NebGuide
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Soil and Water Summaries for 2005 to 2006

Charles S. Wortmann, Soils Extension Specialist

Synopses of soil and water research and products from the UNL Department of Agronomy and Horticulture and its partners in 2005-2006.

This NebGuide provides an update of recent works completed by soil and water science faculty in the Department of Agronomy and Horticulture and their partners. The extension NebGuides and extension circulars cited are available on-line at *http://extension.unl.edu/publications*. Many of the soil fertility resources are available at *http://soilfertility.unl.edu* and manure nutrient management resources are at *http://cnmp.unl.edu*. On-line lessons can be accessed at *http://plantandsoil.unl.edu*. Resources or citations for each entry are included.

Soil Fertility Management

Starter Fertilizer for Corn. Ten trials were conducted in no-till systems in eastern Nebraska. There was a high probability of response to starter nitrogen and phosphorus for irrigated corn when soil test phosphorus (Bray-P1) was less than 15 ppm with a mean yield increase of 13.7 bu/ac. Little or no response occurred for dryland corn irrespective of Bray-P1. Including sulfur in the starter fertilizer increased early growth but did not affect yield. Starter fertilizer effects were similar for in-furrow, over-the-row, and 2x2 placement. Topographic position and soil type were not important to response. *Agronomy Journal (2006) 98:156-162.*

Starter Fertilizer for Grain Sorghum. Twelve trials were conducted under no-till conditions in eastern Nebraska. Application of starter fertilizer containing nitrogen and phosphorus often increased early growth but did not result in increased yield or in drier grain at harvest, irrespective of soil test phosphorus, topographic position and soil type. Including sulfur in the starter fertilizer did not affect crop performance, which was similar for in-furrow, over-the-row and 2x2 placement. *Agronomy Journal (2006) 98:187-193.*

Using Starter Fertilizers for Corn, Grain Sorghum and Soybeans. This revision of an earlier NebGuide provides updated information on starter fertilizer use in row crops. *UNL NebGuide G361.*

Improved Crop Management Through Farmer Research. Two farmer research groups were studied to assess the impact of farmer research, learn more about the opportunities and difficulties of such research and determine lessons applicable to initiation of similar groups. Organized farmer research, typically done with a consultant or Extension educator, was found to be an efficient means of cropping system improvement. Estimated mean gains in annual profitability per farm operation were approximately $2315, $4220, $4730, and $3060 for research on planting, tillage, soil management and pest management, respectively. *Renewable Agriculture and Food Systems (2005) 20:243-251. UNL NebGuide G1556: Farmer Research: Project Initiation and Implementation.*

Carbon and Nitrogen Cycling in High-yielding Systems. Soil organic matter increased with incorporation of crop residuals with a continuous corn system. Corn yields and nitrogen use efficiency were highest in a corn-soybean system; however, there was a loss of soil organic matter and nitrogen reserves. The nitrogen credit attributed to corn-soybean rotations appears to be due to "mining" of soil nitrogen reserves. In contrast, in systems that accumulate soil organic matter, credit should be given to the efficiency of added fertilizer nitrogen in augmenting soil nitrogen sequestration. *Fluid Journal 13 (2005) 3:8-10.*

Soil Properties and Soil Microbial Activity. The effects of variation in soil properties on groups of microorganisms important in crop residue decomposition and nutrient cycling were studied. Soil organic matter content, percent clay and topsoil depth were most important in describing variation in microbial communities within the field. Fungi were associated with soil organic matter that is entrapped within soil aggregates while bacteria and actinomycetes were associated with partly decomposed soil organic matter. *Soil Science Society of America Journal (2006) 70:1480-1488.*

Corn Nitrogen Need as Affected by Plant Population and Row Spacing. In northeast Nebraska corn yield was 4 percent more with 20-inch row spacing compared with 30-inch row spacing. Yield increased with plant population to 25,000 plants per acre. The optimal nitrogen rate was not affected by row spacing or plant population. Therefore, prediction of the optimal nitrogen rate for a field could not be improved by including row spacing and plant population in the nitrogen rate equation. *Agronomy Journal (2006) 98:529-535.*

