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INSIDE THIS ISSUE:

Managing Microbial Inoculants for Silage

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Introduction

Microbial inoculants have been used to improve the fermentation of silages for many years. They help by encouraging a more efficient fermentation and by increasing the rate of acid formation. The later causes a more rapid decline in pH that spares plant protein from degradation and helps to suppressed undesirable microorganisms (e.g., clostridia). Inoculants must be managed properly for them to have a chance of being effective. This fact sheet will discuss ways to best manage your inoculants.

Maintaining the Viability

Bacterial inoculants are subject to death if not stored under proper conditions. Stories of people leaving bags or bottles open to moisture, or allowing inoculants to become over heated during storage are real. Did you know that a partially open bag or bottle of inoculant placed in a freezer or refrigerator will not preserve the viability of the inoculant? If you intend to store unused product this way, it needs to be in an airtight and moisture resistant container. Follow correct storage recommendations based on the manufacturer's instructions.

The temperature of the water in the application tank can affect the viability of your inoculant. Research from our lab has confirmed that lactic acid bacteria used in inoculants are less likely to remain viable when the temperature of water is above 95 to 100°F. In applicator tanks sampled in the field, the amount of expected viable bacteria sampled from tanks with temperatures about 100°F was only 50% of the required viable bacteria needed to meet the recommended application rate. When the water temperature in tanks was greater than 110°F, they contained only 10% of required live bacteria. Of more than 50 application tanks that were sampled, about 22% of them had water temperatures of 90°F or greater. The most common reason for high water temperatures in applicator tanks was due to gaining heat from the engine or exhaust of the chopper. Users are encouraged to monitor the temperature of water in their tanks and if they are found to be high, to take appropriate measures to correct the problem. If moving the tank is not an option, ice packs can be used to cool the water.

On average, bacteria mixed in water are stable for about 48 h. Anything that was mixed and unused after 3 days should probably be discarded. If you notice foul smells or slime in the tanks, discard this material and thoroughly clean the tank and lines before reusing. Cleaning should include the use of a mild cleaning agent but thorough rinsing is required to avoid any detrimental effects of a cleaning agent on the viability of the inoculants.

Microbial inoculants that sit in applicators for dry applications (e.g a Gandy applicator) also most likely lose viability if they become over heated and if storage is longer than a few days.

Form of Application

A commonly asked question is: "does the form of application affect how well my inoculant will work?" The answer to this question is, "it depends". Research from my lab showed that both a dry granular and liquid application of a commercial silage inoculant were equally effective in improving the rate of fermentation of alfalfa with 30% DM. When wilted to about 40 to 50% DM, both forms of inoculation also stimulated the fermentation process when compared to untreated silage. However, the liquid-applied inoculant caused an even faster decline in pH than did the dry-applied inoculant. German researchers reported similar results on grass silage with a DM content of about 40%. These results occurred because bacteria applied in a dry form rely solely on moisture on the crop for reactivation. Thus, it takes longer for the bacteria applied in a dry form to revive, resulting in a slower rate of fermentation than with bacteria applied in water. If all other things are equal, apply an inoculant that has been mixed in water to forages that are ^{3} 40% DM. Low volume liquid applicators are available that require less refilling of application tanks.

Location of Application

Another question often asked is: "does the location of applying an inoculant make a difference on its effectiveness?" If silage is to be stored in a bunk, pile or pit silo the inoculant should be applied at the chopper, which should result in the best distribution of the product. It would be extremely difficult to evenly distribute an inoculant at these types of silos because bacteria cannot move within the pile by themselves. Research from my lab has also shown that distribution of a silage inoculant was more even when applied at the chopper versus when being poured onto the top of forage in the wagon prior to filing in a bunker silo. Some distribution occurred during tractor movement and packing, but it was very uneven throughout the forage mass. For silages that will be stored in a tower or bag silo, application at the chopper or blower/bagger will probably be equally efficient. (If your forage is harvested and chopped far away from where it is ensiled, it would be preferable to have the inoculant applied at the chopper so that the microorganisms can begin their work right away.)

