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# Runoff, Erosion, and Soil Quality Characteristics of a Former Conservation Reserve Program Site in Southwestern Oklahoma

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**Abstract.** *This study was conducted to measure runoff, erosion, and soil quality characteristics of a site in southwestern Oklahoma the first year following conversion from the Conservation Reserve Program (CRP). Treatments included undisturbed CRP, Old World bluestem (*Bothriochlora ischaemum *L.), no-till wheat (*Triticum aestivum *L.) and conservation-till wheat. Significant differences in surface cover were found between each of the experimental treatments, with values ranging from 100% on the undisturbed CRP site to 42% for the conservation-till treatment. No significant difference in runoff was found among the various experimental treatments. The Old World bluestem and winter wheat treatments had only minimal erosion during the first year following conversion from the CRP. Production of Old World bluestem maintained levels of soil quality similar to those of the undisturbed CRP. Conversion of this CRP area to winter wheat production significantly reduced biological nutrient reserves, suggesting a degradation of soil quality. If this trend continues, long term productivity and the quality of air and water resources at this site could be affected.*
**Keywords.** *Conservation tillage, Erosion, Grassland renovation, No-till systems, Runoff, Soil management, Soil quality.*

The Conservation Reserve Program (CRP) was initiated to remove environmentally fragile areas from crop production. Approximately 14.8 million hectares (36.5 million acres) of cropland were enrolled in the original program (Taylor et al., 1994). To participate in the CRP, producers were required to convert cropland to vegetative cover for a 10-year period. The principal program objectives were to reduce erosion on highly erodible cropland, decrease sedimentation, improve water quality, foster wildlife habitat, curb the production of surplus commodities, and provide income support for farmers (Young and Osborn, 1990).

Soil structure has been found to improve when continuously cultivated land is put into grass (Lindstrom et al., 1994). The perennial grass cover established under the CRP at selected locations within the Great Plains has also resulted in significant increases in soil organic carbon (Gebhart et al., 1994). As CRP lands become eligible for release, many land managers who plan to return their land to crop production will consider adopting practices that will help maintain conservation benefits derived from the CRP.

The CRP was established to help stabilize highly erodible soils, thus returning these areas to crop production could have detrimental effects on long-term soil productivity (Young and Osborn, 1990). Selection of appropriate farming practices will be a very important consideration. For example, the residual benefit of the CRP in reducing erosion was found to be eliminated approximately nine months after tillage on a site in northern Mississippi where herbicides were used to prevent the regrowth of vegetation (Gilley and Doran, 1997). Conversely, a no-till management system which preserved existing surface cover and soil organic matter proved to be a suitable management practice for reducing the potential for erosion and degradation of soil quality at a former CRP site in southwest Iowa that was returned to row-crop production (Gilley et al., 1997).

Management systems that include sod have many environmental and production advantages. Detailed information on the effects of grass sod on soil properties and crop productivity at Big Spring, Texas, was provided by Zobeck et al. (1995). In the southeastern United States, sod crops planted in sequence with row crops have been found to increase crop yields, provide more efficient use of water and fertilizer, and reduce runoff and erosion (Bennett et al., 1976; Carreker et al., 1977; Harper et al., 1980; Belesky et al., 1981; Wilkinson et al., 1987). No-till corn planted in sod produces excellent yields when nutrient and water requirements are met (Moody et al., 1963; Jones et al., 1969; Carreker et al., 1973; Box et al., 1976, 1980). However, corn yields are often greatest the first year after sod but then decline with each succeeding year of corn production (Parks et al., 1969; Giddens et al., 1971). Elkins et al. (1979, 1983) concluded that acceptable corn yields could be obtained while maintaining a living grass mulch. Herbicide application rates, vigor of the grass stand, and climatic factors all contribute to the success of intercropping management systems.

