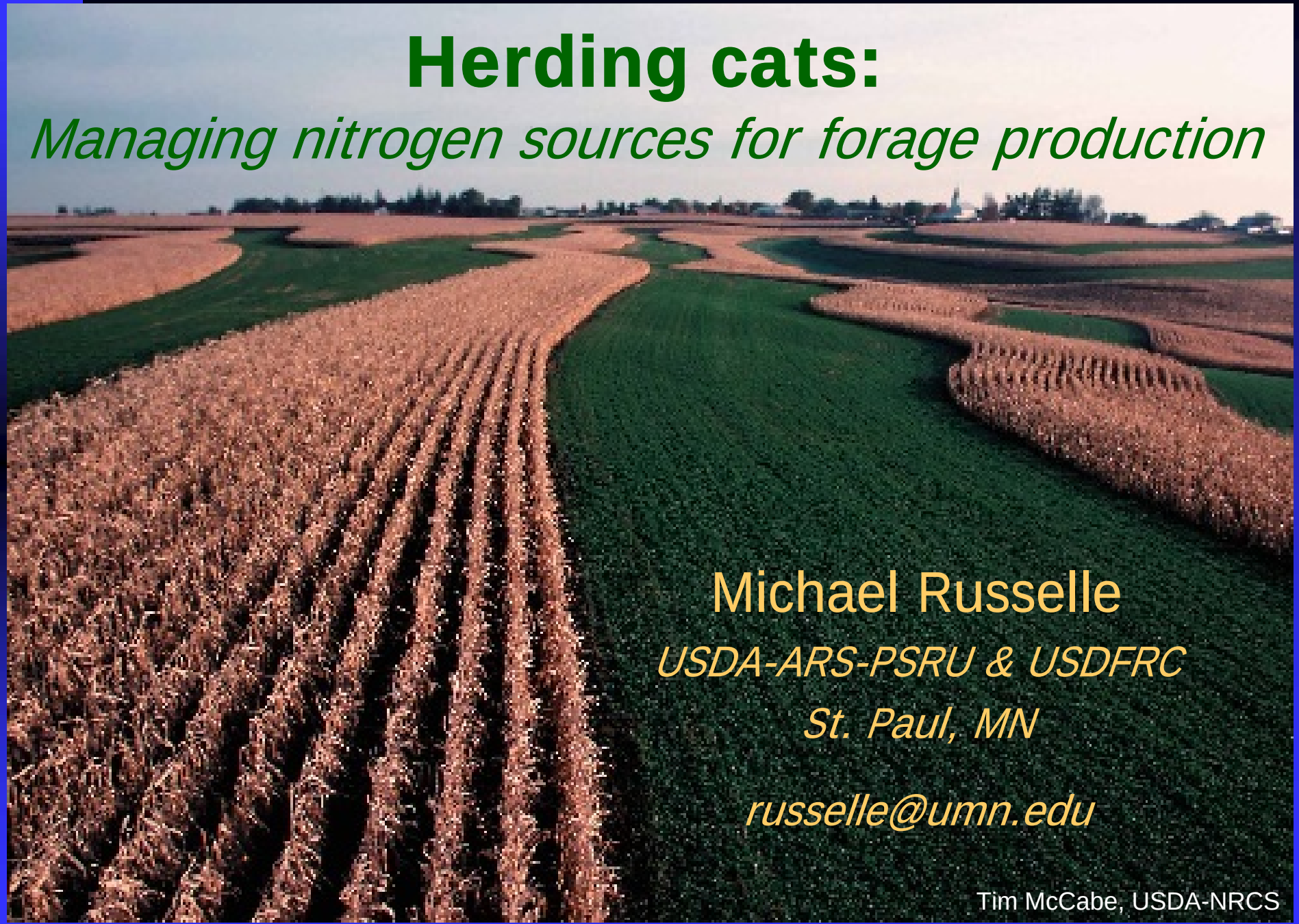
Herding cats:

Managing nitrogen sources for forage production



Michael Russelle

USDA-ARS-PSRU & USDFRC

St. Paul, MN

russelle@umn.edu

Tim McCabe, USDA-NRCS

Milk, meat
Culls
Manure
Feed

Feed
Minerals
Heifers

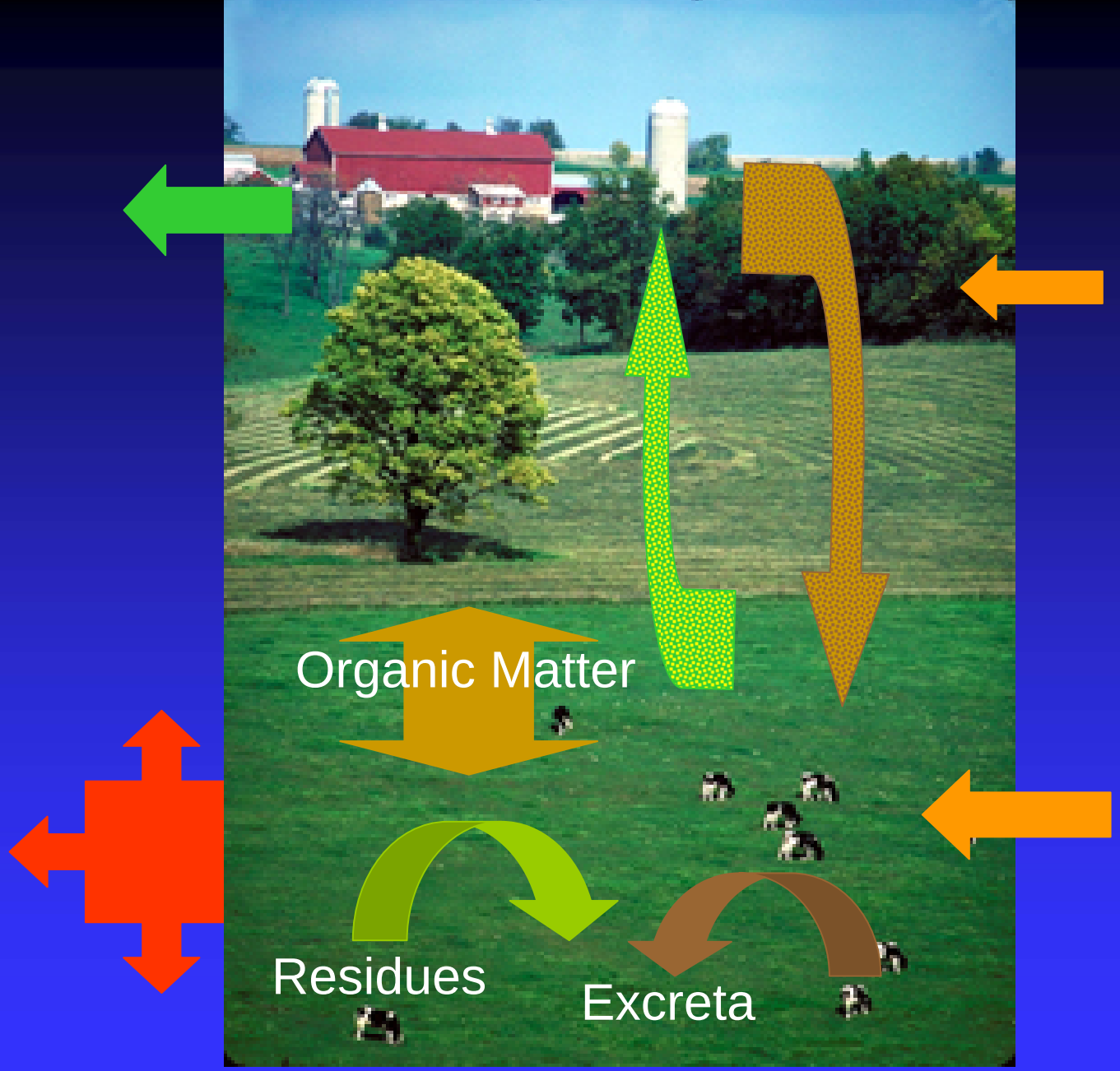
N_2 fix.
Fertilizer
Manure
Atm. dep.

