THE 4R'S CONCEPT AND WATER QUALITY

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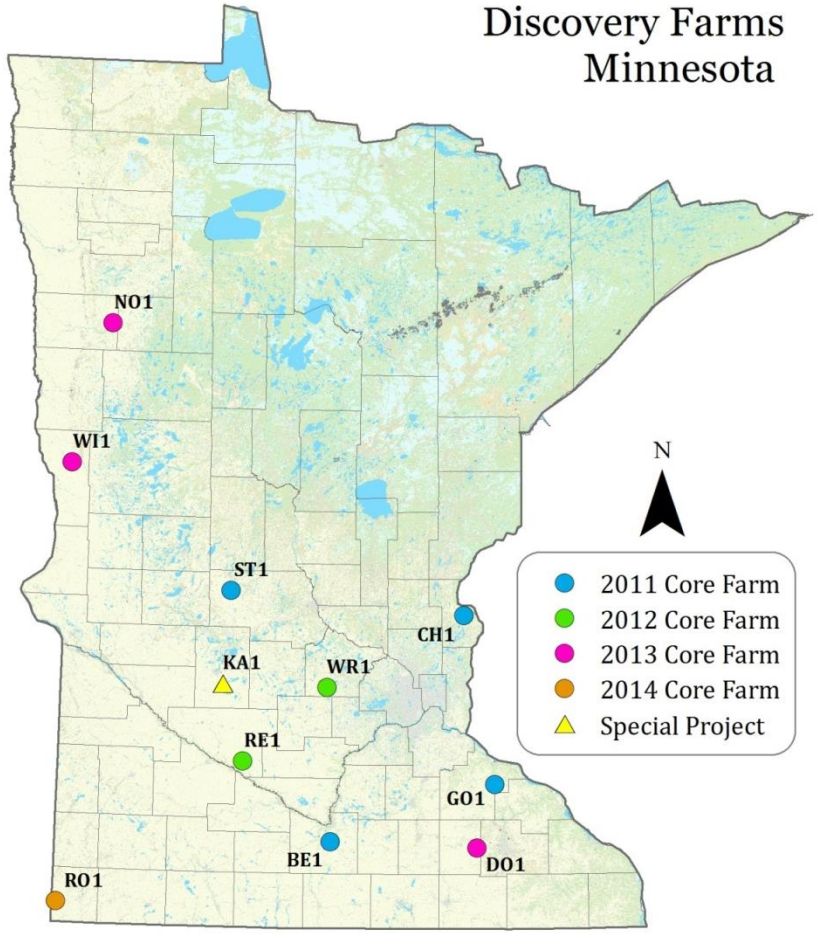
For This Presentation

- A brief description of the Discovery Farm Initiative
- A discussion, using edge-of-field data, impact of the 4R's on water quality
- Include both nitrogen and phosphorus in the discussion

Discovery Farms 2015 Data Retreat

- WY2015
  - 10 Farms, 11 monitored fields
  - Four farms: 5th year monitoring
  - Two farms: 4th year of monitoring
  - Three farms: 3rd year of monitoring
  - One farm: 2nd year of monitoring

- Station Types:
  - Surface & Subsurface: 5 stations
  - Surface runoff only: 3 stations
  - Subsurface tile w/open intakes: 1 station
  - Subsurface tile only (lift pumps): 2 stations



