Cow Comfort at the New KBS Dairy

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On July 7, the milking herd of 95 Holstein cows at MSU’s Kellogg Biological Station moved into a new free stall barn, complete with two robotic milking systems to begin their new careers as self-milked cows. All cows were moved on the same day.

In order to gauge from the cows’ perspective about whether the new barn and robotic milkers agreed with them, we collected data on how well they adapted to being milked by the robots, what impact the new barn and milking systems had on hoof health and lameness in the herd, and how the new barn and free stall water bed mattresses affected how the cows spent each day.

Why is it important that the cows adapt to being milked by the robots? It is well known that stress during milking can inhibit milk let-down, which can reduce milk yield and could lead to health problems for the cow. In theory, there are several reasons a robotic milker could provide a low stress milking environment compared with a conventional milking parlor. A cow can choose when she wants to be milked, the cow doesn’t spend time waiting in a holding pen outside the parlor, there are no humans present, and the cow receives a grain reward while she is milked.

Adaptation to Robots
To examine in practice how well the cows adapted to being milked by the new Lely Astronaut A3 Milking Systems, our first study measured the number of times cows vocalized, defecated, urinated, stepped and kicked while in the robots. We began our observations starting with each cow’s first milking (day 0) by the robots and continued collecting data for one month (day 32). We also measured milk yield over the same time period.

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We suspected that the cows would adapt quickly to the robotic milkers, and that as they became more comfortable in their new milking environment, they would show fewer stress-related behaviors while being milked.

During their first robotic milking (day 0), the cows vocalized, eliminated, stepped and kicked frequently, suggesting that they did not initially like being in the robotic milker.

However, in less than 24 hr, stepping and kicking prior to teat attachment dropped and vocalization and elimination nearly disappeared. In both cases, the rapid reduction in stress-related behaviors could be attributed to the cows becoming more comfortable in the milker or because they began to focus on eating grain in the robot’s feeder.

Importantly, milk yield, which had dropped to an average of 35 lb/cow in the first 24 hr in the new barn, rebounded to nearly 70lb/cow per day. Reduced initial milk yield was likely due to cows not letting down, particularly during their first milking by the robots. During the first milking, the robot uses lasers to scan the udder and teats to learn the cow’s conformation. This process can take several minutes, which caused the first robotic milking to be longer than later milkings, a fact which may have contributed to the cow’s discomfort during her first milking by the robot.

Another indication that cows adapted quickly to the robotic milkers is the number of cows that milk themselves voluntarily versus the number that need to be fetched and milked. Within a week of introducing the cows to the robotic milkers, over 80% of the herd was milking voluntarily. After 2 wk, over 90% was milking voluntarily and after two months over 97% of the herd was milking voluntarily. In terms of labor, this means only 2-3 cows of the 95 in the herd must be fetched every 12 hr to be milked while the remainder of the herd goes through the robotic milkers voluntarily over twice a day.

Changes in Locomotion
In our second study, we examined changes in hoof health and locomotion scores of the milking herd during the transition from the old free stall dairy barn (with a 4.0% sloped concrete floor and free stalls -- 36 inch wide by 96 inch long -- with water beds and shavings) to the new free stall barn (with a level concrete floor and stalls -- 48 inch wide by 96 inch long -- with water beds and straw-bedded rubber mattresses).

Because automatic milking systems rely on cows voluntarily visiting the milking robots and lame cows are less active, lame cows can require more fetching by stock persons and milk less frequently than non-lame cows.

The end result is that lameness might cause greater economic losses in a robotic system than in a parlor system. We hypothesized that locomotion scores and hoof health would improve when cows moved to the new barn, due to improvements in cow comfort including: 1) potentially less time standing, especially during milking; 2) larger stalls with water beds; and, 3) level floors.

Hooves were examined in May and August by a hoof trimmer and the number and types of problems were recorded. Overall, the number of hoof problems observed increased during the study with the most prevalent problem in both barns being hairy heel warts (digital papillomatosis). Locomotion scoring was performed weekly by two trained observers using a numerical 1-5 rating system (1 = not lame, 5 = severely lame).

In the old barn, the average locomotion score of the herd was 2.1 with only a few cows scoring 4 or 5. After moving to the new barn, the average locomotion score of the herd increased to about 3.0 by mid August and more cows were observed with scores of 3 or 4 (see Figure 1). Before moving to the new barn, 74.1% of the herd was not lame (with locomotion scores of 1-2) and 25.9% of the herd was lame (with locomotion scores of 3-5).
However, at the end of the study 78.3% of the herd was lame. Contrary to our expectations, hoof health problems and locomotion scores increased in the new barn. These problems may resolve as the new flooring becomes smoothed by wear and the cows transition to pasture.

Cow Behavior
Locomotion scores and hoof health also may improve as the cows become more comfortable in the new barn and establish new routines related to milking and feeding. In our final study, (lasting 32 days) which compared cow behavior before and after move from the old to the new barns, we saw changes in behavior that suggested that the cows were not yet as comfortable in the new barn as they were in the old barn.

We had expected that cows would stand and perch more in the stalls in the old barn because the floor was quite sloped (4.0%) and the stalls were smaller and contained rubber mattresses bedded with straw rather than water beds and shavings as in the new barn. And in fact, we did see cows perching 2.5 times as often in the old barn than in the new barn. Unexpectedly, however; cows spent more time lying in stalls in the old barn and more time standing in the alleys and stalls in the new barn.

There are several possible explanations for this change in lying behavior, but the most likely is that our observations of cow behavior in the new barn were made 3 wk after the move, and it is possible that the cows were still adjusting to the new water beds, social groups, and routine of the new barn. However, ambient environmental temperature also could have been a contributing factor as the temperatures were in the mid-90s F. during observations in the old barn and in the mid-80s F. during observations in the new barn.

In summary, cows adapted quickly to changes in the milking system itself, but appear to be adapting more slowly to changes between the old and new barns. We intend to continue observing the KBS herd to see how long changes in behavior and hoof health and gait persist and what impact pasturing the cows will have on these factors and on the percent of animals voluntarily milking.
Maximizing Digestible Energy Intake of Corn Silage-based Diets: Part 2

Mike Allen
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Part 2 discusses maximizing energy intake of corn silage-based diets. Part 1 (published last July) focused on concentration, effectiveness, and digestibility of NDF in corn silage. This article focuses on ruminal starch digestibility and optimizing fermentability of diets.

Starch Digestibility

Digestibility of starch in corn silage is highly variable and affected by maturity at harvest, hybrid genetics, and by growing environment. Corn kernels harden as the corn plant matures and becomes drier. As the plant matures, sugar in kernels is converted to starch and moisture concentration decreases allowing the starch granules to become more tightly packed. The moisture concentration of whole plant corn forage must be reduced by drying in the field before ensiling to minimize effluent loss and inhibit growth of undesirable microorganisms in the silo.

However, in some situations, when corn forage is at the appropriate moisture concentration for harvesting, kernels become too dry and hard and more resistant to digestion. The dry matter (DM) concentration of corn kernels relative to that of the whole plant can vary by as much as 10 percentage units for corn forage harvested at 35% whole plant DM (Allen et al., 2003).

In addition, many corn hybrids have been developed for rapid rate of kernel drying while retaining moisture in the stover. Hybrids with this trait are called “stay-green” because the stalks and leaves stay green (moist) while the kernels dry down. While beneficial for grain hybrids, there is no proven benefit of the “stay-green” trait for silage hybrids and hybrids with a rapid rate of kernel drying likely have reduced starch digestibility.

The endosperm is about 83% of the dry weight of kernels and contains the starch granules (5-30 µm in diameter) embedded in a protein matrix. Kernel texture is affected by type of endosperm: floury or vitreous. Proportions of vitreous and floury endosperm vary among corn hybrids and maturity at harvest. Corn hybrids with kernels containing high proportions of vitreous (or horney) endosperm are glassy in appearance and are called corneous, or flinty and those containing high proportions of floury endosperm are chalky in appearance and are called floury, opaque, or soft (Kotarski et al., 1992).

Degradation of starch from corn by ruminal microbes is related negatively to the vitreous: floury endosperm ratio (Philippeau et al., 1999b; Philippeau et al., 2000) but not related to the amylose:amyllopectin ratio of starch (Philippeau et al., 1998). Resistance to degradation by ruminal microbes for starch in vitreous endosperm compared with floury endosperm is primarily because of the distribution of proteins in the endosperm; concentrations of zein proteins increase and glutelin proteins decrease with increasing vitreousness (Philippeau et al., 2000). The insoluble zein proteins limit accessibility to the starch granules to ruminal microbes compared with the soluble glutelin proteins (Philippeau et al., 2000).