Gases

Runoff

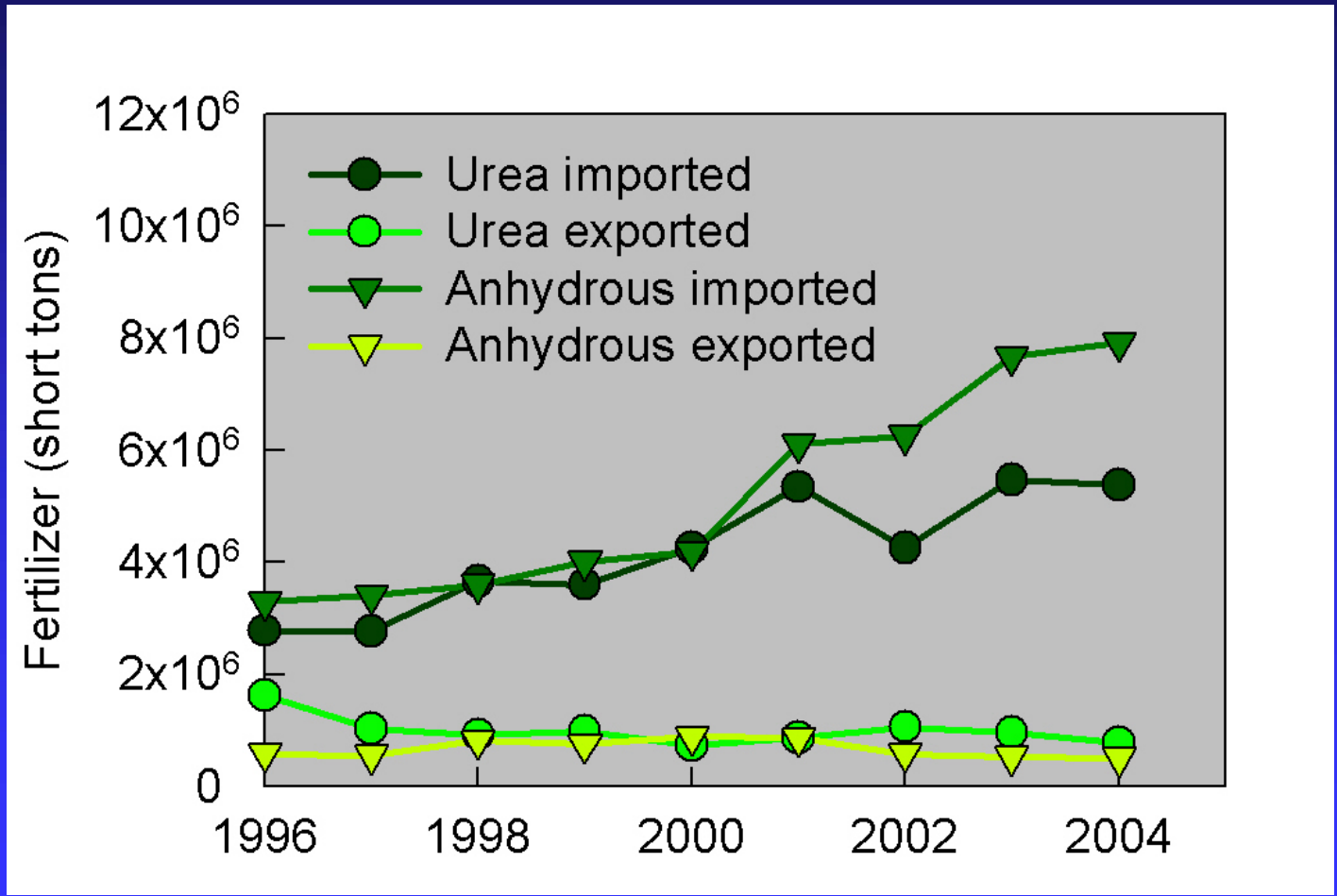
Leaching

Ron Nichols, USDA



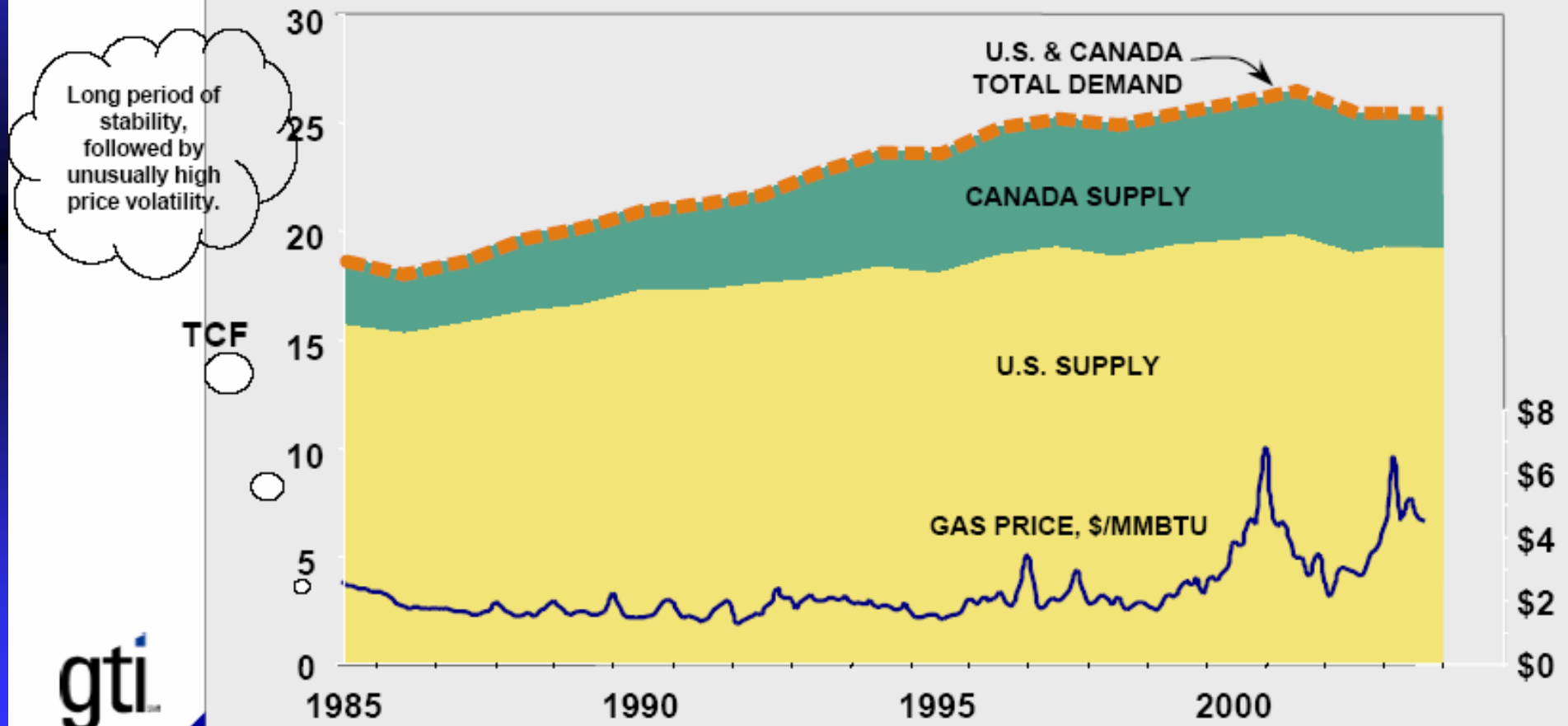
Ron Nichols, USDA

Fertilizer N trade



Increased Price Volatility

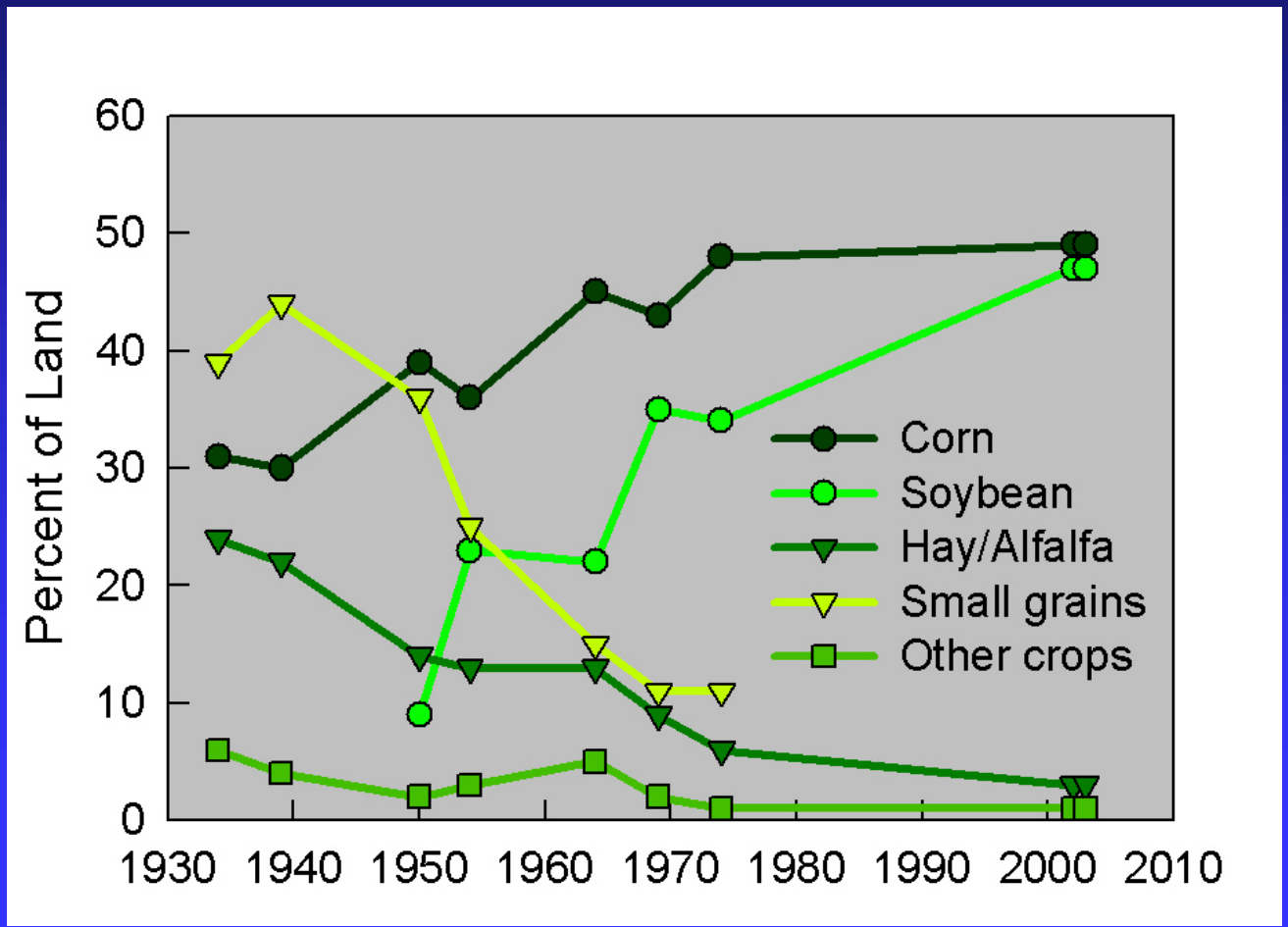
Reflect Changes in Supply, Demand, Purchasing Habits, and Regulations



