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Charles A. Shapiro
University of Nebraska-Lincoln, cshapiro1@unl.edu

Gary W. Hergert
University of Nebraska--Lincoln, ghergert1@unl.edu

Melinda McVey McCluskey

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Soil Fertility Considerations for Land Coming out of CRP

Charles A. Shapiro, Soil Scientist — Crop Nutrition
Gary W. Hergert, Extension Soils Specialist
Melinda McVey McCluskey, CRP Research Coordinator

Bringing CRP land back into production should be similar to cropping previously hayed or pastured ground. Haying or grazing land will remove nutrients and, without fertilization, reduce nutrient levels. The duration of CRP and whether it was hayed influences soil fertility status. Most CRP land was not fertilized. The residual nitrate-N levels will be low, unless manure has been applied. The status of the immobile nutrients phosphorus (P), potassium (K), and zinc (Zn) 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.

The first recommendation for developing CRP land is to test the soil. University of Nebraska NebGuide *G91-1000, Guidelines for Soil Sampling* provides guidelines for sampling patterns, core numbers, and sampling depths. For most CRP land, sampling the top 8 inches should be sufficient. It is important to sample separately areas with different cropping histories, erosion histories, soil types, and management practices so that specific recommendations can be made for each area in the field.

An alternative to sampling areas of the field based on known differences is grid sampling. Grid sampling provides an excellent method for assessing field variability. 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, grid sampling will show the distribution of specific soil chemical measurements. Choose specific soil tests for the soil chemical measurements that will vary greatly or will assist with other management decisions. Suggested chemical measurements include organic matter, phosphorus, potassium, and zinc. The maps generated from the grid sampling can be used for four to five years. These maps will permit more accurate fertilizer application by targeting deficient areas instead of simply applying fertilizer based on the composited soil samples average. Knowledge of fertility status will help cropping and tillage decisions.

If the soil tests indicate the need for lime then liming should be considered before the land is taken out of CRP. Tillage decisions will affect liming rates since lime must be thoroughly incorporated to work 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 much longer compared to incorporated lime. Liming is a long-term investment and it takes years to get the full effect of an application. Schedule lime applications so that they coincide with a tillage event that may be part of a conservation plan or necessary for a specific crop in a long-term rotation.

Selection of a crop and tillage system will affect fertilizer decisions such as rate, application method, and source. For example, if CRP fields are plowed, there is erosion potential. However, the land coming out of sod will have improved soil aggregation due to lack of tillage and the addition of organic carbon during the previous ten years. The presence of many fine roots will hold the soil together more effectively than soil that has been in row crops for several years. Land that will be tilled can have fertilizer applied before the tillage operation. Tillage also may change the recommended rates of various nutrients. For example, broadcast phosphorus is not recommended for no-till rainfed agriculture in Nebraska, and phosphorus rates for starter applications are half-broadcast rates. Phosphorus may not be recommended if soybeans are to be grown but will be recommended for small grains or alfalfa.

Nitrogen: The large quantity of residue that has accumulated on CRP land presents a number of challenges to producers as they contemplate returning the land to row crop production. On a smooth bromegrass CRP field at the Northeast Research and Extension Center, we have estimated that four to five tons of high carbon material exist on the surface and an unknown amount of root material. Since the stover is poor quality, there is little opportunity to sell it as hay.

Research with no-till has shown that nitrogen broadcast on residue may result in nitrogen tie-up (immobilization) and nitrogen loss to the atmosphere (volatilization). Both these conditions can be avoided by placing the nitrogen below the residue layer. While knife application of nitrogen is recommended, we recognize that application equipment will need coulters and some CRP plantings may be difficult to knife into regardless of equipment. With the large quantity of root material, some immobilization could occur even with knife application. The increased organic matter that has built up over time will begin to break down during cropping. Nitrogen will be released as this happens. It is difficult to predict how much nitrogen will be released and when the nitrogen release will occur during the growing season. All of these factors need to be taken into consideration in making nitrogen decisions for CRP cropland.

