Risks Associated with Fall Fertilization Decisions

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FALL FERTILIZATION is coming under increasing scrutiny as people become more concerned about possible deleterious environmental effects from nutrient losses. In an era of increasing nutrient use efficiency, fall fertilization appears at first glance like a dinosaur, out of place in the modern world. So why do we apply nutrients so far in advance of planting? What are the risks of doing it or not doing it?

Logistical Risk

Perhaps the primary risk reduced by fall fertilization is logistical. **Table 1** shows the number of days suitable for field work in Indiana in 1998. April and May combined had 24 suitable days, while October and November had a combined total of 53. Fall offers more time to accomplish needed tasks. Limited quantities of applicators and employees, common in many fertilizer outlets, can pose significant logistical problems to accomplishing all fertilizer applications in the spring for customers representing thousands of acres. Time in the fall can be spent applying some of the needed nutrients for the next crop. This leaves time in the spring to finish the remaining nutrient applications and apply herbicides and perform other services.

For the farmer, spring is an anxious time. There are many field tasks that need to be done, such as tillage, planting, and applying herbicides. The primary objective is to get the crop in at the first good opportunity. Planting delays, especially when weather is favorable, are to be avoided. Fall fertilization allows the farmer to accomplish some needed tasks before the spring rush, reducing tension and anxiousness.

Table 1. Number of 1998 days suitable for field work in Indiana.

Month	Number of days suitable for field work	Month	Number of days suitable for field work
April	7	September	27
May	17	October	24
June	12	November	29

Data: Indiana Agricultural Statistics Service (http://www.aes.purdue.edu/agstat/annbul/9899/pg23.html)

Agronomic/Economic/Environmental Risks

Fall may provide much needed time to accomplish tasks, but what are the agronomic, economic, and environmental risks associated with fertilizing or not fertilizing in the fall? A common example of risk is fall nitrogen (N) fertilization. **Table 2** shows yields and N losses from a seven-year study (1987-1993) in south-central Minnesota on a Webster clay loam soil. Years 1987-1989 were very dry, and no tile line drainage occurred, so no N loss data were collected. However, in the remaining four years, wetter conditions did produce subsurface tile drainage. In those years, fall applications of N without nitrapyrin (a nitrification inhibitor) resulted in corn grain yield reductions of 9 bu/acre and N losses 13 and 19 lb N/acre/yr greater than fall-applied N with nitrapyrin or spring-applied N, respectively. These data demonstrate that under certain conditions, fall-applied N can result in yield and environmental losses of N as nitrate-N (NO_3-N). Both result in lost revenue and money spent on fertilizer. Managing such risks requires knowledge of local soil properties and environmental conditions.

Table 2. Corn yield and nitrate-N losses to subsurface tile drainage as affected by time of anhydrous ammonia application and nitrapyrin at Waseca, MN, 1990-1993.

Application time	Nitrapyrin	Average corn yield, bu/A	NO_3-N lost, lb N/A/yr
October 25	No	128	59
October 25	Yes	137	46
May 1	No	137	40

Application rate was 135 lb N/acre. Cropping system was a corn/soybean rotation.
Data source: Randall, G.W. and M.A. Schmitt. 1998. Advisability of fall-applying nitrogen. p. 90-96. *In* K.A. Kelling and J.L. Wedberg (ed.) Proc. 1998 Wisconsin Fertilizer, AgLime and Pest Management Conference, Madison, WI. 19-21 Jan. 1998. University of Wisconsin, Madison, WI.

Phosphorus (P) and potassium (K) can also be lost from fields if applied to areas that are subject to erosion or runoff. Subsurface applications or incorporation can help reduce these risks. Soils with a low cation exchange capacity (CEC) are likely to lose fall-applied K or ammonium (NH_4) forms of N. An exception to this is organic soils. Although they have a high CEC, they do not hold K tightly, increasing the risk that significant amounts of K can be lost.

So is it always preferable to apply nutrients in the spring? There are other risks that arise when too many things are attempted. Among them are uneven stands from planting too fast, poor early season weed control, and misapplications of herbicides and nutrients. Compaction is a serious problem that often goes undetected but can significantly cut yields and profits. Long term (44-year) rainfall averages collected by the National Agricultural Statistics Service from the north central region show that fall is typically drier than spring. Wetter spring conditions combined with more equipment trips over the field can lead to compaction.

Compaction is characterized by less air space in the soil, higher soil weight per unit volume, poorer drainage, slower infiltration of water, restricted root growth, and more resistance to a soil probe. Compaction can reduce yields and last for several years. Most of the damage is done with the first pass of a piece of equipment. **Figure 1** shows the long-lasting effects that compaction can have on yields in Minnesota. Yield reductions were worst the first year and got better with time. However, the Waseca site did not regain yield after four years. The severity of both surface and subsurface compaction will depend on many factors, such as equipment weight, tire width, tillage system, climate, and soil properties. Because water cannot infiltrate as readily in soils with surface compaction, there is an increased risk of nutrient and sediment loss through runoff and erosion. Delaying all nutrient applications until spring increases the risk that soils will become too compacted.

