Membership-Phase 6 Cover Crop Panel

Name	Affiliation	Role
Ken Staver	University of Maryland	Panel Chair
Charlie White	Penn State University	Panel Member
Jack Meisinger	USDA – Agriculture Research Service	Panel Member
Paul Salon	USDA-Natural Resources Conservation Service	Panel Member
Wade Thomason	Virginia Tech	Panel Member
Jason Keppler	*Maryland Department of Agriculture*	*Watershed Technical Workgroup representative*
David Wood	*Chesapeake Bay Program Office*	*Modeling Team representative*
Mark Dubin	*University of Maryland*	*AgWG Coordinator*
Lindsey Gordon	*Chesapeake Research Consortium*	*Staff*

P6 CC panel three main tasks (May 19-2016)

- Use 5.3.2 panel table efficiencies for traditional cover crops as base and …

1. Modify efficiencies for mixtures based on new data from PSU and VT, probably a little higher.
2. Modify table to apply to cropland where manure is applied in fall, mostly corn silage.
3. Modify table to apply to winter cereal production fields (commodity) with no fall nutrients applied.

A couple of key changes from 5.3.2

- Traditional and commodity cover crops can be applied to all row crop land uses except for some minor specialty crops (e.g., spinach)
- Cover crop efficiencies will be applied to specific land uses, rather than the average crop acre
- Commodity cover crop effect will only consider impact of no fall nutrient applications. After Jan. 1 dealt with in the winter cereals land use with NM

Schedule –working backwards from October 20

- Draft to P6 cover crop panel by September 10 for internal comments
- Draft final report posted by September 15
- Dealing with comments as they come in from September 15-October 15
- If comments are manageable, final report by October 20

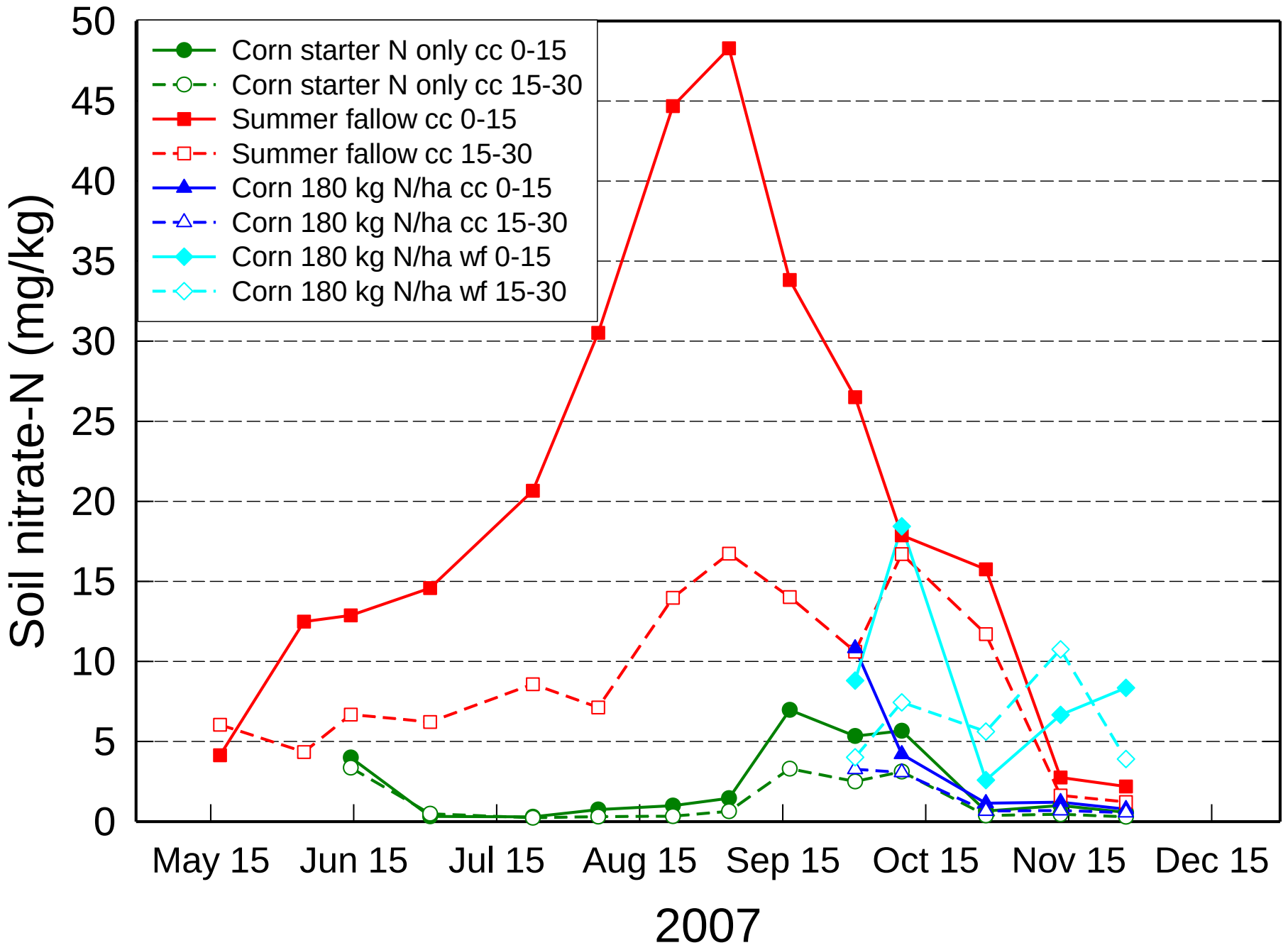
The essential cover crop effect on N losses

