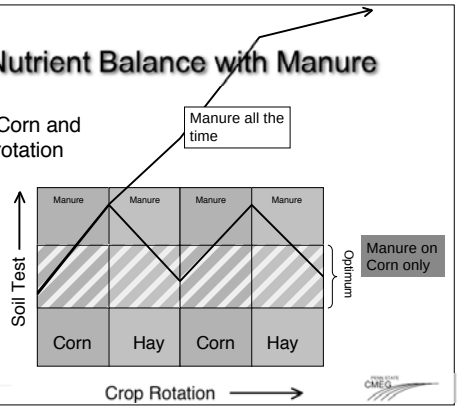
N Based Manure Application
Dairy Manure on Grass Hay

Small Excess of P & K

- No crop or animal concerns
- Environmental problems
  - Eutrophication
  - 51% of soil samples above optimum P
- Watch rotation balance

Manure Nutrient Balance with Manure

- Manure on Corn and Forages in rotation



Manure Nitrogen Timing

Example N Requirements

N Rec Cutting	Exp. Yield (ton/A)	(lb./A)
1	2	100
2	1	50
3	1.5	75
Total	4.5	225

Estimating Manure Application Rates for Grass

- 1st Cutting N requirement = 100 lb N/A
- Manure analysis = 30 lb N/1000 gal
- Manure N availability = 0.4
  - Late Fall applied
- N Balanced Manure Rate

100 lb N/A ÷ (30 lb N/1000 gal x 0.4) = 8333 gal/A

Manure Nitrogen Availability

Based on Total N - AG Table 1.2-14

Planned Manure Application Season	Target Crop Utilization	Planned Manure Application Management	Nitrogen Availability Factor[1]		
			Poultry Manure	Swine Manure	Other Manure
Spring[2]	Spring utilization by grass hay and small grains Summer utilization by corn, other summer annuals and grass hay	Incorporation the same day Incorporation within 1 day Incorporation within 2-4 days Incorporation within 5-7 days Incorporation after 7 days or no incorporation	0.75 0.50 0.45 0.30 0.15	0.70 0.60 0.40 0.30 0.20	0.50 0.40 0.35 0.30 0.20
Summer	Summer utilization by grass hay Fall utilization by grass hay and small grains				
Early Fall[3]	Fall and spring utilization by grass hay and small grains	Incorporation within 2 days Incorporation within 3-7 days Incorporation after 7 days or no incorporation	0.50 0.30 0.15	0.45 0.30 0.20	0.40 0.30 0.20
Late Fall or Winter[4]	Spring utilization by small grains and grass hay	All situations	0.50	0.45	0.40
	Summer utilization by corn or other summer annuals	No cover crop Cover crop harvested for silage Cover crop used as green manure	0.15 0.15 0.50	0.20 0.20 0.45	0.20 0.20 0.40

Surface Band Manure Application

- Ammonia losses were lower and apparent recovery of mineral N from manure on grass forage was much higher with drag-shoe than with splash plate application
  - Ammonia loss was 25% less at low and 50% less at high manure rates
    - Jokela, et al. Vermont
  - Ammonia loss was 41% less compared to surface broadcast
    - Van Vliet, et al. Ag Canada
  - Apparent N recovery was 20 to 30% greater with summer and 18% greater for an early application in spring
    - Bittman et al. Agron J 91:826-833 (1999)

Aerator Manure Application

- Ammonia loss reduced by shallow injection of manure
  - Aerway SSD vs. Broadcast

    ~50% decrease
    (Bittman et al., 2003)
  - Aerway SSD vs. Broadcast

    57% decrease
    (Van Vliet, et al. Ag Canada)
  - Aerway on no-till corn
    No reduction in N volatilization
    (PSU &USDA PSWMRU)
  - How you use this equipment can make a major difference

Direct Ground Injection (DGI)

- High Pressure Injector
  - Forces manure into the soil with high pressure spurts of manure
- Designed for grassland use
  - thatch and roots stabilize the soil
- DGI vs. Broadcast
  - ~60% decrease in ammonia volatilization (Morken and Sakshaug, 1995)
- DGI vs Broadcast on no-till corn
  - ~50% reduction in N volatilization (PSU &USDA PSWMRU)

Shallow Disk Manure Application

- Ammonia loss reduced by shallow injection of manure
- Shallow disk vs Broadcast
  - Ammonia volatilization reduced 40% in March and 70% in June (Misselbrook et al., 1996)
- Shallow disk vs Broadcast
  - Ammonia volatilization reduced 70% (Chadwick and Laws, 2002)
- Shallow disk vs Broadcast on no-till corn
  - ~50% reduction in N volatilization (PSU &USDA PSWMRU)

Urease Inhibitors

- Urease enzyme rapidly breaks urea down and results in ammonia volatilization if on the surface
- Urease Inhibitors reduce Breakdown of Urea

Urea $\xrightarrow{\text{Urease (Inhibitor)}}$ $NH_4^+ + CO_3^{2-}$

NH_4^+ $\xrightarrow{\text{High pH}}$ $NH_3 \uparrow$

- Urease inhibitor inhibits breakdown allowing time for urea to be incorporated by rain
- Works well with fertilizer
- Limited results with manure

Summary

- Best time to add manure to forage crops is when the field is in corn
- Build and maintain soil test levels in optimum
- Analyze manure and account for N availability on grass forages
- Apply based on N needs through the year

Summary

- Balance for P and K on legumes
  - Be aware of potential negative N effects
- Watch out for P and K imbalances
  - Especially if manure applied continuously to the rotation
- Consider alternative manure application technologies

Profitable Forage Production

Dr. Dan Undersander
University of Wisconsin

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Topics to be covered

- Buy Pure Live seed (PLS)
- Impact of nurse crops on future yields
- Rotational benefits of turning over forage stands
- Feeding forage

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Pure Live Seed (PLS)

Determine actual live seed in bag

PLS = % Germination * % purity / 100

If % Germination = 95%
% Purity = 70%

Then:
PLS = 95*70/100 = 66.5%

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Pure Live Seed (PLS)

Determine actual live seed in bag

PLS = % Germination * % purity / 100

Actual live seed cost is
= Cost / PLS * 100
= $4.00 / 90% PLS*100 = $4.44/lb seed
= $4.00 / 70% PLS*100 = $5.71/lb seed

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Seed Cost

Seed purity = 90.9%
Germination = 90%

PLS =
90.9 * 90 / 100 = 82%

Actual Seed Cost
$5.00 / 82% * 100 = $6.10

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Adjustments for Low PLS

- Calculate seed cost based on PLS rather than weight of bag
- Adjust seeding rate if PLS less than 80%

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Seeding year stress reduces yield of alfalfa in future years

- Autotoxicity
- Potato Leaf hopper
- Cover Crop
- Drought?
- Other?

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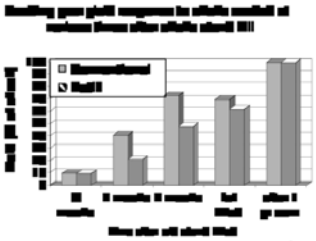
Alfalfa autotoxicity – conventional vs notill seeding



Cosgrove et al., 1996

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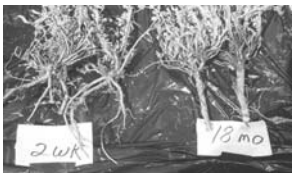
Autotoxicity reduces future yield

- Smaller plants, misshapen roots
- 20 to 30% reduced yield in production years



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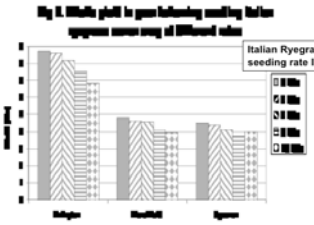
Alfalfa yield in year following seeding with Italian ryegrass cover crop at different rates



High ryegrass seeding rates reduce alfalfa stand and yield in future years

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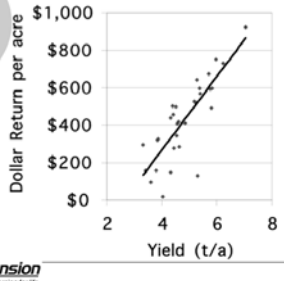
Alfalfa Yield and Dollar Return from Wisconsin Green-Gold Program



Profitability increases with yield
- fixed inputs remain constant
- variable inputs increase only slightly.

