"Novel Approaches to Manure Application in No-till "

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The webcast is archived at:
http://www.extension.org/pages/Manure_Application_in_No-Till

What is the lowest temperature that manure can be applied with no-till?

Beegle: There is no minimum temperature that manure can be applied to no-till. If late fall or winter manure application is necessary and allowed, spreading late to fields where there is low potential for runoff, and when soils are cold can be beneficial because there will be little microbial activity and thus little mineralization and nitrification. The cold tends to stabilize the manure and reduce the amount of the more mobile forms of N, particularly nitrate N in the field over the winter. Realize that as the weather warms in the spring these microbial processes will start up and the manure nutrients will become more available and mobile. For this reason, having a cover crop that also begins to grow as the weather warms can capture these available nutrients and hold them against loss.

Are there any adverse effects to the soil structure with chisel plowing and disking?

Beegle: Tillage often negatively affects soil structure by breaking down soil aggregates. Also, tillage can compact the soil. This is especially a problem with a heavy disk where the weight is concentrated on a very small area at the bottom of the disk.

Ketterings: In addition, the more aggressive the tillage operation, the more horsepower and fuel is needed.

Are odors a concern with manure application on no-till?

Beegle: Anytime manure is surface applied there is the potential for significant odor from the application. If tillage is done immediately following application or the manure is directly injected, this dramatically reduces odor. In no-till, manure is surface applied and can cause odor concerns. However, in many cases even when there is tillage incorporation, it is done several days or more following application. In this case odor is just as much of a concern as it is in no-till.

Ketterings: Odor issues will be greatly reduced when manure is mixed with the soil shortly after or during application. This can be done with various forms of tillage or injection. Manure is an excellent source of nutrients and organic matter. Odor emissions can limit manure application, so addressing such odor issues can results in greater use of manure nutrients and that benefits the farm operation (less reliance on inorganic fertilizers, maintenance or even buildup of soil organic matter with manure addition, depending on its solids content).

Is the slope of the land a concern regarding manure application in no-till? What are the maximum slopes on which application is permitted?

Beegle: Slope is a concern with manure application. Generally, the greater the slope, the greater the potential for runoff. This can be manure itself running off the field or rainfall running off the field carrying nutrients from the manure. Regulations on allowable slopes for manure application would vary from state to state. In general, the low disturbance application methods talked about here will reduce the potential for runoff of manure on sloping land. Injected manure cannot run off the field and rainfall runoff should not be in direct contact with injected manure thus reducing the nutrients that could be carried off the field in the runoff.

Ketterings: There is no limit on slope for application of manure (other than obvious limits posed by the practicality of such applications). Application rates and timing are capped by the P-index which includes an assessment of the total amount (source) and transport risk (determined by soil erosion, flooding frequency, distance to streams, presence of concentrated flows etc.).

Was the 6,000 gal per acre according to agronomic rates and soil tests or to replicate the need for producer to avoid over topping of their lagoon?

Beegle: The rate used in the PA low disturbance manure incorporation research (6000 gal/A Dairy Manure) was an agronomic rate determined based on the actual manure analysis and meeting the N needs of the corn crop assuming N availability with immediate incorporation. This same rate was then used for all systems studied even though a higher rate would be recommended for some of these other systems.

Ketterings: In New York, we used a 7000-9000 application target to meet agronomic N needs and limit P application.

Do you have any experience with Detrich injectors?

Ketterings: We have a trial in place this year with multiple rates. The injectors work well. The question is: What are the nutrient benefits of the manure as a function of timing of application and rate of application?

Are we hurting soil structure when using Detrich injectors?

Beegle: Any soil disturbance has the potential to destroy soil structure. Thus any injection or mechanical incorporation will potentially harm soil structure. The amount of harm is determined by the aggressiveness of the tillage and the soil conditions. There will be more harm when the soil is wetter.

Ketterings: As Doug indicated, any soil disturbance will cause some change in soil structure. In some situations this might be good (i.e. breakup of compacted layers, breakage of preferential flow paths that can conduct manure and fertilizer nutrients to groundwater). With injectors, such disturbance will be minimal.