A field recently plowed out of meadow is generally much less erodible than fields which have been continuously tilled. The fine root network and improved soil structure created by meadows serve to maintain high infiltration rates and protect the soil against erosive forces

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(Foster, 1982). Furthermore, the erosion-reducing effectiveness of sod is directly proportional to prior vegetative dry matter production (Wischmeier and Smith, 1978). The objectives for this study were to measure runoff, erosion and soil quality characteristics at a former CRP site in southwestern Oklahoma currently being used to produce Old World bluestem and winter wheat.

## MATERIALS AND METHODS

### STUDY SITE CHARACTERISTICS

The study site was located approximately 11 km (7 miles) southeast of Duke, Oklahoma, at latitude 34°36′N and longitude 99°34′W on a LaCasa (Fine, mixed, thermic, *Typic Arguistolls*) soil. The LaCasa series consists of deep, dark, generally well-drained soils which developed from weathered material. Native vegetation was mostly short and mid-length grasses.

Annual precipitation in this area averages 610 mm (24 in.). The frequency of a 64 mm (2.5 in.) rainfall of one-hour duration is approximately once every 10 years, and a 25 mm (1.0 in.) rainfall of one-hour duration can be expected every year (Hershfield, 1961). Mean annual temperature is 17°C (63°F), ranging from 4°C (39°F) in January to 29°C (85°F) in July. The average frost-free growing season is 214 days, extending from April to November.

Four treatments which included undisturbed CRP (unmanaged CRP), Old World bluestem (managed CRP), no-till wheat, and conservation-till wheat, were established at the study location as adjacent field comparison strips 402 m (1320 ft) long × 76 m (250 ft) wide which covered an approximate area of 3 ha (7.5 ac). The study site was placed in the CRP in 1989 and seeded to Old World bluestem. Following grass establishment, no other activities occurred on the undisturbed CRP treatment until rainfall simulation tests were conducted in June 1996.

A chronology of the major field operations is shown in table 1. Grass cover on the areas converted from the CRP was burned in April 1995 and 67 kg urea-N/ha (60 lbs/acre) was applied to the Old World bluestem treatment. Vegetative regrowth from the Old World bluestem treatment was swathed and baled in September 1995. Additional urea and diammonium phosphate fertilizers were applied to this treatment in March 1996 at rates of 67 kg N/ha (60 lbs N/acre) and 22 kg P/ha (20 lbs P/acre), respectively.

Two disking operations were performed on the conservation-till wheat plots in July 1995 to kill and partially incorporate the sod. An additional disking operation was performed in October 1995 just before seeding to winter wheat. Following disking, clumps of Old World bluestem were still visible on the soil surface. Glyphosate herbicide was applied to the no-till wheat plots in July 1995 to prevent the regrowth of Old World bluestem. Before seeding to winter wheat in October 1995, the no-till and conservation-till areas received granular mixed fertilizers at rates of 302 kg/ha (270 lbs/acre) 37-15(6.6 P)-0 and 45 kg/ha (40 lbs/acre) for 18-46(20.2 P)-0, respectively. Additional urea was applied in March 1996 at a rate of 39 kg N/ha (35 lbs N/acre). Wheat harvest occurred in June 1996 soon after completion of the rainfall simulation tests.

The total amount of potentially acidifying N fertilizer added to the experimental plots was 134 kg N/ha (120 lbs N/acre) for Old World bluestem and 159 kg N/ha (142 lbs N/acre) for wheat (no-till and conservation-till). The total P applied was 22 kg/ha (20 lbs/acre) to Old World bluestem and 30 kg/ha (27 lbs/acre) to wheat.