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Rotational benefits of turning over forage stands

- Legume credits
- Rotational benefit
- Assessing stand density

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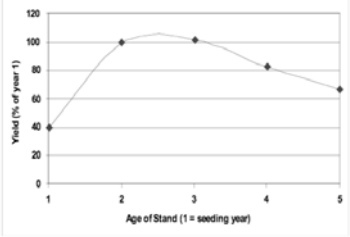
Alfalfa Yield vs Age of Stand

Data from IA, MI, MN, ONT, and WI



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Alfalfa Legume Credits

Stand Density	Medium/Fine Soils		Sandy Soils	
	-----Regrowth after last cutting------			
	>8 inches	<8 inches	>8 inches	<8 inches
	----------lb nitrogen/acre----------			
Good, > 4 plt/ft^2	190	150	140	100
Fair, 1.5 to 4 plt/ft^2	160	120	110	60
Poor, < 1.5 plt/ft^2	130	90	80	40

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Alfalfa Legume Credits

In the second year, following fair and good stands on medium and fine textured soils can take credit of 50 lbs N/acre.

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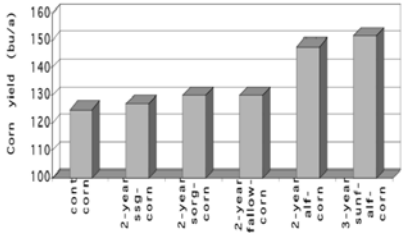
Rotational benefit of alfalfa on corn yield



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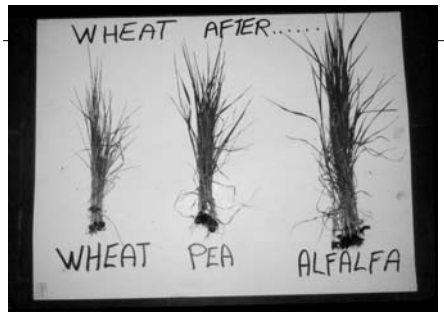
Increased Wheat Growth Following Alfalfa



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Alfalfa affect on wheat growth

- Nitrogen contribution to wheat (Kelner 1997)
  - First year following alfalfa - 91 lb N/acre
  - Second year following alfalfa - 161 lb N/acre
  - Third year following alfalfa - 150 lb N/acre
- Wheat yield increase due to alfalfa (Forster 1998)
- Increase protein of wheat as well

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When to turn over a forage Stand

- Plant density is not a good indicator of yield
  - Stands should have at least 6 plants/ft^2

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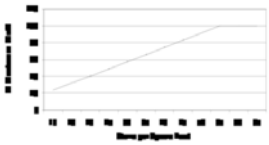
When to turn over a forage Stand

- Stem Density is a good indicator of yield potential
  - Stands should have at least 50 stems/ft^2



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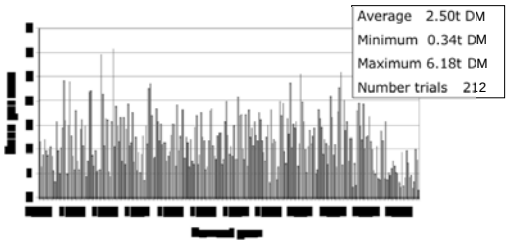
Yield difference between top and bottom alfalfa entries in Univ of Wisconsin Variety Trials



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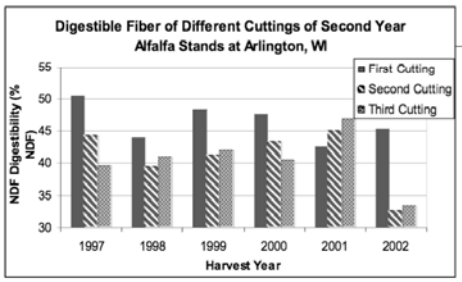

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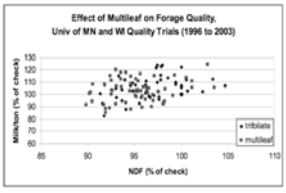
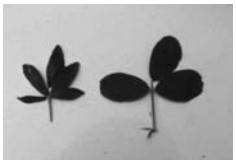
Effect of Multileaf Alfalfa on forage quality





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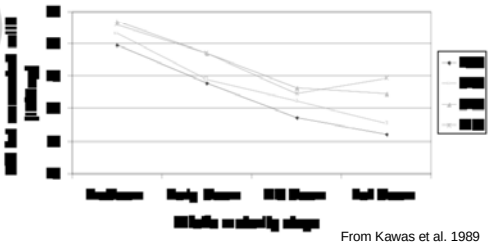
Effect of forage quality on 4% fat corrected milk at four concentrate levels



From Kawas et al. 1989

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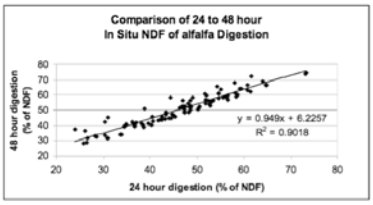
Alfalfa Digestion



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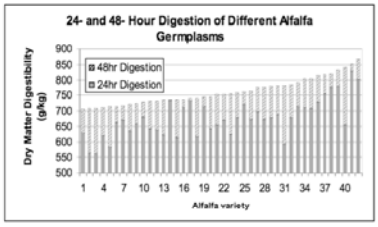
But Genetic Differences Exist!



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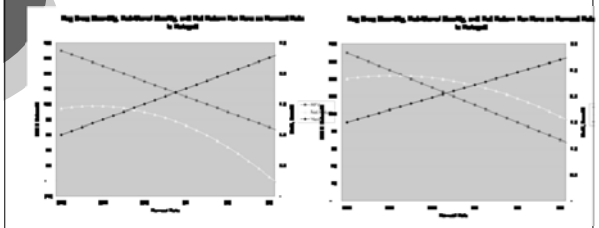
Effect of Quality Premium on Profitability



$0.80 per unit RFV

$0.65 per unit RFV

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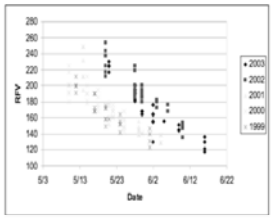
Growing Environment

What is the right maturity stage to cut alfalfa?



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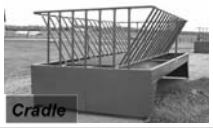
Measure from soil surface.

Measure to top of stem tip, not tip of highest leaflet.

Estimates are made at 4 to 5 locations in a field.

The tallest stem may not be the most advanced in maturity.

Feeder types



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Ring

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Cone

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Trailer

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Cradle

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Dry Matter Waste

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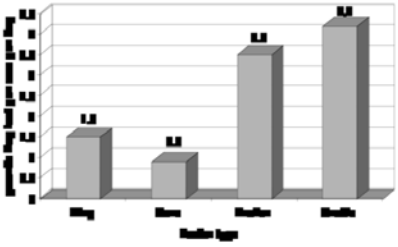
Effect of feeder-type on hay waste by beef cows



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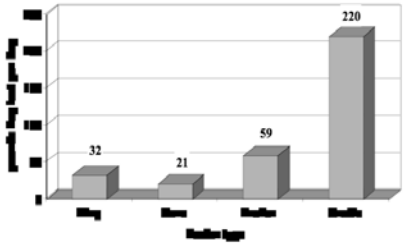
Effect of feeder-type on hay waste by beef cows



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Antagonism

- Boss cows pushed lower ranking cows away.
  - 15 to 30 times per hour from linear feeders

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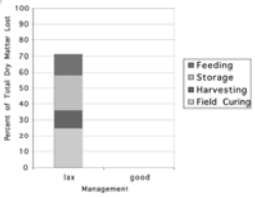
Typical Forage Harvesting Losses

29% Fed
71% Lost



Field curing -26%

Harvesting -14%

Storage -35%

Feeding -30%

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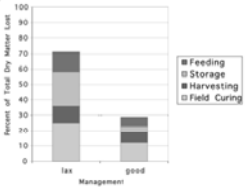
Optimum Management

71% Fed
29% Lost



Field curing -12%

Harvesting -8%

Storage -5%

Feeding -8%

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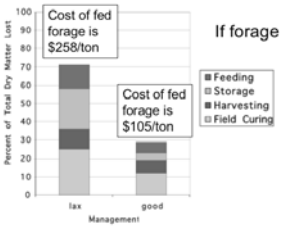
Reducing the cost of a ton of forage



If forage costs $75 / ton to produce

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"Waste is worse than loss. The time is coming when every person who lays claim to ability will keep the question of waste before him constantly."