Nitrogen release from sod is unpredictable. In sod that contains legumes, additional nitrogen has been fixed compared to solid stands of grass. Plowing will release much of the nitrogen during mid-season, whereas nitrogen release rates from chemically killed sod tend to be much slower. In both cases, however, the potential for short-term immobilization early in the season exists so some nitrogen should be applied for early growth, probably as a row-applied starter. Rates of nitrogen between 20-40 lb./acre should be sufficient to provide early nitrogen. Additional nitrogen can then be applied by methods that enhance nitrogen use efficiency.

Determining an optimum nitrogen rate for grain crops planted to land that was previously in sod is complicated by the tillage method used, the type of CRP forage, and the mineralization rate. Current nitrogen recommendations for grain crops are based on research conducted on long-term cropped fields. The best guideline is to follow nitrogen recommendations for given crops based on soil organic matter and nitrate. After planting, monitor the crop to determine how tillage, residue, and mineralization are affecting nitrogen uptake and release.

A number of crop monitoring technologies exist to help determine if the soil is supplying enough nitrogen. A detailed description of the chlorophyll meter is available in NebGuide *G93-1171, Using a Chlorophyll Meter to Improve N Management*. In order to use the chlorophyll meter, first determine the nitrogen rate (including credit for increased mineralization) and a realistic yield goal. Apply the nitrogen early in the season. In addition, fertilize some strips through the field with 50 to 75 pounds more nitrogen than calculated. Strips where nitrogen is applied at an increased rate can be compared to the rest of the field using the chlorophyll meter. If chlorophyll meter readings are less than 95 percent of the high nitrogen strips, apply additional nitrogen.

Another monitoring method is the Presidedress Nitrate Test (PSNT). The PSNT is a soil sample taken from a depth of 1-2 feet when corn is 6-12 inches tall. If soil samples deeper than 1 foot are taken, split them into 1 foot 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 6-12 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 *Soil Testing to Optimize Nitrogen Management for Corn* (PM-1521, March, 1993). In irrigated corn production, late season nitrogen applications can be made through the irrigation system. In rainfed areas, high clearance sprayers can be used later in the season.

The wet spring and dry post-planting conditions in 1995 affected early and mid season crop color in a study evaluating method and rate of nitrogen application on a smooth bromegrass CRP field. Observations from this study illustrate the difficulty of predicting optimum nitrogen management methods. Knife application was compared to broadcast application of urea-ammonium nitrate solution (UAN) at 0, 50, 100, 150 and 200 pounds nitrogen per acre. Visual observations indicated that broadcast nitrogen was moved into the soil by timely rains (.40 inch within three days). However, the rainfall apparently was not sufficient to move the knifed nitrogen away from the point of application and young seedling roots did not reach the nitrogen.

Consequently, at mid-season the broadcast plots were visually more uniform than the knife plots. These differences were noticeable at the lower nitrogen rates. At 150 and 200 pounds nitrogen per acre, these differences were not visible. Height and color differences were also found due to tillage. Undisturbed residue was compared to residue that was shred (rotary mowed) in the spring before planting. The shred residue on the surface made conditions ideal for nitrogen immobilization. In no-till plots, temperatures were cooler and less aeration occurred, reducing mineralization. This combination meant that little nitrogen was released from the soil organic matter. The applied nitrogen was tied up by microbes breaking down the high carbon residue. At harvest these differences were reflected in a 10 bushel yield advantage to the plow treatment.

Treatment differences were most visible at low nitrogen rates. At recommended nitrogen rates the differences between the shred and undisturbed no-till were not visible. The plowed treatments were taller and greener than the no-till. However, the plowed treatments that had the residue shred were paler green and shorter than the undisturbed plowed treatments. The shredded residue apparently immobilized more nitrogen due to increased surface area and soil-residue contact. The yields for 1995 only showed differences due to nitrogen rate. Nitrogen application method and residue shredding did not affect yields.