Miscellaneous

Applicators should be properly calibrated to match application rate with forage delivery rates. Checking inoculant use with tons harvested should be calculated at least once if not more times during the day. It is unwise to reduce the recommended application rate in order to treat more tons.

Bacteria are sensitive to high levels of chlorine or peroxide in water. Be sure that the water you use is safe. Tanks and lines should be cleaned regularly to prevent the build up of unwanted pollutants and bacteria. Never add sugar, molasses or other substance to the water of the inoculant mix. Inoculants should never be mixed in hot water.

Dry Cow Mastitis and Strategies Designed to Reduce the Risk of New Intramammary Infections (IMI) during the Dry Period.

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Introduction

The dry period has been historically recognized as the pivotal time for restoration of intramammary health through resolution of pre-existing intramammary infections (**IMI**). Research over the past 2 decades has clearly determined the dry period is also an important time during which intramammary infection occurs. Thus, the prevalence of IMI in the dry period cows is really a balance between (1) end of lactation cows entering the dry period with contagious and environmental IMI, (2) cure rates of IMI during the dry period and (3) acquisition of new IMI during the dry period. Epidemiologically, the dry period is an important contributor to herd problems with contagious, major intramammary pathogens, environmental pathogens and minor pathogens of mastitis. In all cases *intramammary infection during the dry period leads to lower productivity in succeeding lactations with increased incidence of clinical flare up during the first 100 DIM in the next lactation.* Intramammary infection is common during the dry period with major mastitis pathogens being isolated from as high as 50% of dry cows (Green et al., 2005).

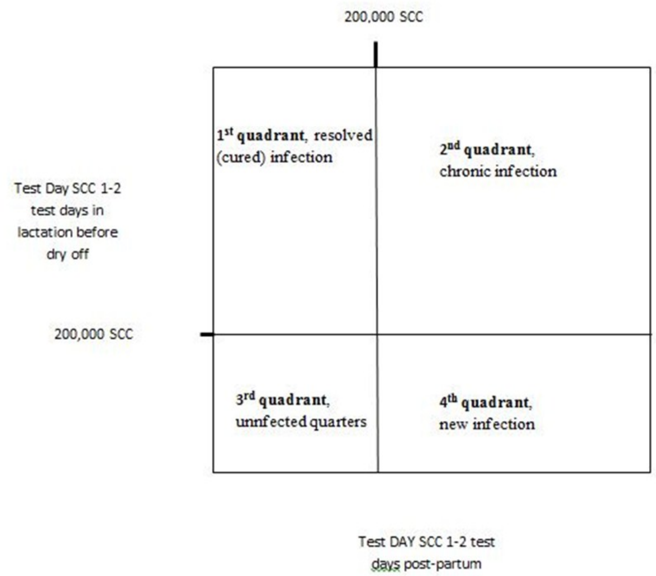
IMI during the lactating period directly impacts the prevalence of dry cow IMI because persistent infections across lactation show up upon entry into the dry period. IMI spreads through the lactating herd via several widely recognized routes. Clearly, milking procedure management is a key contributor to the incidence of contagious as well as environmental pathogen transmission. Wearing gloves, application of pre- and post-milking dipping procedures, and timely, proper claw and vacuum maintenance critically impact incidence rates. Indeed anything that increased callous formation on teat ends was associated with high incidence of contagious IMI (Dufour et al., 2012). Wearing gloves has been proposed to be one of the most crucial components of milking technique because the number of *S. aureus* organisms on gloves is likely to be much lower than numbers on the skin of milking personnel. Pre-milk dipping likely controls both environmental and contagious pathogen transmission (Dufour et al., 2012a, Dufour et al. 2012b, Dufour et al., 2011, Piccinini et al., 2009). Factors such delayed or inappropriate milk let down, inadequately maintained and adjusted automatic take offs, vacuum fluctuations or inappropriate vacuum levels or personnel distraction that prolongs milking time predisposes teat ends to extensive callous formation. Stall beds of cement or sand rather than rubber or mattress were associated with lower prevalence of IMI. Management factors associated with increased incidence of IMI transmission of contagious pathogens are milking personnel not wearing gloves, overcrowding during the first 1-60 days in milk (DIM), lack of a culling program based upon repeated clinical flare-ups from a contagious IMI.