**Table 1. Chronology of major field operations for selected experimental treatments**

| Date | Old World Bluestem | Conservation-till Wheat | No-till Wheat |
|---|---|---|---|
| **April 1995** | Burn + Urea-N | Burn | Burn |
| May | | | |
| June | | | |
| July | | Disk (twice) | Apply herbicide (glyphosate) |
| August | | | |
| September | Swath and bale | | Apply herbicide |
| October | | Granular fertilizer applied (N & P) Disk and plant | Granular fertilizer applied (N & P) Plant |
| November | | | |
| December | | | |
| January **1996** | | | |
| February | | | |
| March | Fertilize urea-N +P | Fertilize urea-N | Fertilize urea-N |
| April | | | |
| May | | | |
| June | Simulation tests | Simulation tests | Simulation tests |

### RUNOFF AND EROSION CHARACTERISTICS

Two rainfall simulation plots with 3.7 m (12 ft) wide × 10.7 m (35.1 ft) long sheet metal borders were established on uniform slopes within each experimental treatment in areas of similar soils. A portable rainfall simulator designed by Swanson (1965) was used from 13 June 1996 to 18 June 1996 to apply rainfall at an approximate intensity of 64 mm/h (2.5 in./h). Water from a municipal well at Duke, Oklahoma, was trucked to the study site. Chemical analysis of this water indicated a pH of 7.7 and an electrical conductivity of 0.77 dS/m (mmhos/cm). The major anionic salts contributing to the electrical conductivity were bicarbonate, chloride, and sulfate and the major balancing cations were sodium, calcium, and magnesium. The Sodium Adsorption Ratio (SAR) of this water was 2.69, and the adjusted SAR was 4.90 indicating little sodium hazard or permeability problem.

The initial one-hour rainfall application occurred at existing soil-water conditions. A second one-hour application (wet run) was conducted approximately 24 h later. A trough extending across the bottom of each plot gathered runoff. Discharge was measured using an HS flume with stage recorder. Runoff samples were collected at 5-min intervals in a trough located at the bottom of each plot and later analyzed for sediment content.

The final series of rainfall simulation tests were planned for the undisturbed CRP treatment. Following the initial run at this site, a severe wind storm damaged the rainfall simulator. As a result, data for the wet simulation run are not available for the CRP treatment at this location.

Colored slides were taken at three locations within each plot prior to the simulation tests and later projected onto a screen containing a grid. The number of residue, grass, or crop elements intersecting the grid points were then determined (Mannering and Meyer, 1963). The ratio of the number of intersection points over the total grid points times 100 is the percent of the soil surface covered by residue.

The amount of vegetative material present on the soil surface greatly influences runoff and erosion. Therefore, duplicate samples of vegetative dry matter were collected within 0.589 $m^2$ (6.34 $ft^2$) circular areas in the immediate area of rainfall simulations before irrigation. Standing vegetative materials and residue lying on the soil surface within the frame were removed immediately prior to the rainfall simulation tests and stored in paper bags. The material was later oven dried, and the weight of dry matter per unit area was calculated. Duncan's multiple range test was used to identify statistical differences in vegetative mass between experimental treatments.

### Soil Quality Characteristics

Basic indicators of soil quality as described by Doran and Parkin (1994, 1996) were used to evaluate the four experimental treatments. Soil quality assessments for the 0 to 76 mm (0-3.0 in.) depth were conducted in the field on three replicated sites within each treatment on 17 and 18 June 1996 in areas near rainfall simulation tests. For treatments cropped to wheat, replicates were taken from the crop row between row wheel track and between row non-wheel track areas. For treatments in grass, replicates were chosen from bare, medium cover, and heavy cover areas. In this sense, variability between replications provides an estimate of within treatment variation only. On site soil quality measurements as described by Sarrantonio et al. (1996) included soil dry bulk density, pH, electrical conductivity, nitrate-N, water holding capacity, infiltration time, soil respiration, and water-filled pore space before and after irrigation with one 25 mm (1.0 in.) increment of water.

Aluminum rings, 15 cm (6 in.) in diameter, installed in the soil to a 76 mm (3.0 in.) depth, were used for infiltration and respiration measurements. The soil water content 16 h after irrigation was used as an estimate of field water-holding capacity. Further details on the utility and reliability of these approaches for measuring soil water status are given by Lowery et al. (1996).