Increasing maturity at harvest resulted in increased vitreousness and decreased in situ ruminal starch degradation for both flint and dent hybrids. Also, starch degradability by ruminal microbes was much greater for the dent hybrid compared with the flint hybrid at similar DM concentrations from ~ 30% to ~ 40% whole plant DM (Philippeau and Michalet-Doreau, 1997).

Grain from flint corn decreased ruminal starch digestibility compared with grain from dent corn (34.8% and 60.8%, respectively) when fed to steers in 67% grain diets, but did not affect total tract starch digest-
digestion in the intestines (Philippeau et al., 1999a). In a recent experiment with lactating cows, rate of ruminal starch digestion was faster and rate of ruminal starch passage tended to be slower in diets containing corn grain with floury versus vitreous endosperm, resulting in a mean increase for ruminal starch digestibility of 22 percentage units (Taylor and Allen, 2005).

Although compensatory postruminal starch digestion decreased differences among treatments for total tract starch digestibility, starch entering the duodenum was more digestible for grain with floury endosperm compared with vitreous grain, resulting in greater total tract starch digestibility for floury corn grain compared with vitreous corn grain.

Effects of fermentation during ensiling on solubility of endosperm proteins can increase degradation of starch by ruminal microbes. Stock et al. (1991) reported that solubility of endosperm proteins was highly related to moisture level in high moisture corn and solubility and starch digestibility increased with time of storage.

Philippeau and Michalet-Doreau (1998) reported that ensiling increased in situ ruminal starch degradation for both flint and dent hybrids. Allen et al. (2003) reported that the extent to which in vitro starch digestibility increased with ensiling and time of ensiling was greater as grain moisture content increased.

Ruminal Fermentability of Diets
A primary consideration for formulating diets of lactating cows is the fermentability of the diet; sub-optimal ruminal fermentability will decrease substrate for microbial protein production, decrease DM digestibility and decrease the efficiency of conversion of feed to milk. Excessive ruminal fermentability decreases meal size and feed intake, efficiency of microbial protein production, ruminal pH, and fiber digestibility. Consideration of ruminal fermentability is especially important for corn silage-based diets because of the large variability in fermentability of corn silage.

Ruminal fermentability is often less than optimal when mature corn silage is fed. When corn kernels from silage pass through the cow undigested, DM intake (DMI) often increases as the cow attempts to meet her energy requirements. However, not all cows can increase DMI enough to make up for the lost energy from undigested kernel passage.

Dry matter intake for high producing dairy cows is often limited by the filling effects of the diet. Thus, when these cows consume diets with decreased digestibility, they have little ability to eat more. In contrast, feed intake of lower producing cows is often limited by mechanisms related to absorbed fuels from the diet; as digestibility decreases, intake increases to compensate, at least until gut fill begins to limit intake.

In this case, even though milk production might not be affected, feed costs will increase because more feed is required to produce the same amount of milk. Because the grain in over-mature corn silage is less fermentable, more supplemental grain can be added in the diet in place of forage to increase the energy density.

Alternatively, a more fermentable grain source can be substituted such as rolled barley or high moisture corn for less fermentable starch sources such as dry corn grain.

Processing corn silage by rolling can increase ruminal and whole tract digestibility of kernels but kernels should not be crushed to the extent that they are completely broken into fine pieces: over-processed corn silage (rollers too close) can result in starch that is so rapidly fermented that feed intake, fiber digestibility and milk fat percent are reduced. Additional rumen undegraded protein might be necessary to compensate for lower microbial protein production if ruminal fermentability cannot be adequately adjusted.

Ruminal fermentability is often excessive when corn silage is harvested premature (<30% DM), particularly when supplemented with very high moisture corn (<70% DM). Excessive fermentation acid production can decrease ruminal pH which can reduce fiber digestibility, rumen microbial protein yield and animal health.

In addition, rapid fermentation of ingested feed during a meal produces fatty acid that can cause satiety. Although acetate is the volatile fatty acid (VFA) produced in the greatest quantity in the rumen, propionate has a greater effect on limiting intake (Allen, 2000) and more propionate is produced as fermentability of diets increase.

Feed intake was reduced dramatically by up to 7 lb of dry matter per cow per day when highly fermentable starch sources were substituted in diets for less fermentable sources in several experiments reported in the literature (Allen, 2000). Rapidly fermented starch sources also can decrease efficiency of microbial protein production; rate of starch digestion was related negatively to efficiency of microbial-
al protein production in two recent experiments (Oba and Allen, 2003; Voelker and Allen, 2003).

When large amounts of highly fermentable organic matter (OM) are provided to ruminal microbes quickly, they sometimes uncouple growth from fermentation reducing the microbial protein produced per lb of OM fermented and increasing the production of acids in the rumen that must be neutralized or buffered. Highly fermentable diets are also likely to cause the partition of digestible energy away from milk production towards body condition (Oba and Allen, 2000).

The ruminal fermentability of diets is easily manipulated in diets altering the fermentability of supplemental cereal grains. Ruminal starch fermentation ranges from less than 40% to greater than 90% depending upon sources, variation in particle size, gelatinization of starch, and amount and solubility of endosperm proteins.

Dry rolling and grinding decrease particle size of grains, which increases surface area of the grain available to microbes and therefore, rate of fermentation. Steam rolling or flaking increase surface area and also gelatinizes starch, which increase accessibility by microbes and rate of fermentation. Different grain types such as wheat, barley, corn, and sorghum have major differences in amount and solubility of endosperm proteins.

Wheat and barley have low concentrations and greater solubility of endosperm proteins, resulting in greater rates of fermentation than corn or sorghum. Corn grain hybrids have a wide range in amount and solubility of endosperm proteins. High moisture fermentation results in proteolysis and an increase in the solubility of endosperm proteins, increasing rate of starch digestion.

The optimum ruminal fermentability of diets for dairy cows is likely affected by milk production level and management factors such as bunk space per cow and feeding system and is therefore unlikely to be the same across all groups of cows. Furthermore, our current inability to accurately predict ruminal fermentability of OM limits our ability to formulate diets without evaluating cow response. Indicators of expected cow responses to differences in ruminal fermentability of starch and fiber are listed below.

Indicators of poor starch digestibility (often observed with over-mature corn silage or corn silage with vitreous endosperm):
- increased feed intake for cows across production levels;
- consistent feed intake;
- lower milk yield for high-producing cows;
- poor conversion of feed to milk for cows across production levels;
- elevated milk fat concentration;
- positive response to increased diet fermentability; and
- possible response to increased rumen undegraded protein.

Indicators of excessive diet fermentability:
- depressed feed intake particularly for lower-producing cows;
- greater daily variation in feed intake;
- low milk fat particularly for lower-producing cows;
- increased fluidity of manure; and
- positive response to substitution of less fermentable starch source with higher whole tract digestibility (such as dry ground corn).

Indicators of poor forage NDF digestibility:
- depressed feed intake and milk yield for high-producing cows; and
- greater feed intake for lower-producing cows.

Evaluation of cow response to diet changes combined with the knowledge of what factors affect ruminal fermentability and the effects of changes in diet fermentability on animal response are an important part of proper diet formulation for the foreseeable future.

Conclusion
Concentrations and ruminal fermentability of NDF and starch are highly variable across corn silage hybrids and must be considered when formulating diets for lactating cows. While concentration of NDF and starch is easily adjusted for by varying supplemental grain, variation in digestibility of NDF and starch can affect feed intake and milk yield because of our limited ability for diet adjustment. The large variation in ruminal and whole tract digestibility must be considered when formulating diets to maximize milk yield from corn silage-based diets.

References are available at www.msu.edu/user/mdr/ in the electronic version of this article or by requesting them from the author.
This and subsequent articles continue the MDR series of “tips” following the lead article from the April edition titled “Weathering the Storm.” It is our hope that expanding upon the different aspects of dairy management will benefit the industry especially in the current harsh economic climate.

Management Tips

Silage & Bunk Management

Faith Cullens & Craig Thomas
Extension Dairy Educators

This year’s milk price makes recommended harvesting and packing practices even more. Your cows will be living with the results of the corn silage harvest for a whole year. So let’s review the strategies to optimize harvest and packing of this important feed crop.

When to Harvest

Kernel milk line is not the best indicator of corn silage maturity -- whole plant moisture is the way to go in determining when to start chopping. Digestibility of neutral detergent fiber (NDF) and starch is closely linked with whole plant moisture (or dry matter) content.

