MULTI-REGION

Nutrient Management Following Conservation Reserve Program

By Paul E. Fixen

The major nutrient concern for reactivated CRP land is the effect of plant residues on nitrogen (N) management. The quantity of residue accumulated in CRP fields can be large. For example, researchers have estimated above-ground levels of 4 to 5 tons/A for a bromegrass CRP field in northeast Nebraska.

Nutrient management will be just one of the challenges faced by farmers in bringing Conservation Reserve Program (CRP) land back into production. The potential for crop nutritional problems does exist and could reduce yields and profitability.

Grass residues grown in low nitrogen (N) environments usually have wide carbon to nitrogen ratios (C:N) compared to soil microorganisms or stable organic matter (**Table 1**). 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 in energy supply caused by the residue addition stimulates microbial activity as indicated by the increased CO_2 evolution. The growing population of heterotrophic microorganisms removes nitrate-N (NO_3-N) from the soil and the NO_3-N level is depressed until the energy supply is exhausted. At this point, the microbes die and their decomposing bodies gradually return soil NO_3-N to a level higher than it was initially.

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 4 to 8 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

TABLE 1. Carbon to nitrogen ratios of organic materials.

Organic substances	C:N
Soil microorganisms	8:1
Soil organic matter	10:1
Young sweet clover	12:1
Rotted barnyard manure	20:1
Clover residues	23:1
Green rye	36:1
Corn/sorghum stalks	60:1
Grain straw	80:1
Timothy	80:1
Sawdust	400:1

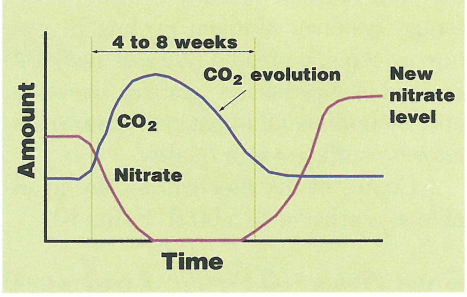

Figure 1. Changes in soil nitrate levels during decomposition of low N residues. Source: B.R. Sabey, Univ. of Illinois

residue as well as its particle size, degree of soil incorporation or tillage, and soil moisture and temperature conditions following sod-kill. Fortunately, some studies are far enough along to offer examples of the timing of the process for specific sets of conditions. Much more data will be available during the next few years.

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 (MP), no yield response was measured to use of a starter fertilizer plus sidedressed N solution (UAN), modest response was measured with a chisel system (CP) and a 32 bu/A response occurred under no-till (NT) (**Table 2**). By the spring of the second year, soil NO_3-N levels had increased to approximately 200 lb/A in the top 2 feet in MP and CH systems where fertilizer had been applied. Second year responses were similar to the first year responses even though no N was sidedressed on MP and CH systems and only 20 lb N/A was sidedressed in NT. A second no-till treatment was initiated in 1991 and again showed good fertilizer response. Successful no-till breakout was very dependent on fertilization at this location where the initial sod was composed of more alfalfa than grass and plowed plots showed no fertilizer response.

When differences in initial soil NO_3-N were taken into account, continuous corn and first year corn following CRP appeared to have similar N fertilizer requirements in a study being conducted by the University of Minnesota (**Table 3**). Somewhat greater N was applied following CRP than following continuous corn due to the lower initial NO_3-N levels of the CRP plots. The cropping systems were established in 1988 with the CRP sod consisting of nearly all grass for the last three years. All corn received 15 lb/A of starter N at planting with the remaining N broadcast as urea in early June and incorporated by cultivation. Nitrate-N measured in tile drainage was the lowest following CRP. A 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 could be based on the preplant NO_3-N test.

Management Guidelines

The following set of guidelines was developed from scientists in several states regarding their views of nutrient management following CRP.

TABLE 2. Influence of tillage on response to fertilizer for corn following CRP (east central South Dakota).

	1990 Fertilizer[1]			Spring 1991	1991 Fertilizer[1]		
	No	Yes	Response	NO_3-N[2]	No	Yes	Response
Tillage	Yield, bu/A			lb/A-2 ft.	Yield, bu/A		
MP	122	124	+2	210	156	158	+2
CH	112	126	+14	196	143	161	+18
NT1	82	114	+32	124	120	161	+41
NT2	CRP	CRP	CRP	58	160	183	+23

[1]13-33-13 as a starter in 1990 and 1991; in 1990, 48 lb/A N sidedress on all tillage, in 1991 none on MP and CH, 20 on NT1 and 40 on NT2

[2]From fertilized treatments.