Soil pH, Liming and No-till. Soil pH is decreasing in many soils in the semiarid Great Plains under dryland no-till cropping systems. Studies have determined effects on grain yield, the rate of acidification, causes of the acidification and the effect of using alternative liming materials such as fly ash from coal-powered electrical plants to increase pH. Liming may be necessary in the future to prevent yield loss. *Soil Science. 171:414-422, Plant and Soil 283:367-379, Agronomy Journal. 98:26-33.*

Alternative Crops for the High Plains. Canola production and sunflower production for biofuels and low transfat oils are highlighted in revised regional production guides. Forage crops for dryland production also are featured in a new multi-state production guide.

Regional Bulletins

- *High Plains Sunflower Production Handbook (MF2384), Kansas State University*
- *Great Plains Canola Production Handbook (MF2734), Kansas State University*
- *Pea Production in the High Plains (EC187), University of Nebraska–Lincoln*

Crop Yield Potential

Hybrid-Maize Simulation Model. The Hybrid-Maize model simulates the growth and yield of a corn crop under rainfed or irrigated conditions to:

1) assess the overall site yield potential and its variability based on historical weather data;
2) evaluate effects of planting date, hybrid maturity, and plant density on yield;
3) analyze yield in relation to silking and maturity in a specific year;
4) explore options for irrigation management, and
5) evaluate current crop status and predict yield for different weather conditions during the season.

The software is available at *http://hybridmaize.unl.edu*. *Agronomy Journal (2006) 98:187-193. UNL NebGuide G481, Setting a Realistic Corn Yield Goal.*

Use of Spatial Technology in Soil and Water Management

Processing of Yield Map Data. Yield maps reflect systematic and random sources of yield variation as well as numerous errors caused by the harvest and mapping procedures used. A framework for processing multi-year yield map data was developed for mapping yield zones. Steps include 1) raw data screening, 2) standardization, 3) interpolation, 4) classification of multi-year yield maps, 5) post-classification spatial filtering to create spatially contiguous yield classes, and 6) statistical evaluation of classification results. *Precision Agriculture (2005) 6:193-212. UNL Extension Circular 704, Listening to the Story Told by Yield Maps: Precision Agriculture.*

Mapping of Soil Organic Carbon (SOC). Interpolation with ordinary kriging and regression kriging were compared with soil organic carbon determined by automated carbon-nitrogen analyzer (reference method) or estimated from weight loss-on-ignition. In regression kriging, secondary information was considered, including relative elevation, slope, soil electrical conductivity and remotely sensed soil surface reflectance to improve the accuracy of soil organic carbon maps. Measurement of soil organic carbon by the automated carbon-nitrogen analyzer in combination with regression kriging resulted in the most precise soil organic carbon maps with a 6-15 percent gain in map precision by using the secondary information. Soil organic carbon maps derived from loss-on-ignition estimates were less precise but were improved with regression kriging. Secondary information should be used in soil organic carbon mapping to reduce sampling cost and/or increase map precision. *Soil Science (2006) 171:374-387.*

Analysis of Variability in Automated Soil pH Measurements. An automated system for mapping soil pH on-the-go has been developed, tested and commercialized. It can determine soil pH approximately every 10 seconds as it moves across a field. In this publication, different sources of measurement error were analyzed and precision was found to be comparable to results from manually extracted soil samples. *Applied Engineering in Agriculture (2006) 22:335-344.*

Site-specific Management of Soil pH. Questions about mapping lime requirement based on grid sampling, directed sampling and on-the-go sensing are addressed. Issues affecting the economics of variable rate lime application are discussed. *UNL Extension Circular EC705, Site Specific Management of Soil pH (FAQ).*