-Thomas Edison

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PENNSTATE

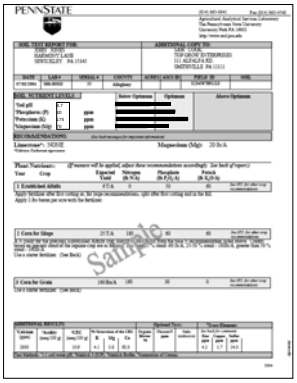
Strategies for Dealing with Higher Fertilizer Prices

Douglas Beegle
Department of Crop and Soil Science
Penn State University
(814) 863-1016, dbb@psu.edu

PENN STATE CMEG Crop Management Extension Group

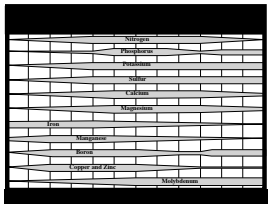
Soil Testing

- Make sure you have balanced fertility to get the most out of what nutrients you apply
  - Maintain Optimum
    - pH
    - P
    - K
    - Mg
- Don't waste money on nutrients you don't need
- www.aasl.psu.edu



Soil Acidity

- Low soil pH often limits efficient use of other nutrients and pesticides



•Limed No-till

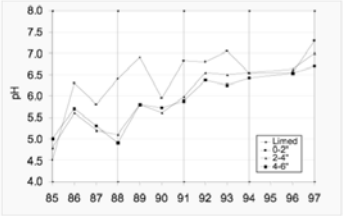
•Unlimed No-till

Adjust for Lime Quality

- Soil test for pH and lime requirement
- Know the quality of your limestone
  - CCE
    - Greater or less than 100% adjust rate
  - Fineness
    - 95% through 20 mesh
    - 60% through 60 mesh
    - 50 % through 100 mesh
  - Compare prices based on quality
- Plan and spread ahead to give it time to work
- Watch soil conditions when spreading lime

Regular Liming

- Lime regularly to maintain optimum pH
  - Especially critical with reduced tillage and long term perennial forage crops



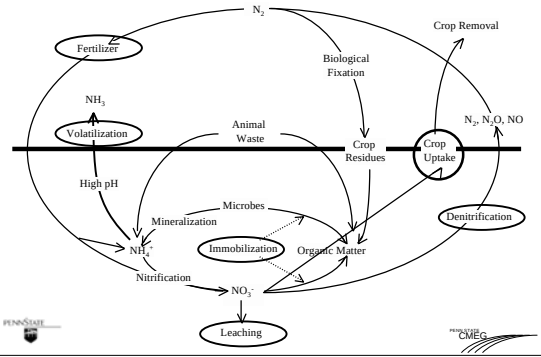
Starter Fertilizer

- Starter recommended on lower testing soils
  - Analysis not critical: NH_4-N + P
    - MAP & APP – Excellent
    - Be careful with DAP and Urea in starter
  - Small amount
    - Assuming nutrient needs of crop being met
    - High analysis with low rate often more economical
  - Placed close to the seed - Within 2"
    - Pop-up – watch rate and materials

Starter Fertilizer

- Starter not as important on high P soils
  - The higher the soil P the less likely the response
    - Recent Research: 2-4 bu/A, ~20% of the time
    - Often see early growth response that does not result in a yield response
  - Probably don't need it except under very adverse conditions
    - Cold, wet, soils
    - Forget it for late planting on warm soils
  - Ammonium sulfate alone will give good response on high P soils
    - Doesn't add excess P
    - You need the N anyway
  - Low rate of popup also works

Nitrogen Cycle

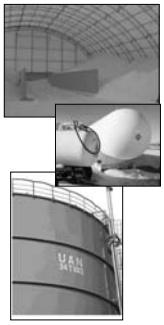


Economic Optimum N Rate vs N and Crop Price

- Fertilizer N recommendations are a guessing game to begin with
- Recommendations usually contain an economic component
  - Example: PSU Corn Recommendations are based on 10:1 Corn price to N price ratio
  - If prices vary significantly from this, recommendations can be adjusted
    - Right now the ratio is around 7:1
    - ~5% reduction could be justified
- Recommendations generally have a safety buffer built in
  - Don't exceed recommended rates
- Carefully evaluate N needs under current economic conditions
  - Don't short change the crop
  - Don't apply more N than necessary
- **THINK: EFFICIENT USE OF N**

Fertilizer Nitrogen

- Fertilizer Materials
  - Urea (46-0-0) - Volatile
  - UAN (30-0-0) - Volatile
  - Ammonium Nitrate (33-0-0)
  - Ammonium Sulfate (21-0-0-24S)
  - Anhydrous Ammonia (82-0-0) - Gas
  - MAP (11-52-0)
  - DAP (18-46-0)

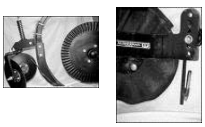


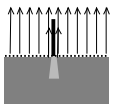
Managing Nitrogen

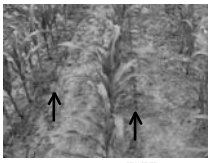
- Application Methods
  - Incorporation
    - Incorporate urea containing sources including manure as soon as possible to reduce volatilization losses
      - 30% loss possible within 1 week
      - ~$35 worth of N
      - Most of the loss is in the first 48 hours
    - Tillage, ½ in. soaking rain
      - Timing is critical
      - Coordinate fertilizer/manure application and tillage
    - No-till vs tillage – N economics
      - At current prices tilling to incorporate manure will net about $10
      - BUT . . . Consider the value of the other benefits of no-till

Managing Nitrogen

- Application Methods
  - Injection
    - Economics should be positive
    - Less soil disturbance – no-till
  - Banding
    - Surface banding usually reduces volatilization significantly compared to broadcasting
      - Surface dribbling, almost as good as injection







Urease Inhibitors

- Reduces volatilization losses from *unincorporated urea N*
  - Buys time for incorporation or rainfall
  - Usually 10 to 14 days
  - Depends on rate
- Can be used with Urea and UAN
- No benefit if immediately incorporated
- Less benefit if early in cold, wetter conditions
- Less benefit if dribbled UAN
- Don't confuse with nitrification inhibitors
  - N Serve
  - DCD

Urease Inhibitors

- NBPT (Agrotain)
  - Pennsylvania Research
    - Urea broadcast at planting for corn compared to:
      - Urea w/ NBPT + 14 bu/A
      - Ammonium Nitrate + 15 bu/A
    - UAN sprayed at planting for corn compared to:
      - UAN w/ NBPT + 7 bu/A
      - Ammonium Nitrate +10 bu/A

•Fox, PSU

Fertilizer Additives

- Urease inhibitors, nitrification inhibitors, and controlled release N fertilizers are legitimate products for managing N behavior
- However. . . If the conditions are not there for losses to occur, these products may work perfectly but show no practical benefit
- Consider the probability that conditions for a benefit will occur
- Consider the expected magnitude of the benefit
- Consider the cost of the product and alternative management

Fertilizer Additives

- Evaluating Product Benefit Over Time

Product Response	5 bu/A	10 bu/A	5 bu/A	10 bu/A
Corn Price	$4.00/bu		$2.00/bu	
Profit when responds ($10/A/yr	+$10	+$30	$0	+$10
Years Benefit Expected	5 Year Profit/Loss ($/A)			
1	-$30	-$10	-$40	-$30
2	-$10	+$30	-$30	-$10
3	+$10	+$70	-$20	+$10
4	+$30	+$110	-$10	+$30
5	+$50	+$150	$0	+$50

Fertilizer Additives

- ESN Yield Response Summary
  - Controlled Release N

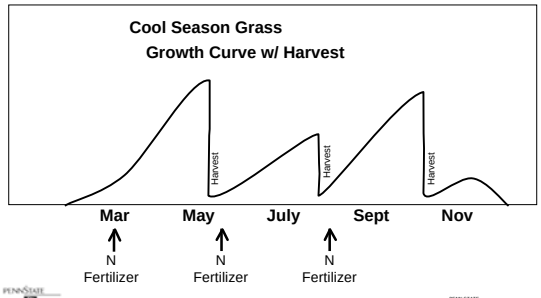
Corn yield difference of (bu/acre)	<-5	-5 to 0	0 to 5	>5 bu/ac	>10	All comparisons
Comparisons in group	17	37	31	101	69	186
Percentage of total comparisons	9.1	19.9	16.7	54.3	37.1	100.0
Group average yield increase (bu/acre)	-10.5	-2.0	2.9	16.6	20.6	8.1

