

Soil Fertility Considerations for Land Coming Out of Conservation Reserve Program (CRP)

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This guide discusses issues relating to soil fertility for land coming out of CRP.

Bringing Conservation Reserve Program (CRP) land back into production has some of the same challenges as cropping previously hayed or pastured ground. Haying or grazing land removes nutrients and, without further fertilization, nutrient levels will stay reduced. The duration of CRP, and whether it was hayed, influences soil fertility status. Depending on the mix of plants, significant crop residue will be on the surface. This will present practical problems in planting into the organic layer on the surface and determine whether this plant residue will affect nitrogen requirements.

Most CRP land was not fertilized. Soil residual nitrate-N (nitrogen) levels will be low, as will sulfur on sandy soils, unless manure or commercial fertilizers were applied. The status of the immobile nutrients phosphorus (P), potassium (K), zinc (Zn), and iron (Fe) can only be determined by a soil test. Soil levels of these nutrients should be similar or lower than before conversion to CRP.

In western Nebraska, much of the CRP land was in various wheat-fallow systems. Because of this, phosphorus and zinc will be lower on high pH calcareous soils than on lower pH soils due to faster reversion to insoluble forms.

Testing

The first recommendation for developing CRP land is to test the soil. University of Nebraska–Lincoln Extension's NebGuide G1740 *Guidelines for Soil Sampling* found at <http://www.ianrpubs.unl.edu/sendIt/g1740.pdf> provides guidelines for sampling patterns, core numbers, and sampling depths. For most CRP land, sampling the top 8 inches should be sufficient.

Separately sample field areas with different cropping histories, erosion histories and slopes, soil types, and management practices so you can make specific recommendations for each area. Be sure to sample the soil and not the dead plant layer on the surface.

Grid Sampling

An alternative to sampling areas of the field, based on known differences, is grid sampling, an excellent method for assessing field variability. Detailed information about grid sampling can be found in Extension Circular EC154 *Soil Sampling for Precision Agriculture* found at: <http://www.ianrpubs.unl.edu/sendIt/ec154.pdf>. Grids can be any size, but a grid spacing of 150 feet to 250 feet is recommended.

Although the analytical cost will be considerably higher than conventional soil testing, grid sampling will show the distribution of specific soil chemical measurements. Choose specific soil tests for any soil chemical measurements that may vary greatly or which will assist with other management decisions. Suggested chemical measurements include soil pH, organic matter, phosphorus, potassium, and zinc.

The maps generated from the grid sampling can be used for four to five years. Using these maps will help you target fertilizer application more accurately, since they target deficient areas instead of simply applying fertilizer based on the composited soil samples average. Knowledge of fertility status will help cropping and tillage decisions.

Liming

If soil tests indicate the need for lime, then consider liming before taking the land out of CRP. Tillage decisions will affect liming rates since lime must be thoroughly incorporated to work most effectively. On no-till fields, reduce lime rates

and make several applications over a number of years. Soil acidity correction will occur, but will take longer compared to incorporated lime.

Liming is a long-term investment and it takes several years to get the full benefit of an application. Schedule lime applications to coincide with a tillage event. More detailed discussion of liming can be found in NebGuide G1503 *Management Strategies to Reduce the Rate of Soil Acidification* (<http://www.ianrpubs.unl.edu/sendIt/g1503.pdf>) and NebGuide G1504 *Lime Use for Soil Acidity Management* (<http://www.ianrpubs.unl.edu/sendIt/g1504.pdf>).

Selecting a Crop and Tillage Method

Selecting a crop and tillage system will affect fertilizer decisions such as rate, application method, and source of nutrients. If CRP fields are tilled, increased erosion is possible, but opportunities exist to incorporate nutrients and lime. Land coming out of sod will have improved soil aggregation due to lack of tillage and the addition of organic carbon during the CRP period. Fine roots from grasses hold the soil together more effectively than soil that has been in row crops for several years. Tillage also may change the recommended rates of various nutrients.

For example, broadcast phosphorus is not the preferred application method for rainfed agriculture in Nebraska, and phosphorus rates for band applications are one-half of broadcast rates. Depending on soil test results, phosphorus may not be recommended if soybeans are to be grown. It might be, however, for corn, small grains, or alfalfa. Whichever crops are grown, if the field is going to be tilled when CRP ends, consider applying phosphorus or lime to take advantage of the opportunity for incorporation.

Nitrogen and Corn

If you're contemplating returning the land to row crop production, the large quantity of residue that can accumulate on CRP land presents challenges. On a smooth bromegrass CRP field at the Haskell Agricultural Laboratory near Concord, Neb., four to five tons of high carbon material accumulated on the surface after 10 years in CRP. This residue contained 110 lb of nitrogen. An unknown amount of belowground root material also accumulated. In addition to the surface residue, there was about 1.5 tons of standing grass. Since the grass residue was poor quality, there was little opportunity to sell it as hay.