Mapping Soil Mechanical Resistance with a Multiple Blade System. A triple blade soil mechanical resistance mapping system was developed for on-the-go mapping of soil strength at three levels up to 12 inches deep. The measurements, at different travel speeds, were compared to standard cone penetrometer measurements. In addition, an agricultural field example was used to illustrate the potential applicability of the system developed to support site-specific tillage. *Applied Engineering in Agriculture (2005) 21:15-23.*

Carbon Sequestration and Greenhouse Gas Emissions

Carbon Sequestration in No-till Irrigated and Rainfed Corn-based Agroecosystems. Carbon dioxide exchange was quantified in three corn and soybean no-till production systems employing year-round tower eddy covariance flux systems and measurements of soil carbon stocks, CO_2 fluxes from the soil surface, plant biomass and litter decomposition. The results for the first three years suggest that soil carbon loss was least with the rainfed corn-soybean rotation, intermediate with irrigated continuous corn and greatest with the irrigated corn-soybean rotation. Direct measurement of soil carbon stocks, however, did not detect a statistically significant change in soil organic carbon. *Agricultural and Forest Meteorology (2005) 131:77-96.*

Nitrous Oxide (N_2O) and Carbon Dioxide (CO_2) Emissions in Intensively Managed Soils. Accumulation of soluble salts resulting from application of fertilizer nitrogen may affect microbial production of N_2O and CO_2 in agricultural soils. Average CO_2 production decreased with increasing electrical conductivity at all soil water contents, indicating a general reduction in microbial activity with increasing EC. Average cumulative N_2O production at 60 percent water-filled pore space decreased with increasing electrical conductivity. However, at 90 percent water-filled pore space, N_2O production was 2 to 40 times greater than that at 60 percent water-filled pore space and maximum N_2O losses occurred at the highest electrical conductivity level. Differences in gas emissions at varying soil electrical conductivity may be due to changes in mechanisms of adjustment to salt stress and ion toxicities by microbial communities. *Journal of Environmental Quality (2006) 35:1999-2010.*

Carbon Deposition from Corn Roots to Soil. Roots have been shown to be more important than leaf and stem residues to long-term carbon contributions to soil organic matter. Belowground carbon deposition comes from root growth and exudation of carbon compounds from roots. Analysis of the literature and our own measurements suggested that belowground carbon deposition is approximately 29 percent ± 13 percent of the carbon in aboveground corn residues and that the contribution of root carbon exudation depends on daylength, solar radiation and soil temperature. *Soil Science Society of America Journal (2006) 70:1489-1503.*

Water Resource Protection

Residual Effects of Composted Feedlot Manure of Phosphorus in Runoff. The effect of compost applied one to four years previously was studied. Runoff and erosion were 69 percent and 120 percent greater for no compost compared with where compost had been applied. The previous application of compost resulted in soil test phosphorus in the 0- to 2-inch depth of 380 ppm for low phosphorus compost and to 779 ppm for high phosphorus compost compared to 16 ppm with no compost. Total phosphorus loss in runoff was 1.6, 2.1 and 3.8 lb/ac for the no compost, low phosphorus compost, and high phosphorus compost, respectively. *Journal of Environmental Quality (2006) 35:651-657.*

Long-term Effects of Feedlot Manure Application. The effect of manure or composted manure, applied at rates to meet phosphorus removal or nitrogen requirement of corn silage, on silage yield and soil properties was evaluated following 10 years (1993-2002) of annual application. The use of a winter cover crop significantly reduced shallow vadose zone nitrate accumulation in some years, but reduced silage yield in some years when it was allowed to grow too late into the season and soil moisture was depleted. Careful accounting for residual nitrate-N allowed manure application at rates supplying total crop nitrogen requirement with acceptable root zone and shallow vadose zone nitrate accumulation. Soil phosphorus concentrations near the surface were at 500 ppm Bray-1 phosphorus or greater following 10 years of manure application to supply the total crop nitrogen requirement. *Journal of Environmental Quality (2005) 34:1672-1681.*