Soil samples from depth intervals of 0 to 76 mm (0-3.0 in.) and 0 to 305 mm (0-12.0 in.) were collected for characterization and laboratory assessments by compositing 12 randomly sampled 19 mm (0.75 in.) diameter cores from each treatment (table 5). Samples were stored under ice in an insulated chest. Moist soil samples were passed through a 4.75 mm (0.187 in.) sieve before analyses for microbial biomass C and N by the chloroform fumigation/incubation procedure, and mineralizable N by the anaerobic incubation method. Samples which passed through a 2 mm (0.08 in.) sieve were analyzed for 1N KCL extractable mineral N ($NO_3$ and $NH_4$), total C and N by dry combustion, carbonate C by calcimeter, organic C by difference, and particle size analysis by the hydrometer method.

The methods used for laboratory analyses were all standard procedures employed by the USDA-ARS Soil and Water Conservation Research Unit, Lincoln, Nebraska, and the University of Nebraska Soil and Plant Testing Laboratory. Gravimetric data were converted to a volumetric basis using field measured soil bulk density which enabled conversion of data to ecologically relevant units which are needed for meaningful soil quality evaluations (Doran and Parkin, 1996).

## Results and Discussion

### Study Site Characteristics

Slope gradients for the experimental treatments ranged from 1.8 to 3.3% (table 2). The statistical analyses indicated a significant difference in slope between the undisturbed CRP and Old World bluestem plots, but no significant difference in slope was found between the Old World bluestem, no-till wheat, and conservation-till wheat plots.

Table 2 also shows significant differences in surface cover among the experimental treatments. The undisturbed CRP treatment had 100% surface cover, but after burning in April 1995, regrowth of Old World bluestem covered only 79% of the ground surface in June 1996. Establishment of a conservation-till management system, which included three disking operations, reduced surface cover to approximately 42%, while no-till wheat production resulted in 71% surface cover.

A vegetative mass of 4890 kg/ha (4370 lb/acre) was measured on the undisturbed CRP site. Vegetative material had not been removed from this site during the CRP period. The 2560 kg/ha (2290 lb/acre) of vegetative material on the Old World bluestem plots consisted of regrowth following burning. Lower amounts of vegetative mass, which represented 25 and 18% of the material present on the undisturbed CRP site, were measured on the no-till and conservation-till wheat plots, respectively.

### Runoff and Erosion Characteristics

Cumulative runoff for each treatment is shown in table 3. For both the initial and wet simulation runs, no significant difference in runoff was found among the various experimental treatments. Data from the initial simulation run suggests that conversion of this CRP site to winter wheat production using no-till or conservation-till management techniques did not significantly reduce infiltration. However, it should be pointed out that the higher conductivity of the groundwater (0.77 dS/m,

**Table 2. Slope, surface cover, and vegetative mass for selected experimental treatments**

| Treatment | Slope (%) | Surface Cover* (%) | Vegetative Mass† (kg/ha) |
|---|---|---|---|
| Undisturbed CRP | 3.3 a | 100 a | 4890 a |
| Old World Bluestem | 1.8 b | 79 b | 2560 b |
| No-till wheat | 2.3 ab | 71 c | 1220 c |
| Conservation-till wheat | 2.4 ab | 42 d | 900 c |

* Values given are the average of six measurements. Within each column, differences are significant at the 5% level (Duncan's multiple range test) if the same letter does not appear.

† Values given are the average of two measurements. Metric to English conversion: 1.12 kg/ha = 1 lb/acre.

Table 3. Runoff, sediment concentration, and soil loss for selected experimental treatments*

| Treatment | Run | Runoff † (mm) | Sediment Conc. (ppm × $10^3$) | Soil Loss (kg/ha)‡ |
|---|---|---|---|---|
| Undisturbed CRP | Initial | 10 a | 1.47 bc | 110 ab |
| Old World Bluestem | Initial | 8 a | 0.78 c | 57 b |
| No-till wheat | Initial | 3 a | 2.38 a | 61 b |
| Conservation-till wheat | Initial | 10 a | 2.25 ab | 210 a |
| Old World Bluestem | Wet | 26 a | 0.65 a | 170 b |
| No-till wheat | Wet | 29 a | 1.50 a | 480 ab |
| Conservation-till wheat | Wet | 35 a | 1.62 a | 540 a |

* Plots were 3.7 × 10.7 m (12.0 × 35.1 ft). Values given are the average of duplicate plots. Runs lasted for a 60-min duration. Average rainfall intensity was 63 mm/h (2.5 in./h).