There are environmental pathogen challenges to both lactating and dry cows. These pathogens are endemic in the cow's environment and therefore present a constant threat to the mammary gland. Environment also impacts IMI problems by reducing immune resistance through enhanced stress, increasing the likelihood of teat skin-streak canal contact with environmental pathogens, and enhancing environmental loads of intramammary pathogens by providing moisture and temperatures that sustain microbial growth and viability. Interestingly, the environmental effect may be both parity and stage of lactation-dependent. Environments that appear safe for 3rd and greater lactation animals may increase prevalence of IMI in first parity heifers. Dufour et al, (2012) speculated facility design and management practices in the future may have to be adjusted to the cow rather than the cow being asked to adjust to the environment.

The *dry period* is an important time during which IMI are acquired while pre-existing IMI are eliminated. The most important dry cow IMI challenge is from environmental pathogens like the enterobacteria and environmental *Streptococci* sp. These challenges typically occur with greatest incidence very early and then very late in the dry period. Acquisition of these new IMI in the dry period often results in clinical flare ups during the first 60-100 DIM in the next lactation. The most common pathogens isolated are *Escherichia coli*, *Streptococcus uberis, Streptococcus dysagalactaie, coagulase negative Staphylococcus. epidermitis* and the contagious, coagulase positive *Staphylococcus* sp. Thus, with the exception of coagulase positive *Staphylococcus* sp., a high proportion of major pathogens involved in dry cow infections tend to be environmental bacteria.

Assessing Dry Cow Status and Challenges

Preventing new IMI and eliminating pre-existing IMI during the dry period is a key element in herd mastitis control programs. Dry cow IMI that persist into the next lactation contribute directly to elevated bulk tank SCC. Bacteriologic culture pre- and post-dry period remains the gold standard for assessing efficacy of dry cow management programs. The problem with bacteriology is the method is labor intensive and costly. Since SCC can serve as a surrogate for IMI however, assessing SCC at dry off and SCC after freshening can serve as a proxy for monitoring dry period management schemes. Indeed, 200,000cels/ml of composite milk sample from all 4 quarters can be utilized as the threshold indicator for the presence of IMI in the dry period (Cook et al, 2002, Dufour and Dohoo, 2012). The tool depicted in figure 1 can be extremely helpful in determining success or failure in the dry cow programs. Cows with paired SCC locating them in the 1st quadrant represent IMI cures during the dry period. Cows with paired SCC locating them in the 2nd quadrant represent existing IMI's not cured or existing IMIs cured but followed by another new IMI during the dry period. Cows with paired SCC locating them in the 3rd quadrant are cows with complete prevention of new IMIs. Cows with paired SCC locating them in the 4th quadrant represent cows with newly acquired IMI's during the dry period. Moreover, herds struggling with a high prevalence and incidence of contagious coagulase positive *Staphylococcus aureus* IMI could be expected to see high bulk tank SCC coupled with persistently high SCC in consecutive test days across lactation. Since major contagious IMI pathogen like *Staphylococcus aureus* resist resolution even in the dry period, many animals in these herds would be expected to reside in the 2nd quadrant of figure 1.