DISCOVERY FARMS MINNESOTA

ST1

Stearns County
Meyer Farm
WY2015

DISCOVERY FARMS MINNESOTA

RE1

Renville County
Simonsen Farm
WY2015

The Right Rate for Nitrogen

Use current guidelines for the North-Central region introduced in 2006

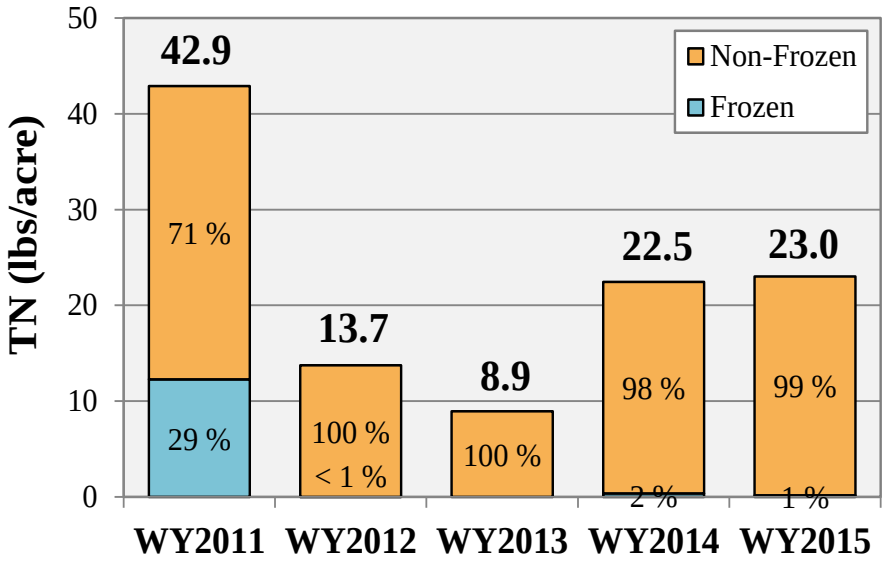
- Account for N in manures, previous crop, and measurement of carryover nitrate-N
- Use same practices that are used for optimum production
- Concentrate on nitrogen use efficiency (NUE); was 1.25 lb. fertilizer N/bu. Now 0.66 lb. fertilizer N/bu.

Blue Earth County Site

- Follows North-Central N guidelines for corn/soybean rotation
- Injects manure late (it is analyzed and credited)
- If fertilizer N is used, apply it in November
- Manure also applied in November

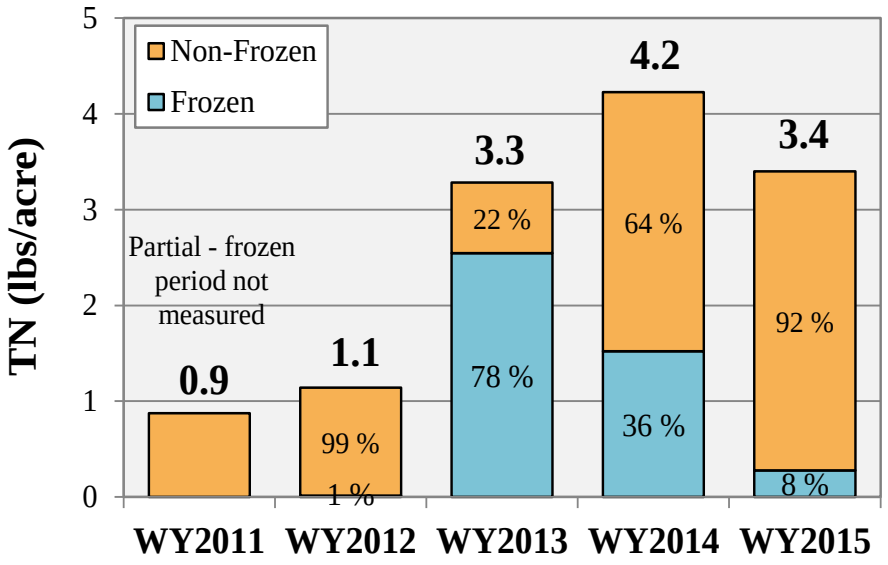
BE1 – Total Nitrogen Yield

Tile



- **32%** of the subsurface total nitrogen loss occurred during the month of **May**.