•Agrium

Managing Nitrogen

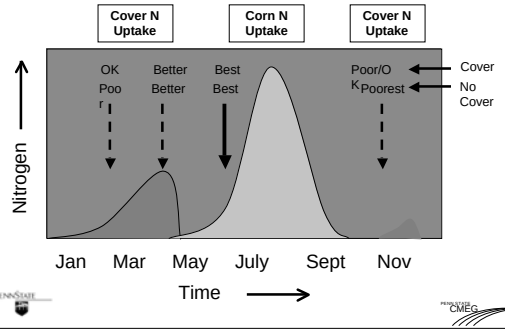
- Application Timing :
  - N Behavior is very dynamic
    - Once applied many things can happen to the N – most of them are negative
  - Apply as near to time of crop need as possible
  - Avoid periods of high potential loss

Nitrogen Timing on Grass Hay



Timing of N Application

As near to crop use as practical



Managing Nitrogen Timing

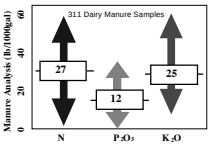
- Examples of improved N timing:
  - Topdress N on wheat and barley in the spring
  - Split N between cuttings on grass hay or pasture
  - Manure as close to planting as possible
    - Crop or Cover Crop
  - Sidedress corn in June
- Corn Sidedressing
  - Splits – Depends on history
    - No Manure or legume history
      - 30 to 50% of N at planting, balance sidedressed
      - Adjust based on conditions
    - Manure or legume history
      - Starter N
      - Most at sidedressing
      - Adjust based on conditions
      - Use PSNT or Chlorophyll Meter

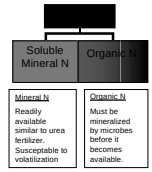
Manure Nitrogen

Animal	N	P_2O_5	K_2O	
Dairy (S)	10	4	8	lb/ton
Dairy (L)	28	13	25	lb/1000 gal
Beef (S)	11	7	10	lb/ton
Swine (L)	50	55	25	lb/1000 gal
Layer (S)	37	55	31	lb/ton
Broiler (S)	66	63	47	lb/ton

Manure Nitrogen

- Manure Analysis
  - Manures, biosolids, composts, etc.
    - Moisture
    - Total N
    - Ammonium N
    - Total P_2O_5
    - Total K_2O
- Manure nutrient availability
  - N depends on handling
    - Timing & Incorporation
    - Cover crops
  - P and K similar to fertilizer
  - Availability is the key to nitrogen value of manure
  - Fertilizer replacement is key to P and K value of manure





Manure Nitrogen Availability

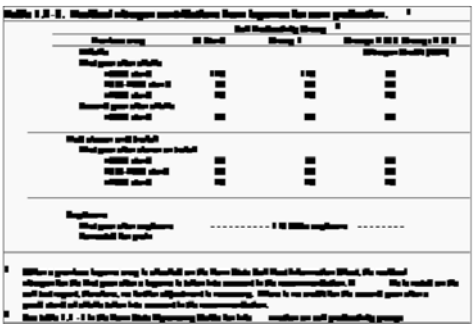
Manure N Availability Based on Total N (PSU Agronomy Guide Table 1.2-14)

Planned Manure Application Season	Target Crop Utilization	Planned Manure Application Management	Nitrogen Availability Factor		
			Poultry Manure	Swine Manure	Other Manure
Spring	Spring utilization by grass hay and small grains Summer utilization by corn, other summer annuals and grass hay	Incorporation the same day Incorporation within 1 day Incorporation within 2-4 days Incorporation within 5-7 days Incorporation after 7 days or no incorporation	0.75 0.50 0.45 0.30 0.15	0.70 0.60 0.40 0.30 0.20	0.50 0.40 0.35 0.30 0.20
Summer	Summer utilization by grass hay Fall utilization by grass hay and small grains				
Early Fall	Fall and spring utilization by grass hay and small grains	Incorporation within 2 days Incorporation within 3-7 days Incorporation after 7 days or no incorporation	0.50 0.30 0.15	0.45 0.30 0.20	0.40 0.30 0.20
Late Fall or Winter	Spring utilization by small grains and grass hay	All situations	0.50	0.45	0.40
	Summer utilization by corn or other summer annuals	No cover crop Cover crop harvested for silage Cover crop used as green manure	0.15 0.15 0.50	0.20 0.20 0.45	0.20 0.20 0.40

Legume N

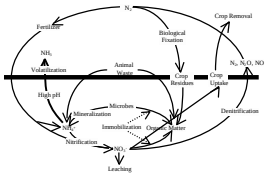
- Properly inoculated legumes meet their N requirement by fixing atmospheric N.
- Significant N remains in residue from legume when crops are rotated.

Residual Legume N



Real World N Management It's Tough!

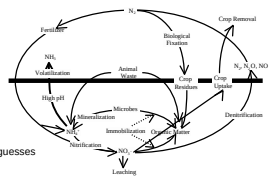
- Very complex
- Very leaky
- Dependent on weather
- We understand N behavior but it is very difficult to predict usefully



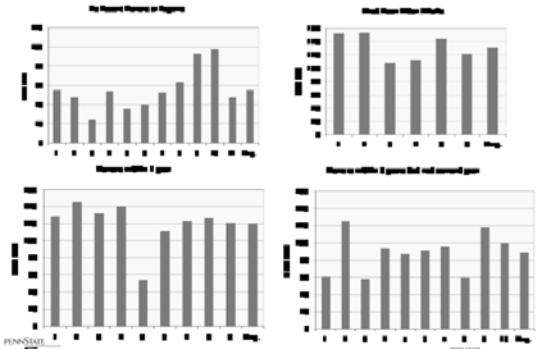
"Predictions are difficult , especially about the future" Yogi

Real World N Management It's Tough!

- Recommendations
  - Crude, but hopefully educated guesses
  - Get us started in the ballpark
- Adjustments
  - Rough estimates
    - Soils
    - Manure
    - Legumes
  - Refine our guesses
- Management
  - Source, method and timing of application
  - Take a stab at implementation based on our guesses
- Experience
  - N Management is a series of successive approximations
  - Probably always chasing our tail
- **We really have to continually work at N management**



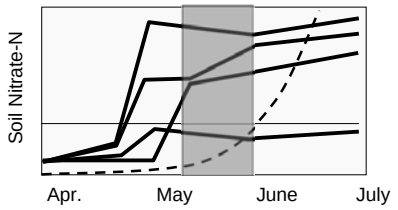
N Supplying Capability - Manure & Legumes



Tools for Adjusting N Management

- In-season Pre-sidedress Tests for Corn
  - Pre-sidedress Soil Nitrate Test for Corn (PSNT)
  - Chlorophyll Meter Test
- <u>In-season</u> tests ~12" tall corn
- Improved recommendations in manured systems
- Eliminates insurance N
- Requires sidedressing N

In-season N Testing



Control
Prev. Alfalfa
Manure
Fertilizer
N Uptake by Corn

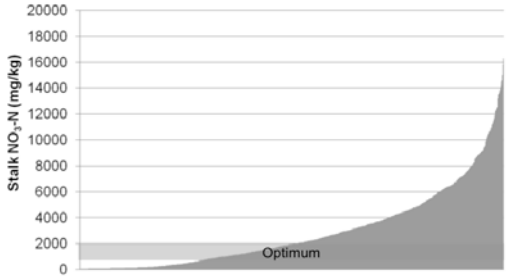
Tools for Adjusting N Management

- In-season Pre-sidedress Tests for Corn
  - Pre-sidedress Soil Nitrate Test for Corn (PSNT)
  - Chlorophyll Meter Test
- In-season tests ~12" tall corn
- Improved recommendations in manured systems
- Eliminates insurance N
- Requires sidedressing N

Tools for Adjusting N Management

- Late Season Stalk Nitrate Test
  - Excellent postmortem assessment of N management
  - Procedure
    - Sample between ¼ milkline and 3 weeks after black layer
    - 8" piece of stalk 6" above the ground
    - Cut into little pieces, dry and send to the lab
    - Optimum 700-2000 ppm NO_3-N

PA Stalk Nitrate Summary 2000-05 (n=1692)

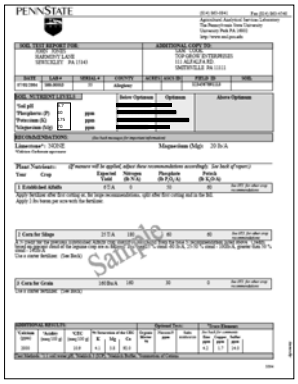


Adjusting N Management

- In-season adjustments with PSNT or Chlorophyll meter
- End of season assessment with late season stalk nitrate test
- Sample representative fields
  - Productivity
  - Rotation
  - Manure history
  - etc.
- Keep good records
- Analyze trends over years

