Management Practices Influence Productivity of Degraded or Eroded Soils

M.M. Mikha, P. Stahlman, J.G. Benjamin, and P.W. Geier

Summary
Management practices influence the productivity of eroded or degraded soil. This study investigates the influence of beef manure amendment compared with commercial fertilizer (urea) applied at two rates (60 and 120 lb N/a) with two tillage practices (conventional tillage, CT, and no-tillage, NT). In 2006, a study site was established on eroded/degraded soil at the Kansas State University Agricultural Research Center–Hays in Hays, KS. In 2011, winter wheat yield and wheat biomass production were greatly influenced by manure addition compared with commercial fertilizer. Wheat yield and wheat biomass were not influenced by nitrogen (N) rate and tillage practices. Overall, manure addition improved the productivity of eroded soil. More analysis is being conducted to evaluate manure amendment on different aspects of soil quality in this eroded/degraded soil.

Introduction
In the central Great Plains region, soil degradation is a consequence of soil organic matter losses due to soil disturbance and plant residue decomposition. Continuous tillage promotes soil organic matter decomposition and enhances soil erosion. Although no-tillage minimizes soil disturbance and promotes soil organic matter accumulation, manure amendment can restore the productivity of degraded/eroded soils by improving the nutrient status and increasing soil organic matter levels. The objectives of this study were to (1) identify the rate of beef manure necessary to supply nitrogen to the dryland cropping system and (2) evaluate the advantages of using manure as an amendment versus managing those same eroded soils with chemical fertilizer.

Procedures
The experiment site was established in 2006 on eroded/low-productivity soil at the Kansas State University Agricultural Research Center–Hays. The management practices consisted of two tillage practices, conventional tillage (CT, chisel disk) and no-tillage (NT), and two N-sources (beef manure and commercial fertilizer) applied at two rates, low (normal N rate for crop needs) and high (twice the normal N rate). The current crop rotation is grain sorghum (2006)/forage oat (2007)/winter wheat (2008)/grain sorghum (2009)/millet (2010)/winter wheat (2011). The four replicated experiment plots (21 ft by 45 ft) were organized in a randomized complete block design. In September 2010, before planting winter wheat, solid beef manure and commercial fertilizer (urea) were applied at 60 lb N/a (low rate) and 120 lb N/a (high rate). Winter wheat (hybrid Dandy) was seeded in October at 59 lb seed/a with a Sunflower 9711 drill (Sunflower Manufacturing, Beloit, KS) with 7.5-in. row spacing. Grain was

harvested in July 2011 using a plot combine. Grain yields were determined at 12.5% moisture.

Results

The 2011 winter wheat grain yield and plant biomass production (Table 1) were significantly affected ($P \leq 0.05$) by N source. The addition of manure significantly ($P \leq 0.05$) increased wheat yield and wheat biomass compared with fertilizer treatment. The interaction of N source and N rate greatly influenced wheat biomass production, especially with the manure amendment. Tillage practices and N rate had no influence on grain yield and plant biomass. No differences in wheat yield and wheat biomass were observed between commercial fertilizer treatments (at both N rates) and the control. Overall, the improvement of winter wheat yield and biomass production in this eroded soil with manure amendment treatments could be related to improvements in many aspects of soil quality and soil nutrient status compared with commercial fertilizer. The influence of manure amendment on soil quality parameters is being conducted and will be reported periodically for the duration of the experiment.

Table 1: Effect of tillage, nitrogen (N) source, and nitrogen rate on wheat yield and wheat biomass production of eroded soil in Hays, KS, 2011

Tillage treatment	N source	N rate	Wheat yield	Wheat biomass
		lb/a	bu/a	lb/a
No-till	Control[1]	0	9.1	1976
	Manure	120	15.9	3637
		60	17.9	3343
	Fertilized	120	9.3	2251
		60	10.4	2302
Tillage	Control	0	7.6	1953
	Manure	120	16.8	4080
		60	15.3	3396
	Fertilized	120	8.9	2226
		60	8.9	2544
Tillage (mean)			NS[2]	NS
No-till			13.4	2883
Conventional-till			12.5	3062
Nitrogen source (mean)			0.0051*	0.023*
Fertilizer			9.4b	2331b
Manure			16.5a	3614a
Nitrogen rate (mean)			NS	NS
High[3]			12.7	3050
Low[4]			13.1	2896
N source × N rate (mean)			NS	0.045
High fertilizer			9.1	2239c
Low fertilizer			9.6	2423c
High manure			16.3	3858a
Low manure			16.6	3369b

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