Flume

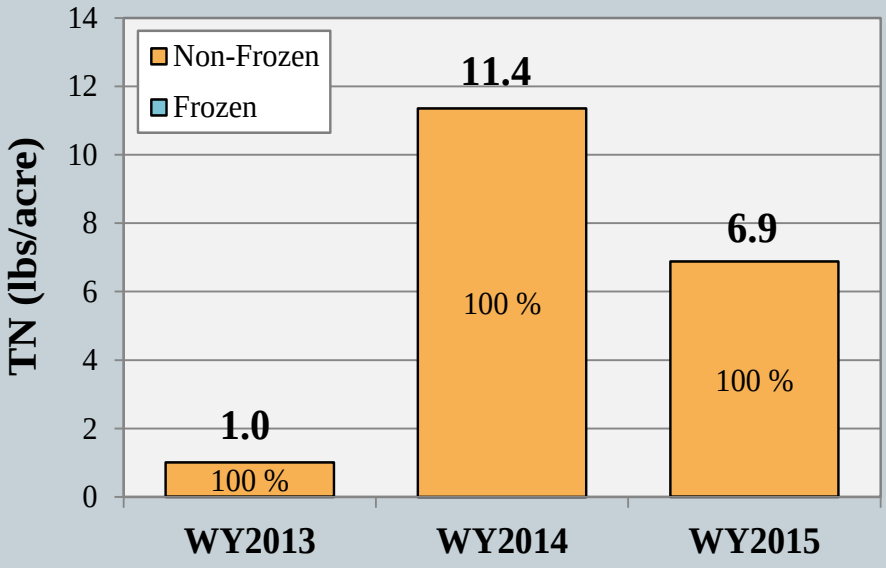


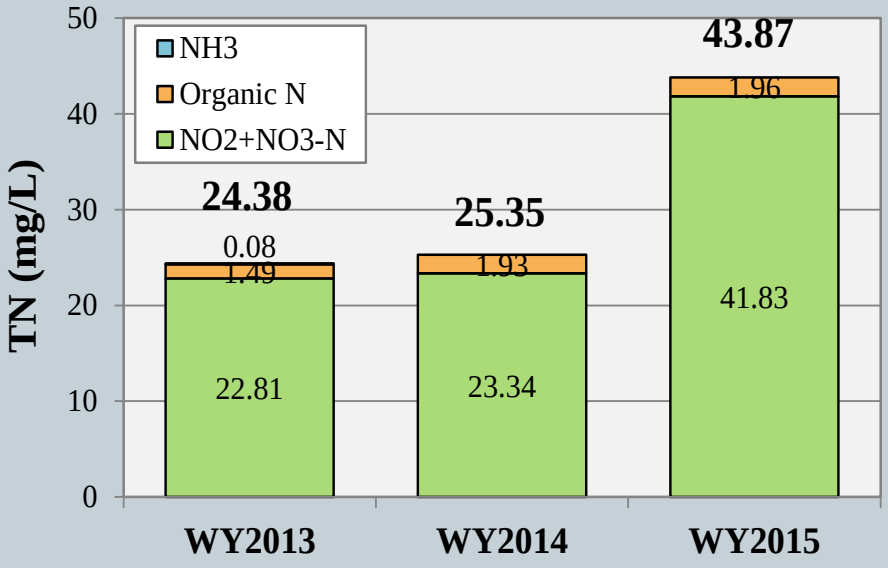
- **45%** of total nitrogen loss occurred during the month of **May**.
- **35%** during the **September 8** event.

Nitrogen Rate When Fertilizer N Is Used

- Norman County
- Wheat in 2016
- Fall nitrate measured in fall 2016 = 24 lb./acre
- University guidelines used
- Routine fall sampling for NO3-N

NO1W – Total Nitrogen Yield and FWMC





- **93%** of subsurface total nitrogen loss occurred during the month of **June**.

The Right Rate for Phosphorus Use

- Follow suggestions based on the results of the analysis of soil samples. Higher rates of phosphorus are applied when N rates are based on manure use.

Considering Nitrogen Fertilizers

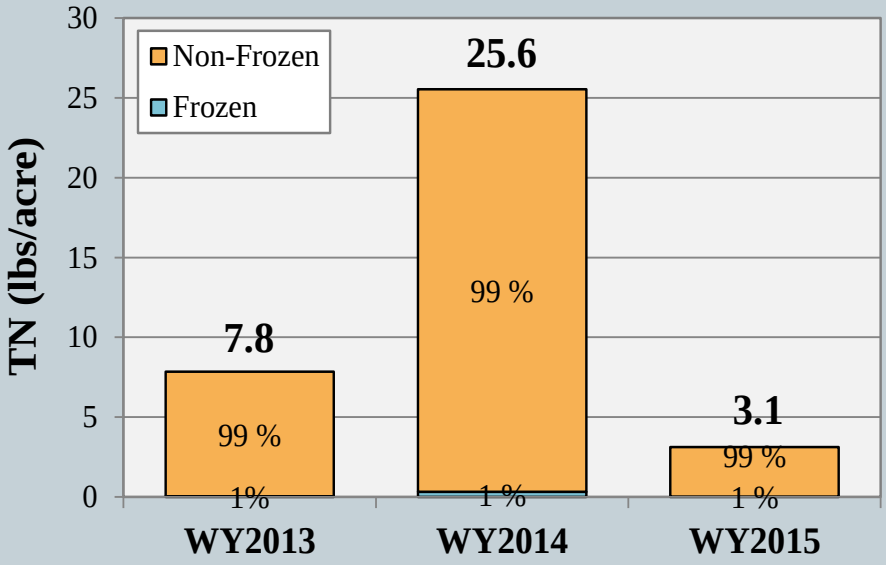
- There's an old expression:

