

Sediment and Nutrient Losses

*Eric Cooley and Dennis Frame
UW Extension/Discovery Farms*



Data



- The data presented in this presentation were provided by the U.S. Geological Survey as part of a cooperative agreement with the UW-Discovery Farms Program.



Monitoring at SED



- Monitored from December 2004 - October 2006
- Field year = 12-months (Nov. 1 – Oct. 31)
– Always represents the year in which it ends
- Field year coincides with the crop year.



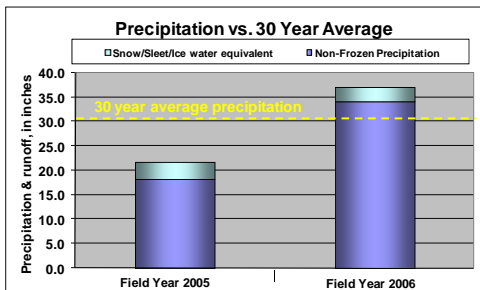
2005 Field Year



- The first year November 2004 – October 2005 = drought year.
- Precipitation (ice, sleet and snow) was 21.7 inches, compared to the 30-year average of 30.5 inches for Manitowoc County .



Precipitation



Sediment losses





- Measured sediment losses represent only a portion of what occurred due to issues at the monitoring site.
– (see SED Part 4)
- There were events that occurred in March that caused significant soil erosion, but these events were not sampled.



2005 Sediment loss

- The majority of sediment entering the monitoring site came from the area immediately north of the flume.






DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2005 Sediment loss

- Sediment moved from the field adjacent to the station, which was plowed in the fall.
- Major contributing factor to loss was the accidental plowing of the grass waterway.
- Waterway was reseeded in the spring of 2005.






DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2005 Sediment loss

- June 2005 after planting
- Field is not steep, but it does slope into an area of concentrated flow which then flows to the stream.
- Remainder of the year was dry with little runoff.

DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2005 Sediment loss

- The lesson learned is that on these gently sloping fields in Northeastern Wisconsin, grassed waterways play a critical role in reducing soil erosion and sediment delivery to surface waters.





DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2005 Sediment loss

- Data was not collected during the winter months because of frozen water conditions.
- Backwater subsided in early April and sampling started again.
- Remainder of the year was dry, with only a few small runoff events occurring.




DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2005 Sediment loss

- The monitored events during 2005 produced approximately 1,000 lbs of sediment.
 - yield of about 3.4 lbs/acre
- Values are greatly underestimated because the monitoring equipment was not working during the critical runoff periods.



DISCOVERY FARMS UNIVERSITY OF WISCONSIN - EDUCATION

USGS

2006 Field Year




- To improve the site, the waterway was re-graded to create better getaway conditions.



DISCOVERY FARMS USGS


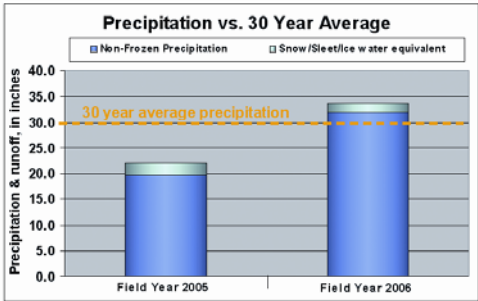
2006 Field Year



- Second year was much different than the first.
- 37.1" precipitation (ice, sleet, & snow)
 - > 6" above the 30-year average
- Majority recorded in the spring (May 7.1")


DISCOVERY FARMS USGS

Precipitation

DISCOVERY FARMS USGS


2006 Field Year



- 2006 had a more complete monitoring record, but still issues.
 - Water flowing under the wing wall.
- USGS was able to estimate discharge.

DISCOVERY FARMS USGS

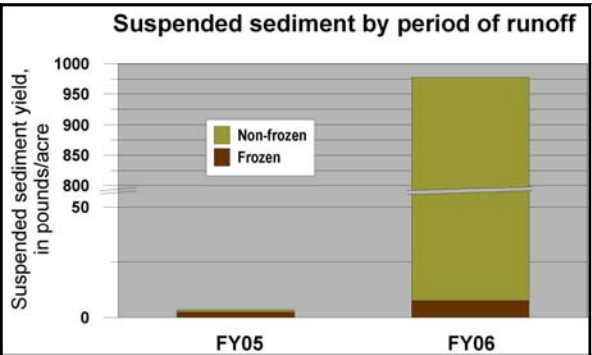
2006 Field Year



- The computed sediment and nutrient losses listed are reasonable, based on the experience of the authors and USGS staff.
- About 1,000 lbs/acre of sediment passed through the flume.
 - >99% lost during the non-frozen ground period


DISCOVERY FARMS USGS

Suspended sediment by period of runoff




DISCOVERY FARMS USGS


2006 Sediment loss




- A three day surface water runoff event that started on May 30, 2006, and ended June 2, 2006, accounted for 92% of the total sediment losses at this site.