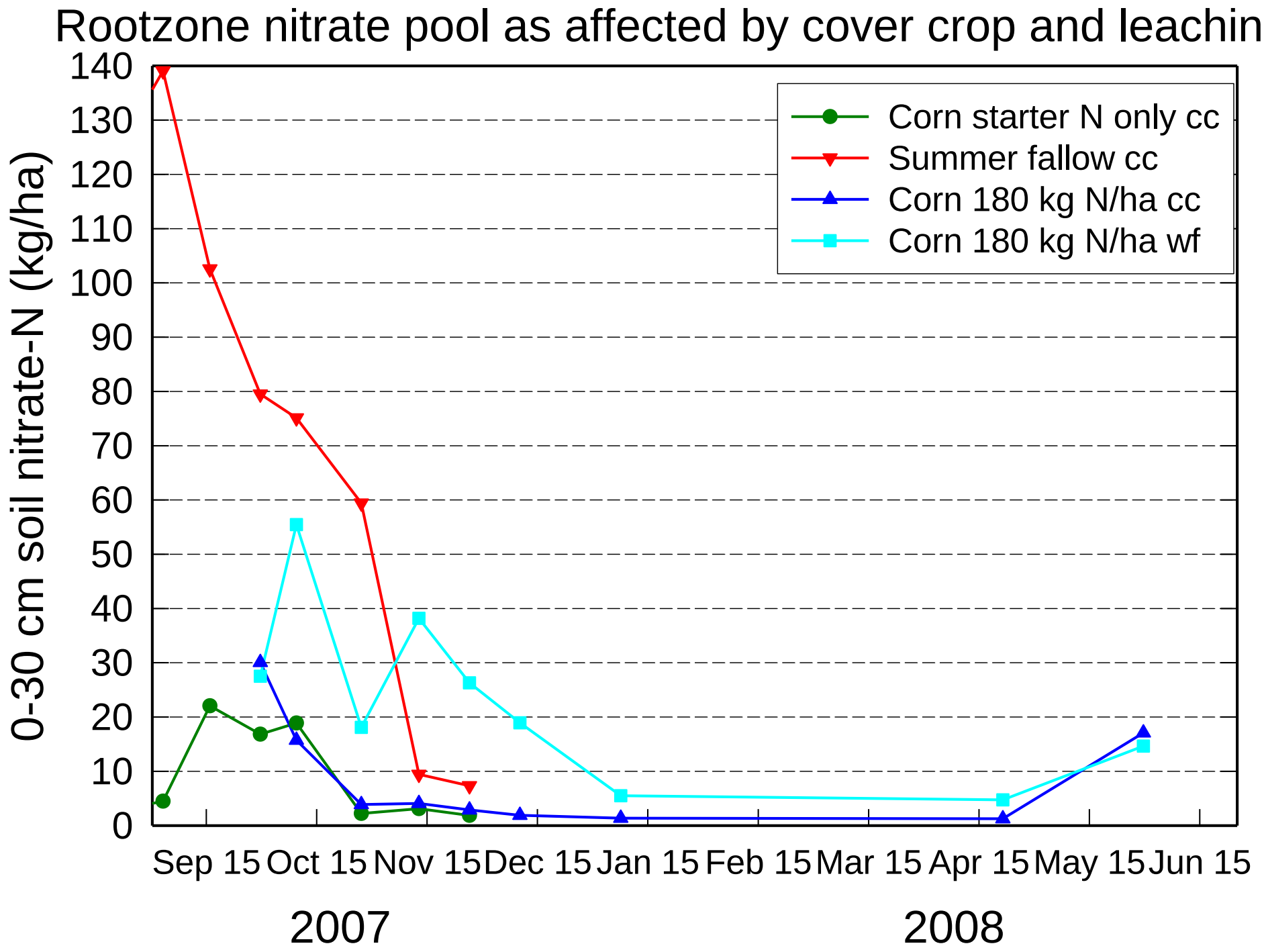
- Reduce soil nitrate pool outside of summer growing season to minimize potential for nitrate leaching, which is the major route of N loss from cropland in many parts of the Bay watershed.
- Pretty simple in traditional case of pure stands planted in otherwise winter fallow settings with no fall nutrients (basically the 5.3.2 approach).
- P6, considering real world situations where nitrate pool is adjusted (up for fall manure, down for commodity cover crops), and cover crop uptake potential is reduced by reducing grass content in mixtures with legumes.