Dry matter between 32-36% (moisture levels 64-68%) indicates that the digestibility of NDF and starch are optimal. Another consideration for when to harvest is the storage type (see Table 1 for moisture goals by storage type). If silage harvest is too wet, fermentation will be dominated by undesirable clostridial and butyric acid-forming bacteria which can lead to poor feed intake and milk yield. If silage is harvested too dry, starch digestibility will be lower. Drier silage is difficult to pack, resulting in too much oxygen present and causes heating and molding of silage.

Harvesting Tips

When the crop is ready, it should be harvested quickly to minimize

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Moisture Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal bunker</td>
<td>70-65%</td>
</tr>
<tr>
<td>Silo bag</td>
<td>70-60%</td>
</tr>
<tr>
<td>Upright concrete stave silo</td>
<td>65-60%</td>
</tr>
<tr>
<td>Upright oxygen limiting silo</td>
<td>60-50%</td>
</tr>
</tbody>
</table>

the exposure to oxygen. You should chop, spread and pack the crop within two hours to minimize losses due to exposure. Chop at proper length of cut, generally ½ inch for unprocessed and ¾ inch for processed silage, to ensure proper compaction minimizing oxygen entrapment. Using a kernel processor will increase starch availability and reduces waste from uneaten cobs. Raising the cutting height from 6 to 18 inches will increase total plant digestibility, but will reduce total silage yield by 15%.

It’s all about Density

A reasonable goal for packing density of corn silage is 15 lb DM/cu ft, however, many producers are struggling to meet this goal. If you head out to a farm that uses a custom harvester or dairy well equipped with packing machinery, it is not hard to see why. The amount of corn silage delivered to the bunk is phenomenal - unfortunately it can be too much to pack properly in the time available. As a general rule, the calculation for tractor packing weight is 800 times the tons per hour delivered to the bunker. If you are short of packing weight, consider adding another tractor, adding weight to the front or rear of tractors, adding tire weights, or slowing down harvest. The layers being packed should be 6 inches thick or less. Thicker layers trap more oxygen resulting in poorer quality feed.

Cover Quickly

Finally, cover and seal the bunker or pile tightly and quickly after harvest. When silage is not covered, air and moisture can easily enter the silo and adversely affect both the

“As a general rule, the calculation for tractor packing weight is 800 times the tons per hour delivered to the bunker. If you are short of packing weight, consider adding another tractor, adding weight to the front or rear of tractors...”
ensiling process and the quality of silage during storage and feeding. This creates a great potential for excessive dry matter and nutrient losses, moldy feed and other problems. The extent of these losses in the top 2 to 4 ft, if there is no protection, is far greater than most people realize.

Several studies at Kansas State University have reported at least a 30% loss from the top 3 feet of silage in uncovered bunker silos versus bunkers covered with plastic sheeting weighted down with tires. In a 12 ft high X 80 ft wide X 140 ft long bunker, the top 3 ft of silage contains approximately 226.8 tons of dry matter.

Therefore, properly covering the bunker could prevent the loss of about 80 tons of dry silage matter. If corn silage (34% DM) is worth $35 per ton (as fed), the total savings potential, in terms of lost corn silage dry matter, is approximately $8,000. This does not take into account any negative effects that the top 3 ft of spoiled material might have on intake, milk production, or reproduction.

After the plastic sheet is placed over ensiled forage, it must be weighted down. Tires are the most commonly used weights, and they should be placed close enough together so they touch (about 20 to 25 tires per 100 sq. ft.). To reduce the number of tires needed, and water pooling inside the tires, cut tires in half and place the open side down.

In addition to the standard bunker management practices, the last few years have brought a number of feed shrink reducing improvements to the industry including oxygen barrier plastic covers that yield almost zero spoilage on the top, covering sidewalls with plastic, overlapping plastic, bunker facing equipment, and aerobic stabilizing inoculants.

Dairy Farm Energy Audit Program

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Michigan dairy producers can reduce their on-farm energy usage by participating in a Farm Energy Audit. Michigan State University, the Michigan Agriculture Electric Council and your local electrical power provider are gearing up to assist farmers with on-farm energy audits. Energy usage in all areas of the dairy farm will be examined during the farm energy audit process.

Electrical usage on the dairy farm for lighting, milk cooling, ventilation, water heating, and milking system operation will be evaluated to determine if your systems are operating in an energy efficient manner. The audit will make recommendations on system changes when it is economical to reduce electrical usage.

The energy audit program also will examine the efficiency of farm machinery and equipment usage. The audit programs will match the proper size of your tractors to the proper size of farm implements. The program will make sure your equipment tires are properly sized and properly inflated to assure efficient operation.

If irrigation energy is used on the farm, the audit program will examine the efficiency of your irrigation systems. Audits of energy usage on on-farm crop drying equipment also will be completed as part of the program.

Farm Energy Auditors are being trained around the state to perform on-farm energy audits. Several electrical power companies in the state are providing energy audits for their clients. Contact your electrical power supplier to see if they are participating in the energy audit program.

A list of trained energy auditors can be accessed at the Web site for the Michigan Agricultural Electric Council at http://maec.msu.edu/ag_auditors.htm.
Can You Afford Ovsynch during Tough Economic Times?

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Dept. of Large Animal Clinical Sciences

Reproductive Management

In an effort to decrease medication costs during these tough economic times, the veterinarians at the MSU Training Center for Dairy Professionals reviewed the current program for first service breeding in a 3,600-adult cow herd. The existing program was a combination of Presynch followed 11 days later by Ovsynch (Pursley et al., 1995). All cows received their first insemination at the end of the Ovsynch protocol. The management team in this herd theorized that if more cows could be bred following natural estrus detection after the Presynch portion of the program, the farm could save the cost of the Ovsynch portion of the program (The costs of medications for these programs are listed in Table 1 on page 10).

The management team determined that they could save approximately $8.50 per cow by inseminating to a standing estrus as opposed to allowing a cow to go through the Ovsynch protocol.

A preliminary on-farm trial was designed to answer the question: How successful would first service be by inseminating based upon standing estrus versus inseminating at the end of the Ovsynch protocol? Cows that freshened between December 15, 2008 and January 31, 2009 were selected and randomly divided into two groups. Cows in Group 1 were inseminated based upon visual estrus detection following either of the prostaglandin injections in Presynch (Figure 1). Cows in Group 2 (not inseminated in the Presynch) continued through Ovsynch and were inseminated for the first time following Ovsynch, is in Table 2 also. All cows received first insemination by 80 days in milk (DIM). Table 2 shows the numbers of cows in each classification along with the associated costs.

Based upon the results shown in Table 2, if cows were bred based only upon observation of standing estrus, the farm would save between $8.23 and $11.50 per cow in injection and handling costs.

Figure 1: Presynch and Ovsynch protocols (Pursley et al., 1995).

Ovsynch protocol. The management team in this herd theorized that if more cows could be bred following natural estrus detection after the Presynch portion of the program, the farm could save the cost of the Ovsynch portion of the program (The costs of medications for these programs are listed in Table 1 on page 10).

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For a herd of 1,000 cows averaging 920 first services per year (based upon a 13 month calving interval and perfect estrus detection), the savings in injection costs would be between $7,664 and $10,672 per year.

The conception results for both programs are summarized in Figure 2 (page, 22). The conception rate of breedings in the “standing” category (BS1, BS2, OTH) resulted in 24.4 of the cows becoming pregnant on their first service.

The cows that were allowed to pass through the Presynch program and were bred following Ovsynch had a conception rate of 37.9; a

PGF2α
60-66 DIM (days in milk)

GnRH
74-80 DIM

PGF2α
85-91 DIM

GnRH
92-98 DIM

GnRH
94-100 DIM

Timed Insemination
95-101 DIM

60-66 DIM
11d
14d
7d
56h
16h
74-80 DIM
85-91 DIM
92-98 DIM
94-100 DIM
95-101 DIM
Table 1: Medication costs including administration costs (Neuder and Raphael, 2009).

<table>
<thead>
<tr>
<th>Injection</th>
<th>Drug</th>
<th>Cost (4/15/2009)</th>
<th>Cost to Administer</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGF2α</td>
<td>Cloprostenol1</td>
<td>$2.27/dose</td>
<td>$1.00/dose</td>
<td>$3.27/dose</td>
</tr>
<tr>
<td>GnRH</td>
<td>Factrel2</td>
<td>$1.48/dose</td>
<td>$1.00/dose</td>
<td>$2.48/dose</td>
</tr>
</tbody>
</table>

1 Estrumate®, Schering Plough Animal Health, Inc.  
2 Factrel®, Fort Dodge Animal Health, Inc.

Table 2: Treatment Groups and total program costs (Neuder and Raphael, 2009).