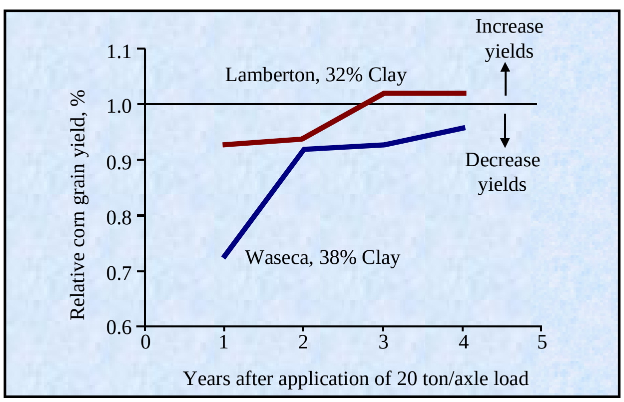

Figure 1. Relative corn yield over time as affected by 20-ton per axle load for two soils at Lamberton and Waseca, Minnesota, 1982-1985. The soil at Waseca was wetter at the time of compaction. Data: Swan, J.B., J.F. Moncrief, and W.B. Voorhees. 1994. Soil compaction: Causes, effects, and control. BU-3115-GO. University of Minnesota Cooperative Extension Service, University of Minnesota, St. Paul. (Available on-line with updates at http://www.extension.umn.edu/distribution/cropsystems/DC3115.html).

The risk of late planting is also present if too many tasks are attempted in the spring. The data in **Figure 2** demonstrate the need for timely planting. Corn yields in parts of Wisconsin, for example, are expected to drop off quickly after about May 10. This demonstrates the importance of taking advantage of early opportunities to plant.

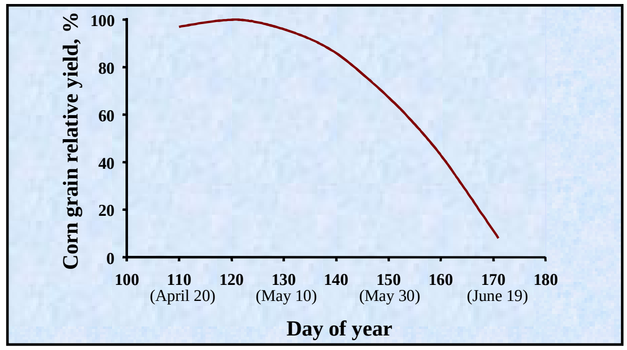

Figure 2. Expected corn grain yield for a harvest population of 32,000 plants/acre in Wisconsin's relative maturity zone of 95-115 days. Data: Lauer, J. 1997. Corn replant/late-plant decisions in Wisconsin. A3353. University of Wisconsin Cooperative Extension Service, University of Wisconsin, Madison (Available on-line with updates at http://cf.uwex.edu/ces/pubs/pdf/A3353.PDF).

Proper Fertilization as Part of Risk Managment

Each season, there are many practices that must be performed correctly to get higher yields, better use nutrients, and realize profits. Besides the nutrient, yield, and economic risks already discussed, there are ways that proper nutrient management can reduce other risks not directly related to nutrient losses.

Nutrient applications can help alleviate the adverse effects of compaction on yields. Compaction restricts root growth, leading to poorer water and nutrient utilization. **Table 3** shows how K applications helped recover some of the corn grain yield lost to compaction at lower soil test K levels in a Wisconsin study. At higher soil test K levels, enough K was present so that further applications produced little if any yield increases. Paying attention to fertility levels and nutrient stratification can help reduce yield and economic risks of soil compaction.

Table 3. Corn grain yield response to applied K at various soil test K and compaction levels.

Soil test K, ppm*	1985 yield increase to 45 lb K_2O/acre, row-applied, bu/A — Axle weight (tons) <5	9	19
102	18.0	23.0	35.0
131	-4.5	14.5	5.5
234	0.0	5.0	2.5

*ppm=parts per million

Data: Wolkowski, R.P. 1989. Soil compaction and fertility interactions. Ph.D. dissertation. University of Wisconsin, Madison, WI.

Data from Wisconsin indicate that starter fertilizer may help corn compensate for late planting. **Table 4** shows that at later planting dates, response to starter fertilizer was greater, although overall yields decreased. Although not shown, starter fertilizer also increased yields in conventional tillage systems. Overall, increased grain yields were observed in 20 of 24 comparisons. Starter treatments that contained P alone or both P and K usually produced the highest corn grain yields. Starter fertilizer also usually lowered grain moisture compared to treatments where no starter was used, indicating hastened maturity. Response was more probable for longer season hybrids planted later. It is not yet known if these observations will be seen in other states, although research is being conducted to investigate the possibility.

Table 4. Effect of starter fertilizer on corn grain yield in a no-till system.

		Corn grain yield, bu/acre		
			25 lb P_2O_5 and 25 lb K_2O	
Year	Planting date	No starter	Applied as starter	Response
1989	April 26	147.9	142.6	-5.3
1990	April 23	153.3	149.5	-3.8
1991	April 25	162.6	165.9	3.3
1989	May 3	147.7	146.5	-1.2
1990	May 2	154.6	161.2	6.6
1991	May 2	157.5	170.5	13.0
1989	May 11	140.7	152.5	11.8
1990	May 14	134.5	146.3	11.8
1991	May 13	153.4	164.0	10.6
1989	May 24	89.2	111.1	21.9
1990	May 24	144.7	157.0	12.3
1991	May 23	131.1	158.1	27.0

Data: Bundy, L.G. and P.C. Widen. 1991. Corn response to starter fertilizer: Planting date and tillage effects. New Horizons in Soil Science No. 2-91. University of Wisconsin, Madison, WI.

Summary

There are many risks that farmers and dealers must address each cropping season. Fall fertilization offers a way of reducing the logistical risks associated with the need to accomplish many tasks. Losses of nutrients to the environment and reduced yields can result from fall fertilization. However, such problems can also occur when proper management is compromised in a time crunch. Compaction can increase nutrient and sediment loss as well as reduce yields and revenue. Delayed planting can cause serious crop yield reductions. Proper nutrient management considers the conditions where risks are high and seeks to avoid them. When good management practices have been compromised, informed nutrient use decisions can help rectify the situation. The key to managing risks with fall fertilization is to be familiar with the risks in a particular area and stay informed of the best way of managing nutrients to reduce them. ■

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