In fine-textured rainfed cropland, knifed nitrogen application early in the season may be a reasonable option. This application was made May 25, 1995 after most of the heavy spring rains. In a typical year, the nitrogen would be applied earlier, and the spring rains would distribute the nitrogen through the root zone.

Phosphorus: Soil test results will determine if phosphorus is needed. Since little plant material was removed over the life of the CRP contract, there is no reason to expect a dramatic change in phosphorus status. In either acid or calcareous soils, there is a tendency toward lower phosphorus levels over time. Ten years is a long time. In many situations phosphorus levels may have declined due to fixation 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 are higher than band applied or starter phosphorus rates. Use of starter is recommended since both nitrogen and phosphorus can be placed near the seed for early nutrient availability. Available nutrients from residue and soil organic matter mineralization may be delayed until later in the spring. Starter will provide nutrients in the interim.

Included in the smooth bromegrass study (mentioned in the nitrogen section above) were two treatments that did not have starter phosphorus applied. 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 Sandhills Agricultural Laboratory study conducted on land being cropped for the first time, starter was beneficial for early season corn because of slow mineralization in the spring. Treatments without starter showed classical early season phosphorus deficiency (purple leaves). Plants outgrew these symptoms, but were generally a week behind those that received starter. This study was conducted on a soil with a soil test Bray #1 phosphorus level of 6-10 ppm. A growth and yield response is expected at this soil phosphorus level.

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 should be considered on soils with a pH range of 6.5 to 7.0 because of good long-term phosphorus availability. It takes approximately 20 pounds of P_2O_5/acre to increase soil test levels 1 ppm on most soils in Nebraska. Building soil phosphorus levels should only be attempted when soils are extremely low. Manure applications are an excellent way to improve soil phosphorus levels. Broadcast applications with the intent of increasing soil test levels should be considered 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.

Other Nutrients: The same considerations that were discussed for phosphorus should hold for potassium, sulfur, and zinc. Most Nebraska soils have adequate to very high levels of potassium. Sulfur is only a problem on coarse textured, low organic matter soils. Zinc deficiencies are most likely found on eroded hillsides, where land has been leveled, and soils with pH higher than 7.4.

Application is justified if soil tests indicate the need for these nutrients. When possible, nutrient application should coincide with tillage. Nutrients can be applied in bands on the surface and then incorporated with tillage.

Vegetative Management Systems: Tillage and residue management systems may interact with fertility concerns. The challenge is to get the nitrogen below the residue and evenly distributed in the soil. Tillage will allow quicker spring warm up and increase air exchange to speed the breakdown of accumulated soil organic matter. However, researchers have reported that just a few years of plowing will erase all the positive CRP effects on the soil quality and physical properties that have accumulated in ten years. Sustained tillage is not the ideal solution since it will leave the soil vulnerable to erosion.

Corn planted into sod may emerge slower and need more early applied nitrogen to make up for slower mineralization rates. The exact extent of these processes cannot be predicted because they are weather dependent. In the example given above, if the nitrogen was knifed in earlier in the spring so that the spring rains would have distributed the nitrogen in the soil, then the height and color differences may not have appeared.

Crop Choice: Soil fertility status may help determine crop choice. Soybeans will have less need for applied nitrogen but will need to be inoculated at planting time. While soybeans have a lower phosphorus requirement, they are more sensitive to starter injury. Soybeans are more sensitive to low pH than corn. On acid soils, corn may be better suited until pH levels are adjusted. If zinc levels are low then soybeans may be better adapted than corn which is more sensitive to low zinc levels. Organic matter levels will also affect herbicide selection and rate.

Summary

Soil testing is the only way to accurately determine fertility status of a specific field. Nitrate-nitrogen levels will probably be low in fields coming out of CRP. Application method and timing need to fit the residue management for the field. Be aware of the potential problems associated with the method chosen and be prepared to adjust to unusual weather conditions.

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