No-till research has shown that nitrogen broadcast on residue may result in nitrogen tie-up (immobilization) and nitrogen loss to the atmosphere (volatilization). Avoid both these losses by placing the nitrogen below the residue layer. With large amounts of belowground root material, some N immobilization can still occur even with knife application (standard knife applicators or strip-tillage implements). The increased organic matter that has built up over time will begin to break down during cropping and nitrogen will be released.

Nitrogen mineralization, or N release from soil organic matter in long-term farmed soils, can range from 20 to 40 lb

of N per percent organic matter. It's difficult to predict how much nitrogen will be released and when from high-carbon grass residue and root biomass. In research conducted at the Haskell Agricultural Lab in the late 1990s, there was almost no N release from the grass thatch in the first year after CRP was taken out of production, regardless of tillage system.

In sod that contains legumes, additional nitrogen has been fixed compared to solid stands of grass. Tillage releases nitrogen more quickly than nitrogen release rates from chemically killed sod. However, only limited N should be counted on in the first year after CRP.

In both cases, short-term immobilization may occur early in the season, so apply some nitrogen for early growth. Row-applied starter is a good alternative to supply a readily available source of N for early plant growth. Row-applied nitrogen for corn and sorghum of 30 to 40 lb/acre should be sufficient until additional N can be applied. However, this amount of N should not be applied in-furrow.

Determining the optimum nitrogen rate for grain crops planted to land previously in sod is complicated by the tillage method used, the type of CRP forage, and the unknown mineralization rate. Current nitrogen recommendations for grain crops are based on research conducted on long-term cropped fields.

University of Nebraska–Lincoln Extension recommendations are explained in Extension Circular EC117 *Fertilizer Suggestions for Corn* (<http://www.ianrpubs.unl.edu/sendIt/ec117.pdf>). To compensate for the lack of soil release of nitrogen and the potential for N immobilization, add 50 lb N to the recommendation for corn planted to land coming out of CRP. Set a realistic yield goal for this soil type, which may be equal to or lower than other crop fields on the farm. After planting, monitor the crop to determine how tillage, residue, and mineralization are affecting nitrogen uptake and release.

Several crop monitoring technologies exist to help determine if the soil and fertilizer are supplying enough nitrogen. A detailed description of the use of a chlorophyll meter for N management is available in NebGuide G1632 *Using a Chlorophyll Meter to Improve N Management* (<http://www.ianrpubs.unl.edu/sendIt/g1632.pdf>).

Before using a chlorophyll meter, first determine the nitrogen rate as described above. Apply nitrogen early in the growing season. In addition, fertilize some strips through the field with 50 to 75 lb more nitrogen than calculated. Compare strips where nitrogen is applied at an increased rate to the rest of the field using a chlorophyll meter or another method of assessing in-season N status. If chlorophyll meter readings are less than 95 percent of the high nitrogen strips, apply additional nitrogen, usually an additional 20 lb per acre, wait a week, then use the chlorophyll meter again.

Pre-sidedress Nitrate Test (PSNT)

Another monitoring method is the Pre-sidedress Nitrate Test (PSNT). The PSNT is a soil sample taken to a depth of 1 to 2 feet when corn is 6 to 12 inches tall. If soil samples deeper than one foot are taken, split them into one-foot

Table I. Effect of tillage and method of application on corn yields in first-year CRP, Concord, Neb.

<i>N Rate</i>	<i>No-till Broadcast</i>	<i>No-till Knife</i>	<i>Plow Broadcast</i>	<i>PlowKnife</i>	<i>N rate Mean</i>
lb/N acre	----- bu/ac -----				
0	40	34	51	53	45
50	49	53	69	70	60
100	63	80	82	91	79
150	84	82	94	101	90
200	85	88	103	104	95
Tillage Mean	66		82		

Average of three years' data (1995, 1996, and 1997). Starter was applied as a 2 in x 2 in placement at 100 lb/acre 10-34-0 every year. Annual rainfall was 31, 31, and 25 in/year for 1995, 1996, and 1997, respectively.

increments. The test indicates whether sufficient soil nitrate is available for the crop.

This method is most beneficial where legumes were in the CRP crop mix or where manure history suggests a large amount of nitrogen mineralization will occur. Sampling at the 6- to 12-inch plant height allows for time to sidedress-apply additional nitrogen. Nebraska has not completed research on this procedure, but Iowa has published its PSNT recommendations in *Nitrogen Fertilizer Recommendations for Corn in Iowa Pm-1714 May 1997 p.2* (<http://www.extension.iastate.edu/Publications/PM1714.pdf>).

When fertigation is not possible, or in rainfed areas, use high-clearance sprayers later in the season. As explained above, unless you have reason to expect a high amount of nitrogen, CRP ground is expected to be low in soil nitrates the first year after CRP. The PSNT may be more beneficial for corn grown the second year after CRP ground returns to row crop production.

Research on rain-fed corn conducted on land coming out of CRP near Concord, Neb., in the mid-1990s illustrates the lack of N mineralization in Year One after CRP. Each year, for three years, a new area of CRP was taken out of CRP. This was before Round-up Ready® corn technology was widely available; your yields may be enhanced by better weed control.

