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Beware of N Lockup in Reactivated CRP Fields

Carbon to nitrogen ratios higher than 30:1 could temporarily immobilize soil or fertilizer N in high-residue fields.

While the Conservation Reserve Program (CRP) is uncertain, most agree that at some point a significant acreage currently in CRP will be brought back into production. We already know peak contract expirations for 36 million acres of CRP will occur in the fall of 1996. While nutrient management will not be the major challenge faced by most farmers in bringing CRP land back into production, the potential for nutritional problems does exist and could reduce profitability and/or contribute to water quality problems. Our purpose here is to address some of these concerns, plus look at some ongoing projects involving managing post-CRP fields.

Depressed N availability

C:N ratio. Our major nutrient concern centers on the effects of organic plant residues on N management. The quantity of residue accumulated in CRP fields can be very large. For example, Nebraska researchers have estimated above-ground levels of 4 to 5 tons/A for a bromegrass CRP field in northeast Nebraska. Grass residues grown in low N environments usually have wide carbon to nitrogen ratios (C:N) compared to soil microorganisms or stable organic matter. If the C:N ratio is greater than 30:1, soil or fertilizer N can be temporarily immobilized during residue decomposition.

The traditional illustration of this concept was developed by Sabey (Figure 1). Initially, the increase of energy supply caused by the residue addition stimulates microbial activity as indicated by the increased CO2 evolution. The growing population of heterotrophic microorganisms removes nitrate from the soil and the nitrate level is depressed until the energy supply is exhausted. At this point, the microbes die and their decomposing bodies gradually return soil nitrate to a higher level than it was initially.

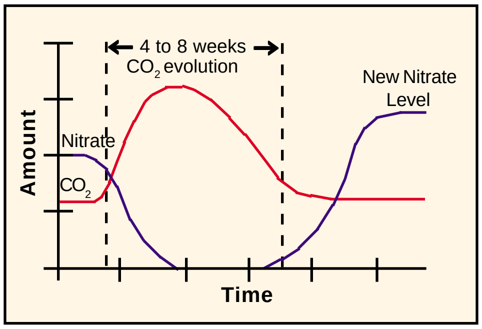

Figure 1. Changes in soil nitrate levels during decomposition of low N residues, Sabey, University of Illinois.

Depression period. The overall contribution of the residue to plant-available N is positive, but a period of depressed N availability occurs along the way. The critical question related to N management following CRP is how deep is the depression period and how long does it last? Even though Figure 1 shows four to eight weeks, the actual duration is probably much more variable. Depth and duration will depend primarily on the quantity of residue, the actual C:N ratio of the above, and below-ground residue--as well as its particle size, degree of soil incorporation or tillage, and soil moisture and temperature conditions following killing of the sod. Fortunately, some studies are far enough along to offer examples of the timing of the depression period for specific conditions. Much more data will be available during the next couple of years.

Effects of tillage

Primary tillage had a marked effect on fertilizer response by corn following six years of an alfalfa/smooth brome sod in east central South Dakota. If the sod was plowed, starter plus sidedressed UAN produced no yield response (Table 1). Modest response was measured with a chisel system. A 32-bu/A response occurred under no-till. By the spring of the second year, soil nitrate levels had increased to approximately 200 lbs/A in the top two feet in the moldboard plow and chisel systems where fertilizer had been applied. Second year responses were similar even though no N was sidedressed in the plowed or chiseled systems and only 20 lbs/A was applied in the no-till. A second no-till treatment was initiated in 1991 (Table 1). Successful no-till production was dependent on fertilization at this location where the initial sod was composed of more alfalfa than grass. Plowed plots showed no fertilizer response.

Rotation effects

In southwestern Minnesota, somewhat greater N was applied following CRP than when following continuous corn because of the lower initial nitrate levels of the CRP plots (Table 2). The CRP plots were nearly all grass the preceding three years. Corn received 15 lbs/A of starter N at planting. Remaining N was broadcast as urea in early June and incorporated by cultivation. Nitrate in the tile drainage was lowest following CRP. Calculated rotation effect was similar for CRP and continuous corn, both being negative. Negative numbers indicate that either net immobilization occurred or that N losses exceeded the contribution from organic matter for the season. Preliminary evaluation of this ongoing study indicates that N rates following CRP for similar soil/climate conditions can be based on the preplant nitrate test.

Table 1. Influence of tillage corn response to fertilizer following CRP in east central SD.

Tillage	1990 Fertilizer* no	1990 Fertilizer* yes	resp	Spring 1991 NO_3-N**	1991 Fertilizer* no	1991 Fertilizer* yes	resp
	bu/A			lbs/A-2 ft	bu/A		
MP	122	124	+2	210	156	158	+2
CH	112	126	+14	196	143	161	+18
NT 1	82	114	+32	124	120	161	+41
NT 2	CRP	CRP	CRP	58	160	183	+23

* 13-13-13 as a starter in '90 and '91; in 1990, 48 lbs/A N sidedressed on all tillage; in 1991, none on MP and CH, 20 lbs/A N on NT 1 and 40 lbs/A on NT 2.

**From fertilized treatments

Table 2. Rotation effects on corn yield and N relationships in southwestern Minnesota.

Rotation	Primary tillage	N	yield	Fall NO_3-N '93	Fall NO_3-N '94	Tile loss	Rotation effect*
		lbs/A	bu/A	lbs/A-10 ft		-----N, lbs/A-----	
Cont. corn	MP	147	164	150	165	13	-15
Corn soybean	none	95	172	118	103	12	+8
Soybean corn	MP	0	45	94	99	12	-
Corn alfalfa	MP	15	170	46	36	3	+73
Corn CRP	MP	158	177	41	58	1	-22

* N uptake + tile loss + Fall '94 nitrate - Fall 93" nitrate - fertilizer N.

Guidelines

The following set of guidelines was developed from responses solicited from scientists in different states regarding their views on nutrient management following CRP.

Yield goal. Anticipated yield is frequently a factor in determining N needs and is critical in developing an economically sound management plan. It needs to be realistic, taking into account the positive changes that have likely occurred in soil physical properties during the ten years of sod.

Soil testing. After a decade of CRP, the status of immobile nutrients such as P, K, or Zn can be determined only with a soil test. Soil test levels will likely be similar to the levels before CRP. However, haying or grazing without fertilization could cause levels to decline.

Liming. If soil tests indicate a need for lime it should be applied before the land is taken out of CRP. For no-till, lime should be applied as soon as possible, using finely ground limestone. Depth of tillage should always be taken into account when lime needs are estimated.

Starter. Use of a starter fertilizer containing N, P, and K will provide nutrients early in the season when roots may not be able to obtain adequate nutrition from the soil or decaying residues.

P and K. Prior to tillage, a single large P or K application is recommended to increase soil test levels to optimum when a single tillage operation is planned for the first year out of CRP followed by no-till. If the CRP land is to be no-tilled and P and/or K soil tests are low or very low, band application is recommended. At higher soil test levels, method of application is less important.

Inoculation. Soybeans should be inoculated the first time they are grown following CRP.

Nitrogen. Knife applications are often recommended for no-till to reduce immobilization and volatilization. Ongoing studies will provide more specific information as it becomes available.

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