Phosphorus Management for Surface Water Protection. A regional extension circular was co-authored by 11 nutrient management specialists from Nebraska, Iowa, Missouri and Kansas. This is a resource for better understanding the role of phosphorus in surface waters, for assessing the risk of agricultural phosphorus loss to surface waters, and for learning of phosphorus management options for reducing this risk. Several phosphorus indexes are described and information is included on the cost effectiveness of various phosphorus management practices. *UNL Extension RP187, Agricultural Phosphorus Management and Water Quality Protection in the Midwest.*

Runoff Sediment Analysis. An improved method for measuring runoff-suspended solids was developed. The method uses a turbidity meter with sucrose solution instead of water as a suspending media to dampen the effect of particle size distribution. This dampening effect improved the estimation of total suspended solids in runoff samples by at least 20 percent compared to water suspensions. *Journal of Environmental Quality (2006) 35:815-823.*

Soil Conductivity as a Measure of Soil and Crop Status. Soil apparent electrical conductivity (ECa) was measured during the growing season over four years (2000-2003) on a site where feedlot manure was applied at either nitrogen requirement or phosphorus removal rates for corn silage. An inorganic fertilizer treatment also was measured. Soil ECa was found to be highly correlated to soil nitrate-N in the root zone, reflecting dynamic changes in plant available soil nitrogen throughout the growing season as influenced by manure or anhydrous ammonia application. *Soil Science Society of America Journal (2006) 70:1600-1611.*

Composting Manure and Other Organic Resources. This is an update of an earlier NebGuide and provides information on methods and management of composting, land application and issues and options. *UNL NebGuide G1315.*

Comparison of Tools for Assessment of the Risk of Phosphorus Runoff. A comparison and evaluation of five tools for assessing the potential for phosphorus runoff (P indexes) developed for the Midwest was conducted by comparing the results of a wide range of scenarios and in consideration of research findings. The phosphorus indexes differed greatly in the weight given to different factors contributing to phosphorus loss. The information gained was used to develop the Nebraska 2005 Phosphorus Index. *Journal of Soil and Water Conservation (2005) 60:221-227.*

Manure Use Planning: an Evaluation of a Producer Training Program. A training program for producers in manure use planning was evaluated with input from livestock producers who attended the training. The need for and impact of the training was greater for continuing operational and maintenance skills of manure utilization than for strategic planning skills. The Extension program has been adjusted to focus on operational and maintenance skills. *Journal of Extension (2005) Vol 43 Article N0. 4RIB5; available on-line at http://www.joe.org/joe/2005august/rb5.shtml.*

Education

Basic Soils Course by Distance Education. Ten distance education basic soils lessons are available on-line at *http://plantandsoil.unl.edu*. Each lesson earns one continuing education unit. The lessons are:

- Part 1: The Origin and Development of Soil (How Soil Gets a Life and a Name)
- Part 2: Physical Properties of Soil and Soil Water
- Part 3: Soil Organic Matter
- Part 4: Soil pH
- Part 5: Nitrogen as a Nutrient
- Part 6: Phosphorus and Potassium in the Soil
- Part 7: Soil and Plant Considerations for Calcium, Magnesium, Sulfur, Zinc and other Micronutrients
- Part 8: Characteristics of Fertilizer Materials
- Part 9: Fundamentals of Soil Testing
- Part 10: The Scientific Basis for Making Fertilizer Recommendations

On-line Lessons on Manure Phosphorus Management. Four lessons are available on-line at *http://plantandsoil.unl.edu*. One continuing education unit is earned for completing each lesson. The lessons on Manure Phosphorus (P) and Surface Water Protection are:

- Manure P, Soil P and Water P Dynamics and Interactions

- Field and Management Factors Contributing to Phosphorus Loss Risk
- Transport Factors Contributing to Phosphorus Loss Risk
- Assessment of the Risk of Agricultural Phosphorus Delivery to Surface Waters.