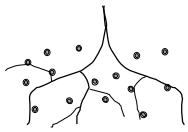
Managing Phosphorus & Potassium

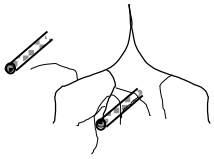
- Soil Test
  - Make sure you have balanced fertility to get the most out of what nutrients you apply
  - Don't waste money on nutrients you don't need
  - www.aasl.psu.edu



P & K Application

- Phosphorus Fertilizer
  - Triple Superphosphate (0-46-0)
  - DAP: 18-46-0
  - MAP: 11-52-0
  - APP: 10-34-0 (Fluid)
- Potassium Fertilizer
  - Muriate of Potash - KCl (0-0-60)
- Broadcast
  - build up on low testing soils
  - maintenance on higher testing soils
- Banding
  - low testing soils
  - less than recommended application rates
- Starter P & K on low testing soils
- K less sensitive to placement than P





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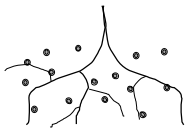
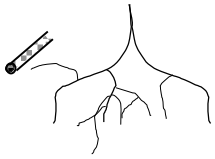


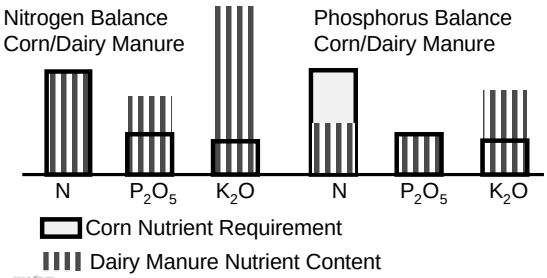


Manure Phosphorus and Potassium

- Availability similar to fertilizer
  - Substitute pound for pound
- No substitute for starter
- Not leached
- Not volatized
- Accumulates in soil
- Lost by erosion

Animal	N	P_2O_5	K_2O	
Dairy (S)	10	4	8	lb/ton
Dairy (L)	28	13	25	lb/1000 gal
Beef (S)	11	7	10	lb/ton
Swine (L)	50	55	25	lb/1000 gal
Layer (S)	37	55	31	lb/ton
Broiler (S)	66	63	47	lb/ton

Nutrient Balance
Corn/Dairy Manure



Summary

- Soil Test
- Lime
- Evaluate starter fertilizer program
- Account for all sources of nutrients
- Manage manure for maximum nutrient utilization
- Incorporate or dribble urea or UAN or use a urease inhibitor
- Time N application as close to crop uptake as practical
- Use in-season tests to adjust N management
- P & K Soil test

Recent Research on the use of Copper Sulfate in Dairy Production Practices
Sally A. Flis

In 2002 the United States Department of Agriculture (**USDA**), Animal and Plant Health Inspection Service reported that 53.9% of lameness cases in mature cows and 61.8% of lameness cases in bred heifers were due to papillomatous digital dermatitis (**PDD**) or hairy heel warts. The treatment and prevention of PDD in dairy herds in the United States increases production costs due to decreased milk production, impaired reproductive performance, decreased cow longevity, and the cost of treatment and control methods (Shearer and Hernandez, 2000; Ishler et al., 2001; Cook, 2006). Economic loss will vary depending on the severity of the case, but is generally associated with a minimum cost of $90 to 100 per case (Ishler et al., 2001). In some cases, severe lameness leads to culling, Brown et al. (2000) reported that 29% of dairy cows examined after slaughter had PDD lesions. Culling of animals due to a preventable and treatable hoof disease will result in lower farm productivity and profitability.

A recent article presented 21 available compounds or commercial products that could be used in footbaths for the prevention of PDD (Cook, 2006). Producers have tried many products in footbaths rather than individual hoof topical treatments to reduce cost and increase the efficiency of control. Flis et al. (2006) reported that 14 out of 17 farms surveyed in Northeastern NY and Northwestern VT in 2005 were using $CuSO_4$ footbaths for the prevention and control of PDD. Further, it is assumed that the waste from footbaths is deposited into manure storage systems after use. In the case of $CuSO_4$ footbaths, research has reported manure Cu concentrations for 20 farms in NY and found that the concentrations of Cu in the manures evaluated were above that which could be explained by poor absorption of excess Cu in the ration (McBride and Spires, 2001).

Recently research has been conducted to determine footbath product use practices on dairy farms in NY and VT, effects of excess Cu disposed of to manure storage on bacterial populations and mineral concentrations, effects of the application of dairy manure high in Cu on the growth and yields of cool season forage grasses and corn, and the fractionation of excess Cu applied to soil from dairy manure high in Cu.

Footbath Survey Results

Significantly more farms responded to a survey conducted in northeaster NY and Northwestern VT, that they used some type of footbath than did not (71 versus 27 farms, respectively $P < 0.001$). In Northeastern NY, 37 farms reported using some type of footbath and 12 reported not using a footbath. This was very similar to the farms that returned surveys from Northwestern VT, with 34 farms using a footbath and 15 not using a footbath. Farms reporting the use of a footbath had significantly more lactating cows and tillable hectares than those that did not. All farms classified as large (>700 cows) reported using a footbath.

The top four products that were reported used in footbaths in the survey were $CuSO_4$, formaldehyde, tetracycline, and $ZnSO_4$. Overall, $CuSO_4$ was the most frequently reported product used in footbaths. The reported use rates of the products in footbaths were not as variable as expected. The average concentration of $CuSO_4$ reported used in footbaths was 5.0 ±

0.4%, which is a recommended concentration in recent publications (Cook, 2006). Producers that reported the use of $CuSO_4$, formaldehyde, tetracycline, and $ZnSO_4$ disposed of footbath waste to manure handling systems 98.4% of the time. More research is needed to better understand the control of PDD with these products, the effects of disposal of these products on manure storage, actual application rates of products, and effects on crops and soils due to the field application of these products.

Excess Cu and Manure Storage

Research conducted on the effects of high Cu concentration on the function of manure storage examined Cu concentrations of 0, 1, 2, and 3 lbs/1000 gal manure. Results of mineral analysis found significantly more Fe in the 1 and 2 lbs/1000 gal manure treatments than in the 0 and 3 lbs/1000 gal manure treatments. While the values were statistically different, this was a small numerical difference, likely making the difference not biologically significant in the mini-pits or field application. There were no other significant effects of Cu treatment level on the dry matter, ash, or mineral concentration of the samples. The treatment levels that were imposed in this project had no significant effect on the total bacterial populations, the mineral concentrations, or dry matter, density and ash of the manure. Further research is needed to determine if the addition of these products is changing the profile of the bacterial populations and what function of Fe is in manure storage. Recent results form an agricultural testing laboratory showed very high concentrations of Cu, indicating that the testing of higher manure concentrations.

Cool Season forage Grasses

In research conducted with timothy and orchardgrass in a sandy loam soil it was found that, tillering rate and re-growth rate both decreased as copper application level increased in timothy. In the timothy and orchardgrass dry root weight decreased as Cu application level increased. These effects may result in a decrease in the longevity of the stand and an overall decrease in yield, especially for timothy stands. The Cu concentration of the shoots increased slightly as the Cu application rate increased in. However, the Cu concentration of the shoots was with in the expected range of 0 to 20 mg/kg. There was only a numerical increase in the Cu concentration in the roots with increased Cu application. Overall, the Cu concentration in the shoots was lower than in the roots, 33.2 vs. 66.6 ppm, respectively.

Corn and Soil Cu Fractionation

Research conducted with 2 cumulative application of Cu at 0, 9, and 18 lbs/acre from dairy manure found that there is no effect on the growth or yield of corn grown for silage. The application of excess Cu from dairy manure also had no effect on the forage quality or mineral concentration of the corn tissue. These findings are similar to research conducted with Cu-enriched swine manure. The measure of available Cu by the Modified Morgan's extraction in the soil was only increased with a second application of high-Cu dairy manure; the extraction of Cu by $CaCl_2$ was not effected by application of high-Cu dairy manure in this research. Further application of high-Cu dairy manure may result in increases in this fraction of Cu in the soil and lead to increased Cu concentration in corn tissue or possible negative effects on corn. More

research is needed to determine common cumulative Cu applications from high-Cu dairy manure on field and the effects on soil fractions of Cu and plant Cu concentration.

