6-5-2008

Heavy Rain, Soil Erosion and Nutrient Losses

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Abstract
As we write this article spring rains are coming hard and fast causing substantial soil erosion when soils are most vulnerable because of degraded crop residue cover, soil preparation by tillage and no crop canopy. The soil profiles in most of Iowa are now filled to capacity with water. The profiles are at or near saturation. Therefore, the intensity and amount of rain we received have exceeded the soil capacity to filter water and minimize surface runoff even in fields with the most adequate conservation practices.

Keywords
Agronomy, Agricultural and Biosystems Engineering

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Bioresource and Agricultural Engineering

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ICM News

June 5, 2008

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As we write this article spring rains are coming hard and fast causing substantial soil erosion when soils are most vulnerable because of degraded crop residue cover, soil preparation by tillage and no crop canopy.

The soil profiles in most of Iowa are now filled to capacity with water. The profiles are at or near saturation. Therefore, the intensity and amount of rain we received have exceeded the soil capacity to filter water and minimize surface runoff even in fields with the most adequate conservation practices.

Why is rainfall so destructive to bare cropland? In a normal rainfall, raindrops range in size from 1 to 7 millimeters in diameter and hit the ground going as fast as 20 miles per

hour. The impact of millions of raindrops hitting the bare soil surface can be incredible, dislodging soil particles and splashing them 3 to 5 feet away .

A heavy rainstorm may splash as much as 90 tons of soil per acre. However, the majority of the soil splashed is not immediately lost from the field. Most of the splashed soil particles don't leave the field; they clog surface pores, which in turn reduces water infiltration, increases water runoff, and increases soil erosion.

Soil erosion in conventionally tilled field

Tillage and cropping management systems are critical components for reducing raindrop impact on soil particles due to the availability of crop residue to protect the soil surface. Excessive tillage can damage soil structure, leading to increased soil sealing and soil erosion. Conservation systems promote soil aggregates, infiltration and soil tilth.

Additionally, the improved soil structure of no-tillage and other conservation tillage systems stands up better against raindrops. A conservation system that includes high amounts of crop residue such as corn or fall cover crop traditionally provide abundant residue cover to protect the soil surface from spring rains.

Farmers are encouraged to assess residue cover since last fall's harvest and ask themselves the following questions:

- Was surface residue enough to prevent soil erosion?
- Is the surface residue cover distributed evenly across the field?
- Is there enough residue cover left after winter decomposition?

If these questions can be answered no, then fall tillage passes and fall manure or anhydrous application need to be considered based on the amount of residue and the

residue distribution in the field.

Remember that spring is the best time to evaluate conservation systems for their impact on improving soil and water quality since this is generally when we see the most runoff producing rainfall events

Options for Adjusting Spring Field Operations

With spring weather and the most susceptible field conditions for water erosion here, what options remain before planting or should be considered in future years? Farmers should consider the effect of any additional tillage on remaining crop residue. If residue cover should fall below 30 percent, adjust your field operations to minimize potential soil erosion due to early spring rain.

Options for steep slope areas include cover crops, permanent vegetation, strip cropping, and planting on the contour, all of which can reduce the speed of water runoff and slow soil erosion. If soil crusting occurs, consider using a rotary hoe to allow seedling emergence to occur unrestricted. The faster the crop is growing, the sooner a crop canopy will develop, a partial crop canopy is better than none at all.

Conservation structures such as terraces, grassed waterways and field buffers are good components of a conservation system, which help in slowing water flow, settling out sediments and directing water away from the field to a suitable outlet. Remember that field observations in the spring can help in developing a more comprehensive conservation plan that greatly improves soil and water quality.

Nitrogen Loss

This unseasonable heavy rain we are experiencing can cause significant nitrogen (N) loss due to leaching and sediment loss due to surface runoff. From long-term studies in Iowa, nitrate concentration in tile drainage commonly can be as high as 20 mg/L during the spring drainage period. Considering these concentrations and recent rain where as much as 2 to 4 inches of water may have been existed through the tile systems, nitrogen losses could be on the order of 9 to 18 lb-N/acre.

Nitrogen leaching can also be affected by tillage system as well. Normally, well established long-term tillage system will create a better soil structure and water permeability leading to greater water infiltration and reducing surface runoff and soil erosion.

A six-year study (1993-1998) on subsurface drainage and drainage water quality in northeast Iowa showed lower nitrate concentration where no-till practices have been used compared to where a chisel plow system was used (9.5 mg/L for no-till versus 11.2 mg/L for chisel plow).

Despite the lower concentrations of nitrate, the no-till system had greater average annual volumes of subsurface drainage (10 inch for no-till versus 5 inch for chisel plow) so that

the overall average annual nitrate losses were greater for the no-till system (20 lb/acre for no-till versus 12.1 lb/acre for chisel plow).

So while nitrate concentrations may be lower due to potential increases in infiltration and drainage under a no-till system, the overall nitrate losses would be expected to be similar or potentially even greater for the no-till system. Overall, the impacts of tillage on nitrate losses are expected to be small especially compared to changes as a result of any nitrogen application rate changes.

What Are the Lessons of the Current Rainfall Events?
Heavy rain in such an intensity that causes significant property and soil damage is an opportunity to examine what can be done differently in the field to minimize, if not control, soil erosion. Some recommendations are:

- Look at the pattern of surface runoff and the placement of buffer strips on the field when directing surface runoff and minimizing sediment transport.
- Examine your choice of tillage and compare it to other fields in the area, to evaluate the degree of damage caused by soil erosion in each conservation system.
- Evaluate the residue cover, the uniformity of residue distribution, and residue effectiveness in minimizing soil erosion.
- Document your field conditions with photos, if possible, and assess the water ponding on the surface under each tillage system.
- Evaluate your field fertility conditions, especially if nitrogen was applied in the fall. There can be substantial nitrogen, phosphorous and potassium loss due to leaching and surface water runoff. The amount of nitrogen will be highly affected by tillage system as well. No-till land tends to have greater soil permeability which in some cases could lead to greater potential of nitrogen leaching.
- Soil testing is critical, especially after such rain events. No-till fields tend to have greater soil moisture content and slower nitrogen mineralization, therefore, soil nitrogen testing during late spring will give an advantage to overcome any nitrogen deficiency through side dressing.
- Evaluate your plant populations, the damage your field experienced, and the alternatives for replanting.

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Category: Soils

Tags: rain nutrient losses

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