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Classification</th>
<th>Description</th>
<th>Total Cost for Injections</th>
<th>Number of cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>BS1</td>
<td>Bred 2-6 days after Visual Heat</td>
<td>$3.27</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>BS2</td>
<td>Bred 2-6 Days Visual Heat</td>
<td>$6.54</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>OTH</td>
<td>Bred Visual Heat Not Related to PGF2α Injection</td>
<td>$4.56 (average/cow)</td>
<td>87</td>
</tr>
<tr>
<td>Group 2</td>
<td>BG1</td>
<td>Timed Inseminated Following ovsynch</td>
<td>$14.77</td>
<td>137</td>
</tr>
</tbody>
</table>

A significant increase of 13.5% for cows that became pregnant following first AI. If these preliminary results are correct, that would mean that a 1,000-cow dairy could expect about 135 more pregnancies from first AI by letting all cows go through the Presynch/Ovsynch program whether they were observed in estrus or not.

But here is the most important question: Was the increased value of the additional pregnancies with all cows treated with Ovsynch worth more than the savings from purchasing less PGF2α and GnRH associated with inseminating some cows following detected estrus? For that answer the Net Present Value (NPV) of cows that were pregnant was compared with the NPV of cows that were not pregnant. The NPV is a tool used in business management to predict the future value of an investment (pregnant cow) that has been discounted to today’s dollars. The NPV of a cow is a prediction of future profitability of that cow adjusted back to today’s value.

The important concept to understand when using the NPV for cows is that each dairy farm has a limited number of available slots for cows and the dairy manager wants to maximize the profit from each of those slots. Of course, this is all based upon the premise that all the slots are full and therefore the dairy is running at maximum capacity.

Keeping a cow because she is “paying her way” (presumably recouping her daily expenses for feed and care) is not the same as retaining a cow because she brings more value to a slot compared with a different cow or replacement (Eicker and Fetrow, 2003).

Many ways have been developed to rank cows in a herd to help producers make decisions concerning culling, replacing, breeding, and treatment of sick animals. Because of the high number of variables involved in modeling these types of decisions, along with the complicated mathematics, many of these models are not broadly accessible.

However, in 1999, the programmers at Valley Ag Software (DairyComp 305, Tulare, CA) introduced a new module for their program named “Cow Value”. It computes a farm-specific value for the predicted future profit of each animal based upon parameters specific to that dairy and the current economic state of the industry. Table 3 (page, 22) shows an example of the values used by the module to estimate the NPV of a cow.

One of the major impacts upon the overall NPV of a cow currently in the herd is pregnancy status. When running the model, we used the same inputs for each cow with the exception of pregnancy status. We ran the model twice, once with the trial cow being classified as non-pregnant and again with the trial cow being classified as confirmed pregnant.

The difference between the values of each cow coded “pregnant” versus the value of each cow coded “open” was determined to be the net present value of the pregnancy created.

Going back to our trial results, we subtracted all the costs for the medications used on each cow and added the average value of each pregnancy created using this NPV model. Cows in the model that were classified as open had $0.00 additional value added to the costs they incurred. The results are summarized in Figure 3 (on page, 22).
High-fertility, High-producing Cows -- An Oxymoron?

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Dept. of Animal Science

Ronald J. Erskine
Dept. of Large Animal Clinical Sciences

Herd Management

Intensive genetic selection for high milk yield is often considered a major component of decreasing fertility of dairy cows. But is that the whole story? Our current research indicates that there is probably more to the relationship between milk production and reproductive performance than just genetics. In fact, non-genetic factors such as management practices and herd-related factors are likely to be substantially involved, meaning that it might be possible for herd managers to have a direct impact on getting high producing cows pregnant.

Data from the USDA indicate that milk production per cow has more than doubled during the last few decades, from an average of 9,700 lb/year in 1970 to nearly 20,500 lb/year in 2007 (http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/). In turn, with a roughly 1 in 3 chance of success to any single insemination, it is almost twice as difficult to get a cow pregnant today than it was 50 years ago.

Intriguingly, from time to time, we observe cases of herds with milk rolling herd averages above 30,000 lb yet maintaining impressively high yearly cow conception rates at or above 45%. Ladine Farms from Michigan, recently highlighted in the April 2008 issue of MDR, is a case in point. A similar observation could be made on individual cows: it is not uncommon for the healthiest higher yielding cows in a herd to become pregnant to their first breeding. So how does the production-reproduction relationship work?

Connecting Milk Yield with Reproduction

Aiming at this question, we set out to study the nature of the relationship between milk yield and reproductive performance of Michigan dairy cows, and how it might be associated with management practices and herd-related factors. This preliminary study, which was presented at the 2009 American Dairy Science Association conference, was based on 776,957 lactation records from 851 Michigan Dairy Herd Improvement Association (DHIA) dairy herds recorded from 1998 to 2007. Criteria for inclusion in this study were a minimum herd size of 25 cows and a maximum testing interval of 45 d. Also, given the low representation (< 5%) of dairy breeds other than Holstein, we restricted our analysis to Holstein herds.

We used cow data to estimate the within-herd correlation between 305-d milk yield and projected calving interval for each year from 1998 to 2007. Figure 1 depicts the frequency distribution of the correlation between 305-d milk and calving interval for Michigan DHIA herds from 1998 to 2007. A total of 4627 herd by year combinations (referred to as herd-years) are represented in the figure. VWP = Voluntary Waiting Period.
2009 Income Tax Planning

Larry Borton
Dept. of Agricultural, Food & Resource Economics

If your tax goal is to owe zero income and payroll taxes, then this year’s low milk prices make it easy. But if your objective is to get income through the tax system with paying the lowest taxes, then planning may be more challenging. First are some facts about this year’s taxes.

- Tax rates are lower this year and next year and scheduled to increase in 2011. The 10% tax bracket will disappear after 2010 so the lowest bracket will be 15%. The highest bracket will increase from 35% to 39.6% for ordinary income. The long term capital gains rate (used for raised, cull cows that are sold) increases from 0% or 15% to 10% or 20%. These will happen without Congress changing any laws.
- Social Security and Medicare remain at 15.3% on the first $106,800 of earned income and 2.9% for higher income.
- Michigan income tax rate remains at 4.35% for 2009.
- A 1-year requirement exists to treat new farm equipment and machinery as five-year property rather than its normal 7-year life. This only applies to new (original use) items and does not include grain bins, fences, cotton gins or land improvements. By electing to use ADS (Alternate Depreciation System) the 7-year property can be depreciated over 10 years but all farm machinery and equipment, both new and used, placed into service in 2009 would then need to be depreciated over 10 years.
- The 50% bonus depreciation was extended for another year and covers virtually all new farm property placed into service in 2009. All new property within a class (like 5-year, 7-year, 10-year, 15-year or 20-year) must be treated the same. This is mandatory unless the taxpayer elects out of this provision. Anyone required to use ADS (most fruit farmers) is not eligible for this provision.
- The direct expensing remains at $250,000 for 2009 with phase out beginning at $800,000 of qualified property placed into service.
- For 2009 and 2010 an educational credit increased to a maximum of $2,500 for the first 4 years of study (it was previously $1,800 for the first 2 years).
- First time home buyers credit (refundable) up to $8,000 if the house is closed by November 30, 2009.
- A maximum of $1,500 credit for qualifying energy property purchased for your principal residence. It’s calculated as 30% of the purchase price for items that qualify.

Dairy farmers may want to minimize deductions and increase income for this year if their taxable income is low or negative. Depreciation can be reduced but only for items placed into service in 2009. This would include electing out of 50% bonus depreciation. Items previously placed into service already have a method that cannot be changed now. Prepaid expenses may still be used but fewer farmers will use them this year. If a taxpayer has the 0% long term capital gains bracket available (for taxable income below the 25% ordinary income tax bracket), it makes sense to use this bracket. If profits are made in the next 3 years, then income averaging still might use these brackets if unable to use them this year.

Another way to increase income is to convert a traditional IRA, SEP-IRA or a SIMPLE IRA to a Roth IRA. As of 2008 an employer-sponsored retirement plan like a 401(k) or 403(b) also may be directly converted to a Roth IRA. These were usually not taxed when contributions were made and will be taxed when distributions are made.

The amounts converted count as taxable income in the conversion year but if the tax rate is zero, then there will be no tax. Future qualified distributions from a Roth IRA will not be taxable income. Converting may be done by a farmer or even a spouse if married, filing jointly.

A further complication may arise if milk income was deferred from the end of 2008 to the beginning of 2009. The IRS has a program to audit dairy farmers to check for this. Any deferral of income from milk sales is being disallowed based on a Minnesota court case where grain delivered to a cooperative was not considered a sale until it was later sold by the cooperative.