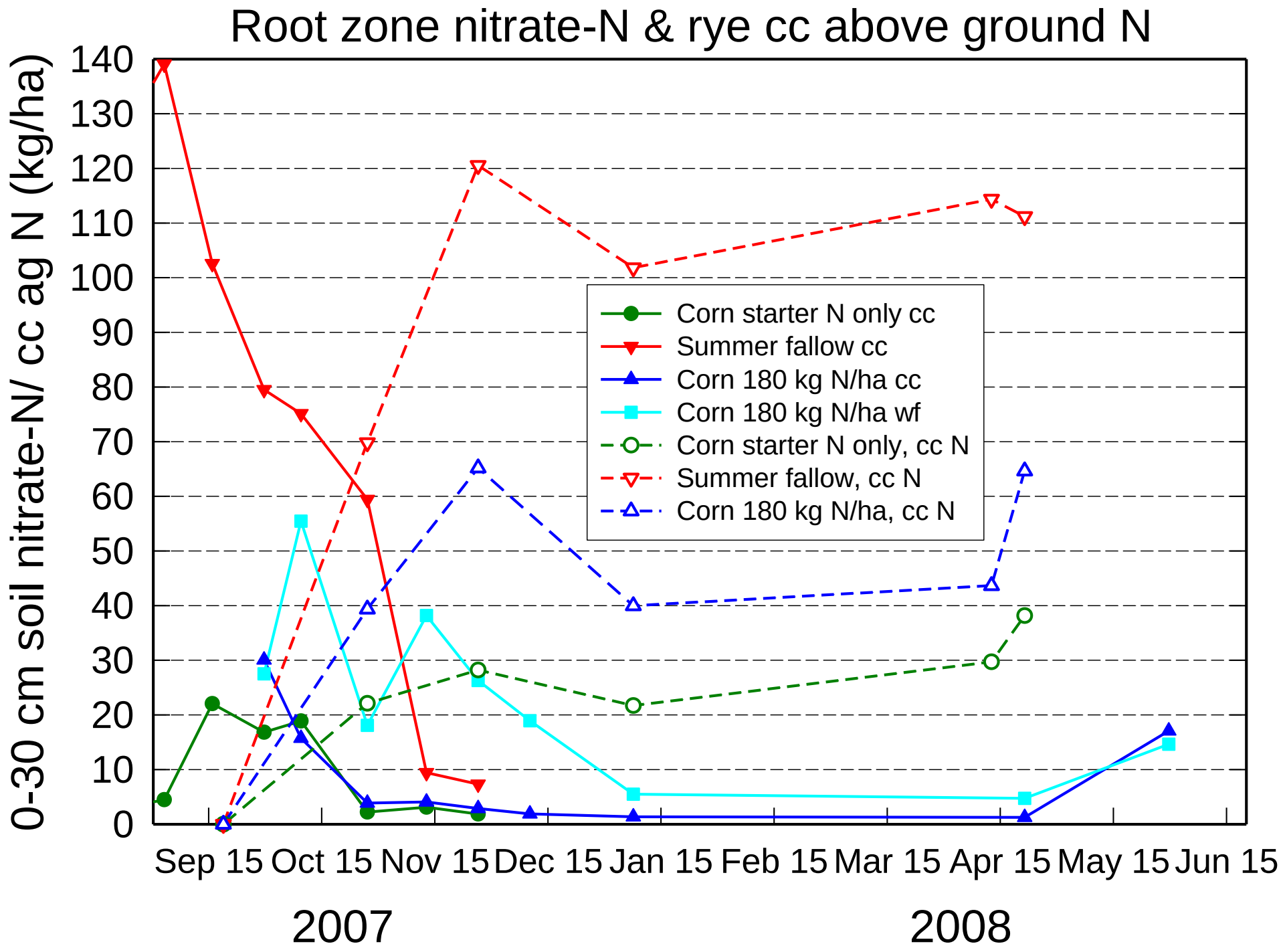
Basically trying to put numbers on one big sliding scale between root zone nitrate and cover crop uptake potential