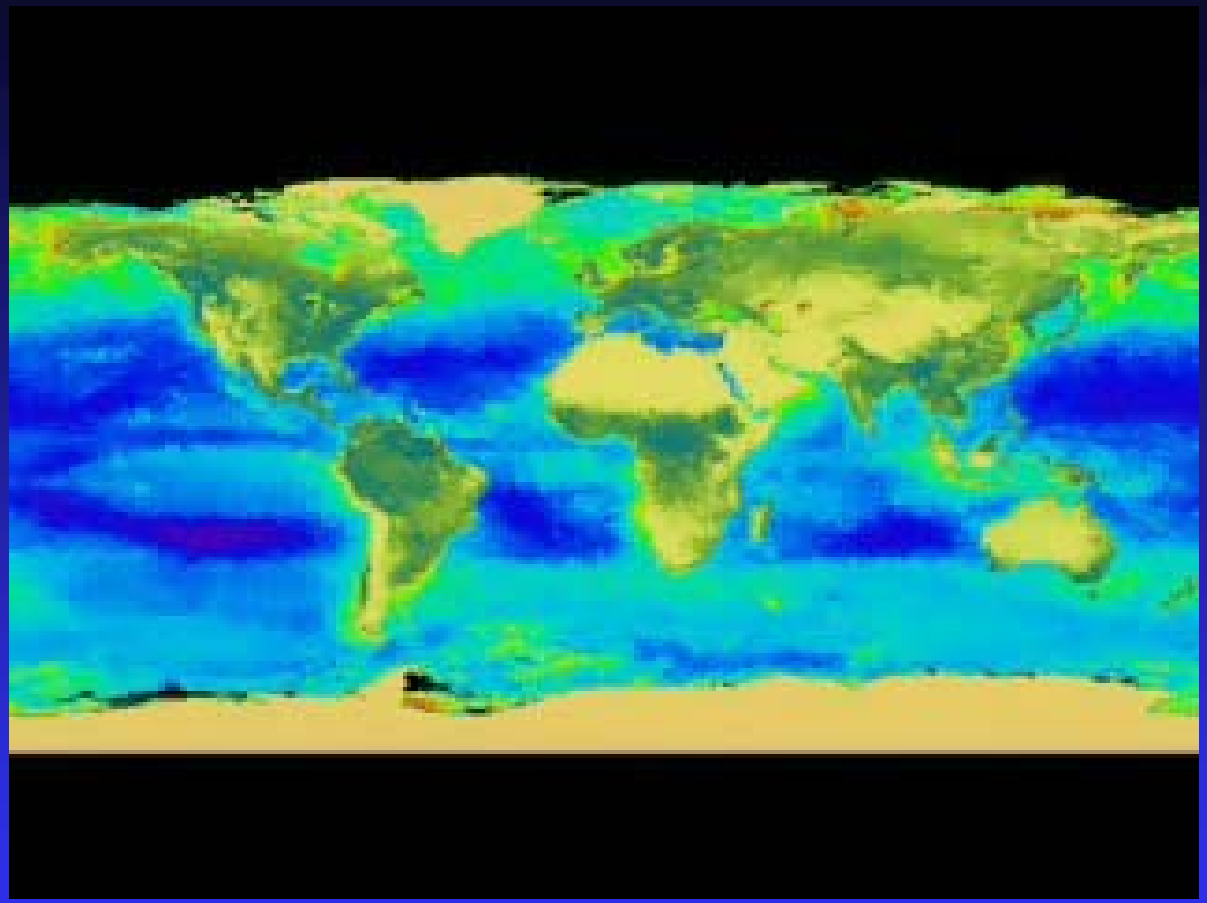
Source: National Petroleum Council (2003)