Other tools that can be employed to assess outcomes of the dry cow program are to record the incidence or prevalence of clinical IMI occurring during the first 30-60 DIM. A high incidence of environmental pathogen mediated clinical IMI in this period is often associated with acquisition of environmental IMI during the dry period (Bradley and Green, 2000, Green et al., 2002a). Alternatively, high numbers of cows residing in the 2nd quadrant could also occur because of a great deal of IMI pathogen resistance to the antimicrobial employed in the dry treatment. A strategy to address this type of problem would require updating the bacterial cultures and sensitivity patterns for the IMI.

Dry Cow Programs

Blanket dry cow therapy : The aims of blanket dry cow therapy are (1) resolution of pre-existing IMI and (2) prevention of new IMI during the dry period. Although cures of pre-existing IMI still play a role in lowering SCC, in many herds, preventing new IMI during the dry period has emerged as the main strategy behind blanket therapy. Although public concern over the blanket use of antimicrobials may eventually limit these programs, there is little doubt intramammary antimicrobial therapy in the dry period lowers the risk of new IMI during the early dry period. Awareness of the role of more than one microbial pathogen in dry cow mastitis is an important element to consider during decisions about antimicrobials best suited for the herd dry cow program. Recognizing the relative incidence and prevalence of pre-existing versus newly acquired IMI at dry off can affect dry cow antimicrobial selection strategies. Knowledge about the dominant organism(s) involved in pre-existing IMI and newly acquired IMI during the dry period provide added scientific basis for antimicrobial selection. Antimicrobials targeted toward environmental Streptococci may not be well suited against gram negative environmental enterobacteria. Antimicrobials selected to prevent new IMI during the early dry period (environmental streptococci and enterobacteria) may in turn not always be best suited to resolve coagulase positive, contagious IMI due to *Staphylococcus aureus*. Information about the relative importance of contagious IMI during lactation, and environmental IMI during the lactation and dry periods impact dry cow antimicrobial strategies. Moreover, knowledge of antimicrobial sensitivity pattern (s) of the dominant organisms involved in IMI in the herd will augment appropriate dry cow antimicrobial selection. Thus, clear identification of goals, the patterns of IMI and the sensitivity of major and minor IMI pathogens help form the correct dry cow antimicrobial selection.

One drawback of blanket antimicrobial therapy during the dry period is the lack of antimicrobial persistence in the intramammary tissues. Dry cow formulations are generally designed to sustain antibiotic levels by preventing systemic absorption while providing slow release into the gland. Most dry cow antimicrobial preparations provide sufficient antimicrobial activity for 4-6 weeks into the dry period. Accordingly, during the late colostrogenic phase of the dry period, when the second wave of IMI infections occurs, there may be insufficient dry cow protection in programs based solely upon blanket antimicrobial therapy.

Teat sealants provide added technology to drive dry cow program success. Sealants are available as external or internal sealants. External sealants produce a physical barrier that coats the outer skin of the teat end and streak canal. These products tend to be short lived on teat ends as they fall off by 10-14 days post dipping. Accordingly, one time use at the time of dry off provides protection during the early dry period when there is a high incidence of newly acquired environmental dry cow IMI. In the absence of intramammary dry cow antimicrobial therapy and reapplication of the external sealant, cows remain vulnerable to IMI during the late dry period. Thus, frequent reapplication is warranted with external teat sealants.