Bly, SDSU

TABLE 3. Rotation effects on corn yield and N relationships in southwest Minnesota in 1994.

Rotation	Primary tillage	Fert. N, lb/A	Yield, bu/A	Fall NO_3-N, lb/A-10 ft. 1993	Fall NO_3-N, lb/A-10 ft. 1994	Tile loss	Rotation effect,[1] N, lb/A
Cont. corn	MP	147	164	150	165	13	-15
Corn/soy	none	95	172	118	103	12	+6
Soy/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
LSD 0.05			8			0.7	

[1](N uptake + Tile loss + Fall 1994 nitrate - Fall 1993 nitrate - Fertilizer N). Klossner et al., 1995. Univ. of Minn.

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 challenges of pest management and surface roughness for the specific field, but should also consider the positive changes that have likely occurred in soil physical properties during the 10 years of sod. In most cases, improvements in surface organic matter, infiltration rate, field water holding capacity, aggregate stability, and air filled porosity are likely. Subsoil properties may have improved in some cases. In more arid areas, depletion of water in the soil profile by the deep-rooted sod may be a negative factor if precipitation is insufficient for profile recharge.

SOIL TESTING. After a decade of CRP, the status of immobile nutrients like phosphorus (P), potassium (K), or zinc (Zn) can only be determined with a soil test. Soil test levels will likely be similar to the levels before CRP, however, haying or grazing without fertilization or manuring could cause levels to decline.

LIMING. If soil tests indicated a need for aglime it should be applied before the land is taken out of CRP. For no-till, finely ground aglime should be applied as soon as possible. Depth of tillage should always be taken into account when lime needs are estimated. In no-till, assume a 2-inch depth if no cultivation is used for weeds or a 3-inch depth if cultivation is used.

STARTER. Use of a starter 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. If a single tillage operation is planned for the first year out of CRP followed by no-till, a single large P and K application to increase soil test levels to the optimum prior to the tillage operation is recommended. 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 but use of a starter is still advisable.

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

NITROGEN. Knife applications of N are often recommended for no-till to reduce N immobilization and ammonia volatilization losses. Considerable uncertainty exists as to the appropriate N rate adjustment following CRP. The potential exists for significant regional variation due to

soil, cultural and climatic factors. However, three general approaches have emerged for making N rate decisions:

1. Use standard recommendations based on soil NO_3 present at planting unless significant legumes were present in the sod. This approach usually results in higher N rates than normal due to very low spring NO_3-N levels.

2. Apply a conservative N rate and use the late spring soil N test or some other approach to determine sidedress N need.

3. Reduce N rate by 50 lb/A or more depending on nature of the sod and other factors considered for standard forage N credit determination.

Local studies and experience should be used to determine the most appropriate approach on a site-specific basis. BC

Dr. Fixen is Northcentral Director, PPI, P.O. Box 682, Brookings, SD 57006.

Information Agriculture Conference

PLANNED FOR JULY 30 - AUGUST 1, 1996

Dates for the 1996 Information Agriculture Conference are now set for Tuesday, July 30 through Thursday, August l. The event will take place at the Krannert Center for the Performing Arts, University of Illinois, Urbana.

Dr. Harold F. Reetz, Jr., PPI Midwest Director, Monticello, IL, will serve as chairman of the coordinating committee for the conference. Organizers include PPI, the Foundation for Agronomic Research (FAR), National Center for Supercomputer Applications, University of Illinois College of Agricultural, Consumer and Environmental Sciences, Dealer PROGRESS Magazine, and CCNet Agribusiness Task Force, Champaign-Urbana Chamber of Commerce.

The conference will focus on site-specific crop and soil management technology and computer communication systems for agriculture. Program features will include yield mapping and interpretation, variable rate systems, data management, remote sensing, global positioning system potential, geographic information systems, and communication developments.

An exhibit hall will allow space for companies and organizations to display products and services related to modern crop production and information. An area will also be available for volunteer "poster" presentations where researchers and others can share results of studies and field experience.

Registration fees are $200 per individual before July 15, 1996 (students $100). Exhibitor fee is $300 for a standard booth area. The fee includes conference registration for one person.

For registration and lodging information, contact:

Mary Hughes, PPI
2805 Claflin Road, Suite 200
Manhattan, KS 66502
Phone (913) 776-0273
Fax (913) 776-8347
E-mail: 72253.114 @ compuserve.com

Additional details will be available on the Information Agriculture Conference Home Page on the Internet at:
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