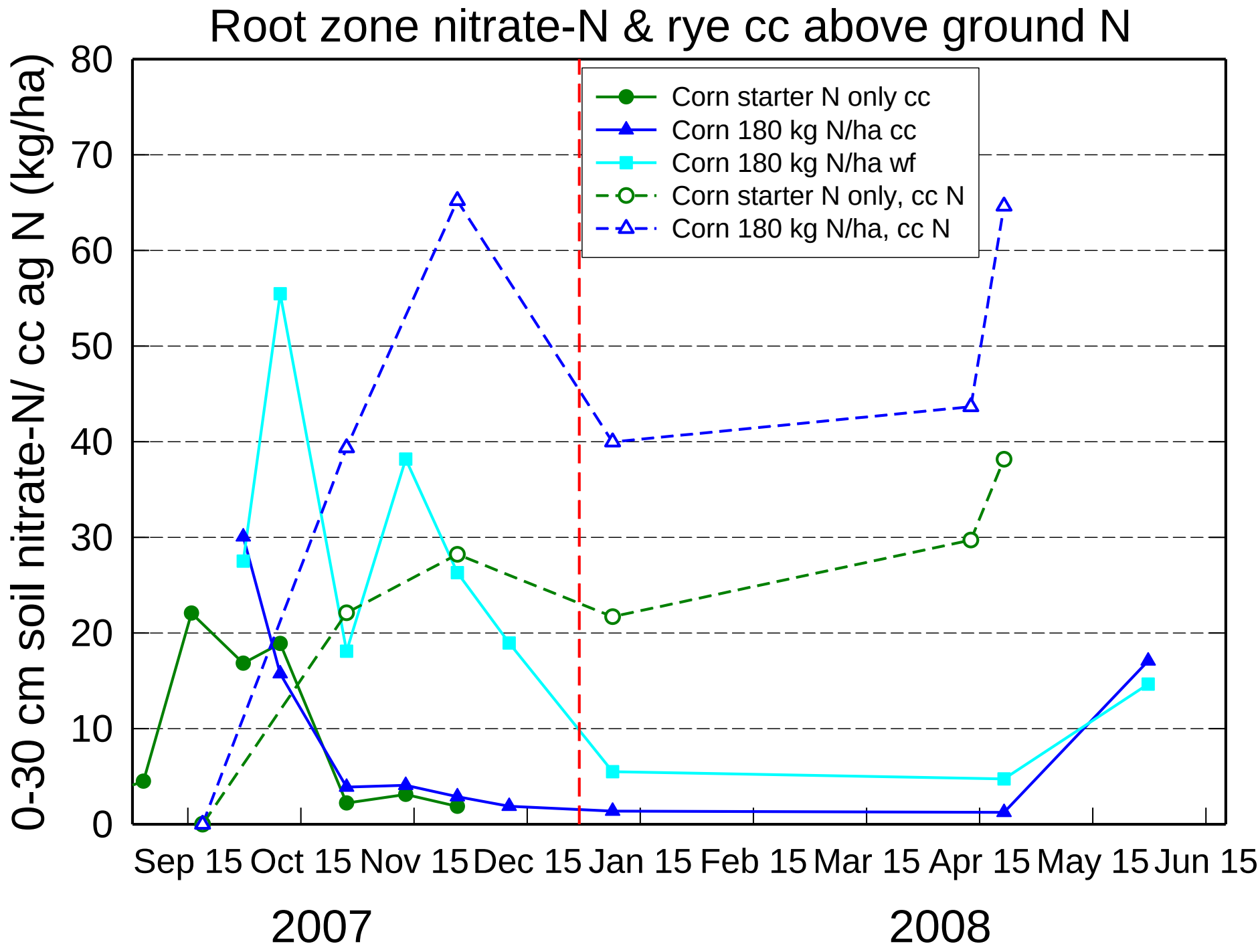
- Considering more complicated situations in P6 with limited data to cover all the options
- First principles, efficiency goes down as root zone nitrate pool goes up and cover crop uptake potential goes down.
- Commodity cover crop, concept is that eliminating fall N reduces root zone nitrate so efficiency increases, but baseline is not well defined (maybe not panel's purview?)