Because the farmer did not “sell” the grain to the cooperative, no installment sale (or deferral of income) was possible in spite of having a contract in place before delivery of the commodity. Although our goal is to use up our lower brackets, there may not be enough income to use them and there may be a loss from the farm operation.
Carrying Back Net Operating Losses

Farmers with a Net Operating Loss (NOL) may be able to carry back the loss 5 years or 2 years and essentially get a refund of income taxes paid in prior years. The reason for doing this is to make a little more cash available. The concept is to take this year’s business or farm losses to years when income taxes were paid and offset taxable income in those years to get tax refunds. The calculations to get the refund are quite complex, but we can get a general knowledge for it without getting lost in computations.

A NOL can be claimed by an individual, C Corporation, partner, LLC member or S Corporation shareholder. A taxpayer must have negative taxable income but only business losses can be carried back or forward. So if a spouse’s wage income, for example, makes taxable income positive, then the taxpayer does not have a NOL even though the farm or business had a loss.

Some items are not part of a NOL and will reduce or eliminate it. These include dependent and personal exemptions ($3,650 per person in 2009), some non-business deductions, and excess capital losses (like investments). Another item that reduces the NOL is the Domestic Production Activities Deduction (DPAD) which many farmers have used and can be quite large for members of cooperatives.

When income is carried back to earlier years, the loss is absorbed by the Modified Adjusted Gross Income (MAGI) from that year. The MAGI is the taxpayer’s adjusted gross income plus personal and dependent exemptions plus the DPAD and some other items. Any loss greater than the amount absorbed is carried over to the succeeding year (or years) until the loss is used up. A NOL can be carried forward up to 20 years.

For example, a sole proprietorship has a NOL. The taxpayer is married, filing jointly with no children. Because of low milk prices and high input costs, their taxable income for 2009 is negative $60,000. When personal exemptions (2 times $3,650 = $7,300) and the standard deduction ($11,400) are added back, then the NOL is -$41,300 (-60,000 + 7,300 + 11,400). To illustrate how the carry back works, the table below shows an adjusted gross income and taxable income for 2007 and 2008. Using these to calculate the taxes refunded:

<table>
<thead>
<tr>
<th>Year</th>
<th>Adjusted Gross Income (assumed)</th>
<th>Deductions (standard for these years)</th>
<th>Exemptions (two for each year)</th>
<th>Taxable Income (#1 - #2 - #3)</th>
<th>Income Taxes (at 10% and 15% rates)</th>
<th>DPAD</th>
<th>MAGI (#4 + #5 + #6)</th>
<th>NOL remaining after absorbing #7</th>
<th>Federal Income Taxes after</th>
<th>Taxes Saved (#5 - #9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>$30,000</td>
<td>$10,700</td>
<td>$6,800</td>
<td>$12,500</td>
<td>$1,250</td>
<td>$1</td>
<td>$20,300</td>
<td>$21,000 (41,300 - #7)</td>
<td>0</td>
<td>$1,250</td>
</tr>
<tr>
<td>2008</td>
<td>$40,000</td>
<td>$10,900</td>
<td>$7,000</td>
<td>$22,100</td>
<td>$2,513</td>
<td></td>
<td>$32,100</td>
<td>0</td>
<td>$1,110</td>
<td></td>
</tr>
</tbody>
</table>

Thus, the total federal taxes saved were $2,653 (1,250 + 1,403). In 2007 the $41,000 NOL carried back from 2009 absorbed all $20,300 of MAGI and reduced taxes by $1,250. In 2008 the remaining $21,000 NOL carried over from 2007 was completely absorbed and left $11,100 of taxable income which reduced income taxes to $1,110 (using the 10% tax bracket). This resulted in $1,403 taxes saved for year 2008. All of the NOL was absorbed and $2,653 federal taxes can be refunded.

Carrying back NOLs will not reduce self-employment taxes. Your social security and Medicare payments do not change from the amounts paid or due.

A NOL cannot be made larger by using section 179 direct expensing on depreciable items placed into service. One of the limits on direct expensing is that business income must be positive and if it was positive, there probably would not be a NOL. However, if eligible for using 50% bonus depreciation, it doesn’t have the business income limit so that can make a NOL larger.

Some tax brackets in the past have been quite low. The federal long term capital gain rates have been 0%, 5% and 15% while the ordinary rates have been 10%, 15%, 25% and higher. If you absorb taxable income from last year at 0%, that doesn’t put any cash in your refund although it may be necessary in...
Spread Manure in Winter with Great Caution

Natalie Rector
Extension Manure Nutrient Specialist

Manure Management

For many dairy producers and other livestock farmers, surface-spread manure during the winter is necessary. This practice comes with inherent risks of variable weather conditions but eventually the snow will melt and the ground will thaw.

Producers need to watch the weather forecasts just as closely in the winter as they do in the summer. Weather predictions calling for rain or a thaw are red flags to stop manure applications.

What to Do When Snow Melts
If soil conditions are saturated when winter sets in there will be less space for additions of manure to be absorbed during thaw events.

The worst case scenario is when there is rapid snowmelt before the ground has a chance to thaw. In this instance, the snow turns to water and has two options before it can infiltrate into the soil: either runoff or pond. These situations need to be prevented. A discharge of manure nutrients to surface waters is a violation that can be enforced by the Department of Environmental Quality and a situation, which no producer wants to create.

Avoid negative situations by prioritizing fields for winter time manure applications. Begin by figuring out how many acres are needed for wintertime spreading.

After harvest is a perfect time of year to drive the perimeters of all fields and assess the risks each field has for wintertime spreading. First of all, know where any surface waters are and what they connect to.

This can be done by drawing on your own knowledge, using soil survey maps or FSA aerial maps. These maps will be especially important when dealing with land you rent or know less history of. As you drive each field, ask yourself what would happen if manure was applied to this field and there was a rapid spring melt? Then follow up with, what could be done ahead of time to prevent or minimize the situation.

Two of the most important factors in prioritizing fields for winter-time spreading are slope of the field and if there are surface waters adjacent or close enough that run off would reach them.

Knowing what fields are apt to have surface runoff in the spring is also a good indication of what might happen if manure is applied. Fields such as this one should not receive surface applications of manure during any season.
Portions of fields that slope (especially greater than 6%) directly to surface waters should not receive manure during the winter. Fields with slopes greater than 3% should not receive liquid manures.

But even fields with less slope, may carry water off site and reach surface waters. These fields may benefit from observing setbacks from surface water during spreading, reducing rates and (or) seeded buffer strips along water courses to decrease the risk of runoff reaching surface waters.

Fields with surface drainage inlets are naturals to catch runoff; and if the runoff contains manure the inlet will take the manure to the surface water outlets. These areas of fields should be avoided during surface applications regardless of the time of year. Even with low risk fields, strategize what practices you have to reduce the risk of spring-time runoff even more.

Fall tillage that leaves soil surfaces rough or better able to soak in manure may be an option on certain fields. Seeding a cover crop on fields that will receive manure over the winter is another option. Applying manure whenever the soil conditions allow and reducing the rate per acre of manure applications also will help reduce the risk of runoff. Utilize your own knowledge of the fields and common sense to tell you what fields need the most attention.

Keeping records of field applications is not only a good idea, but necessary to receive Right-to Farm Nuisance Protection and to show that you are following a Comprehensive Nutrient Management Plan (CNMP) if you have one on your farm.

Plans are only good if they are communicated to all family and farm operators. Once you have prioritized and strategized which fields will be utilized for winter spreading, be sure that the person hauling the manure is informed and aware of any areas where setbacks are needed or portions of fields that should not receive manure at all.

No single factor causes runoff and over all, no set of circumstances guarantees manure won’t reach surface waters. Weather changes day to day and so does the risk; reduce your risk by having a plan in place and being prepared to make day to day decisions on winter spreading.

Always have an emergency plan in place, for the unfortunate event of a manure release to surface waters. In such an instance, cease spreading immediately, contain the discharge if possible and report the incident to DEQ. The Michigan Department of Environmental Quality’s Pollution Control hotline is: 800-292-4706; and, the Michigan Department of Agriculture’s spill response is: 800-405-0101.

Application of manure to frozen or snow-covered soils should be avoided, but where necessary, a) solid manure should only be applied to areas where slopes are 6% or less b) liquid manure should only be applied to soils where slopes are 3% or less. In either situation, provisions must be made to control runoff and erosion with soil and water conservation practices such as vegetative buffer strips between surface waters and soils where manure is applied.