† Within each type of run and for each column, differences are significant at the 5% level (Duncan's multiple range test) if the same letter does not appear.

‡ Metric to English unit conversion: 25.4 mm = 1 in.; 1.12 kg/ha = 1 lb/acre.

mmhos/cm) used in the simulation tests may have enhanced infiltration into soil over what would have been obtained using water of conductivity similar to that of rainwater (< 0.05 dS/m). Indications for such an effect were suggested by results of infiltration tests conducted during soil quality tests using distilled water.

For the initial simulation run, no significant difference in soil loss was found between the undisturbed CRP, Old World bluestem, and no-till treatments. Soil loss for the initial run on the conservation-till treatment was 210 kg/ha (190 lb/acre), which was three to four times greater than that from no-till wheat or Old World bluestem treatments. For the wet run, soil loss was also greatest for the conservation-till wheat treatment, totaling 540 kg/ha (480 lb/acre). However, these results should be interpreted with caution. Due to dry weather, the wheat crop established very poorly as indicated by final grain yields of 269 kg/ha (4 bu/acre) and 1000 kg/ha (15 bu/acre) for conservation-till and no-till treatments, respectively. Consequently, results of this study would represent a worst case scenario for soil erosion loss due to cropping. Use of this site for production of Old World bluestem, no-till wheat, or conservation-till wheat would not be expected to result in excessive erosion during the first year following conversion from the CRP.

### Soil Quality Characteristics

The soil quality tests indicated important differences in soil physical conditions between experimental treatments. The time required for 25 mm (1 in.) of distilled water to infiltrate varied from 24 min on the undisturbed CRP site to 150 min on the no-till treatment (table 4). Aside from differences in soil structure and organic matter content, differences in infiltration rates between experimental treatments may have also resulted from variations in soil texture (table 5), soil electrical conductivity, and nitrate concentration between sites. These differences may have caused the surface soils to disperse and slake when distilled water was added during the infiltration test for soil quality. Further research is under way to investigate the effects of soil management practices on soil electrical conductivity (nitrate content) and soil infiltration characteristics.

Table 4. On-site soil quality measurements for selected tillage treatments at the 0 to 76 mm depth on the LaCasa soil

| Soil Quality Indicator | Treatment: Undisturbed CRP | Old World Bluestem | No-till Wheat | Conservation-till Wheat |
|---|---|---|---|---|
| Water-holding capacity* ($m^3$ $H_2O/m^3$ soil) | 0.39 a† | 0.29 b | 0.39 a | 0.34 ab |
| Infiltration time for 25 mm of water (min)‡ | 24 b | 96 ab | 150 a | 44 b |
| Soil electrical conductivity§ (dS/m or mmhos/cm) | 0.30 b | 0.27 b | 0.35 ab | 0.78 a |
| Soil nitrate-N (kg N/ha)§ | 1.7 b | 3.0 b | 5.5 b | 37.2 a |
| Soil pH (1:1 soil:water) | 7.9 ab | 8.1 a | 7.4 b | 7.4 b |
| Soil respiration, (kg C/ha/day)‡ | | | | |
| Before irrigation | 141 a | 104 ab | 113 ab | 95 b |
| After irrigation | 101 a | 85 a | 43 b | 53 b |
| Water-filled pore space (%) | | | | |
| Before irrigation | 63 a | 61 a | 68 a | 60 a |
| After irrigation | 86 a | 54 c | 71 b | 65 bc |

* Measured in the field 19 h after application of 25 mm of water.

† Within each row, differences are significant at the 5% level (Duncan's multiple range test) if the same letter does not appear.