Newly developed internal sealants generate physical barriers within the teat cistern and streak canal by formation of plugs in the teat cistern following intramammary application. These products provide a persistent, sustained barrier to IMI across the entire dry period. This provides relief from barrier loss associated with the external sealants. The advantage of both sealants is they eliminate concerns about antimicrobial residues and the inevitable antimicrobial resistance generated by use of intramammary antibiotics (Mollenkopf et al., 2010). Many studies documented combinations of teat sealants and dry cow antimicrobials reduced newly acquired IMI in the dry period by as much as 20-60%. In addition, pre-existing IMI at the time of dry off can experience cure rates as high as 90%. These effects carry over into cost effective reductions in newly detectable IMI in the first 60DIM of the next lactation (Petrovski et al., 2012, Berry and Huxley, 2007). Because sealants only provide barrier function and do not increase intramammary antimicrobial function in the dry period, these products only reduce acquisition of new IMI by environmental pathogens during the dry period (Mutze et al., 2012). Thus, any anticipated reduction in pre-existing IMI at the time of dry off would be unfounded. Use of sealants to resolve pre-existing contagious major pathogen IMI by bacteria such as coagulase positive *Staphylococcus aureus* would likely result in little success unless accompanied by antimicrobial therapy. Indeed, combined treatments with internal teat sealants and antimicrobials in cows with high SCC at dry off enhanced dry period cure rates and reduced the incidence of clinical mastitis in the first 100 DIM in the next lactation (Newton et al., 2008, Bradley et al., 2010). Beneficial effects of this combine treatment on cows with low SCC before dry off were not quite as obvious. Rational dry cow programs based upon scientific input;

Bradley et al. (2004) proposed dry cow programs be designed to address (1) resolution and/or treatment of pre-existing IMI at the time of dry off and (2) prevention of new infections in dry off . Treatment of pre-existing infections requires selection of an antibiotic with activity against the most prevalent pathogen in the herd. This data can be assembled from culture and sensitivity records of samples from acute flare-ups or cows and/or cows with persistently elevated SCC (>200,000) across several test day samples within 100 days of dry off. Alternatively, others suggested cows with contagious IMI could be reliably identified as (1) 3 test day milk sample SCC >200,000 with no history of contagious IMI during the lactation or (2) a history of contagious IMI early (<90DIM) in the lactation with SCC >100,000 in test day milk samples afterward (Torres et al., 2008). Persistent elevation of SCC likely stems from major environmental *Streptococci* sp. or the coagulase positive *Staphylococcus aureus*. Many times the dry cow drug of choice would be penicillin, cloxacillin, or cephalasprin. However, evidence based approaches to dry cow antimicrobial selection should be driven entirely off retrospective culture and sensitivity data. Selection based upon the major enterobacteria pathogen, Escherichia *coli* is not likely to be necessary in most cases because this pathogen is often eradicated from udders at the time of lactation flare up or during self-cure in mid-dry period. . Successful strategies to eradicate persistent pre-existing IMI should also include the integration of well-designed culling programs into the management scheme. Older parity cows with > 3 flare ups in a single lactation, with more than 1 quarter IMI and SCC persistently >200,000 cells/ml over several test day milk samples should become cull rather than treatment candidates. Other factors rendering these cows into the cull cow pool should be high bulk tank SCC, high prevalence of *Staphylococcus aureus* and a high IMI rate determined as SCC>200,000 cells/ml at the time of dry off.

Green et al., 2002 and Bradley et al., (2002, 2004) also stressed a successful dry cow strategy should include a program designed to prevent acquisition of new IMI in the dry period. As mentioned earlier, these IMI are most often due to environmental *Streptococci* sp. and minor pathogens like coagulase negative *Staphylococcus epidermidis*. The ideal choice of dry cow agent would be any preparation based upon retrospective sensitivity data on these organisms or a long acting antibiotic with activity against gram positive organisms (e.g. pennicillin, cloxacillin, or cephalosporin). In addition, frequent application of external teat sealants (minimally at the beginning and end) in the dry period will further prevent new dry cow IMI. Alternatively, use of an internal teat sealant at the time of dry off should be employed to establish a sustained barrier against acquisition of a dry cow IMI.