For more of the manure management GAAMP, visit: www.michigan.gov/mda.
Feed Inventory Management

Mike McFadden
Extension Dairy Educator, Central Michigan

**Feeding Management**

Feed costs are the single largest expense on most dairy farms comprising between 40 and 60 percent of the total cost of producing milk. It is thus important to closely manage farm inventories of feeds in order to maximize the margin potential of the farming enterprise. Feed inventory management focuses on determining the amount of feeds required for the dairy, the amount of feeds that are available and optimal allocation of available feeds to meet the nutritional requirements of the different categories of cattle on the farm.

Managing feed inventories on your farm involves first taking inventory of the average number of livestock anticipated to be on the farm for the next year and the rations desired to be fed to them. Fermented or wet feeds should be converted to a dry matter basis.

**Example:** 100 cow group is fed 40 lbs corn silage per day on an as fed basis. Forty pounds as fed corn silage x 35% dry matter = 14 lbs corn silage dry matter per cow per day. Fourteen pounds dry matter x 100 cows x 365 days = 511,000 pounds or 256 tons of dry matter. Therefore, to feed the 100 cow group at a rate of 40 lbs of corn silage per head per day will require 256 tons of corn silage dry matter.

When these calculations have been totaled for all the livestock on the farm including dry cows, heifers, bulls and steers, then we have determined our annual feed requirements on a dry matter basis.

2 Strategize the optimal means of supplying the required amount of feed for the livestock. Information required for this includes available acreage, accurate estimates of crop yields, crop rotations and current feed inventories. Availability and size of feed storage facilities is also an important consideration. Adequate feed storage facilities enable producers to separate stored feeds by quality as well as allowing wet feeds to fully ferment before they are utilized. Recommended minimum feed removal rates should be followed to ensure that forage quality is optimized and spoilage and losses are minimized (Table 1).

**TABLE 1:** Minimum silage removal rates.

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Cold Weather (inches/day)</th>
<th>Warm Weather (inches/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower silo, top unloading</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Tower silo, oxygen limiting</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bunker silo/silage pile</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Silo bag</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

Calculating the capacity of a bunker silo or the amount of feed contained within requires determination of the cubic feet of capacity or contents, and the density of the stored feed.

For example, a bunker silo that is 25 feet wide, 130 feet long and averages 10 feet in height equals 32,500 cubic feet of capacity. If the silage has a density of 15.75 pounds of dry matter per cubic foot, the silo can hold 32,500 cubic feet x 15.75/ cubic foot = 511,875 pounds or 256 tons of silage dry matter.

This silo would seem to be adequate in size to contain the corn silage required for the 100-cow group mentioned previously. In actuality an additional 25-50 tons of silo capacity and silage would be required to compensate for storage and feeding losses.

The following spreadsheets can be found at the University of Wisconsin Team Forage Harvest and Storage website: [http://www.uwex.edu/ces/crops/uwforage/storage.htm](http://www.uwex.edu/ces/crops/uwforage/storage.htm)

- Silage Pile Capacity Calculator
- Silage Pile Dimension Calculator
- Bunker Silo Density Calculator
- Bunker Silo Sizing Calculator

Silage density can be determined by weighing cored samples from a bunker silo, comparing a measure area of silage removed with its observed weight, or estimating from readily available data tables. (See website above).
Feed supplies can be inventoried at any time during the year but there are three periods when it is especially advantageous to assess the status of feeds. In the fall, feed supplies should be measured and any shortfalls can be addressed by purchasing feed. This is also a good time to make ration adjustments to avoid running out of feed or having to make future drastic or undesirable ration adjustments.

An early summer feed inventory identifies potential shortfalls in feed supplies and may suggest the purchase of standing crops from other producers. A late summer feed inventory can be helpful in deciding how much corn should be harvested as silage or as grain.

### Conclusion

The primary purpose of managing feed inventories is to balance the amount of available forages and grains with the nutritional requirements of the livestock production unit. Careful management of inventories allows advantageous purchases of required feeds, is helpful in planning for production of feeds, and ultimately can play a critical role in providing sufficient quantities of feed to allow optimal production by the livestock enterprise.

### Table 2: Estimated % Silage Losses during Operations.

<table>
<thead>
<tr>
<th>Silo Type</th>
<th>Moisture %</th>
<th>Filling</th>
<th>Storage</th>
<th>Feed Out</th>
<th>Total Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright</td>
<td>65</td>
<td>1-3</td>
<td>11</td>
<td>1-5</td>
<td>13-19</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1-3</td>
<td>9</td>
<td>1-5</td>
<td>11-17</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2-4</td>
<td>8</td>
<td>1-5</td>
<td>11-17</td>
</tr>
<tr>
<td>Sealed upright</td>
<td>60</td>
<td>1-2</td>
<td>5</td>
<td>0-3</td>
<td>6-11</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>2-3</td>
<td>4</td>
<td>0-3</td>
<td>6-12</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>2-4</td>
<td>4</td>
<td>0-3</td>
<td>6-13</td>
</tr>
<tr>
<td>Bunker, no cover</td>
<td>70</td>
<td>2-5</td>
<td>19</td>
<td>3-10</td>
<td>24-34</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>3-6</td>
<td>22</td>
<td>5-15</td>
<td>30-43</td>
</tr>
<tr>
<td>Bunker, covered</td>
<td>70</td>
<td>2-5</td>
<td>11</td>
<td>3-10</td>
<td>16-23</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>3-6</td>
<td>10</td>
<td>5-15</td>
<td>18-31</td>
</tr>
<tr>
<td>Stack, covered</td>
<td>70</td>
<td>3-6</td>
<td>11</td>
<td>3-10</td>
<td>17-27</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>4-7</td>
<td>12</td>
<td>5-15</td>
<td>21-34</td>
</tr>
<tr>
<td>Silage bags</td>
<td>60-70</td>
<td>1-2</td>
<td>7</td>
<td>1-5</td>
<td>9-14</td>
</tr>
<tr>
<td>Wrapped silage bales</td>
<td>50-60</td>
<td>2-3</td>
<td>12</td>
<td>1-5</td>
<td>15-20</td>
</tr>
</tbody>
</table>

“Silage density can be determined by weighing cored samples from a bunker silo, comparing a measure area of silage removed with its observed weight, or estimating from readily available data tables.”

### References


View the online version of MDR (including archived issues) at: www.msu.edu/user/mdr/
Is 3X Milking For You?

Craig V. Thomas
Extension Dairy Educator, Eastern Michigan

Milking Management

Due to plummeting milk prices and rising production costs dairy producers across the state are struggling to make ends meet. Producers are desperate to cut costs, increase income, and shore up shrinking margins.

In the April, 2009 issue of Michigan Dairy Review (https://www.msu.edu/user/mdr/vol14no2/vol14no2index.html) this situation was addressed in the article entitled, “Weathering the Storm.” One strategy cited was switching from 2X to 3X milking. Milking 3X has its pro’s and con’s, but is worthy of evaluation in the current economic climate.

Pros
1. A summary of 19 research studies indicates that, regardless of milk yield for 2X, 3X milked cows will increase daily milk production 6.8 to 8.6 lbs/cow per day with a 95% confidence range.
2. Even though percentage of components (butterfat and protein) usually declined slightly on 3X, overall production of components increased (butterfat +0.2 lbs/cow per day; protein +0.18 lbs/cow per day).
3. Anecdotal reports also suggest improvements in udder health based on lower SCC’s, increased overall health, and sometimes even improved reproductive performance.
4. Hence, 3X offers an opportunity for increased milk revenue via increased milk volume, increased solids production, and potentially lower SCC’s.
5. Three times a day milking also offers an opportunity to more effectively and efficiently utilize milking facilities if extra capacity is available.

Cons
1. milking three times a day requires adequate milking facility capacity and may not be feasible if any factors are present that may limit the ability of cows to respond with higher milk production (e.g., poor feed quality, limited feed bunk space, environmental stress, excessive wait time in holding pens, long travel distances to and from milking facility).
2. Milking 3X requires an adequate supply of well-trained and motivated labor willing to milk cows at often undesirable times of the day.
3. Milking 3X requires an increased level of management to insure cows are fed properly and any less than favorable health issues (e.g., lameness, mastitis) are not exacerbated by the increased intensity of production and handling.
4. Cows milked 3X will require more intensive management to insure adequate feed intake and maintenance of proper body condition.
5. Milking 3X requires a commitment of at least 6 months and a monitoring program to determine if it is successful.

Reminder: Marginal Costs versus Returns
When making the decision whether or not to switch to 3X milking, be sure to consider more than just the potential increase in milk revenue. Three times per day milking will also produce increased costs. Milking 3X obviously increases labor and feed costs, but other costs also will rise such as electricity (to run parlor and cool extra milk produced) and livestock marketing (e.g., milk hauling, promotion fees, coop dues). One also should consider other less tangible cost increases, for example, increased management time and intensity.