Changes in cropping systems

Practical advantages with environmental consequences

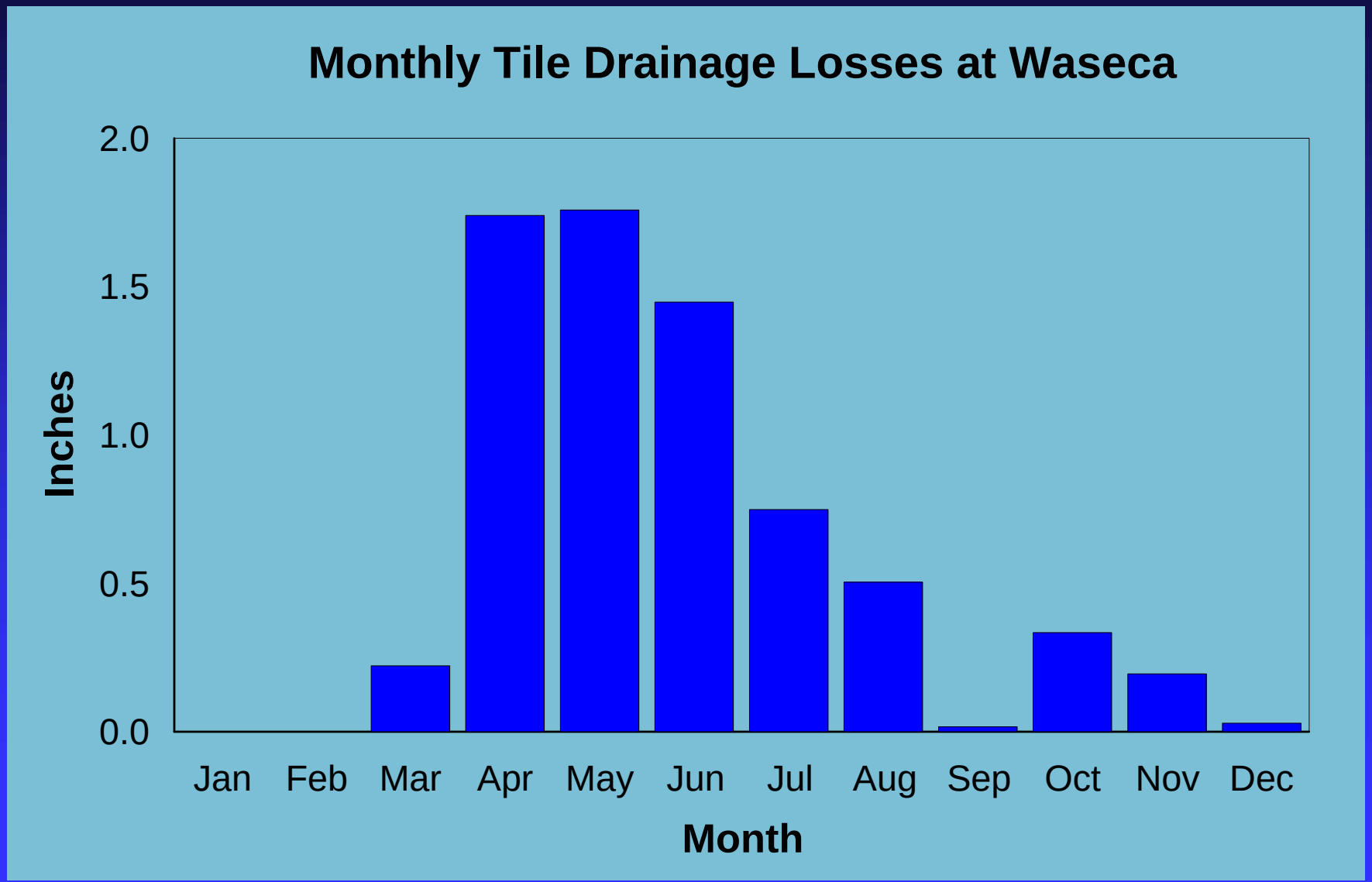


K.J. Kuehner



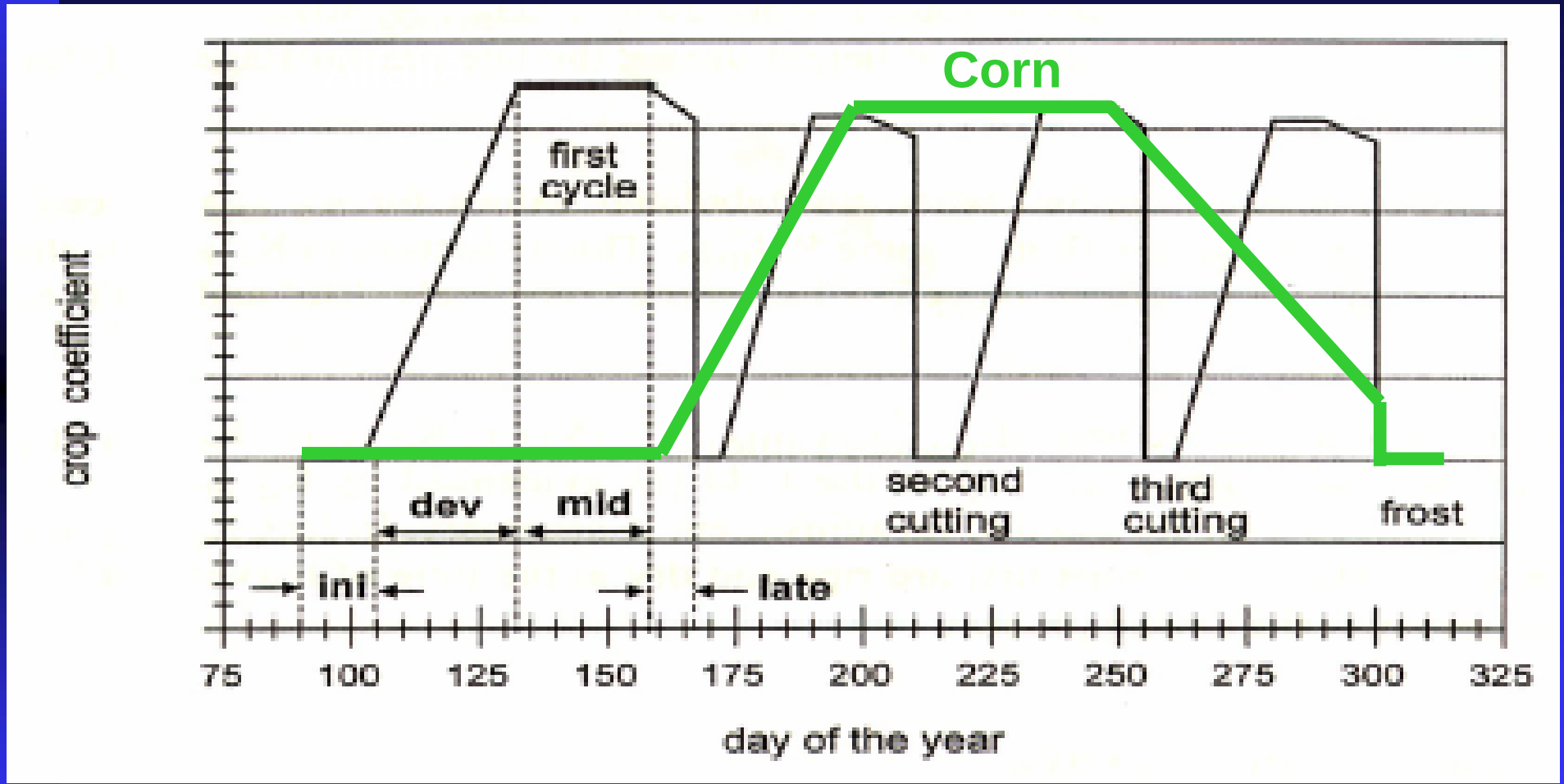
Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Project

When does leaching occur?