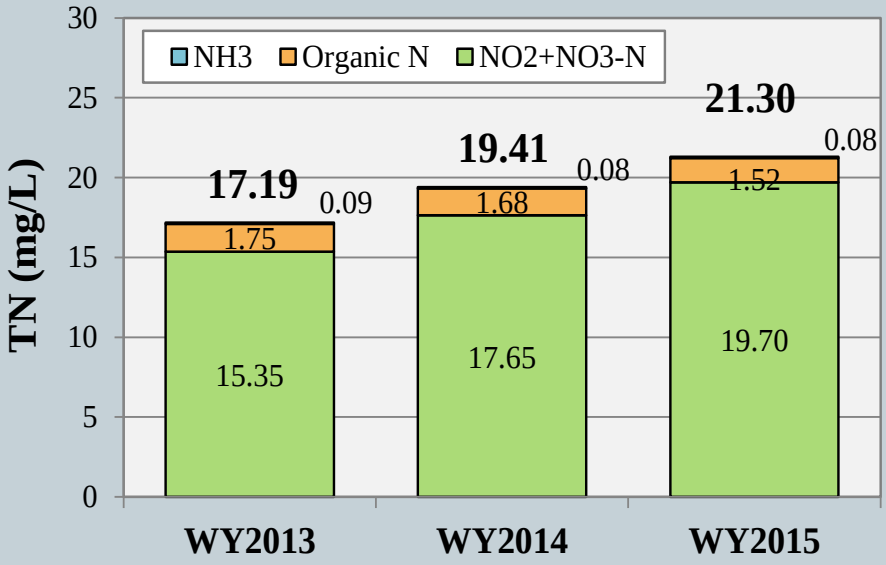
- "If applied properly, a pound of nitrogen is a pound of nitrogen regardless of source"

Right Source For Nitrogen Application

- Choose between organic or inorganic sources
- Organic sources can be considered to be slow release forms of nitrogen
- In the end, all sources converted to NO3-N

WI1 – Total Nitrogen Yield and FWMC

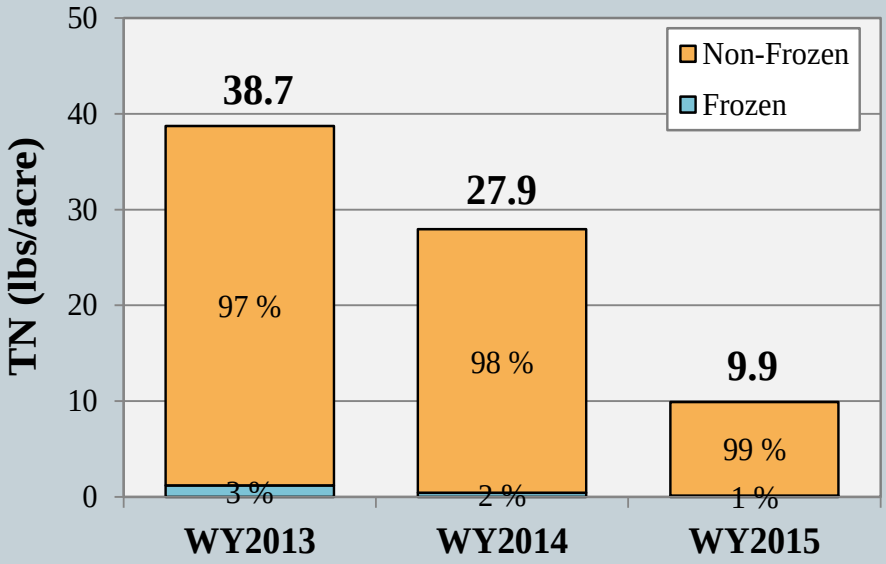




- **60%** of the total nitrogen loss occurred during the month of **June**.