When one considers all the relevant factors, switching from 3X to 2X is not a trivial and easy decision. All the aforementioned factors, plus the milk price, need to be considered. I have developed a simple Excel® spreadsheet decision aid for this purpose.

The spreadsheet allows you to specify changes in the cost and usage of purchased and homegrown feeds, livestock marketing expenses, hired labor expenses, utility expenses, and other expenses (Table 1). It also allows you to adjust feed costs for shrink (Table 2). This is quite important. We tend to only think in terms of actual cow feed intake rather than the total feed used (including shrink) to get that intake.

The model then produces two tables based on milk price ($9-$15/cwt) and daily 3X production response (2.9 lbs/cow). One table shows the gain/loss in daily marginal revenue (per 100 milking cows) (Table 3) and the other the same information on an annual basis (Table 4).

Given the default inputs used, 3X milking does not produce a profit at any level of production response until milk prices exceed $10/cwt. From a practical perspective, switching to 3X is probably not worth the trouble unless milk price exceeds $12/cwt at lower production responses or production response exceeds 5 or 6 lbs/cow per day at $11/cwt milk price.

The most important thing is to plug your numbers into the model and then determine if and when 3X is
feasible on your operation. If you would like a copy of the spreadsheet model send me an e-mail (thomasc@msu.edu).

Table 1: Enter data in green shaded cells.

<table>
<thead>
<tr>
<th>Expense</th>
<th>Adjustment Factor(^1)</th>
<th>Current Cost Per cwt(^2)</th>
<th>3X Cost Per cwt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Feed</td>
<td>0.80</td>
<td>$5.82</td>
<td>$4.66</td>
</tr>
<tr>
<td>Livestock Marketing</td>
<td>0.90</td>
<td>$0.75</td>
<td>$0.68</td>
</tr>
<tr>
<td>Hired Labor</td>
<td>0.60</td>
<td>$3.07</td>
<td>$1.84</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.60</td>
<td>$0.52</td>
<td>$0.31</td>
</tr>
<tr>
<td>Home Grown Feeds</td>
<td>0.80</td>
<td>$2.96</td>
<td>$2.37</td>
</tr>
<tr>
<td>Other</td>
<td>1.0</td>
<td>$0.35</td>
<td>$0.35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$13.47</strong></td>
<td><strong>$10.20</strong></td>
</tr>
</tbody>
</table>

Adjustment factors are designed to account for the fact that not 100% of the cost is attributable to the increased milk from 3X milking.

\(^1\) Amounts for purchased feed, livestock marketing, hired labor, and utilities are from average in 2007 Michigan Dairy Farm Business Analysis Summary data set.

Table 2: Enter data in green shaded cells.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Lbs (as fed) Per Cow Per Day</th>
<th>Value Per Ton</th>
<th>Total Shrink (%)(^1)</th>
<th>Total Daily Cost Per Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn silage</td>
<td>50.00</td>
<td>$40.00</td>
<td>20%</td>
<td>$1.20</td>
</tr>
<tr>
<td>Alfalfa haylage</td>
<td>30.00</td>
<td>$50.00</td>
<td>20%</td>
<td>$0.90</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>5.00</td>
<td>$140.00</td>
<td>20%</td>
<td>$0.42</td>
</tr>
<tr>
<td>Grass hay</td>
<td>5.00</td>
<td>$120.00</td>
<td>20%</td>
<td>$0.36</td>
</tr>
<tr>
<td>Straw</td>
<td>2.00</td>
<td>$75.00</td>
<td>80%</td>
<td>$0.08</td>
</tr>
<tr>
<td>Other feed #2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other feed #3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other feed #4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other feed #5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other feed #6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other feed #7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>92.00</td>
<td></td>
<td>$2.96</td>
</tr>
</tbody>
</table>

\(^1\) Consider adding storage and feeding shrink, especially for ensiled feeds.

Table 4: 3X Total Annual Profit/Loss Margin (per 100 milking cows).

<table>
<thead>
<tr>
<th>Mailbox</th>
<th>3X Production Response (lbs/cow/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Price</td>
<td>2</td>
</tr>
<tr>
<td>$9.00</td>
<td>($878)</td>
</tr>
<tr>
<td>$9.50</td>
<td>($513)</td>
</tr>
<tr>
<td>$10.00</td>
<td>($148)</td>
</tr>
<tr>
<td>$10.50</td>
<td>$217</td>
</tr>
<tr>
<td>$11.00</td>
<td>$582</td>
</tr>
<tr>
<td>$11.50</td>
<td>$947</td>
</tr>
<tr>
<td>$12.00</td>
<td>$1.312</td>
</tr>
<tr>
<td>$13.00</td>
<td>$2.042</td>
</tr>
<tr>
<td>$15.00</td>
<td>$3.502</td>
</tr>
</tbody>
</table>
High-fertility...

milk would be predicted to correspond to a consistently uniform increase in calving intervals. In turn, a correlation of -1 (left end of Figure 1) would suggest a perfect relationship in the opposite direction; that is, more milk would lead to consistently shorter calving intervals and thus, improved reproductive performance.

As a middle ground, a correlation of 0 would indicate that calving interval would be completely independent of milk production. Now, keep in mind that correlation means association but does not necessarily indicate direct cause and effect between milk yield and calving interval. A correlation between milk yield and calving interval could just indicate common causal factors to both traits.

So, back to Figure 1, between 1998 and 2007, the average correlation between 305-d milk and calving interval for Michigan herds was 0.26, meaning that, on average, more milk per 305-d lactation was associated with longer calving intervals across the state. Moreover, 50% of Michigan herds had correlations between 0.19 and 0.33, again indicating an antagonistic milk production-reproduction relationship for most cases. Actually, in some herds, the situation was even worse, with strongly positive (i.e., undesirable) correlations above 0.80.

Now, at the opposite end of the curve (left of Figure 1), some herds apparently managed to have no relationship between milk yield from reproductive performance (correlation = 0) and some had even reverted the trend and showed a strongly negative (i.e. favorable) correlation of -0.46. Clearly, the relationship between milk yield and reproduction is not a one-size-fits-all relationship. Rather, there seems to be a variation among dairy herds in terms of the link between calving interval and high milk yield. One might then ask: is this variation just by sheer chance? Or, is it something real and manageable, so that it would be possible to drive the correlation between 305-d milk and calving interval to a more favorable condition? We evaluated 16 herd performance indicators and management practices, and how they may relate to the production-reproduction correlation.

Result of the Research

Good news first: management factors such as milking frequency, use of rbST administration, herd expansion and voluntary waiting period were significantly associated with the production-reproduction correlation. Herds with more frequent milking schedules (3X or greater) and with intensive rbST supplementation (>50% of the herd enrolled) had more favorable production-reproduction relationships than herds on 2X milking or with no rbST use. Although no longer used in Michigan, results on rbST are reported due to its main interest in understanding the production-reproduction relationship regardless of industry circumstances.

Also, the correlation between 305-d milk and calving interval decreased (that is, improved the relationship) in herds with longer voluntary waiting periods. Interestingly, herd size was not associated with the production-reproduction relationship, thus implying that small and large herds alike can do as good a job of successfully getting high-producing cows pregnant.

However, if a herd was expanding, the correlation between 305-d milk and calving interval increased and the relationship became more unfavorable. This could be partially explained by expanding farms holding on to open late lactation cows that would otherwise be culled from the herd, thus artificially inflating calving interval. In addition, expansion usually puts a considerable amount of pressure on cows and people. As a result, intensive management may suffer and careful attention to detail may temporarily slip away during herd expansion.

Not as Simple as It Seems

Now, here is the catch: the magnitude of the effect of each individual management practice on the correlation was very small, thus indicating the complex multifactorial nature of the relationship between milk production and reproduction. In other words, no single management strategy is a silver bullet for successful pregnancies in high producing cows.

Furthermore, DHIA data allow us only to identify factors influencing correlations between management and production-reproduction but there may not necessarily be cause-effect implications. This is particularly relevant when considering that 1) rbST is not currently in use in Michigan, and 2) rbST herds may be more likely to also implement other management-intensive practices, such as synchronized breeding schedules or targeted nutrition programs.

The DHIA data on nutrition and reproductive herd management are very limited. More research will certainly be needed in this regard. We are currently working with more sophisticated methods to study these
relationships from a more comprehensive perspective. Still, our results are consistent in indicating that milk yield and reproductive efficiency can be jointly optimized under conditions of intensive management along with careful attention to management detail.