Do the economics include the cost of equipment and cost to return?

Beegle: The economic analysis in the PA low disturbance manure incorporation research was done using the Integrate Farming Systems Model developed by Al Rotz with USDA-ARS at University Park. This model integrates the manure systems into the whole farm system. This includes the cost of purchasing the equipment, the operating costs including labor, maintenance costs, other economic impact that using these systems might have on the bottom line for the whole farm.

Ketterings: In the aerator versus chisel incorporation comparison in New York, the aerator was less expensive to run due to lower fuel costs and ability to incorporate manure with a lower horsepower tractor.

Perhaps the greatest benefit of manure application on no-till is reduced erosion. Is this correct?

Beegle: I am not sure reducing erosion is the greatest benefit, but it is true that surface application of manure in no-till, particularly bedded manure, does increase surface residue and thus can help reduce erosion.

Ketterings: Manure contains all macronutrient and micronutrients. It is a tremendous source of nutrients that stimulated microbial activity as well. Fields with a manure and/or compost history tend to be more resilient, meaning that manured fields can sustain crop production better under extremes in weather conditions (drought and extreme wetness).

Was all the runoff data collected under rainfall simulators with intense rates? The losses seem high for the controls.

Beegle: The runoff data in the PA low disturbance manure incorporation research was done using the WEPP rainfall simulator. The rainfall intensity was 2.5 in/hr. This high intensity rainfall will increase losses. In this specific research, there was some residual surface compaction which resulted in relatively high runoff from the control plots. The minimal disturbance from the injectors and the surface application of manure in the treated plots dramatically reduced the runoff in general.

Any recommendations on maximum axle weight loads?

Beegle: The standard recommendation for maximum axle loads is to keep loads less than 10 tons per axle. Axle load determines the depth of compaction. Axle loads above 10 tons per axle often result in compaction deep in the soil below where tillage or natural freezing and thawing can alleviate the compaction. The other factor that affects compaction is the tire pressure which mainly impacts surface compaction. Using low pressure flotation tires and keeping tires inflated to the lowest allowable pressure will help reduce this surface compaction.

Would feed ration changes help manure characteristics be better applied for water quality protection?

Beegle: Certainly, feeding changes can influence the nutrient content of the manure. The less manure nutrients applied, the less potential there is for nutrient loss to the environment. Examples of this include using phytase in swine and poultry feed. The increased availability of grain P to the animal allows for reduced P supplementation. This can reduce manure P by as much as 40 percent. Also, P can often be reduced in dairy rations. Generally any P fed in excess of recommended levels ends up in the manure. Thus reducing dairy ration P to recommended levels can dramatically reduce manure P and thus the potential for nutrient loss to the environment when the manure is spread.

Ketterings: Of all nutrients imported onto a typical dairy farm in New York, about 60-80% is in the form of feed. It is also not surprising that precision feeding that reduces the P in rations will have a drastic impact on P excretion (and similar for nitrogen). In New York, we have seen a drastic decrease in P excretion as results of a reduction of P in rations (a 40% reduction across the state). As a result of precision feeding, precision fertilizer management that reduced P fertilizer use by 25% over the past several years, and an increase in crop yield, New York State is now in P balance. Without precision feeding this would not have been possible.

What would be the ammonia loss from surface spray application (splash plate) versus direct application on the ground?

Beegle: We have not studied this particular comparison in our research but direct application on the ground such as with trailing hoses typically reduces ammonia loss compared to broadcast application.

Ketterings: We don't have data on this either but direct application on the ground will no doubt result in reduced ammonia loss.

Are there isolation distances for manure application from wetlands and streams?

Beegle: This varies based on state regulations. Many states do have a manure application isolation distance from wetlands and water bodies. In PA, we have a 100 ft manure setback distance unless there is a permanent vegetated buffer protecting the stream.

What are the limitations regarding manure application in areas of seasonal high water tables?

Beegle: Seasonal high water table can have several impacts on manure application. High water tables can result in greater runoff volumes which can increase the potential for loss of manure nutrients in this runoff. A shallow water table can be more vulnerable to leached nutrients.