Conclusions and Future Research

Recent research has found that despite increasing costs $CuSO_4$ is still the most frequently reported product used in dairy footbaths and that 98% of the time the waste from these footbaths is disposed of to manure storage. Research has shown no change in mineral composition or total bacterial count in the manure when excess Cu is added. When high Cu manure is applied to grasses, especially timothy, there is a potential for a decrease in the productivity of the stand. Two years of high Cu dairy manure application does not effect the growth, yield, and composition of corn for silage. Interpretation of soil tests needs to be done with an understanding of the test that was used. Analysis for total Cu, by acid digestion, is the only way to determine the loading rate of Cu applications.

Continued research is needed to determine the best rates and products to use in dairy footbaths, the cycling of nutrients in manure storage, the species present in manure storage after the addition of excess Cu, and the long term effects of dairy manure high in Cu to grass species.

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2007 CORN SILAGE HYBRID MATURITY DATE PERFORMANCE TRIALS

In 2007, the University of Vermont Extension conducted an experiment to evaluate yield and quality of a range of short and long season corn hybrids. It is important to remember that the data presented are from a single test at only one location. Hybrid-performance data from additional tests in different locations and often over several years should be compared before you make conclusions.

TESTING PROCEDURE

In 2007, the corn hybrid maturity trial was conducted in Alburgh, Vermont. There were two replications of each variety. The seedbed at the location was prepared by conventional tillage methods. Fertilizer and herbicides were applied. Plots were planted with a four row corn planter. Plots were planted the length of the field and averaged 200 feet in length. The four row plots were harvested with a two row corn chopper. Yield was measured by weighing wagons on drive-up platform scales. A subsample of corn was taken and analyzed for forage quality Plot samples were dried, ground and analyzed for crude protein (CP), neutral detergent fiber (NDF), 30h *in vitro* digestibility (IVD), and 30h digestible NDF (dNDF).

PRESENTATION OF DATA

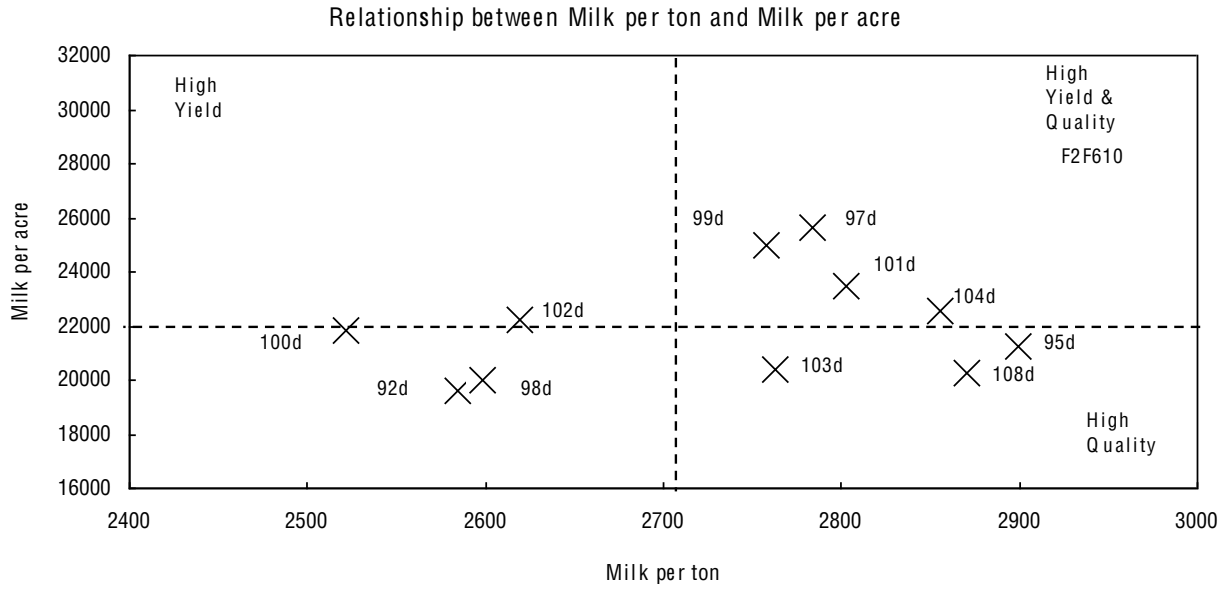
The results are reported as an average of the two replications. There were two replication of each hybrid at one location. The data are reported in Table 10. Dry matter yields were calculated and than adjusted to 35% dry matter for the report. There is also a figure displaying the relationship between milk per ton and milk per acre. The dotted lines dividing the figure into four quadrats represent the mean milk per ton and acre for the location. Therefore hybrids that fall above the lines performed higher than the average and hybrids below the lines performed below average. Lastly, a table has been included to report yields. Hybrids with the same letter were not statistically different in yield. A LSD value is presented for each variable (i.e. yield) comparing if hybrids with different relative maturities differed from each other in yield and quality. Least Significant differences (LSD's) at the 10% level of probability are shown. If there is no significant difference (NS) this means that these hybrids did not differ from one another.

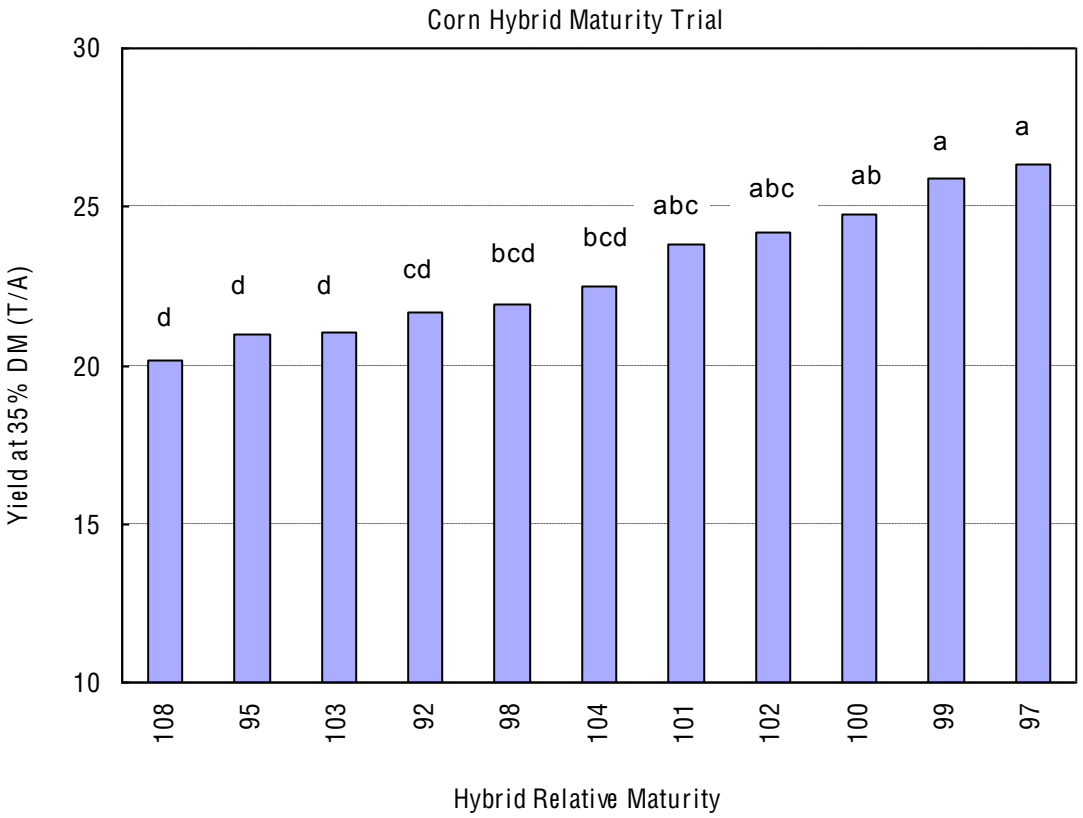
Table 9. Hybrids evaluated in maturity trial

Company	Variety	
	Hybrid	RM
Dekalb	DKC45-82	92
Dekalb	DKC48-46	95
Dekalb	DKC50-44	97
Pioneer	38B86	98
Dekalb	DKC52-59	99
Dekalb	DKC53-18	100
Dekalb	DKC54-46	101
Dekalb	DKC55-12	102
Pioneer	36W65	103
Dekalb	DKC57-79	104
Dekalb	DKC61-69	108

Table 10. Corn hybrid maturity trial.