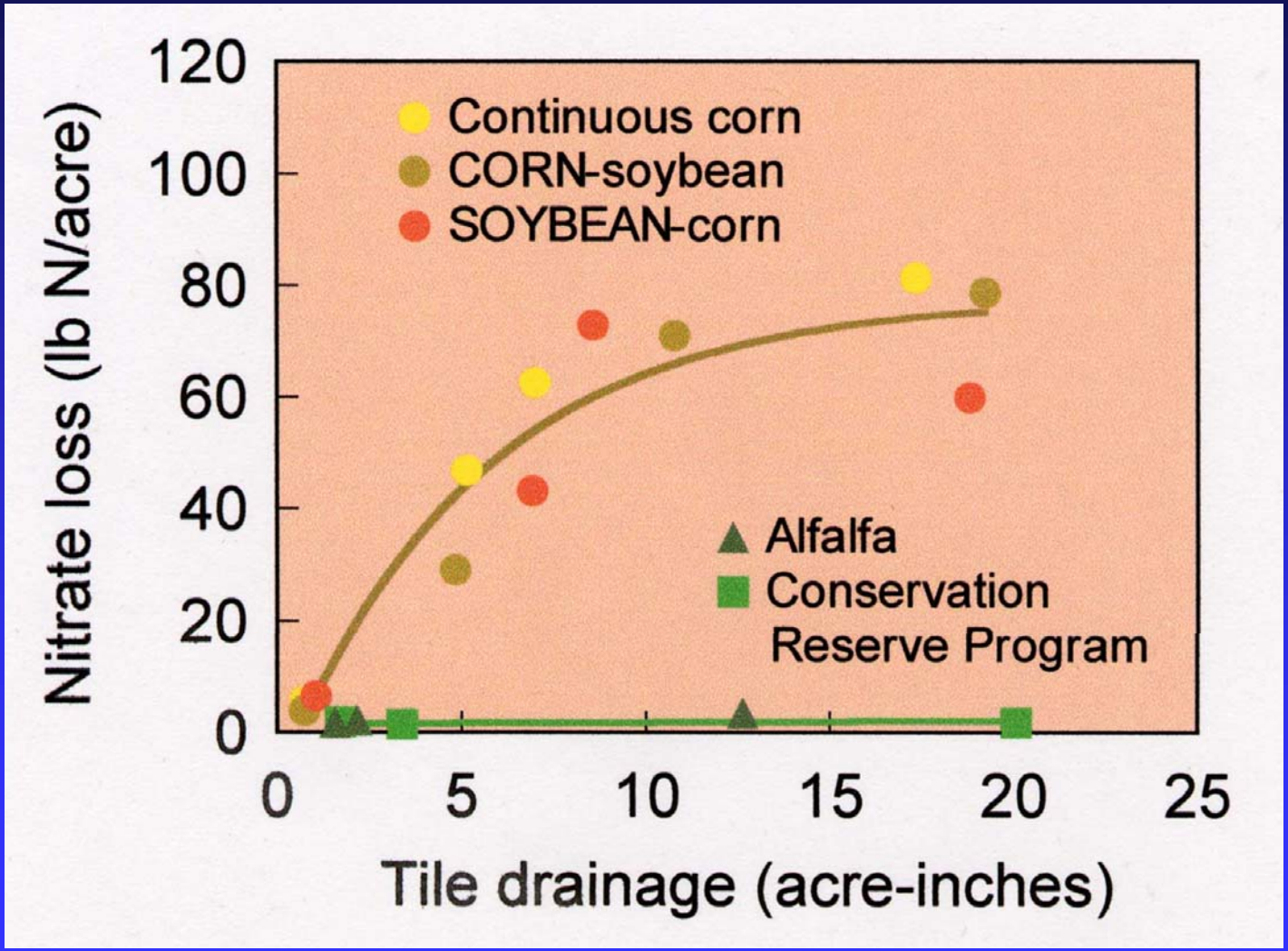
G.W. Randall

Water use by alfalfa and corn

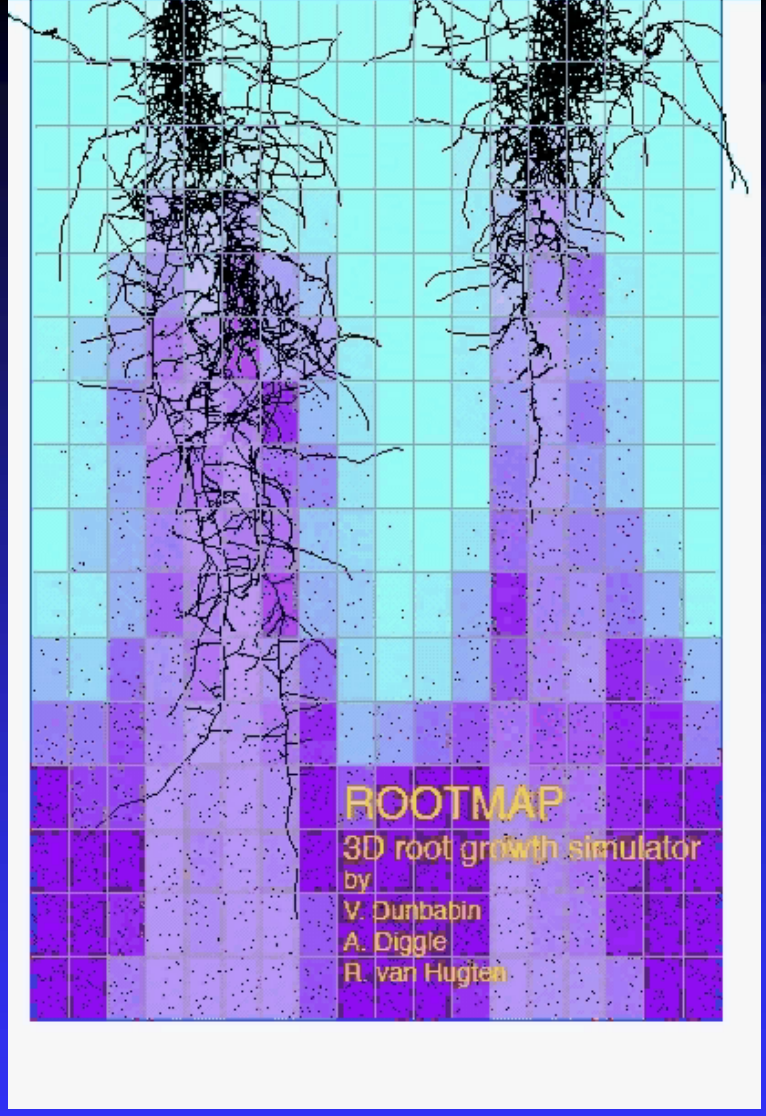


MAFF, BC, 2001

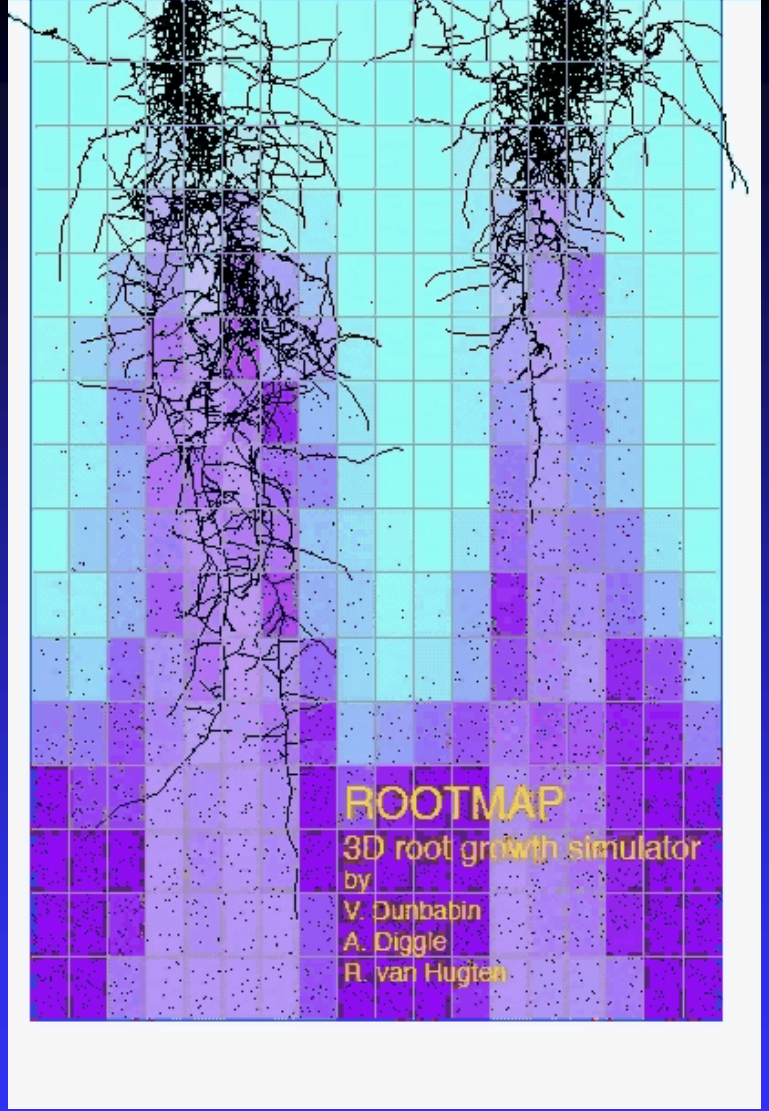
Nitrate leaching loss =
Nitrate concentration X Water flow



Randall et al., 1997



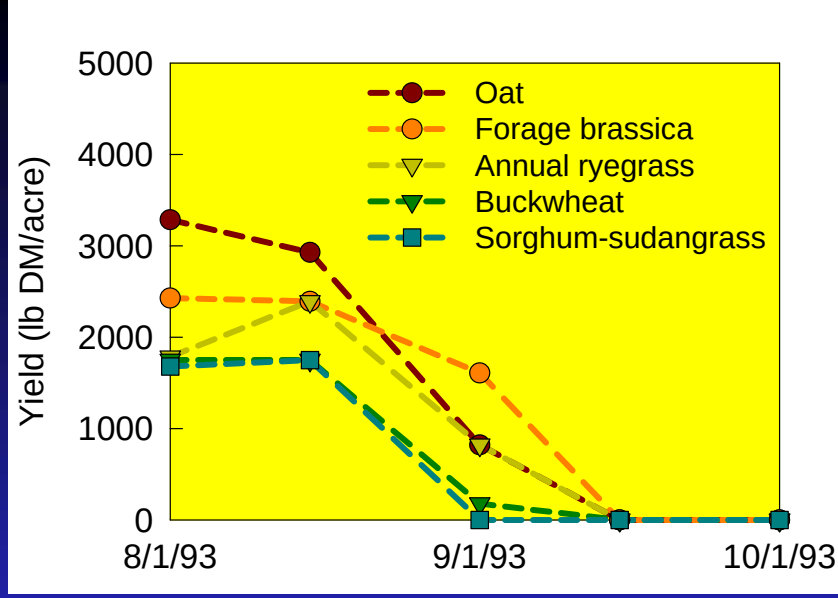
Deep, active roots mean less nitrate loss



How can we achieve deeper rooting?

- Good soil condition
- Good fertility
  (mod. N, opt. P)
- Good seed
- Early planting
- Cultivar
- Cover crops
- Perennial crops

Cover crop growth after silage corn



Latest practical seeding date

Biennial and perennial legumes (red clover, sweetclover, alfalfa)	August 1
Annual and winter legumes (berseem clover, hairy vetch, medic)	August 15
Warm-season annuals (buckwheat, sorghum-sudangrass)	August 15
Cool-season annuals (oat, ryegrass, brassicas, winter rye)	September 1

Stute, 2000

Small grain after soybean

Overseeding cover crops into soybeans in Aug.