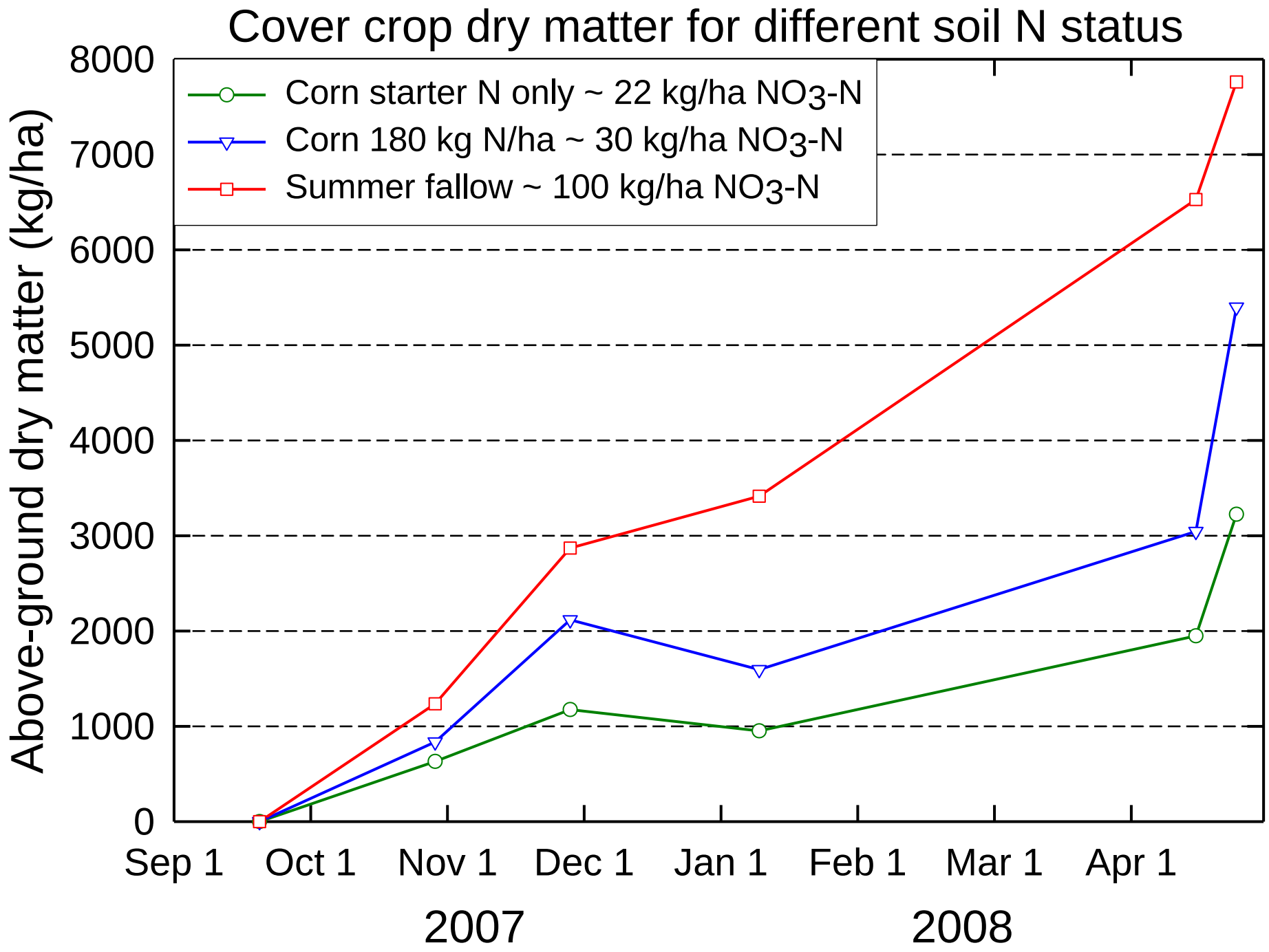
Root zone nitrate-N as a function of summer management