Hybrid	Relative maturity	Yield 35 % DM T/A	Forage Quality Characteristics CP %	NDF %	IVD %	dNDF %	Nel %	Milk per ton	Milk per acre
DKC45-82	92	21.6	6.15	44.8	75.0	44.0	0.64	2585	19576
DKC48-46	95	20.9	6.30	36.8*	81.5	49.5	0.70*	2899*	21269
DKC50-44	97	26.3*	5.95	44.2	78.5	51.0	0.66	2784*	25642*
38B86	98	21.9	6.00	45.9	75.0	46.0	0.63	2598	19982
DKC52-59	99	25.9*	6.45	42.2	78.5	49.5	0.67*	2758*	24994*
DKC53-18	100	24.7*	6.05	47.0	74.0	45.0	0.62	2522	21869
DKC54-46	101	23.8*	7.60	42.4	79.0	50.0	0.67	2803*	23479*
DKC55-12	102	24.2*	6.25	45.3	75.0	45.0	0.64	2619	22211
36W65	103	21.0	7.00	39.6*	79.0	47.5	0.68*	2763*	20365
DKC57-79	104	22.5	7.05	39.4*	80.0	48.0	0.69*	2856*	22545*
DKC61-69	108	20.1	6.95	40.1*	79.5	49.0	0.69*	2871*	20247
Trial Mean		23.0	6.52	42.5	77.7	47.7	0.66	2732	22016
LSD (0.10)**		2.7	NS	4.8	NS	NS	0.02	151	3198




Corn Hybrid Maturity Trial
Yield at 35% DM (T/A)
30
25
20
15
10
d
d
d
cd
bcd
bcd
abc
abc
ab
a
a
108
95
103
92
98
104
101
102
100
99
97
Hybrid Relative Maturity

2007 CORN HYBRID SPECIALTY TRAITS PERFORMANCE TRIALS

In 2007, the University of Vermont Extension conducted an experiment to evaluate yield and quality of corn hybrids with and without specialty traits. It is important to remember that the data presented are from a single test at only two locations. Hybrid-performance data from additional tests in different locations and over several years should be compared before you make conclusions.

TESTING PROCEDURE

In 2007, the corn hybrid specialty traits trials were conducted at two locations in Northwest Vermont. Each site had been in corn production for greater than 4 years. The seedbed at each location was prepared by conventional tillage methods. Fertilizer and herbicides were applied. Plots were planted with a six row corn planter. Plots were planted the length of the field and averaged 350 feet in length. The six row plots were harvested with a self propelled corn chopper. Yield was measured by weighing wagons on drive-up platform scales. A subsample of corn was taken and analyzed for forage quality Plot samples were dried, ground and analyzed for crude protein (CP), neutral detergent fiber (NDF), 30h *in vitro* digestibility (IVD), and 30h digestible NDF (dNDF).

PRESENTATION OF DATA

The results are reported as an average of the two locations. There was one replication of each hybrid at each location. The data are reported in Tables 12 and 13. Dry matter yields were calculated and than adjusted to 35% dry matter for the report. In Table 12, the specialty trait hybrid is compared statistically to its conventional counterpart. In Table 13, all specialty trait hybrids are compared to all of the conventional hybrids. This is basically a trial summary. A LSD value is presented for each variable (i.e. yield) comparing if specialty traits hybrids differed from their conventional counterpart. Least Significant differences (LSD's) at the 10% level of probability are shown. If there is no significant difference (NS) this means that these hybrids did not differ from one another.

Table 11. Hybrids evaluated in specialty traits trial

Company	Variety		
	Hybrid	RM	Traits*
Pioneer	33D11	108	None
Pioneer	33D14	110	HXX, LL, RR2
Pioneer	34A85	108	RR2
Pioneer	34A89	107	HXX, LL, RR2
Pioneer	38B85	96	None
Pioneer	38B87	97	HXX, LL, RR2
Pioneer	38H67	98	None
Pioneer	38H72	99	HXX, LL, RR2

* HXX – The HerculexXTRA insect protection trait offers a high level of resistance to European corn borer and fall armyworm. It also offers good resistance to black cutworm and western bean cutworm, and moderate resistance to corn earworm. Lastly it provides protection against Northern and Western corn rootworm.
LL – LIBERTY LINK CORN is tolerant to broadcast applications of Liberty herbicide, glufosinate ammonium. The gene that gives resistance to glufosinate came from a naturally occurring soil bacterium, *Streptomycin hygroscopicus*. Glufosinate is a fast acting, post-emergent, foliar applied, non-selective contact herbicide that controls a broad spectrum of weeds.
RR2 – ROUND-UP READY CORN is resistant to the herbicide glyphosate, a post-emergent, foliar applied, non-selective herbicide that controls a broad spectrum of weeds.

RESULTS

Table 12. Specialty trait hybrids compared to their conventional counterpart.

Hybrid	Specialty traits	DM at harvest %	Yield 35 % DM T/A	Forage Quality Characteristics CP %	NDF %	IVD %	dNDF %	Milk per ton	Milk per acre
33D11	None	32.4	31.9	8.71	41.1	73.6	48.3	2902	31895
33D14	HXX, LL, RR2	29.8	29.4	8.38	38.4	79.5	54.4	3311	34809
	LSD (0.10)	1.6	NS	NS	NS	NS	NS	NS	NS
34A85	RR2	31.8	31.2	7.66	39.8	76.6	50.7	3238	35098
34A89	HXX, LL, RR2	32.2	33.2	8.43	44.8	71.2	46.6	2844	32914
	LSD (0.10)	NS	NS	NS	NS	NS	NS	NS	NS
35A30	None	32.0	30.8	8.47	40.5	82.3	63.2	3394	36519
35A34	HXX, LL, RR2	31.9	29.8	8.30	42.6	76.5	52.7	3154	33351
	LSD (0.10)	NS	NS	NS	NS	NS	6.7	NS	NS
38B85	None	35.8	27.0	8.50	39.8	77.4	49.5	3217	28552
38B87	HXX, LL, RR2	37.1	30.9	8.92	38.8	77.1	52.0	3180	31554
	LSD (0.10)	NS	NS	NS	NS	NS	NS	NS	NS
38H67	None	36.9	29.1	8.79	40.7	77.5	54.7	3184	29394
38H72	HXX, LL, RR2	35.6	30.6	8.35	43.8	71.6	45.3	2863	28795
	LSD (0.10)**	NS	NS	NS	NS	NS	6.7	NS	NS

** See text for further explanation.
NS - None of the hybrids were significantly different from one another.

Table 13. Trial means comparing hybrids with and without specialty traits.

Specialty traits	DM at harvest %	Yield 35 % DM T/A	Forage Quality Characteristics CP %	NDF %	IVD %	dNDF %	Milk per ton	Milk per acre
None	33.8	30.0	8.42	40.4	77.5	53.3	3187	32292
HXX, LL, RR2	33.3	30.8	8.47	41.7	75.2	50.2	3070	32285
LSD (0.10)**	NS	NS	NS	NS	NS	NS	NS	NS

** See text for further explanation.
NS - None of the hybrids were significantly different from one another.

UVM Extension would like to thank the Gosliga, Brouillette, Quintin, Pouliot, and Rainville families for their generous help with the trials and Karen Hills, Amanda Gervais, and Alison Palmer for assisting with planting, harvesting, and data entry.