DISCOVERY FARMS 


2006 Sediment loss




- Data from several Discovery Farms highlight the fact that large rainfall events at this time of year can produce very high levels of soil loss.
- Fields have been recently planted and therefore very vulnerable to soil erosion.
- Soil loss produced by a single runoff event can contribute the majority of the sediment losses for the entire year.

DISCOVERY FARMS 


2006 Sediment loss




- In seven years of on-farm monitoring, Discovery Farms measured large sediment losses from a single runoff event .
- This occurs under a wide variety of farming systems (no-till, minimum tillage, etc) and in all regions of the state.
- Though not desirable; agriculture is often at the mercy of weather conditions at this fragile time of year.

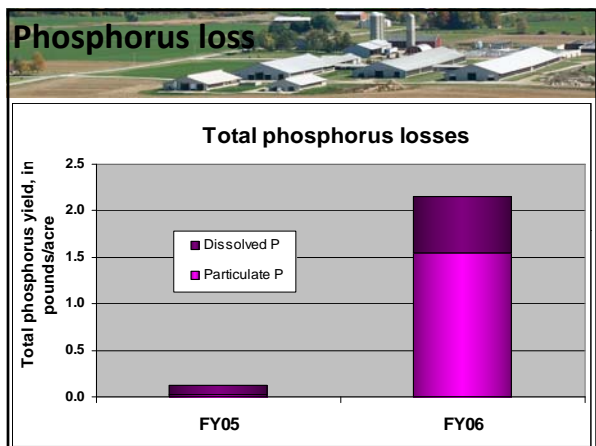
DISCOVERY FARMS 

Phosphorus loss




- Phosphorus losses in 2005 are underestimated.
- Measured total phosphorus loss was ≈ 37 lbs – 0.1 lbs/acre)
- 80% in the dissolved form


DISCOVERY FARMS 



Phosphorus loss




- In 2006, ≈ 640 lbs (2 lbs/acre) of total phosphorus was measured.
- 28% occurred as dissolved

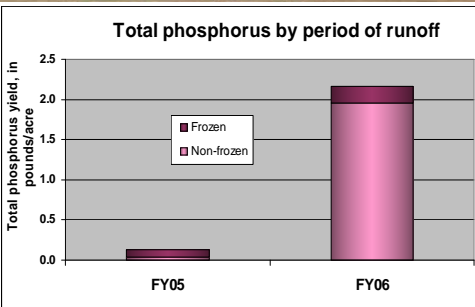
DISCOVERY FARMS 

Phosphorus loss


- The increase in measured sediment losses in 2006 coincided with the increased level of particulate phosphorus losses.
- <10% of the total phosphorus was lost during the frozen ground period in field year 2006.



Phosphorus loss




Year	Frozen (lbs/acre)	Non-frozen (lbs/acre)	Total (lbs/acre)
FY05	~0.1	~0.1	~0.2
FY06	~0.1	~2.0	~2.1




Nitrogen loss

- 2005 nitrogen losses are underestimated.
- Measured total nitrogen losses for 2005 were observed at nearly 850 pounds (about 3 lbs/acre).
- Majority (84%) of total nitrogen in the nitrate form



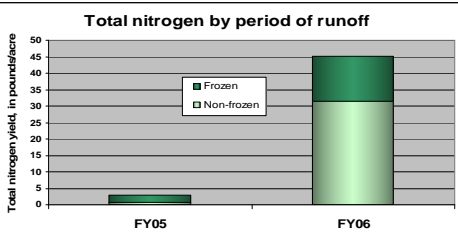
Nitrogen loss

- Runoff events in December 2004 had nitrate concentrations that ranged between 8 and 30 parts per million.
- Nitrate concentrations dropped to around 1 to 2 ppm when the site became operational again in spring.