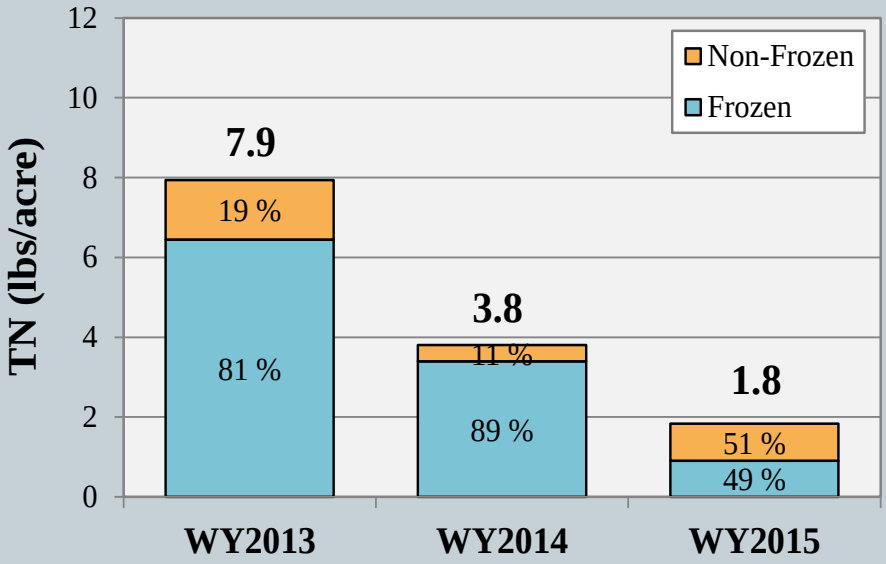
DO1 – Total Nitrogen Yield

Tile



- **67%** of the subsurface total nitrogen loss occurred during the month of **June**.

Flume



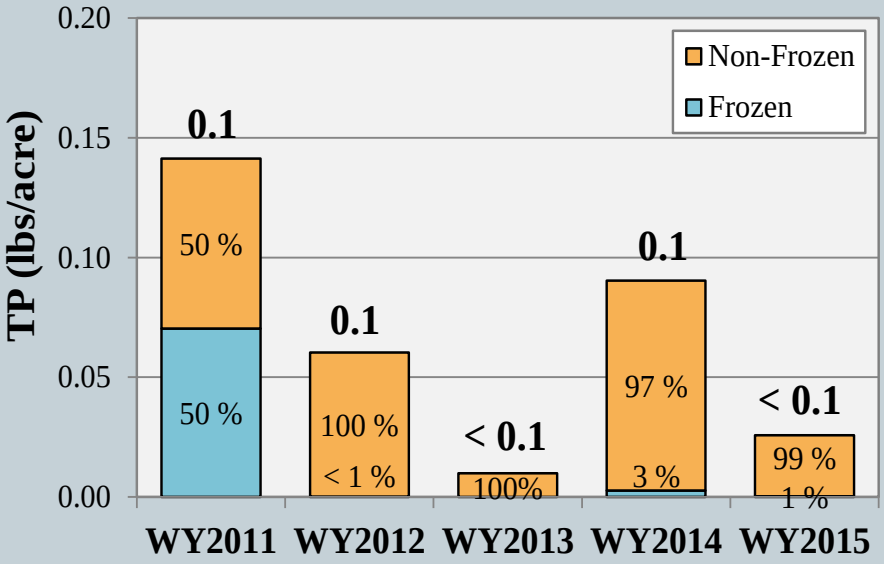
- **49%** of the surface total nitrogen loss occurred during the snowmelt runoff event from **March 8 – March 10**.

The Right Source for Phosphorus

- Don’t expect various sources of inorganic phosphate fertilizers to affect water quality.
- If rate of applied phosphorus is equal, don’t expect differences between organic and inorganic sources and their effect on water quality. (Conclusion of numerous research projects)
- Phosphorus chemistry in soils dominates.

