Water Quality Characteristics of Runoff from Land Application Areas

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Presentation Outline

- WHY is this work being done?
- WHAT is being done?
- HOW is this work being done?
- Nutrient and Microbial Transport from Feedlot Surfaces

WHY is this work being done?

Production agriculture contributes approximately $12 billion to Nebraska's economy

Nebraska's livestock industry accounts for approximately 65% of the state's total agriculture receipts each year.

Cattle receipts total
$6.5 billion

Swine receipts total
$750 million.

Annual animal manure production in Nebraska is approximately 27 million tons.

Nebraska's leading crops comprise 15.7 million acres.

- Corn – 9.0 million acres (1.5 billion bushels)
- Soybeans – 4.4 million acres
- Winter Wheat – 2.0 million acres
- Sorghum – 0.3 million acres

The ethanol industry in Nebraska will soon use over 600 million bushels of corn each year.

The by products from ethanol production are primarily used in beef cattle feedlots.

The cattle, corn, and ethanol industries in Nebraska are closely interrelated.

WHAT is being done?

Research Goal

Identify cropping and management practices that incorporate the use of manure as a valuable nutrient source and soil amendment without causing adverse environmental impacts.

Factors Affecting Nutrient Transport in Runoff

Factors Affecting Nutrient Transport in Runoff

- Manure Application Rate
- Incorporation
- Time Since Manure Application
- Residual Soil Nutrient Content
- Long Term Effects of Manure Application
- Conservation Practices
- Remediation Efforts

Manure Application Rate

Manure Application Rate

- The DP concentration of runoff following N-based manure application can be an environmental concern when applied under no-till conditions without incorporation.
- P-based manure application is an agronomically and environmentally sound management system.

Incorporation

Incorporation

- Concentrations of DP, TP, NO_3-N, and TN in runoff decreased significantly when manure was incorporated by disking.
- Disking of sites on which manure was applied to meet N-based requirements resulted in DP concentrations < 1 mg L^{-1}.

Time Since Manure Application

Time Since Manure Application

- Concentrations of DP, TP, and NH_4-N declined throughout the year on the no-till cattle and no-till swine manure treatments.
- After approximately one month, runoff concentrations of DP and TP did not change significantly on sites where beef cattle manure was applied and then incorporated by disking.

Residual Soil Nutrient Content

Residual Soil Nutrient Content

- On a Sharpsburg silty clay loam soil near Lincoln Nebraska, DP concentrations of runoff increased in an exponential fashion from 0.18 to 3.37 mg L^{-1} as Bray-1 P soil content varied from 50 to 300 mg kg^{-1}.
- DP concentrations were < 1 mg L^{-1} for Bray-1 P soil values < 145 mg kg^{-1}.

Long Term Effects of Manure Application

Long Term Effects of Manure Application

- For selected locations at which manure was applied for several years, runoff was reduced from 2 to 62%, and soil loss decreased from 2 to 65% compared to non-manured sites.
- Runoff and soil loss values were reduced substantially as long-term manure application rates increased.

Conservation Practices

Conservation Practices

- A single 0.75 m wide grass ledge reduced runoff concentrations of DP, PP, and TP from no-till plots on which beef cattle manure was recently applied by 47%, 38%, and 54%, respectively,
- Corresponding reductions in runoff concentrations on the disked plots were 21%, 43%, and 38%, respectively.

Remediation Efforts

Remediation Efforts

- Before the experimental plots were plowed, Bray-1 P soil content ranged from 53 to 414 μg g^{-1}. After the plowing operation, Bray-1 P soil values varied from 16 to 77 μg g^{-1}.
- After plowing, DP concentrations of runoff from the plots with former elevated soil P levels were similar to the control plots on which no manure had been applied.

Long Term Goal

Develop procedures for predicting nutrient transport at field and watershed scales. Use this information to develop comprehensive nutrient management planning materials.

HOW is this work being done?

National Phosphorus Research Project

- USDA – Agriculture Research Service
- USDA – Natural Resources Conservation Service
- USDA – Cooperative Extension Service
- US – Environmental Protection Agency
- University Cooperators


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Nutrient and Microbial Transport from Feedlot Surfaces

Definition

- USM – unconsolidated surface materials (loose manure pack)
- CSM – consolidated subsurface materials (compacted manure and underlying layers)

WHY is this work being done?

In Nebraska there are:

20,000 beef cattle operations

4,570 cattle feeding operations

4.7 million cattle fed and marketed each year

(state population – 1.7 million)

Cattle on Feed (millions) (February 2007)

Texas – 2.80 (20%)

Nebraska – 2.54 (18%)

Kansas – 2.43 (17%)

United States – 14.1

Runoff from beef cattle feedlots may contain microorganisms, nutrients, organic materials, and sediment.

WHAT is being done?

Spatial Variations in Nutrient and Microbial Transport from Feedlot Surfaces

Objectives

- Measure selected feedlot soil properties and nutrient and microbial transport in runoff from selected feedlot locations.
- Compare the effects of USM and CSM on nutrient and microbial transport.
- Determine if nutrient and microbial transport in runoff are correlated to feedlot soil characteristics.

Conclusions

- No significant differences in feedlot soil characteristics or nutrient transport in runoff were found between USM and CSM.
- Concentrations of *E. Coli* were significantly greater in USM than in CSM.

Conclusions

- Pen location was found to significantly influence several feedlot soil characteristics.
- Runoff measurements of DP, EC and NH_4-N were significantly influenced by pen location and were correlated to selected feedlot soil characteristics.

Nutrient and Microbial Transport in Runoff from Soil and Pond Ash Feedlot Surfaces

- Measure selected chemical and physical properties, and nutrient and microbial transport in runoff, from soil and pond ash feedlot surfaces during the summer period.
- To correlate runoff nutrient and microbial transport to selected chemical and physical characteristics of soil and pond ash surfaces.

Nutrient Transport in Runoff from Feedlots as Affected by Wet Distillers Grain Diet

- Measure selected chemical and physical properties, and nutrient transport in runoff, from feedlot surfaces as affected by corn based and wet distillers grain diets.
- Correlate runoff nutrient transport to selected chemical and physical characteristics of feedlot surfaces.

Nutrient Transport in Runoff from Feedlot Surfaces as Affected the Amount of USM

- Measure selected chemical and physical properties, and nutrient transport in runoff, from feedlot surfaces with varying amounts of USM.
- Correlate runoff nutrient transport to selected chemical and physical characteristics of feedlot surfaces.

Size Distribution of Particulate Matter in Feedlot Runoff

- Measure the size distribution of particulate matter in runoff from feedlot surfaces containing USM and CSM.
- Determine the effects of varying amounts of USM on particle size distribution.
- Identify the effects of varying flow rate on the size distribution of particulate matter.

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