Oat cover crops in November

Tom Kaspar, ARS, Ames, IA

Winter rye after corn

Paul Porter, U of MN

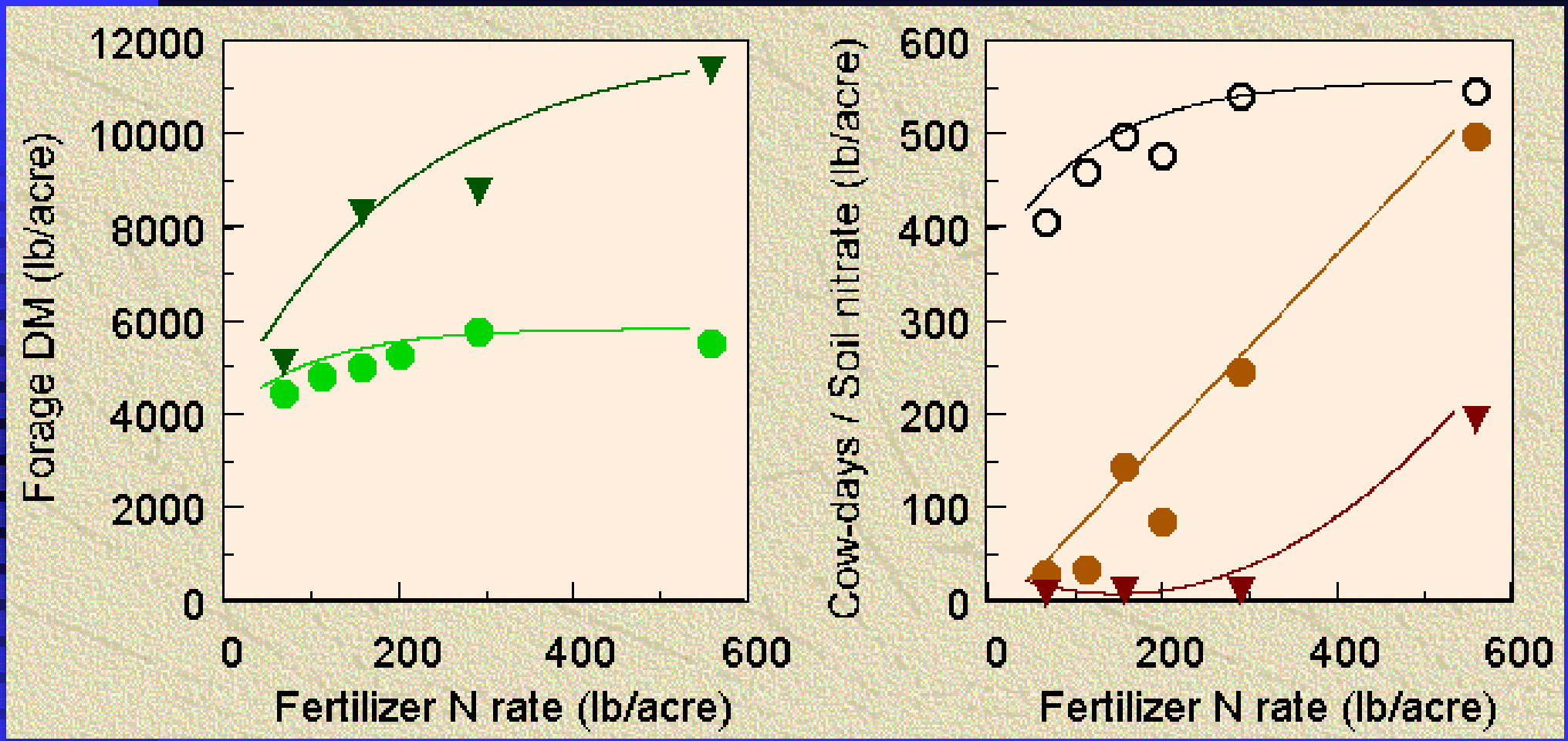
How about perennials?

Fertilizer N ~ 50 lb N/a

Most lysimeters
lost < 1 lb N/a

Max.loss 24 lb N/a

Avg. loss < 5 lb N/a



Optimum N rate was much higher for hay than grazing,

but soil nitrate load increased faster with N under grazing

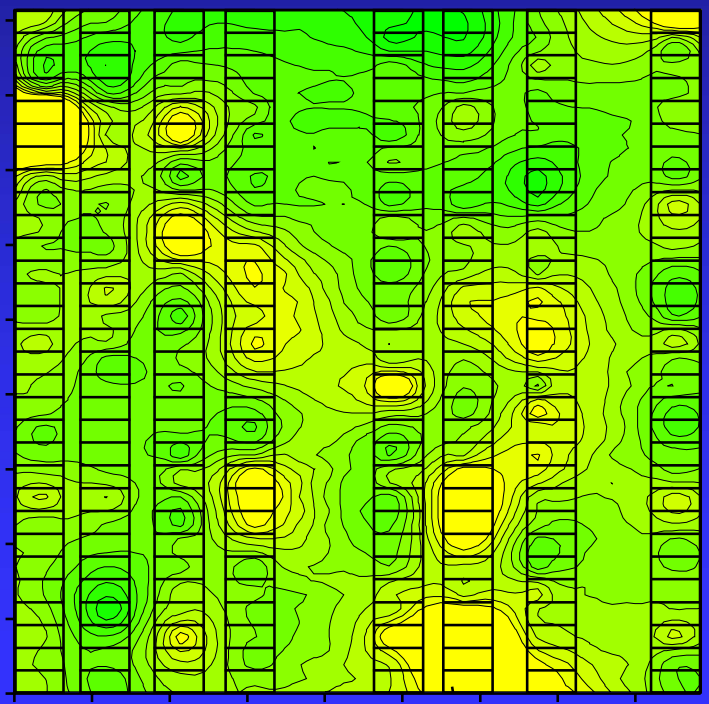
Variable Rate N

Established bermudagrass pasture

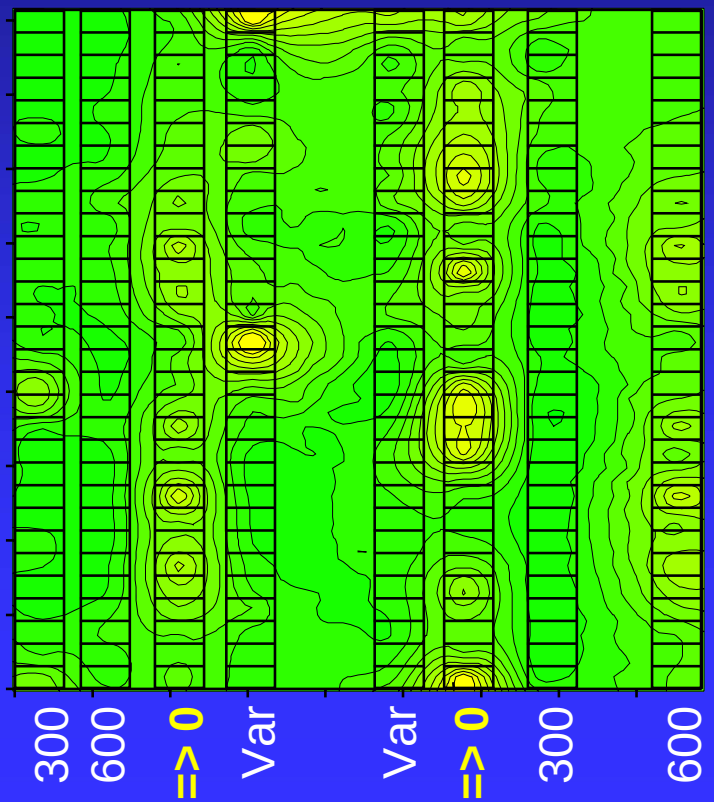
N rate was based NDVI value (color of herbage)

reduced fertilizer N by 60%, reduced yield variability, and produced similar forage yield

Pre-fertilization, May 28



First harvest, June 27



Taylor et al., 1998, J. Plant Nutr. 21:2287

N management decisions

- Who uses legume N credits
  to reduce fertilizer N rates?
- Who uses manure N credits
  to reduce fertilizer N rates?
- Who has fields where a lot of manure
  has been applied over the years?

1st year fertilizer N credit after alfalfa

State	Regrowth	Good	Fair	Poor
		- - - - lb N/acre - - - -		
IL		100	50	0
IA		- - - - 150 - 180 - - - -		
MN		150	75	40
MO		120-140	40-60	0-20
NE		150	120	90
SD		150	50-100	0
MI,IN,OH		140	100	40
WI	< 8”	150	120	90
	> 8”	190	160	130

Manure application with corn silage

Two recognized windows of opportunity:

Preplant	*Too little time*
Post-harvest	*Excess nitrate production*

Potential for sidedressing low rates

Give credit for N and P

Should give credit for at least two years

Second year credit averaged 12%

of total dairy manure N applied

(Cusick et al., 2002)

Manure application on alfalfa

Ken Hammond, USDA

Manitoba Agriculture

Tim McCabe, USDA

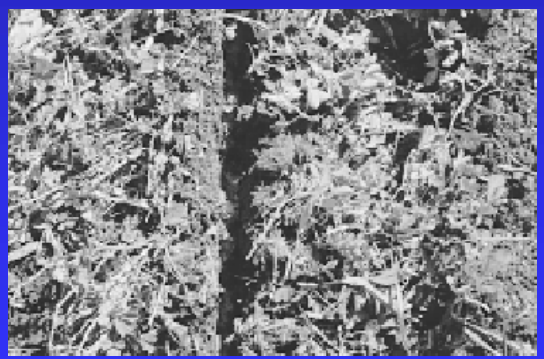
Ballagh Liquid Technologies, Inc.

