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Residue management and manure application

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Abstract
For producers using conservation tillage or no-till, it's important that every field operation leaves the maximum amount of residue cover on the soil surface. As a reminder, conservation tillage is defined as any tillage practice that would leave a residue cover over the soil surface of at least 30 percent or more. Complete residue cover reduces erosion 95 to 98 percent, compared with unprotected soil depending on type of residue (see Iowa State University Extension publication PM 1901a, Residue Management and Cultural Practices - Resources Conservation Practices).

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Complete residue cover reduces erosion 95 to 98 percent, compared with unprotected soil depending on type of residue (see Iowa State University Extension publication PM 1901a, Residue Management and Cultural Practices - Resources Conservation Practices [1]). The effectiveness of residue cover also depends on the uniformity of residue distribution over the soil surface. Avoiding or minimizing disturbance of the soil's surface is an important objective of no-till or conservation tillage. Keeping this objective in mind during manure application in particular, or while applying any injected fertilizer in general, is very important.

Nutrients: the environmental issue

Environmental and nitrogen (N) use efficiency concerns need to be considered along with manure application regardless of the tillage system type. Manure injection is a very effective method, compared with broadcast, in reducing ammonia volatilization where a significant percentage of N in liquid manure is in the form of ammonium, which ranges from 70 to 90 percent, depending on the type of storage system.

Putting the two together: residue and manure

The reduction of residue cover on the soil's surface during liquid manure incorporation comes from turning over and burying crop residue and disturbing the soil surface. Therefore, producers should look for a balance between injecting liquid manure for high N availability, the environmental benefits of incorporation, and maximizing the benefits of no-till and other conservation tillage systems.

Liquid manure application with a knife in corn residue.

Enlarge [2]

Liquid manure application with a narrow knife in soybean residue.

Enlarge [3]

Producers also should explore the efficiencies of using manure injection equipment as another form of tillage to maintain residue on the soil surface. For example, manure application can be substituted for other tillage practices. Another way of minimizing the loss of residue during liquid manure injection is to change the amount of soil disturbance by modifying width and geometry of tools and shanks. Do some experimentation to find the best option for your soil type and residue cover. Residue is extremely important in controlling soil erosion and should be part of every conservation plan and no-till management strategy.

Research about the effects of manure application equipment on odor, residue cover, and crop yields demonstrates the effect of manure application on crop residue. A recent series of Iowa State University experiments evaluated liquid swine manure application methods in no-till soybean and corn residue during three crop seasons (Table 1). Manure was applied to the field at a rate of 5,000 gallons per acre, at an applicator speed of 5 miles per hour. The tool bar had four manure outlets set on 30-inch spacing to apply manure in 30-inch rows. Injection with conventional sweeps, and broadcast application followed by disking resulted in greater reductions in residue, especially in fragile soybean residue. In general, injection with wider soil-engaging tools, at deeper depths or faster speeds tends to bury more residue cover. On sloping land, application on the contour slows the velocity of running water. Surface applications resulted in higher odor levels but better preservation of crop residues.

Also, the concept of a strip tillage system that has been used in an anhydrous ammonia injection and deep phosphorus and potassium banding can be applied to liquid manure injection, where two operations (tillage and manure application) can be implemented. This approach minimizes the reduction of residue cover by reducing any additional tillage operation.

Table 1. Percentage of residue cover before and after manure application (3-year average).

	Soybean		Corn	
Treatment	**Residue cover before application**	**Residue cover after application**	**Residue cover before application**	**Residue cover after application**
Application				
Broadcast	77	74	91	90
Row cleaner	78	49	91	74
Narrow knife	75	48	91	69
Disk/incorporate	80	24	91	57
Sweep	77	31	91	56

Knife	78	44	91	71
Season				
Fall	85	53	93	72
Spring	70	38	88	67

Based on information from paper number 991062, presented at the 1999 ASAE Annual International Meeting, July 18-21, 1999, at Toronto, Ontario, Canada, by H. Mark Hanna, Dwaine S. Bundy, Jeffery C. Lorimor, Steven K. Mickelson, Stewart W. Melvin, Department of Agricultural and Biosystems Engineering, Iowa State University; and Donald C. Erbach, USDA Agricultural Research Service, National Soil Dynamics Laboratory, Auburn, AL.

Conclusions

Manure injection should be recognized as a tillage operation, even in no-till operations. Related information is available from your county extension office: Ask for PM 1811, Managing Manure Nutrients for Crop Production [4] and PM 1558, Management Practices: How to Sample Manure for Nutrient Analysis [5].

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