Conclusion

The dry period offers an enormous opportunity to deal with contagious mastitis pathogens, reduce bulk tank SCC and improve production. This period however, can also increase the risk for new intramammary infections attributable to environmental pathogens. Indeed, earlier control programs for mastitis have reduced the problems with contagious mastitis pathogens but failed to address the acquisition of new infections during the dry period. As a result, problems with environmental pathogens have increased in herds. Susceptibility to these new environmental pathogen infections is highest on either end of the dry period. Environmental, cow and quarter factors also greatly impact the outcome of intramammary challenges during the dry period. One of the major costs of successful infection during the dry period is increased prevalence of clinical mastitis flare up during the first 100DIM in the next lactation. Dry cow IMI also elevate quarter, composite and therefore bulk tank SCC. Strategies to control IMI during the dry period should be directed toward increasing cure rates for pre-existing IMI at the time of dry off, while establishing a sustainable streak and teat end barrier to prevent new IMI during the dry period.

References upon request.

ADVANCED AG SYSTEMS'S
Crop Soil News

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What a difference a year makes!

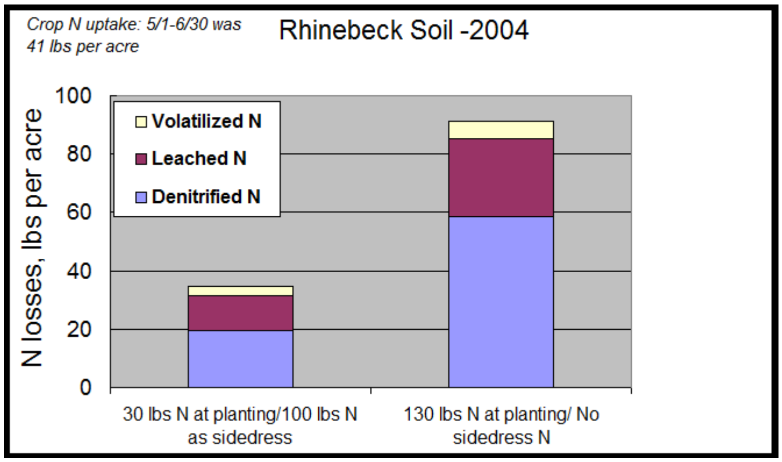
Last year we had several heat waves and the season was running record early. This year the season is running right on the 30 year average – something it hasn't done in a while. Skipping the political science and going to the real science, the Pacific Ocean has a multi-decade swing between warmer than average and cooler than average. It has recently swung to cooler than average which is one of the reasons we did not have an El Nino winter as some were predicting (El Nino is warmer than average Pacific waters). The other 500 pound (226.8 kilo's for our metric readers) gorilla in the room is that the Atlantic Ocean also has a multi-decade swing that is slightly shorter and off cycle from the Pacific. It has switched to a warmer than normal cycle which is why Hurricane Sandy did not get weaker but rather strengthened as it came up the coast. Both of these new cycles have some time to run and we will need to deal with the resultant shift in the weather from what we are used to (the new normal). Getting used to the extremes and adopting cropping systems/ rotations that reduce risk, is going to be critical for producing sufficient high quality forage to support the high forage diets that give our farmers the competitive edge.

Working with farmers over the past 35 years has shown that some go through wild forage supply swings that they blame on the weather. Right next to them another farmer will have the same weather but because they follow a strict rotation, manage to have sufficient forage of high quality. The difference is in the rotation that many give lip service to but few follow – except the latter group that does well in any weather.

The first, and most critical factor in rotation is that **THE SOILS DRIVE THE ROTATION WHICH DRIVES WHAT THE COWS ARE FED.** Some of your farms are flat and uniform. Most are variable in soil type with some in extreme from excessively well to poorly drained. Cows can be fed a wide range of forages from all hay crop to all corn silage as long as it is highly digestible. The question is what high quality forage will the soils on your particular field produce the best under a sustainable, economical rotation? We get criticism for messing with winter forages, sorghums, and red clovers, yet each could be the best crop depending on the field/soil type/weather condition you are working under. By diversifying the crop but still producing quality forage, the weather risk from all your eggs in one basket, is greatly reduced. In the wet spring of 2009, farmers growing winter triticale found that they could get on those fields to harvest an early crop, spread manure, and plant corn because there is 60% less available water under a winter forage in the spring, com-pared to bare soil. In the drought of last year, those experimenting with the new short season forage sorghum found that an inch of water produces 0.84 tons of corn silage while that same inch produces 1.76 tons of BMR sorghum. On deep well drained soils, alfalfa will keep producing as it taps the deeper moisture. On poorly drained soils in a short rotation, red clover will produce as much or more than a good alfalfa yet have potentially higher forage quality. The point is you need to optimize the crop choice for each field and HAVE A WRITTEN PLAN FOR THE NEXT 5+ YEARS. If it is not written, then you are not rotating as the years easily slip by. The bigger the farm the easier the slip from sheer numbers. Yes, you can change the plan based on a number of factors (stuff happens), but with a plan you are always moving forward.