‡ Metric to English unit conversion: 25.4 mm = 1.00 in.; 1.12 kg/ha = 1.00 lb/acre.

§ Field measured values adjusted to a 1:1 soil to water basis.

Soil respiration rates on the undisturbed CRP, Old World bluestem and no-till wheat plots were similar before irrigation (table 4). After irrigation, soil respiration was reduced substantially on each of the experimental treatments. Soil respiration rates following irrigation on the winter wheat plots were significantly less than the undisturbed CRP and Old World bluestem treatments. A water-filled pore space (WFPS) of approximately 60% is considered optimum for aerobic microbial activity. Prior to irrigation, WFPS on all of the experimental treatments was near this optimum value due to rainfall the previous night.

For both sampling intervals, no significant difference in bulk density was found between experimental treatments (table 5). For silt loam soils, a bulk density of 15.5 Mg/$m^3$ (96.7 lb/$ft^3$) is considered the threshold above which plant rooting is limited by soil strength. Significant differences in sand, silt and clay fractions were found between selected experimental treatments.

With the exception of the sand fraction and microbial N, no significant differences in soil quality characteristics were identified at the 0 to 305 mm (0-12.0 in.) soil depth between the undisturbed CRP and Old World bluestem treatments. However, for the 0 to 76 mm (0-3.0 in.) sampling interval, organic carbon and total nitrogen were generally lower on the Old World bluestem and wheat plots than for undisturbed CRP. Similarly, with the exception of the sand and clay fraction, EC, and nitrate-N, no significant differences in soil quality characteristics were identified at the 0 to 305 mm (0-12.0 in.) soil depth between the no-till and conservation-till wheat treatments.

Conversion of this CRP site to winter wheat production was associated with significant reductions in total C and total N at both sampling intervals. Organic C, however, was only lower than CRP in the 0 to 76 mm (0-3.0 in.)

Table 5. Laboratory soil quality measurements for selected tillage treatments at the 0 to 76 and 0 to 305 mm depth on the LaCasa soil

| Soil Quality Indicator | Depth (mm) | Treatment: Undisturbed CRP | Old World Bluestem | No-till Wheat | Conservation-till Wheat |
|---|---|---|---|---|---|
| Dry bulk density ($Mg/m^3$) | 0-76 | 1.29 a* | 1.29 a | 1.25 a | 1.24 a |
| | 0-305 | 1.41 a | 1.48 a | 1.45 a | 1.46 a |
| Sand (%) | 0-76 | 24 a | 23 a | 19 b | 20 b |
| | 0-305 | 23 a | 20 b | 17 c | 19 b |
| Silt (%) | 0-76 | 50 ab | 46 b | 50 ab | 52 a |
| | 0-305 | 48 a | 47 a | 47 a | 49 a |
| Clay (%) | 0-76 | 26 b | 31 a | 31 a | 28 ab |
| | 0-305 | 29 b | 33 ab | 36 a | 32 b |
| Electrical conductivity (≈ 1:1.5 soil:water, dS/m) | 0-76 | 0.13 b | 0.14 b | 0.33 ab | 0.54 a |
| | 0-305 | 0.17 b | 0.18 b | 0.20 b | 0.31 a |
| Soil pH (≈ 1:1.5 Soil: water) | 0-76 | 8.0 a | 8.0 a | 6.9 b | 7.5 a |
| | 0-305 | 8.0 a | 8.0 a | 7.7 b | 7.7 b |
| Total C Mg/ha | 0-76 | 20.8 a | 21.8 a | 14.7 b | 12.7 b |
| | 0-305 | 93.8 a | 101 a | 49.5 b | 45.9 b |
| $CO_3$ - C (Mg/ha) | 0-76 | 3.8 b | 8.6 a | 0.3 c | 0.8 c |
| | 0-305 | 52.6 a | 54.9 a | 1.5 b | 2.4 b |
| Organic C (Mg/ha) | 0-76 | 17.1 a | 13.3 b | 14.4 ab | 11.9 b |
| | 0-305 | 41.3 b | 46.5 ab | 48.1 a | 43.4 ab |
| Total N (Mg/ha) | 0-76 | 1.6 a | 1.3 b | 1.3 b | 1.3 b |
| | 0-305 | 5.2 a | 5.1 ab | 4.7 b | 4.7 b |
| Microbial biomass C (kg/ha)† | 0-76 | 558 a | 444 ab | 439 ab | 376 b |
| | 0-305 | 1370 a | 1190 a | 1200 a | 1100 a |
| Microbial biomass N (kg/ha) | 0-76 | 46 a | 42 a | 55 a | 44 a |
| | 0-305 | 82 b | 115 a | 123 a | 111 ab |
| Mineralizable N (kg/ha) | 0-76 | 44 a | 37 ab | 24 bc | 19 c |
| | 0-305 | 43 ab | 77 a | 38 b | 26 b |
| Nitrate N (kg/ha) | 0-76 | 0.6 b | 4.1 b | 34 ab | 62 a |
| | 0-305 | 0.8 c | 6.2 c | 47 b | 100 a |