Nitrogen loss

- Nearly 75% of total nitrogen losses occurred during the frozen-ground period.




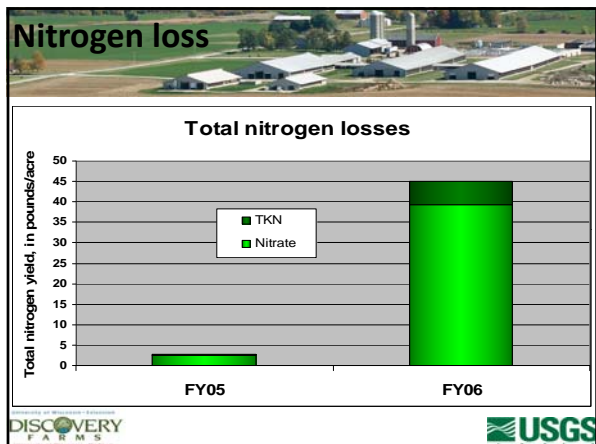
Year	Frozen (lbs/acre)	Non-frozen (lbs/acre)	Total (lbs/acre)
FY05	~0.5	~0.5	~1.0
FY06	~30	~15	~45



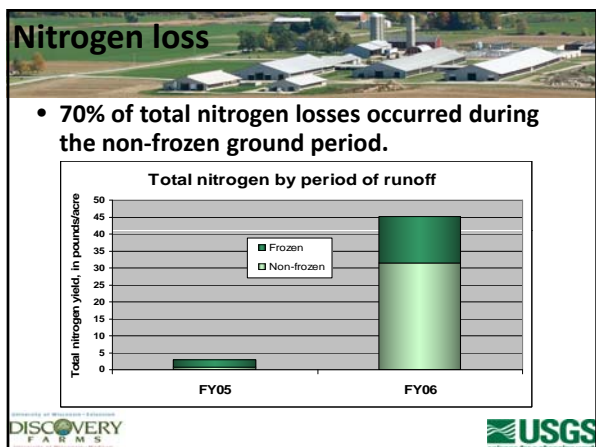
Nitrogen loss

- In 2006, total nitrogen losses reached about 13,000 lbs (44 lbs/acre).
- Nitrate accounted for 87% of the total nitrogen losses (84% in 2005).





- ### Nitrogen loss
- Concentrations ranged between 6 and 61 ppm
 - Highest concentrations occurred on frozen-ground and in the early part of the spring runoff
 - But, 70% of total losses occurred during the non-frozen period



- ### Conclusions
- In Northeastern Wisconsin the establishment and maintenance of grassed waterways in areas of concentrated flow cannot be over emphasized.
 - Runoff in this section of the state has the potential to carry significant levels of sediment and nutrients to surface waters.

- ### Conclusions
- Sediment losses occurred predominantly during non-frozen ground conditions.
 - consistent with data collected on several other Discovery Farms.
 - soil loss can occur during frozen soil conditions, but those losses are greatly influenced by tillage practices and the amount of concentrated flow running across the soil.
 - Sediment losses produced by a single runoff event can contribute the majority of the sediment losses for the year.

- ### Conclusions
- Although phosphorus losses were relatively low during the frozen ground period in 2006 (10%), they were more substantial than sediment loss (1%).
 - Phosphorus losses in the dissolved, reactive form represent a considerable portion of total phosphorus:
 - 45% in 2005
 - 22% in 2006.

Conclusions

- Nitrogen losses in the form of nitrate were higher than expected, likely due to the influence of tile drainage.
- In portions of Wisconsin tile systems play an important role in the potential delivery of nutrients to surface water.
 - Producers and agency personnel should work together to locate and better understand the impact of tile on the water budget.



Information Available

- This presentation is the fifth in a series of six developed to provide the data and information collected at Soaring Eagle Dairy.
- All of the presentations, factsheets and briefs are available on the UW - Discovery Farms website.



Information Available

- There are six factsheets available on SED.
- There are six briefs available on SED (2 page summaries of the factsheets).
- There are six presentation available on SED.



For Additional Information

<http://www.uwdiscoveryfarms.org>

UW Discovery Farms
40195 Winsand Drive
PO Box 429
Pigeon Falls, WI 54760
1-715-983-5668

jgoplin@wisc.edu or drframe@wisc.edu