On-line Lessons on Erosion. Two lessons are available on-line at *http://elkhorn.unl.edu/croptechnology2005/soil_sci/* on erosion and erosion control measures for urban and crop lands. These lessons can be used for resident instruction or distance education. Continuing education units will be available in 2007. *Journal of Natural Resources and Life Science Education 34:126.*

Software Tools for Nutrient, Manure and Crop Management

Software tools for determining fertilizer rates and products. The following software programs are available on-line at *http://soilfertility.unl.edu*.

- *Fertilizing Winter Wheat I. Nitrogen, Potassium, Micronutrients*
- *Fertilizing Winter Wheat II. Phosphorus*
- *Corn Nitrogen Recommendation Calculator*. This is an interactive spreadsheet for determining the most profitable rate of nitrogen fertilizer to apply and exploring different nitrogen management strategies. This software implements the modified UNL nitrogen recommendation for corn.
- *Fertilizer Chooser*. A general software for translating a multi-nutrient recommendation into the correct amounts of fertilizer needed and selecting an optimal combination of fertilizer nutrient sources based on quoted prices for fertilizer products and the cost of application.
- *Yield Check*. This software screens yield map data for six types of errors: 1) combine header status up, 2) start-/end-pass delays, 3) grain flow, distance traveled, and grain moisture outliers, 4) values exceeding minimum and maximum biological yield limits, 5) local neighborhood outliers and 6) short segments and co-located points. Erroneous values are either deleted or flagged for further analysis to identify where they occurred in the field. The output file can then be used in other commercial mapping software to create a yield map or maps of the different categories of erroneous yield values.
- *Hybrid-Maize*. A corn growth model to simulate effects of planting date, hybrid choice, plant population or irrigation on yield potential. Available at: *http://hybridmaize.unl.edu*

Software tools for manure nutrient management. A series of seven software tools with documentation have been published by UNL Extension as extension circulars and can be downloaded from *http://cnmp.unl.edu*.

- *Estimating a Whole Farm Nutrient Balance: Spreadsheet Instructions, EC189.* Import, export and balance of nutrients for a farm are determined. The nutrient balance indicates the risk of water pollution due to excessive build-up of nutrients on the farm.
- *Manure and Land Requirement Estimator: Spreadsheet Instructions, EC190.* The amount of manure nitrogen and phosphorus excreted and available for land application can be estimated for an animal feeding operation considering animal type, ration, and type of manure storage facility. The amount of land required to apply the manure on a nitrogen or phosphorus basis is determined, considering the cropping system and yield levels.
- *Manure Use Plan for Nebraska: Spreadsheet Instructions, EC191.* A plan for land application of manure can be developed for one or several years. The plan specifies the manure source, field and application practices. Nutrients applied are estimated.
- *Calculating the Value of Manure for Crop Production: Spreadsheet Instructions, EC192.* The dollar value of manure for a particular field and crop rotation is calculated considering manure nutrient content, soil test levels, crop yields, expected crop response to the applied manure and expected cost of transport and application. The tool is intended both for livestock feeders and crop producers to determine a fair price for selling or buying the manure.
- *The Nebraska MMP-CNMP Document Generator, EC193.* This software tool works with the Manure Management Planner (MMP) of Purdue University to produce the comprehensive nutrient management plan (CNMP) needed to obtain a permit for a waste handling facility for a concentrated animal feeding operation. It also provides guidance and forms for the required record keeping.
- *The Nebraska MMP-AMUP Document Generator, EC194.* This software tool works with the Manure Management Planner (MMP) of Purdue University to produce an annual manure use plan (AMUP) that complies with Nebraska's regulations for concentrated animal feeding operations. It also provides guidance and forms for the required record keeping.
- *The Nebraska Phosphorus Index (2005): Background and Users Guide, EC195.* This extension circular describes the Nebraska Phosphorus Index (2005) and provides instructions to its use. The latest version has a built-in erosion calculator. The Nebraska Phosphorus Index is used to assess the potential for phosphorus loss in runoff and erosion from agricultural land. It can also be used to assess the effectiveness of management alternatives in reducing phosphorus loss and erosion.

UNL Extension publications are available online at *http://extension.unl.edu/publications*.

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