BAAP, Lithuania

Apply moderate rates Avoid compaction

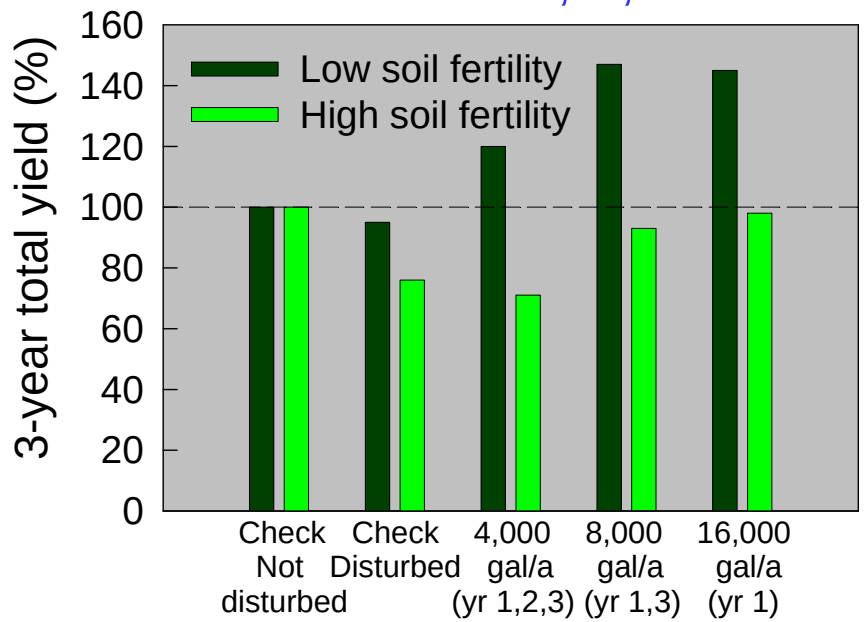
Run-off concerns

Slurry injection in alfalfa



Prairie Agricultural Machinery Institute, Saskatchewan

Yield increases when P, K, or S are low



PAMI, 2001

Potential problems

NH_4^+-K^+ competition – decreased winterhardiness (Joern and Volenec, 1996)

Excess forage K

- Keep soil K in optimum range

Manure on foliage can reduce silage fermentation

- Inoculate before ensiling (Wiederholt et al., 2002)

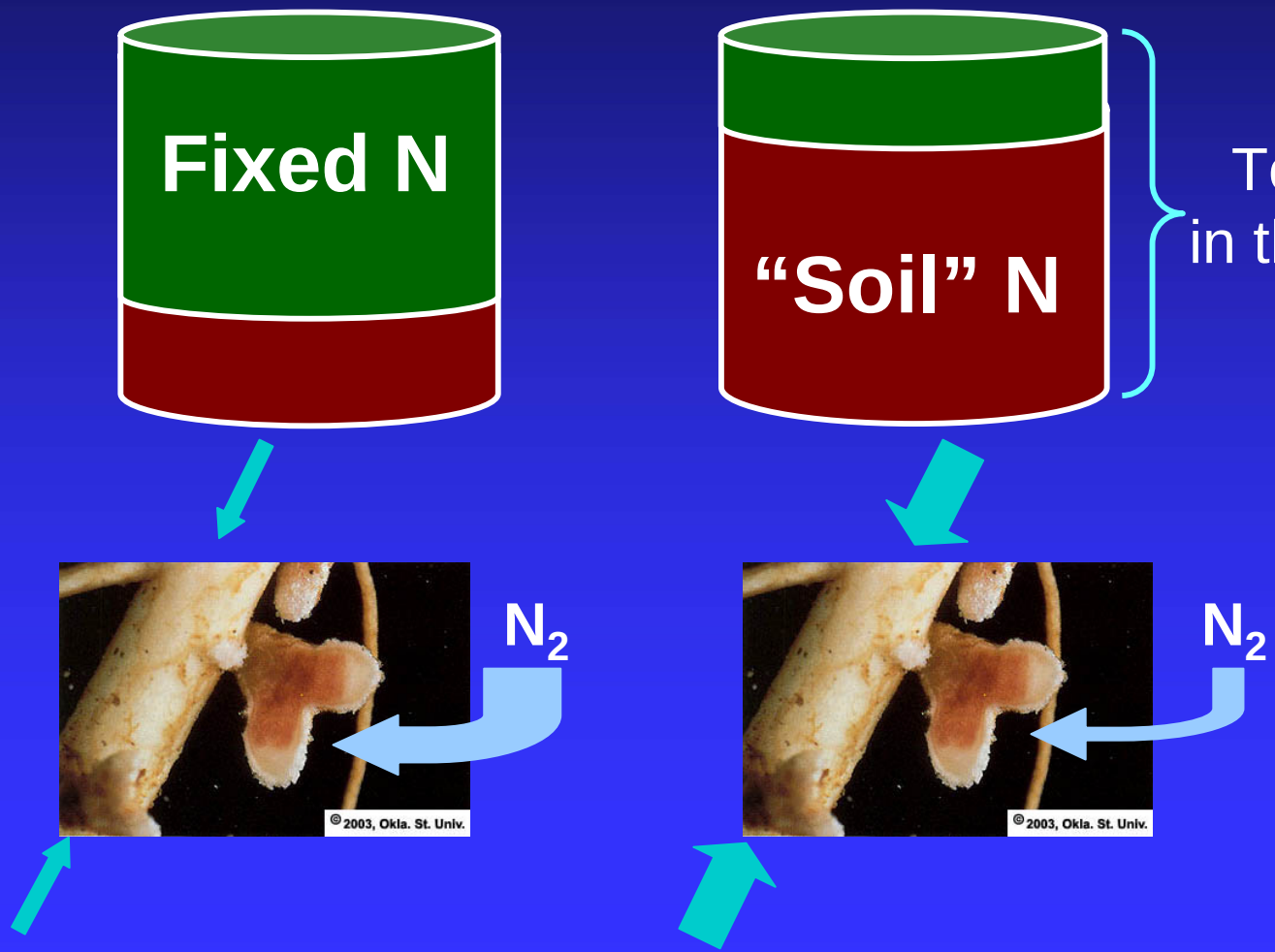
Disease transmission?

- New ARS lab in Marshfield

Excess N

- **WORST** application time: stand termination
- If stand is poor, may apply very low rates