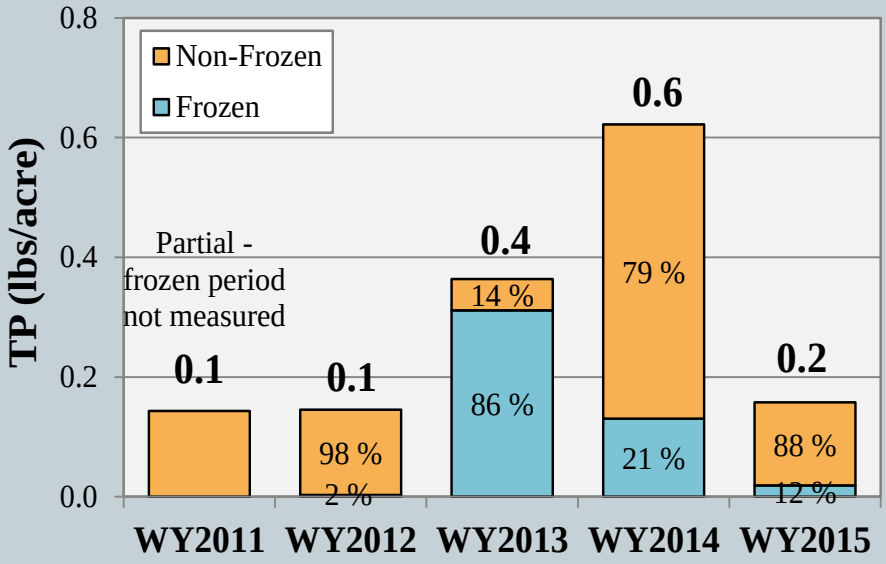
BE1 – Total Phosphorus Yield

Tile



- **39%** of the subsurface total phosphorus loss occurred during the month of **September**.

Flume



- **63%** of TP loss occurred during the month of **September**.
- **60%** from one event on **September 8**.

Right Placement For Nitrogen

- Incorporation important to prevent loss regardless of soil temperatures
- Mobility of nitrate-nitrogen to tile lines should not be affected by placement
- Band and broadcast (thinking about broadcast urea) should have the same impact on water quality if rate is the same

The Situation

- Fall applied urea
- Applied in mid-November (cool soil temperatures)
- No fall incorporation of urea
- Heavy rain in early June
- Runoff collected – high level of NO3-N
- Soil sampled on June 16

NITRATE-NITROGEN IN SOIL FOLLOWING FALL UREA

inches	ppm NO3-N
0 to 3	40.7
3 to 6	40.3
6 to 9	37.7
9 to 12	33.5

Phosphorus In Surface Runoff Chisago County

- No-till production since mid-1990’s
- Sandy loam texture
- Spring applied banded fertilizer before planting corn
- Plant above the band

PHOSPHORUS IN SURFACE RUNOFF – CHISAGO COUNTY

Year	Total P	Non-Frozen	Frozen
	Lb./acre	%	%
2011	1.2	27	73
2012	1.1	28	72
2013	0.2	26	74

AVERAGE PARTICULATE AND SOLUBLE PHOSPHORUS – DODGE COUNTYYY

	Particulate	Soluble
	%	%
Surface runoff	46	54
Tile flow	36	64

Right Placement For Phosphorus

- Alfalfa – corn rotation in Goodhue County
- Corn in 2013, 2014, and 2015
- Confinement hog manure as a nutrient source
- Knifed in spring before planting

PHOSPHORUS IN SURFACE RUNOFF – GOODHUE COUNTY – A SILT LOAM

Year	Non – Frozen Soil	Frozen Soil	Total
2013	18%	82%	0.9 lb./acre
2014	70%	30%	0.8 lb./acre
2015	86%	14%	0.9 lb./acre

For Phosophrus Loss

- Consider each case individually
- Apply appropriate management practices
- To do this : “ensure that nutrient management and water quality research is developed and evaluated in real watersheds and on real farms, not just in a laboratory or computer modal (A. Sharply, 2016)

Right Time For Nitrogen Application

- Same considerations as for optimum production
- No fall nitrogen on sandy soils
- Split applications preferred
- Several choices for split applications
- Concentrate on efficiency of nitrogen use
- Use of inhibitors may influence choice of time of application
- There is no information pertaining to inhibitor use water quality

Right Time For Phosphorus Application

- Greatest efficiency = application close to planting = banded application
- With more time between application and plant absorption, there is a higher probability of attachment to soil particles

In Summary

- 4R management practices for optimum production are also generally associated with least potential damage to environmental quality
- Research has not provided answers to all questions
- There is a good science base for the use of the 4R concept

Questions, Comments, Concerns ??