UNIVERSITY OF MINNESOTA
EXTENSION

Reduce Wind Erosion for Long Term Productivity

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Why Worry About Wind Erosion?

Soil is a non-renewable resource and cannot be built within our lifetime. When it's gone, it's gone. One hundred percent of our global food needs are farmed on only 11% of the world's land -- making soil protection crucial.

While erosion is a natural process, cultivation of the prairie and the dominance of annual crops have significantly sped up soil loss. Some estimate that as much as 19 inches of topsoil has been eroded from agricultural fields! This severely diminishes your soil productivity.

In Minnesota, the average wind erosion rate is 5.2 tons of soil loss per acre per year (Figure 1). North Dakota is slightly lower at 4.7 tons and South Dakota is at 2.4 tons.

While these levels have decreased in the past three decades, wind erosion is still occurring at detrimental rates. The most severe areas of erosion are well above the general estimates of 5 tons per acre per year.

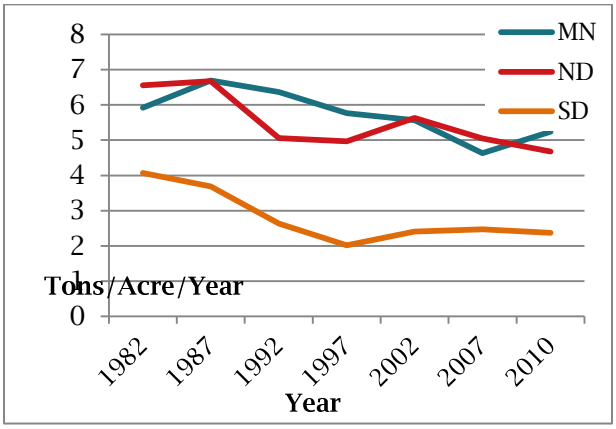

Figure 1: Estimated average annual wind erosion by state and year (2010 NRCS National Resources Inventory).

Figure 2: Soil accumulation in a ditch in western Minnesota. Photo courtesy of MN Ag Services.

To put it into context, 5 tons of soil across an acre of land is equal to the thickness of a dime. While the loss of a dime's thickness is scarcely noticeable over one year, it adds up over 5, 10, or 15 years (Figure 3).

Figure 3: Example of the loss of soil over time.

Why aren't growers and landowners more alarmed about continual soil loss? Each year that there is topsoil loss, tillage masks the effects by mixing in subsoil. There are no 'untreated checks', so the resulting 'top soil' still looks dark. But it is not as dark as the year before.

Vulnerable Areas for Wind Erosion

Certain areas of the US are predisposed to wind erosion. The Red River Valley area in eastern North Dakota and western Minnesota

is particularly susceptible (Figure 4). This is due to a combination of factors.

1. **Relatively flat topography** – wind is able to pick up speed and intensity along flat landscapes. Western Minnesota and the eastern half of the Dakotas are very level, with little change in topography, and few trees over a wide region.

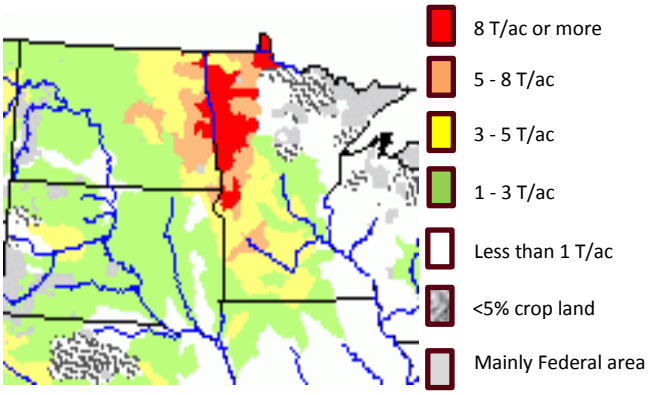

Figure 4: Average annual soil erosion by wind for cropland in Minnesota and North and South Dakota.

2. **Tillage depth and intensity** – tillage increases and accelerates the breaking apart of soil aggregates into individual soil particles. Individual soil particles are lighter and more easily transported by wind than those that are aggregated.

3. **Residue and vegetative cover** – provide a physical barrier on the soil surface to protect against wind erosion. The more cover, the better the protection. Standing residue is more effective at slowing the wind than chopped residue. In 2007, one-third of Minnesota cropland was aggressively tilled leaving 85% of the soil predisposed to erosion.

4. **Crop selection** – short season or rowed crops offer little soil protection until the crop has canopied. After fall tillage, a majority of the eastern North Dakota and western Minnesota fields are left unprotected for 6-9 months of the year. A perennial crop offers a dense mat and increased residue cover to protect the soil. In row-crop systems, inclusion of a cover crop in rotation offers a longer period of soil protection and offers other benefits.

5. **Carbonates at the surface** – carbonates are natural in many of the soils in western Minnesota and in the Red River Valley. Carbonate minerals separate particles from each other, making the soils particularly vulnerable to wind erosion.

Figure 5: Cover crops like this rye anchor the soil during the 6-9 months when the soil is otherwise bare and vulnerable to wind erosion.