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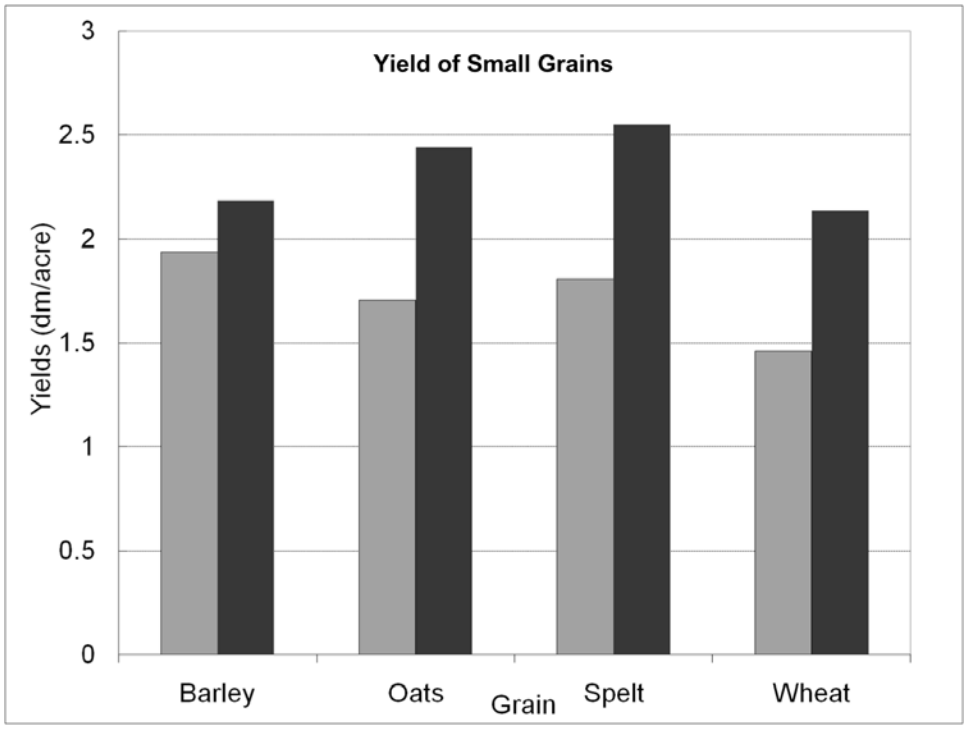
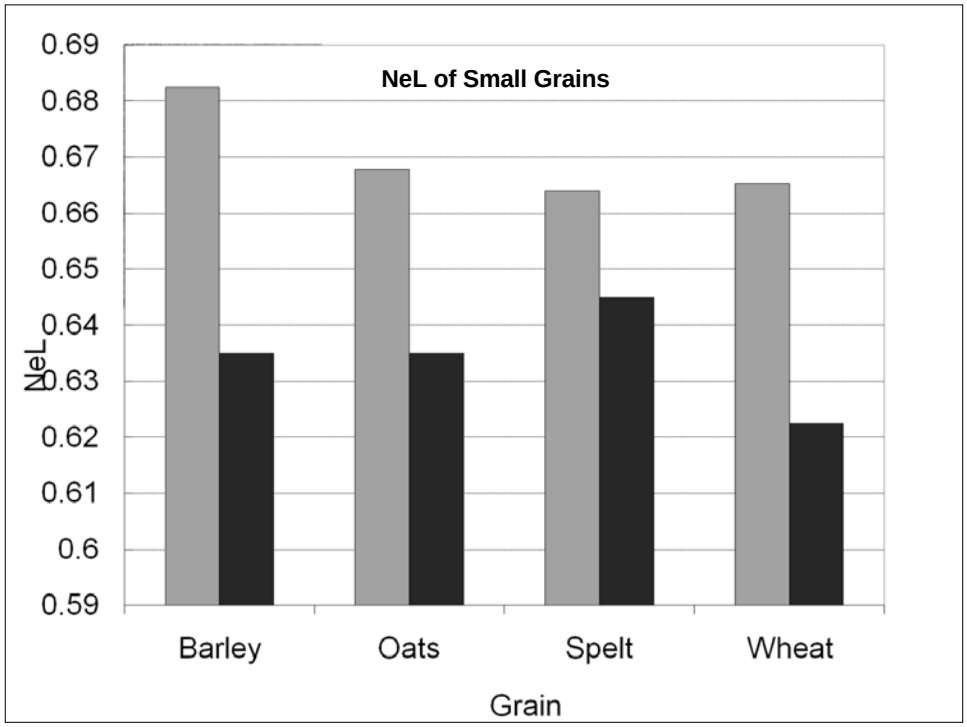
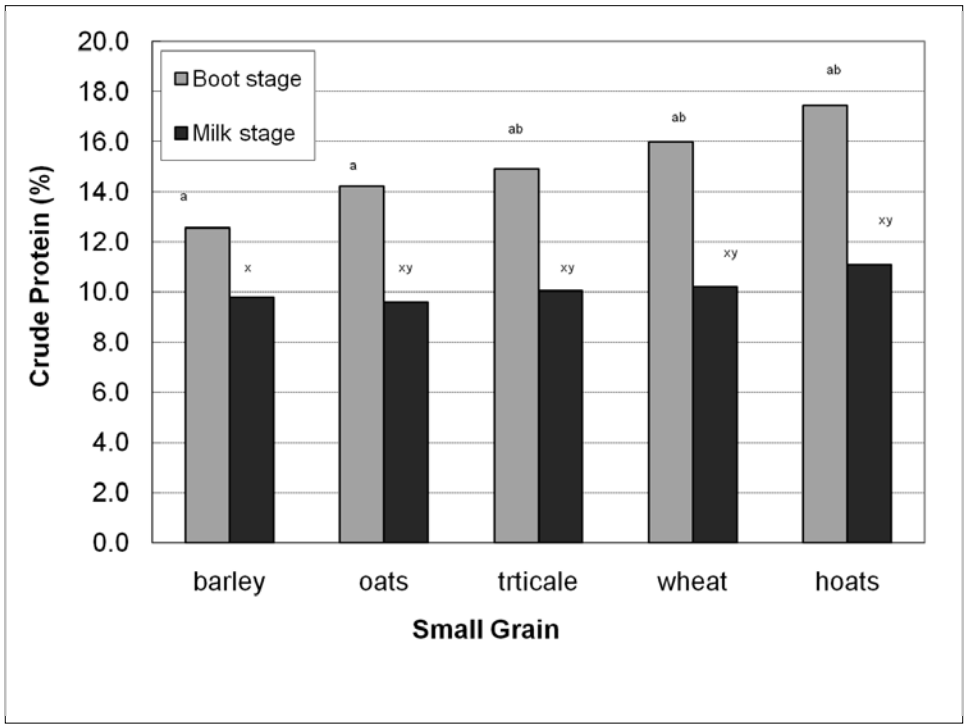
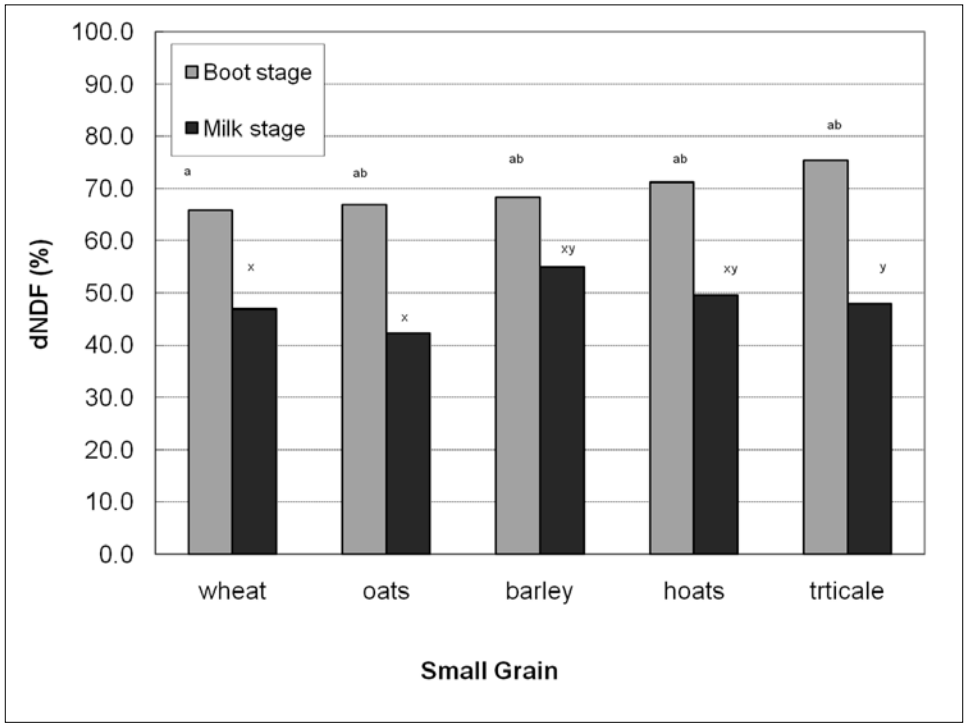

Yield of Small Grains
Yields (dm/acre)
3
2.5
2
1.5
1
0.5
0
Barley
Oats
Spelt
Wheat
Grain


NeL of Small Grains
NeL
0.69
0.68
0.67
0.66
0.65
0.64
0.63
0.62
0.61
0.6
0.59
Barley
Oats
Spelt
Wheat
Grain


Boot stage
Milk stage
Crude Protein (%)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
a
x
a
xy
ab
xy
ab
xy
ab
xy
barley
oats
trticale
wheat
hoats
Small Grain


Boot stage
Milk stage
dNDF (%)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
a
x
ab
x
ab
xy
ab
xy
ab
y
wheat
oats
barley
hoats
trticale
Small Grain