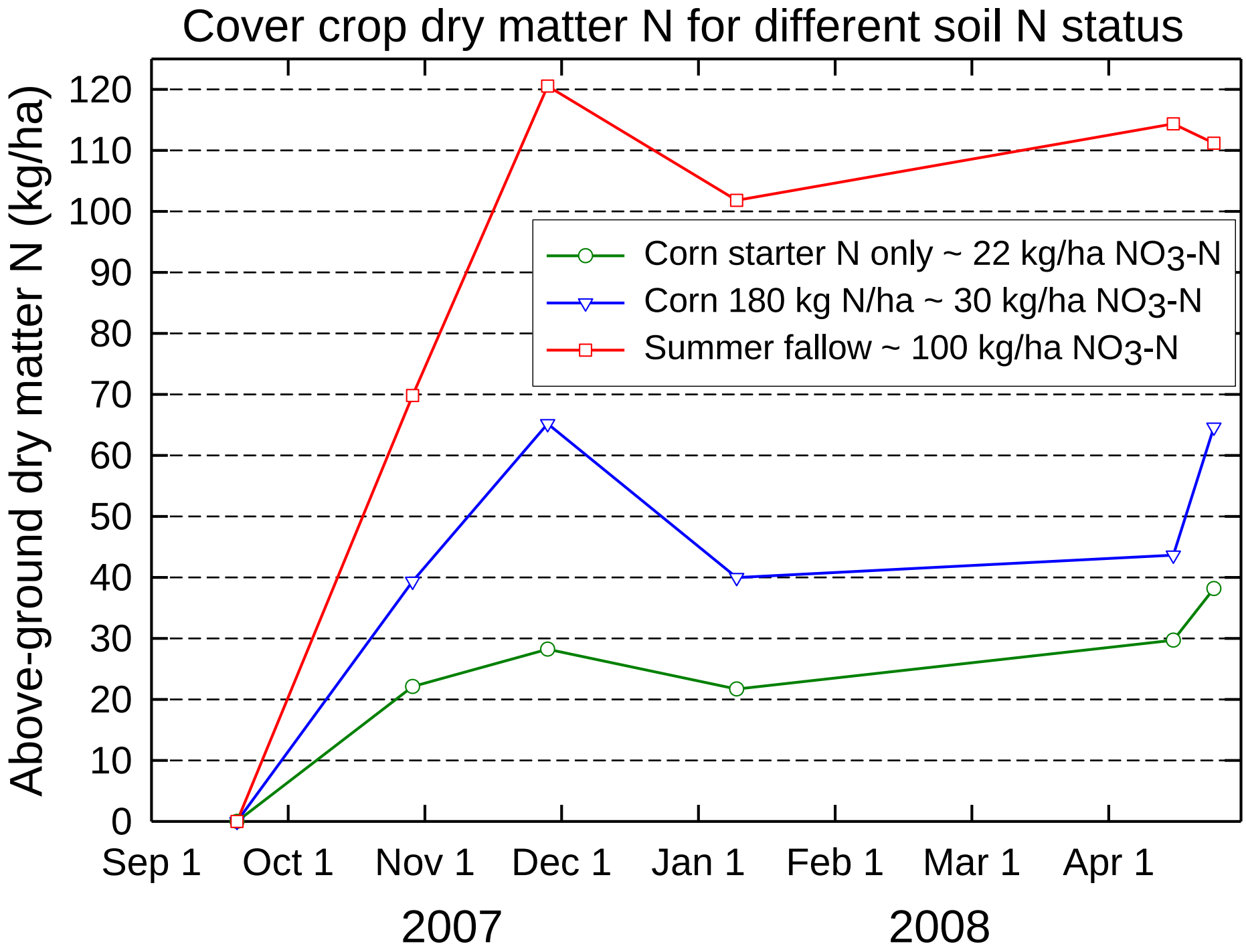


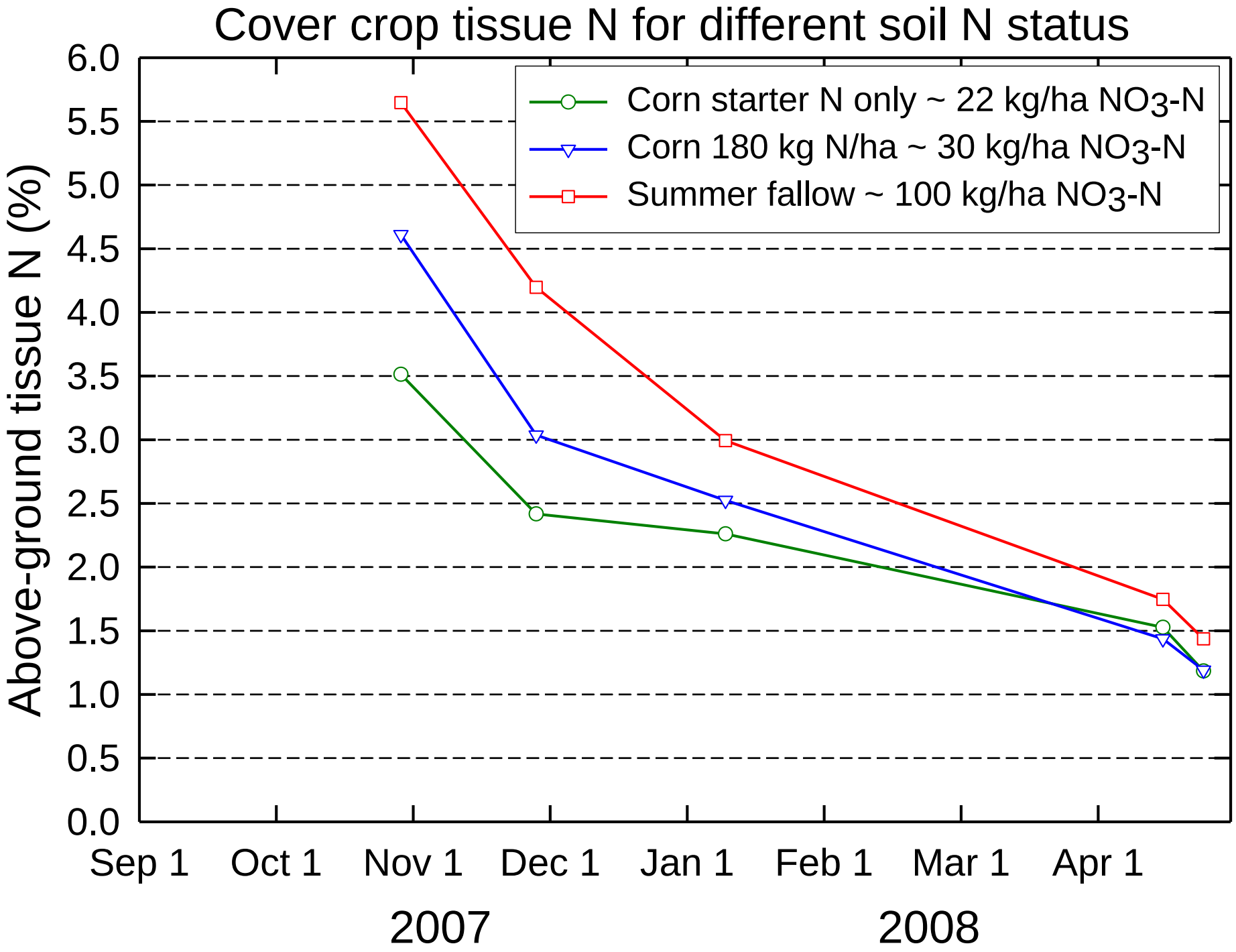

Rootzone nitrate pool as affected by cover crop and leaching
0-30 cm soil nitrate-N (kg/ha)
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Corn starter N only cc
Summer fallow cc
Corn 180 kg N/ha cc
Corn 180 kg N/ha wf
Sep 15
Oct 15
Nov 15
Dec 15
Jan 15
Feb 15
Mar 15
Apr 15
May 15
Jun 15
2007
2008


Root zone nitrate-N & rye cc above ground N
0-30 cm soil nitrate-N/ cc ag N (kg/ha)
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Sep 15
Oct 15
Nov 15
Dec 15
Jan 15
Feb 15
Mar 15
Apr 15
May 15
Jun 15
2007
2008
Corn starter N only cc
Summer fallow cc
Corn 180 kg N/ha cc
Corn 180 kg N/ha wf
Corn starter N only, cc N
Summer fallow, cc N
Corn 180 kg N/ha, cc N


Root zone nitrate-N & rye cc above ground N
0-30 cm soil nitrate-N/ cc ag N (kg/ha)
80
70
60
50
40
30
20
10
0
Corn starter N only cc
Corn 180 kg N/ha cc
Corn 180 kg N/ha wf
Corn starter N only, cc N
Corn 180 kg N/ha, cc N
Sep 15
Oct 15
Nov 15
Dec 15
Jan 15
Feb 15
Mar 15
Apr 15
May 15
Jun 15
2007
2008


Cover crop dry matter for different soil N status
Above-ground dry matter (kg/ha)
8000
7000
6000
5000
4000
3000
2000
1000
0
Corn starter N only ~ 22 kg/ha NO3-N
Corn 180 kg N/ha ~ 30 kg/ha NO3-N
Summer fallow ~ 100 kg/ha NO3-N
Sep 1
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
2007
2008


Cover crop dry matter N for different soil N status
Above-ground dry matter N (kg/ha)
120
110
100
90
80
70
60
50
40
30
20
10
0
Sep 1
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
2007
2008
Corn starter N only ~ 22 kg/ha NO3-N
Corn 180 kg N/ha ~ 30 kg/ha NO3-N
Summer fallow ~ 100 kg/ha NO3-N


Cover crop tissue N for different soil N status
Above-ground tissue N (%)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Sep 1
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
2007
2008
Corn starter N only ~ 22 kg/ha NO3-N
Corn 180 kg N/ha ~ 30 kg/ha NO3-N
Summer fallow ~ 100 kg/ha NO3-N

Key points about how cover crops work

- Traditional cover crops operating well below N uptake capacity (not planted too late or thin)
- Potential for higher uptake reduces loss of efficiency due to higher root zone nitrate pool or reducing grass planting rate in mixtures
- Conversely, also reduces effect of eliminating fall N applications to winter production fields, especially if early planted