The heavier components of the soil, sand and silt, are moved to a lesser degree and are deposited shorted distances from the source. You'll see them accumulated in the ditch, along fence rows or anywhere the wind slows down. However, you will see little clay in the ditch because most of it is suspended in the air and transported greater distances (Figure 6). Clay is the dominant soil texture in the Red River Valley.

Figure 6: Clay particles suspended in the air. Photo courtesy of MN Ag Services.

Can you afford $55 in the ditch?

The most productive soil, called topsoil, is near the surface. The loss of topsoil leads to less healthy and less fertile soil, resulting in lower yields and more commercial fertilizer needed to make up the loss. How much fertility is lost with wind erosion?

To understand how much soil was being deposited in ditches, soil samples were collected in six field ditches across western Minnesota.

Analysis shows a range in accumulation of 2.6 to 32.6 tons of soil in one acre of ditch (Table 1). The average nutrient content of the soil was 55 lbs of total nitrogen (TN), 13 lbs of total phosphorus (TP) and almost 37 lbs of total potassium (TK).

At 2014 fertilizer rates, that is a loss of almost $55.00 into the ditch. This does not take into account the soil and nutrients that were blown further away with the clay, which is often at least ten times more fertile than what ends up in the ditch.

Table 1: Analysis of total nutrients and windblown soil collected in the field ditch.

	SOIL (T/AC)	TN (LBS./AC)	TP (LBS./AC)	TK (LBS./AC)
DITCH 1	2.6	10.3	3.2	8.0
DITCH 2	2.8	12.1	3.6	8.7
DITCH 3	1.6	8.4	1.9	4.9
DITCH 4	32.6	172.9	46.9	124.4
DITCH 5	5.5	23.5	7.2	18.0
DITCH 6	9.3	102.6	12.9	56.3
AVE	**9.1**	**55.0**	**12.6**	**36.7**

Other Effects

Crop Damage - When the soil is not protected either by residue or the crop's canopy, crops may be sand blasted by blowing soil. This can open up holes in the plant to allow for entry of diseases such as Goss's Wilt. Blowing soil can also slice through young emerging plants, leading to a replant decision.

Figure 7: Sand blasting of emerging corn plant.

Environmental Concerns – The immediate health hazard is the suspension and movement of very small particles in the air, which have been linked to increased asthma and other lung ailments in humans. Soil particles that are deposited in surface water contain nitrogen and phosphorus - causing algal blooms in lakes, rivers and bays. When algae die, they decompose and remove oxygen from the water (hypoxia) and cause fish kills.

Ditches filled with eroded topsoil restrict field drainage and can lower crop yields from higher water tables and increase soluble salts in fields. Dredging streams to ease this problem is costly and wreaks havoc on aquatic plant and animal communities.

Five Ways to Reduce Wind Erosion

Keep your soil covered and reduce the wind speed to prevent wind from removing your valuable topsoil.

1. Reduce the number of tillage passes and intensity. Leaving residue on the soil surface protects the soil from blowing away. You can virtually eliminate erosion on most fields with sufficient residue levels (Figures 8 and 9).

2. Adding a cover crop after a short season crop is an excellent way to protect the soil through the winter and early spring months.

Ryegrass is fairly inexpensive, easy to grow and provides excellent coverage from wind and water erosion.

Figure 8: Soil accumulation in a ditch adjacent to a field with 40% residue in western Minnesota.

Figure 9: Soil accumulation in a ditch adjacent to a field with less than 10% residue 1 mile East of Figure 8.

3. Leave residue standing is an effective way to slow down wind speed. Examples are raising the cutting height for small grains and if chopping residue, leave alternating strips of un-chopped stalks.

4. Plant vegetative buffer strips in erosive areas to trap sediment and slow wind speeds.

5. Living windbreaks or shelterbelts are rows of trees and shrubs that effectively slow the wind. When taking out an old windbreak or farm site, plant a new windbreak elsewhere in the field.

There are government programs available to assist with establishment costs and rental payments for these conservation practices.

Summary

Soil loss via wind erosion cuts your profits and reduces productivity by removing a non-renewable crop production resource. Erosion is very costly in nutrient removal replacement terms. Additionally, it reduces the depth of productive soil lowering the water holding capacity. Concepts underlying reducing the impacts of wind erosion include:
(1) maintaining residue to protect the soil surface, (2) reducing tillage to improve soil aggregation, (3) keeping cover for longer using cover crops and perennial crops, and (4) replacing shelter belts to reduce wind speeds. If you use practices to control wind erosion, you will inevitably control water erosion as well.

Soil Erosion Fact Sheet. 2002. Minnesota Board of Water and Soil Resources. http://www.maswcd.org/Youth_Education/StudyGuides/soil_erosion_BWSR.pdf

USDA-NRCS. 1997 National Resources Inventory Summary Report. http://www.nrcs.usda.gov/wps/portal/nrcs/detail//?cid=nrcs143_013777

USDA-NRCS. 2010 National Resources Inventory Summary Report. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1167354.pdf

World DataBank. Jan 2011. Arable Land (% of land area). http://databank.worldbank.org/data/views/reports/tableview.aspx

For more information:

www.extension.umn.edu/agriculture/tillage

www.ndsu.edu/soilhealth

This resource is a collaboration of University of Minnesota Extension and North Dakota State University Extension.

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