Management Practices to Improve Productivity of Degraded/Eroded Soils

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Summary
Productivity of degraded/eroded soils can be restored by using organic amendment, such as manure, and improved soil management. A study is being conducted near Hays, KS, to investigate and compare restorative potential of two nitrogen (N) sources. Dried beef manure and urea fertilizer were each applied at rates of 60 and 120 lb/a N to an eroded upland soil farmed with two tillage practices, no-till (NT) and conventional tillage (CT). Winter wheat yields in 2008 were significantly higher for the manure N source than for fertilizer N. Wheat yield was not significantly different between the two tillage practices. Preliminary data suggest manure addition increases productivity of eroded soils in the central Great Plains Region.

Introduction
Farmlands in the central Great Plains have lost topsoil through wind and water erosion induced by tillage and poor soil management. These soils are now degraded (i.e., low soil quality and productivity). Productivity and quality of degraded/eroded soils can be restored by using manure and improved management. Using manure as a fertilizer source is a management practice that can improve nutrient status of the soil and increase soil organic carbon levels. Continuous manure applications over several years can reduce soil bulk density. Reduction in soil bulk density and greater soil porosity are clear indicators of reduced soil compaction, improved aeration, greater infiltration, and improved conditions for plant root penetration. This study evaluates crop yield improvement associated with management of dryland eroded soils with manure vs. chemical fertilizer.

Procedures
This field experiment is being conducted at the Kansas State University Agricultural Research Center near Hays, KS. The experiment was established in 2006 on low-productivity, eroded soil. Treatments consist of two tillage systems (CT, chisel disk and NT) and two N sources (manure and commercial fertilizer) applied at low (normal N rate for crop need) and high (2X the normal N rate) rates. The crop sequence is typical of the region. The crop in rotation each year is chosen according to weather pattern (temperature and precipitation). The current rotation is grain sorghum (2006)/forage oat (2007)/winter wheat (2008). Individual experimental units (plots) are 21 ft wide and 45 ft long. The experimental design is a split plot with tillage as the main plot and N source and rate as subplots. A control treatment with no added N is also included. Treatments are replicated four times. In September 2007 before planting winter wheat, dried beef manure and commercial urea fertilizer were applied at 60 lb/a N (low rate) and 120 lb/a N (high rate). Winter wheat variety Dandy was seeded Oct. 13, 2007, at 59 lb/a by using a Sunflower 9711 drill with 7.5-in. row spacing. Grain was harvested on July 5, 2008, by using a Massey MF8 plot combine. Grain yields were determined at 12.5% moisture.

Results

Nitrogen source, N rate, and their interaction (source by rate) significantly affected ($P \leq 0.05$) winter wheat grain yield (Table 1). Tillage practices had no significant effect on grain yield. Addition of manure significantly ($P \leq 0.05$) increased wheat yield compared with the urea fertilizer treatment. No differences in wheat yield were observed between commercial fertilizer treatments (at either N rate) and the no-N control. Data suggest addition of organic material, such as manure, improves many aspects of soil quality at this eroded site, which is reflected in the increased crop yield. In addition, the slow release of nutrients in the manure treatment could also have improved soil nutrient status compared with commercial fertilizer. Analysis of soil quality (physical, chemical, and biological) as affected by manure amendments is being conducted and will be reported in the future.

Table 1. Effect of tillage, nitrogen source, and nitrogen rate on wheat production on eroded soil in Hays, KS, 2008

Tillage treatment	N source	N rate	Wheat yield
		lb/a	bu/a
No-till	Control[1]	0	24
	Manure	120	60
		60	47
	Fertilizer	120	25
		60	24
Tillage	Control	0	20
	Manure	120	61
		60	52
	Fertilizer	120	25
		60	22
Tillage (means)			NS
No-till			39
Conventional tillage			40
Nitrogen source (means)			0.004*
Fertilizer			24b
Manure			55a
Nitrogen rate (means)			0.01*
High[2]			43a
Low[3]			36b
N source × N rate (means)			0.03*
High fertilizer			25c
Low fertilizer			24c
High manure			61a
Low manure			49b

[1] Control was not included with the statistical analysis.
[2] High rate (120 lb/a N)
[3] Low rate (60 lb/a N)
* Significant at $P<0.05$.
NS = not significant.
Values followed by a different letter are significantly different.