In Conclusion
In summary, milk yield and timely pregnancies of dairy cows do not necessarily play against each other.

Continued from Page 13

2009 Income Tax Planning...

In fact, production and reproduction can be disconnected from each other or even correlate favorably, as attested to by real case herds in our Michigan dairy industry. Management strategies lay at the core of the production-reproduction relationship in a somewhat complex and intertwined manner. Understanding the mechanisms that drive this relationship can provide insightful information 1) to be aware of and stay away from undesirable scenarios, and more importantly, 2) to accurately target highly profitable management practices that optimize both milk yield and pregnancy success in the herd. Our goal is to continue to work on this subject to provide practical evidence-based insight that will help to guide on-farm management decisions towards an optimal balance between milk production and reproductive performance of Michigan dairy herds.

A NOL may also be carried back to past years or forward to future years for Michigan income taxes. An allowed NOL is also a deduction from household income in those years and may be used to increase the amount of homestead property tax credit and farmland preservation tax credit.

Generally, income and self-employment taxes are less when income is stable over time and the lower tax brackets are used up every year (10% and 15%). Carrying back NOLs is one way to get some cash if income taxes were paid in previous years. Given up in this process is that the NOL gets absorbed faster than the benefit from it.

Your tax practitioner’s computer software should help with the complex calculations to see if there is a benefit. If a taxpayer expects a NOL, tax planning and action before January may increase the amount of refund.

Contact for questions: Larry Borton, Michigan State University Telfarm, 517-355-4700, bortonL@msu.edu.

Visit the Michigan Dairy Review Web site to read about other valuable dairy news including timely information materials at: www.msu.edu/user/mdr/

What’s Happening...
October -- December

Sand-Manure Separation System Open House at Nobis Dairy Farm
October 21
Time: 11:00 - 3:00.

The open house will feature a complete quarry-duty sand-manure separation system that captures 95% percent of the bedding sand for reuse in less than one week after separation.

Nobis Dairy Farm is located west of St. Johns, MI at 5813 West Walker Road.

For additional information, please contact:
Andrew Wedel via email: awedel@mclanahan.com or, Renee Schrift: rschrift@mclanahan.com
Phone: 814.695.9807

Acknowledgements
We are grateful to the Elwood Kirkpatrick Dairy Research Endowment, in association with Michigan Milk Producers Association, the College of Agriculture and Natural Resources and the Department of Animal Science at Michigan State University, for partially funding this research.
Can You Afford Ovsynch?

The average NPV of the group inseminated with standing estrus detection was $105.60 per cow. The average NPV of each cow allowed to go through the Ovsynch protocol increased to $165.40 per cow. Because of the increased conception rate the average NPV difference was $59.80 per cow in favor of Ovsynch, even though the medication and labor costs were higher.

In conclusion, dairy producers are currently reminded that cow profitability is critical, and that not all cows are equally profitable. The analysis in this report demonstrated the importance of conception rates over up-front medication costs for Ovsynch. This emphasizes the larger, but longer term impact of decisions you make today to decrease costs on dairy farms.

References will be provided upon request and are in the electronic version at the MDR Web site www.msu.edu/user/mdr/.

Table 3: Typical herd input parameters for the Cow Value model in DairyComp 305. ([Eicker and Fetrow (2003)].

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd Heat Detection Rate</td>
<td>20%</td>
</tr>
<tr>
<td>Herd Conception Rate</td>
<td>40%</td>
</tr>
<tr>
<td>Voluntary Waiting Period</td>
<td>60 days</td>
</tr>
<tr>
<td>Herd Average Days Open</td>
<td>130 days</td>
</tr>
<tr>
<td>Replacement Heifer Cost</td>
<td>$1600</td>
</tr>
<tr>
<td>Cull Value</td>
<td>$400</td>
</tr>
<tr>
<td>Milk Price $/cwt</td>
<td>$11.50</td>
</tr>
<tr>
<td>Cost of Marginal Feed</td>
<td>$4.00</td>
</tr>
<tr>
<td>Cost of Maintenance Feed</td>
<td>$2.00</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>10%</td>
</tr>
</tbody>
</table>

Lactation 1 Cull Rate 33%
Lactation 2 Cull Rate 33%
Lactation 3 Cull Rate 50%
Lactation 4 Cull Rate 50%
Lactation 5 Cull Rate 99%
Lactation 6 Cull Rate 99%
Lactation 1 305 Milk yield 22,000
Lactation 2 305 Milk yield 24,000
Lactation 3 305 Milk yield 26,000
Lactation 1 Persistency 96%
Lactation 2 Persistency 94%
Lactation 3+ Persistency 92%
Do You Have a Visitors’ Policy?

Ted Ferris  
Dept. of Animal Science

Dan Grooms  
Dept. of Large Animal Clinical Sciences

Animal production is an integral part of our food system in the U.S. As a country, we are blessed with abundant, safe food that is relatively inexpensive as compared to other countries. On the other hand, food safety and food security have become more important in the U.S. (1). As dairy producers, you are acutely aware of the contributions of animal agriculture to our society and the economy. Therefore, it is critical to continue to safeguard the livestock industry to protect the food we produce and our livelihoods.

One aspect that is becoming more important is reducing risk of disease entering livestock operations. There are numerous sources of common and foreign animal diseases and a number of potential routes that disease can enter our farm operations. Taking time now to understand routes of disease transmission and implement steps to control them will significantly reduce the chance of infectious diseases entering your operation.

A significant risk for transmission of common diseases to dairy and beef operations is through individuals and vehicles moving from one farm to another. Such diseases include Bovine Viral Diarrhea Virus (BVDV), cryptosporidium, salmonella, and Johne’s disease. Further, foreign animal diseases (FAD), such as foot-and-mouth disease (FMD), can also be unintentionally carried by visitors through global travel. FMD is endemic in Asia, Africa, Middle East and parts of South America (2).

Because visitors increase the risk factor of disease, livestock producers should consider all visitors (from the vet to the city cousin) as a potential source of disease transmission into their farm and take steps to reduce this risk. A starting place is to develop and implement a visitors’ policy that is clearly communicated to visitors and staff and enforced by all involved.

Visitors Are Welcome
The wording of a visitors’ policy and signs for visitors set the tone for all who visit your operation and may impact attitude and compliance. It is important to communicate expectations and at the same time make people feel they are welcome. In Michigan, a number of dairy and livestock farms provide tours for the public. So there is a need to balance the openness of your facilities with appropriate and responsible biosecurity measures to reduce risks.

Always keep in mind that we cannot eliminate all risk and that risk will increase with the number of visitors and their connection with other farms and recent global travel.

In today’s social and economic climate there is great value in having the public visit our farms. This is probably one of the best ways to reintroduce many consumers to their agriculture roots and reconnect them with the food system.

A farm visit can increase their awareness of food production. At the same time, a good visitors’ policy reminds your visitors that you deeply care about the health and welfare of your animals. And they can better appreciate your hard work to generate high quality food products.

The visitor policy also can assist you over time to quantify your farm’s risk. For example, the visitor sign-in log can let you know more about your visitors, especially if it contains information such as who and where they have been prior to visiting, e.g., other farms, other countries.

A Visitors’ Policy
Establishing a visitors’ policy for all visitors including vendor reps, veterinarians, and consultants, can reduce your risk from this route of disease transmission. A visitors’ policy states guidelines that visitors must follow when visiting your operation. Here’s an example:

Visitor Policy: The health and welfare of our cattle and the safety of the product they produce is of highest priority to us. To help protect our cattle and you, we have developed a visitor policy. Please follow these guidelines.

- Visitor hours are 8 AM to 5 PM.
- Do not proceed into facilities if you have been in another country in the past 7 days.
- Wear clean clothes. If you are coming from another farm, we ask that you do not come in contact with our animals if your clothes are soiled.
- Wear plastic boots or clean and sanitize personal boots.
- Sign our visitors log (over time this will help quantify a farm’s risk from visitors if it contains who and where they have been prior to visiting, e.g., other farms, other countries).
- Enter facilities at designated points.
- Please avoid areas marked “Employees Only” or “Disease Prevention Area” (such as our calf housing).
- Dispose of plastic boots or clean and disinfect personal boots prior to departure.
- Wash hands prior to departure and after disposing of plastic boots or sanitizing boots.
- Enjoy your visit - Thank you.

Note: A visitors’ policy is one of the farm gate biosecurity protocols incorporated in the Biosecurity STOP Sign Campaign that involves producers working with MSUE, animal industries and MDA to demonstrate a set of farm gate biosecurity measures. References are available upon request at the Web site (but not in print version).