The other key factor is knowing what you are working with. We don't try to feed cows without a forage analysis but each year millions of acres are guessed at for soil fertility. Our zinc deficiency last year made the drought impact that much worse. If you are not soil testing the entire farm every other year, then you are guessing.

Neither of these factors are immediate tools for dealing with the cool and wet weather (for the majority of our readership area) of this spring. They are critical for long term survival and profitability of your farm. We have been through this weather before and know what works and what does not.



The biggest "does not" is to mud in a crop in a desperate attempt to "plant something somewhere." I have seen many examples of this and they are all disasters. The yield loss in corn for being slightly late is far less than the 14 – 27% yield loss from soil compaction. There is even greater loss from planter compaction squishing the seed in instead of placing it in an optimum soil condition. With duals you can get over soils that **should not be driven on**. That compaction yield loss will stay for that and many seasons after. If you are getting very late and the top couple of inches are now dry enough to till, no-till may be your safest bet for getting a crop. Other techniques are to run an aeration tillage tool at a 5 or less degree angle to just crack the soil and let it dry faster (the risk is cracking the soil and then getting a heavy rain, which will mean more will soak in – I never said my suggestions were risk free!). Moving to a one pass till-age system is one of the biggest gains you can make. A deep zone system with a rolling basket allows for tillage followed quickly by the planter. Our deep zone tilled fields are running 10 degrees warmer than the non–tilled. If the lower soil layers are too wet, you will just make a smeared mess so raise the unit to just work the friable soil in the top 6 – 8 inch level. This same process can be used with chisel plows. More farmers, especially those who are nearly all corn silage, are using narrow shanks (2 inch instead of 4 inch) and pulling a good leveler behind for a true one pass sys-tem. For wetter fields, they put the stops in and only work the shallower friable ground. This is not ideal but is better than working deep in wet soil to make a lumped, compacted, smeared mess; or to delay planting even further and take a yield hit as you get way past optimum planting window time.

Another step you can take is to **NOT** put all your nitrogen on with the herbicide at planting time. Nitrogen is critical for successful production of profitable crops. Corn uses only 10 to 20% of its total nitrogen in the first 6 weeks. The crop will need about 30 lbs of nitrogen in this time period. Any additional nitrogen for the rest of the season will sit there until it is used by the plant; or is lost by denitrifying or leaching. **In a wet year** applying all the **N at planting** (with herbicide**), 70% of the N was LOST** by the end of June (see graph at right). If it was sidedressed, it **was SAVED for the crop to use**. $75 to $100/acre in nitrogen is too expensive to throw away. Sidedressing can change that. It only costs around $10/A for custom sidedress dry urea or slightly more for liquid nitro-gen dribbled between the rows. If you want to do it yourself, you can use a herbicide sprayer and drop pipes to dribble on solution (20 ft wide sprayer can do 10+ acres/hour). Spinning on urea just before a rain (use an anti-volatilization agent) can cover 15 to 20 acres/hour. The time for doing this is when the corn is about a foot high. **This occurs in mid June when ALL your milk cow feed should be in storage for 2 weeks already**-so the excuse that I have to make haylage doesn't count.

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