Ketterings: The NY Phosphorus Index governs limitations to manure application. This takes into account assessment of the total amount (source) and transport risk (determined by soil erosion, flooding frequency, distance to streams, presence of concentrated flows, etc.

Have you done any research with drag hose applications?

Beegle: Here we are referring to systems where the manure is delivered to the applicator by a hose. In PA we have not done any work with drag hose systems. This would not affect the results from the applicators that we have tested because that is just a method of delivering the manure to the applicator. Drag hoses have the potential to reduce soil compaction because there are no large tanks being driven over the field. Also, these systems can speed up application because the manure is continuously being supplied to the applicator through the hose.

Ketterings: We did some initial field testing of the drag hose application system this summer (alfalfa) where we compared with and without application. Drag hose systems are more and more used in New York to reduce compaction; it is a very effective approach to compaction risk reduction.

The question on drag hose are you referring to umbilical systems or trailing hoses behind the tank?

Beegle: These are two very different things. The drag hose that we were talking about is an umbilical system where manure is delivered to the applicator by a large hose that is dragged behind the applicator. This hose may be fed directly from a manure storage or from nurse tanks that haul the manure from the storage to the field. Trailing hose systems are application systems where the manure is applied to the soil surface by hoses that drag behind the applicator and apply the manure on the surface in a band. Banding manure with these trailing hoses can reduce volatilization compared to broadcast spreading. Also, the trailing hoses are often used to apply manure to hay fields because the hoses will usually apply the manure under the vegetation thus reducing contamination on the foliage.

Ketterings: Most commonly seen in New York is the umbilical system with or without the use of in-field frac tanks (tanks that typically hold about 20,000 gallons of manure and are used to supply the drag hose).

About the new forage applicator shown in the video - What type of an opening is created? Is it closed after the machine passes?

Ketterings: The applicator has disks that create an opening in the soil in which the manure is deposited. There is some surface exposure but this application greatly reduced odor issues and limits surface exposure of manure.

Where can we find the design specs for the ARS Subsurfer?

Pote: We are still completing the patent process, and have not yet published design specs for the Subsurfer. BBI holds the license to manufacture the Subsurfer technology, and the original specs are currently being modified for the production of the new prototypes, but they are not available publicly at this time.

What's the spelling of the company the subsurface applicator is licensed to?

Barron & Brothers website: http://www.bbispreaders.com/

Do you recommend a maximum number of subsurface manure applications on hay/pasture per year? Is there a point where injection will damage the roots system and the producer will see decreased yield?

Pote: In our research, we have made one subsurface application per year on pasture and hay fields, so we do not have the data to make a solid recommendation regarding multiple applications in the same year. However, we suspect that the frequency a pasture could tolerate without negative impacts would depend largely on the type of forage. For example, most grasses could probably tolerate applications every two or three months, but bunch grasses might see decreased yield with more frequent applications, while bermuda grass could probably thrive with monthly applications. One advantage of subsurface application is the longer residual effects of the nutrients, so subsurface nutrient applications may not be needed as frequently as surface applications to achieve the same production levels. In fact, our research has shown that the second hay cutting is when the subsurface application significantly increases productivity compared to an equivalent surface application of nutrients.

The subsurface applicator appeared to have a ripple coulter on the front followed by double disk opener. It seems like a rippled disk would do more damage to sod than a straight edge disk. Was there a strategic reason for using a rippled coulter?

Pote: In relatively dry soils, the rippled coulter makes it easier for the double disks to open the 5-cm wide trench needed to deposit bulky organic amendments such as poultry litter; but as the photographs indicate, only a minor percentage of the sod is damaged in the process.

What was the application rate for litter applied by the Subsurfer & what is the disc spacing (injector spacing) on the subsurfer?

Pote: The application rate was approximately 6 Mg/ha, but we have sometimes applied rates as high as 9 Mg/ha. The spacing between trench openers is 12 inches on the current prototype, but we are designing new Subsurfer prototypes with the spacing reduced to 9.5 inches.