* Within each row, differences are significant at the 5% level (Duncan's multiple range test) if the same letter does not appear.

† Metric to English unit conversion: 25.4 mm = 1.00 in.; 1.12 kg/ha = 1.00 lb/acre.

interval of the conservation-till treatment. The differences in total C observed were largely an artifact of differences in carbonate contents in the surface of CRP and Old World bluestem treatments possibly due to variability in soil, past erosion, or acidification. This decrease in biological nutrient reserves occurred under limited rainfall. The reductions may have been even greater under normal rainfall conditions.

Higher electrical conductivity and soil nitrate values and lower soil pH for the winter wheat treatments are reflective of a soil condition where organic residues have been mineralized and ammoniacal fertilizers nitrified but the resultant nitrates have not been taken up by plants. These results are consistent with a degradation of soil quality resulting from decomposition of biological nutrient reserves due to soil tillage and nitrification of ammoniacal fertilizers where the nitrates formed are neither efficiently utilized nor recycled by plants (Smith and Doran, 1996). Plant growth not only maintains the soil biological reserves of C and N, but also removes excess nutrients from soil resulting in reduced soil nitrate levels, lower potential for N leaching, and neutralization of the acidity produced during nitrification of N mineralized from organic residues.

The presence of 100 kg/ha of nitrate-N in the 0 to 305 mm (12 in.) layer of the conservation-till wheat treatment is well above the amount of N needed for a good wheat crop in this area and represents a potential for loss by leaching and degradation of water quality. In this study, it is likely that the acidity produced from nitrification of ammoniacal forms of N was neutralized, in part, by carbonates present in the surface soil. If so, the resulting loss of carbon dioxide from soil could contribute to reduced atmospheric quality.

## Conclusions

Significant differences in surface cover existed between each of the experimental treatments. Surface cover values varied from 100% for the undisturbed CRP site to 42% for the conservation-till wheat treatment. Measurements of vegetative mass ranged from 4890 kg/ha (4370 lb/acre) on the undisturbed CRP plots to 900 kg/ha (800 lb/acre) on the site in conservation-till wheat.

No significant difference in runoff was found between the various experimental treatments during either the initial or wet rainfall simulation runs. Soil loss values during the wet rainfall simulation run varied from 170 kg/ha (150 lb/acre) for the Old World bluestem treatment to 540 kg/ha (480 lb/acre) for the conservation-till wheat plots. Use of this site for production of Old World bluestem or winter wheat using no-till or conservation-till management would be expected to produce only minimal erosion during the first year following conversion from the CRP.

In general, soil properties on the undisturbed CRP and Old World bluestem treatments were similar. The no-till and conservation-till wheat plots also had similar soil characteristics. Conversion of this CRP area to the production of winter wheat resulted in significant reductions in total N. If this trend continues, long term productivity and the quality of air and water resources at this site could be affected.

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