Nitrogen fixation is (usually) reduced by external N

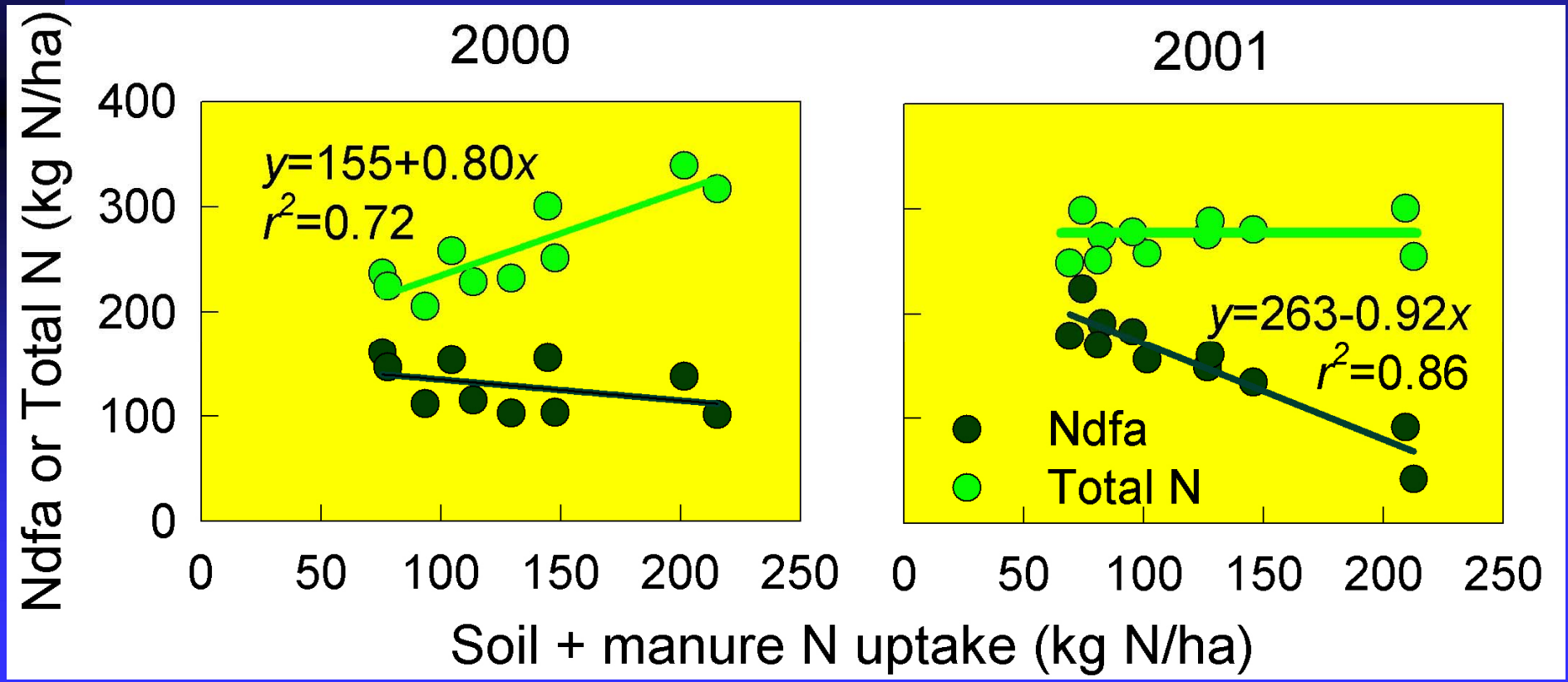


Legumes help buffer N supply

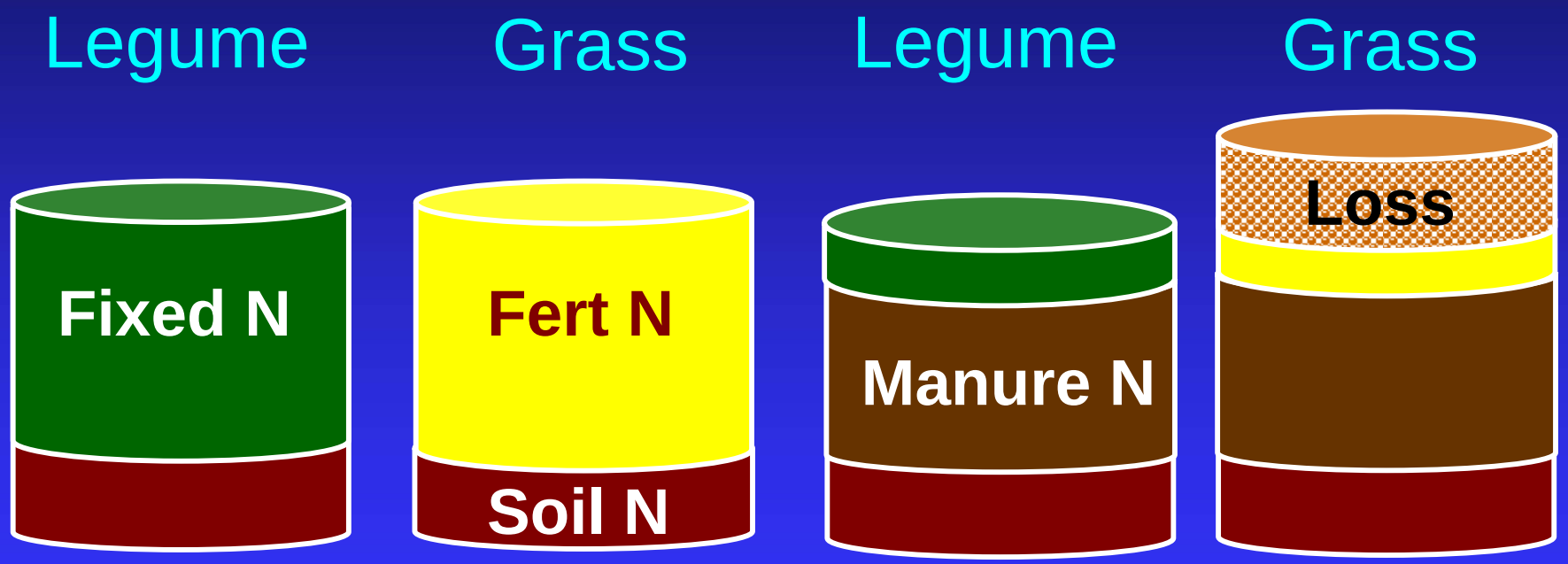
Ndfa = N derived from the atmosphere

With yield increase,
Ndfa response varies

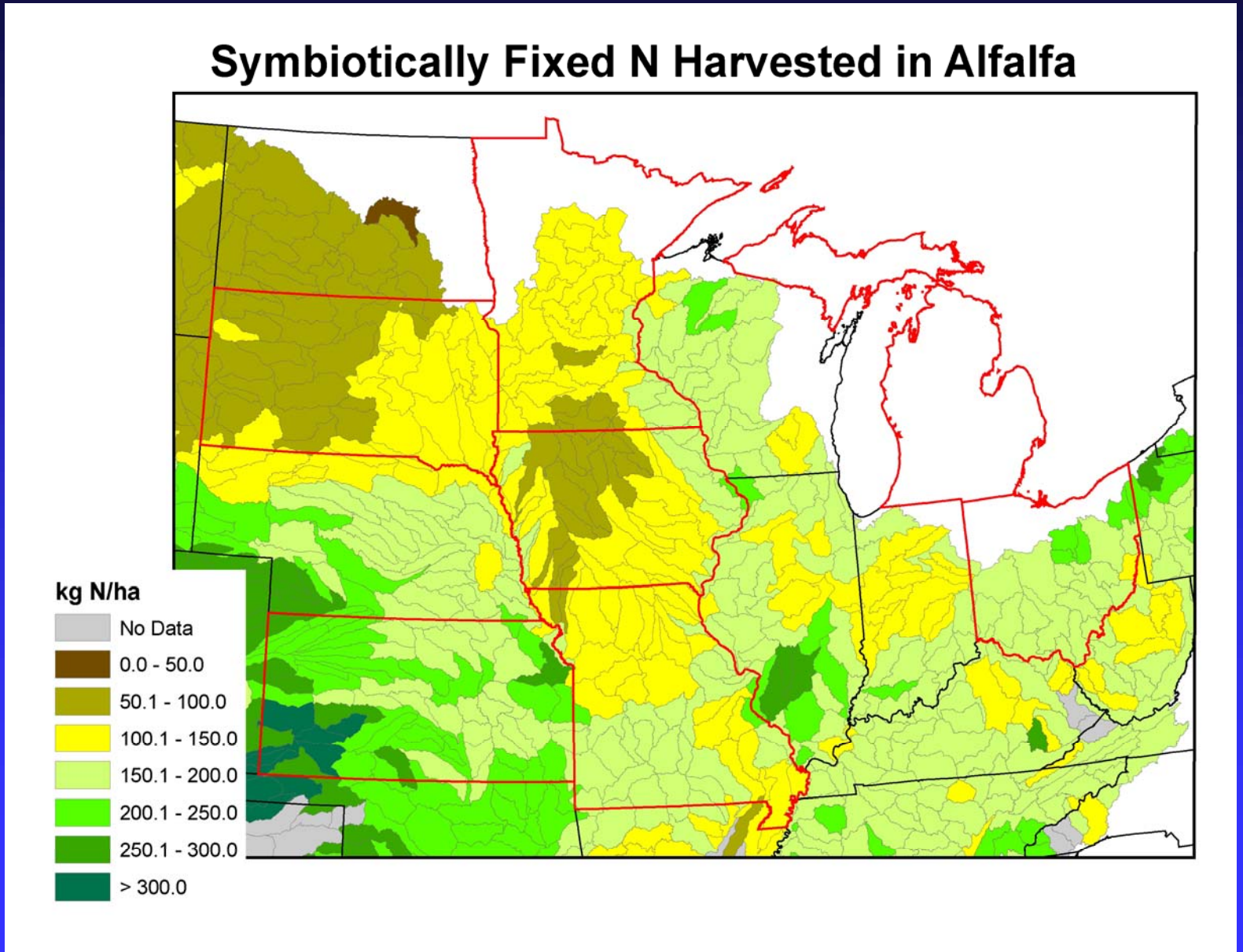
With no yield change,
Ndfa decreases



We need to fertilize non-legumes and can easily guess wrong

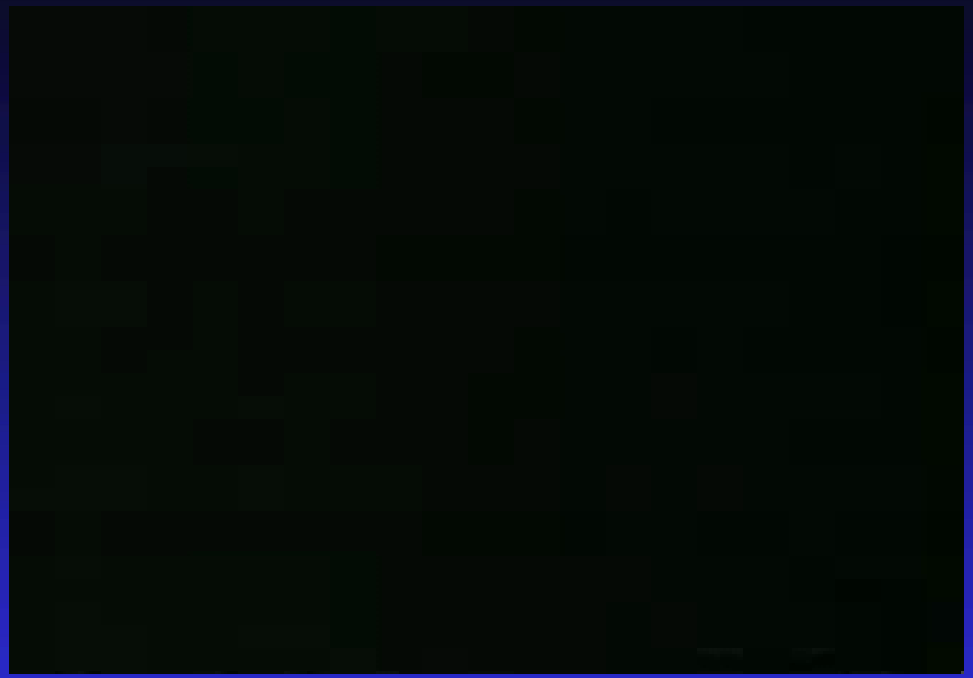


N fixation by alfalfa is not the same everywhere



Some things we don't know
(how research could help)

- How to forecast weather
- How to predict N availability from soil organic matter
- Actual rates of on-farm N fixation
- Optimum legume content of pastures
- How to optimize manure N use by alfalfa



Managing N is a little like herding cats.

It’s impossible to prevent all N from escaping,
but using the right set of tools
can help bring the “herd” to town.

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