With adequate nitrogen, corn yields were typical for the area and rainfall during that period (*Table I*). Average yields were increased about 17 bu/ac when the CRP was plowed. Part of the reason for the increased yields with plowing was the difficulty in planting into the CRP sod, and weed competition. The plowed ground responded better at all N rates. In other CRP research, conducted at the same site, disking in place of plowing produced yields between plowing and no-till.

There was not much difference due to method of N application. This was mostly a function of timely rains after N application, reducing the potential for volatilization. Knifed N application tended to be at least as good, if not better, than broadcast. The yield data does not show this, but from observation, it took the roots longer to “find” the nitrogen in the knife applications. Early season N deficiencies were compensated for by increased N uptake later.

Nitrogen for Wheat and Small Grains

Rainfed small grains may require additional N, depending on how long the CRP was tilled before planting. More mineralization will occur in a tilled versus a non-tilled field.

In rainfed regions, where CRP conversion occurs fairly close to grain planting, an additional 25 lb/acre of N per acre — above values calculated from soil test values and NebGuides — is recommended. For irrigated grains following CRP, an additional 35 to 40 lb/acre of N will likely be required. Monitor crops near the boot stage to determine any N deficiency; supplement with N and apply when needed.

Phosphorus

Soil test results will determine phosphorus fertilizer needs. Without fertilization, there is a tendency toward lower, plant-available phosphorus levels over time. A 10- to 15-year CRP period could cause phosphorus levels to decline due to reversion to unavailable forms. Starter-applied phosphorus may give the crop needed nutrients early in the season before roots reach soil phosphorus.

Recommended broadcast phosphorus rates for row crops are higher than band-applied phosphorus rates. Use of banded fertilizer is recommended since nitrogen, phosphorus, and zinc can be placed near the seed for early nutrient availability. Available nutrients from residue and soil organic matter mineralization may be delayed until late spring or early summer. Banded fertilizer will provide nutrients in the interim.

In the N study above, two treatments did not receive either banded or broadcast phosphorus. Both treatments showed slight phosphorus deficiencies early in the season, but by the time the corn was waist-high, the symptoms disappeared. These soils tested high in soil phosphorus, so yield response to phosphorus was not expected. Yields in 1995 showed no response to starter application.

In a UNL Sandhills Agricultural Laboratory study conducted on land being cropped for the first time, Starter P was beneficial for early-season corn because of slow mineralization in the spring and a low soil test (6-10 ppm Bray-1 P). Treatments without starter showed classical early-season phosphorus

deficiency (purple leaves). Dual placement P with ammonia or UAN or as a separate band closer to the surface is another good application procedure.

Soils with extremely low phosphorus levels may require broadcast phosphorus to increase soil phosphorus levels. Row-applied phosphorus may not be sufficient for maximum yields when soil test phosphorus Bray-1 levels are 5 ppm or below. Broadcast P should be considered on soils with a pH range of 6.5 to 7.2 because of good long-term phosphorus availability.

Depending on the soil, it may take approximately 10 lb of P_2O_5 /acre to increase soil test levels 1 ppm. Only attempt to build soil phosphorus levels when soils are extremely low and land is owned or under long-term base. Manure applications are an excellent way to improve soil phosphorus levels.

Consider broadcast applications to increase soil test levels when only a single tillage year is planned. A single large phosphorus application with subsequent starter applications is recommended when tillage is planned for the first year out of CRP and then plans call for no-till. Strip-till apply Zn with a 10-34-0 band closer to the surface.

For wheat and small grains, applying P directly with the seed is an efficient way to apply P. P applications should be based on soil tests. With extremely low soil P, some broadcast plus banded P is recommended.

Other Nutrients

Soil testing should be the basis for applying potassium, sulfur, and zinc. Most Nebraska soils have adequate to very high levels of potassium. Sulfur deficiency is only a problem on sandy, low organic matter soils. Zinc deficiencies are most likely on eroded hillsides, where land has been leveled, or for soils with pH higher than 7.4.

Fertilizer application is justified if soil tests indicate the need for these nutrients. When possible, apply nutrients at the same time as tillage. Nutrients can be applied in bands on the surface and then incorporated with tillage or can be applied at different application depths with strip-tillage implements.

Summary

Soil testing is the only way to accurately determine fertility status of a specific field. Use any tillage to incorporate lime or phosphorus. Nitrate-nitrogen levels will normally be low in fields coming out of CRP, and nitrogen in the

accumulated organic residue will not be available the first year after CRP.

Application method and timing need to fit the residue management for the field. Given the variable nature of CRP residue quality and quantity, nitrogen management for grains is best accomplished with soil injection and some type of in-season N status assessment.

Be aware of potential problems associated with the method chosen and be prepared to adjust to unusual weather conditions. Given the unknowns with nitrogen fertility on corn, it might be better to plant soybeans the first year and plant corn the second year after CRP. When planting soybeans into CRP, use microbial seed inoculants.

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