Overall effects (adjustments likely)

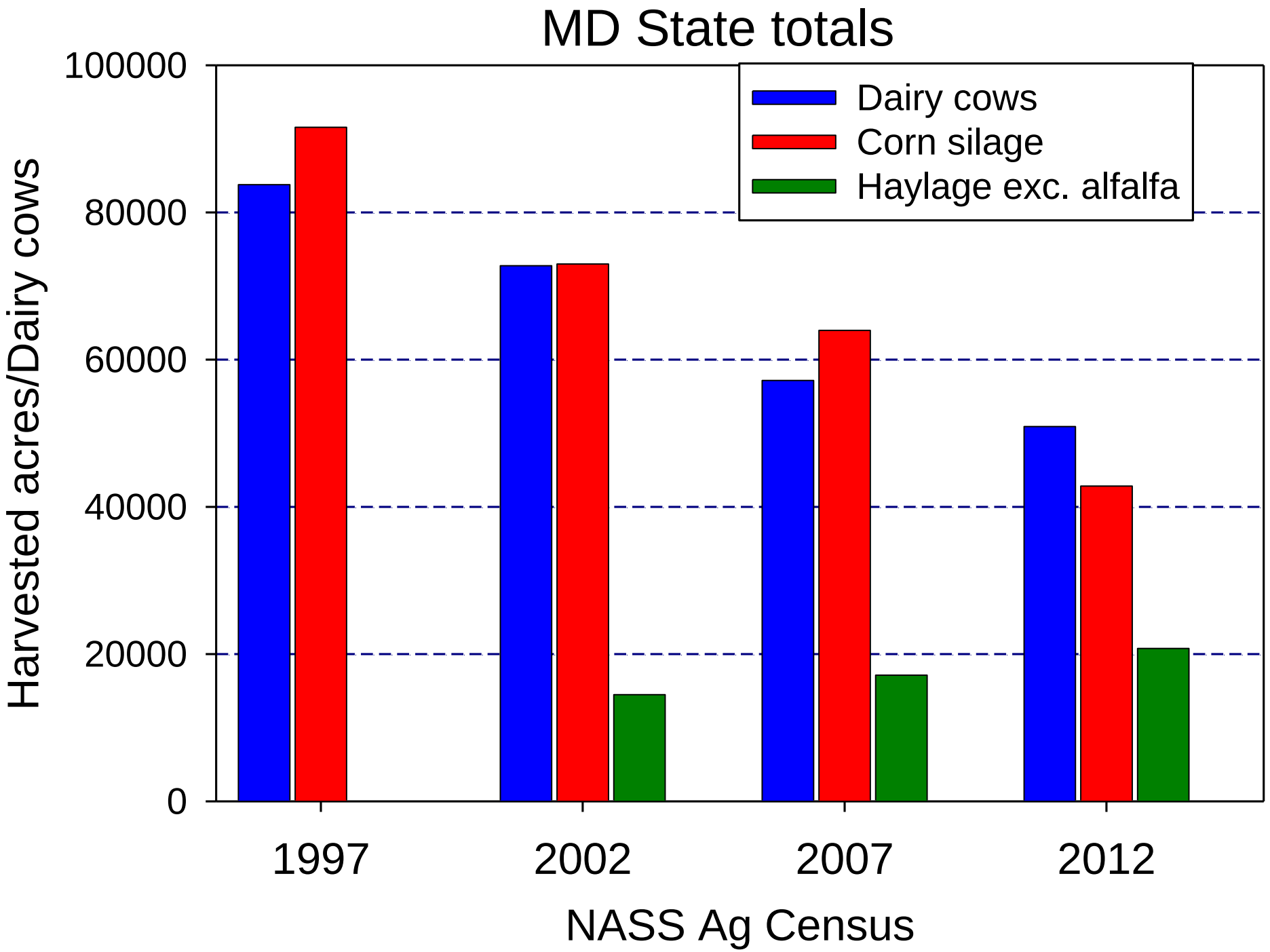
- Pure stand traditional cover crop reductions from 5.3.2 panel not changed but will be applied to specific land uses.
- Mixture values likely increased from ~ 0.5 of pure stand values to ~0.7-0.8 of pure stand values.
- Commodity cover crop efficiencies ~ 0.5 of 5.3.2 traditional cover crop values and applied to land use where planted.
- New cc practice for crop land with unavoidable fall manure applications, ~ 0.8 of 5.3.2 traditional values.
- Defining baselines critical although not clearly part of panels task (e.g., historical patterns of fall nutrient applications).

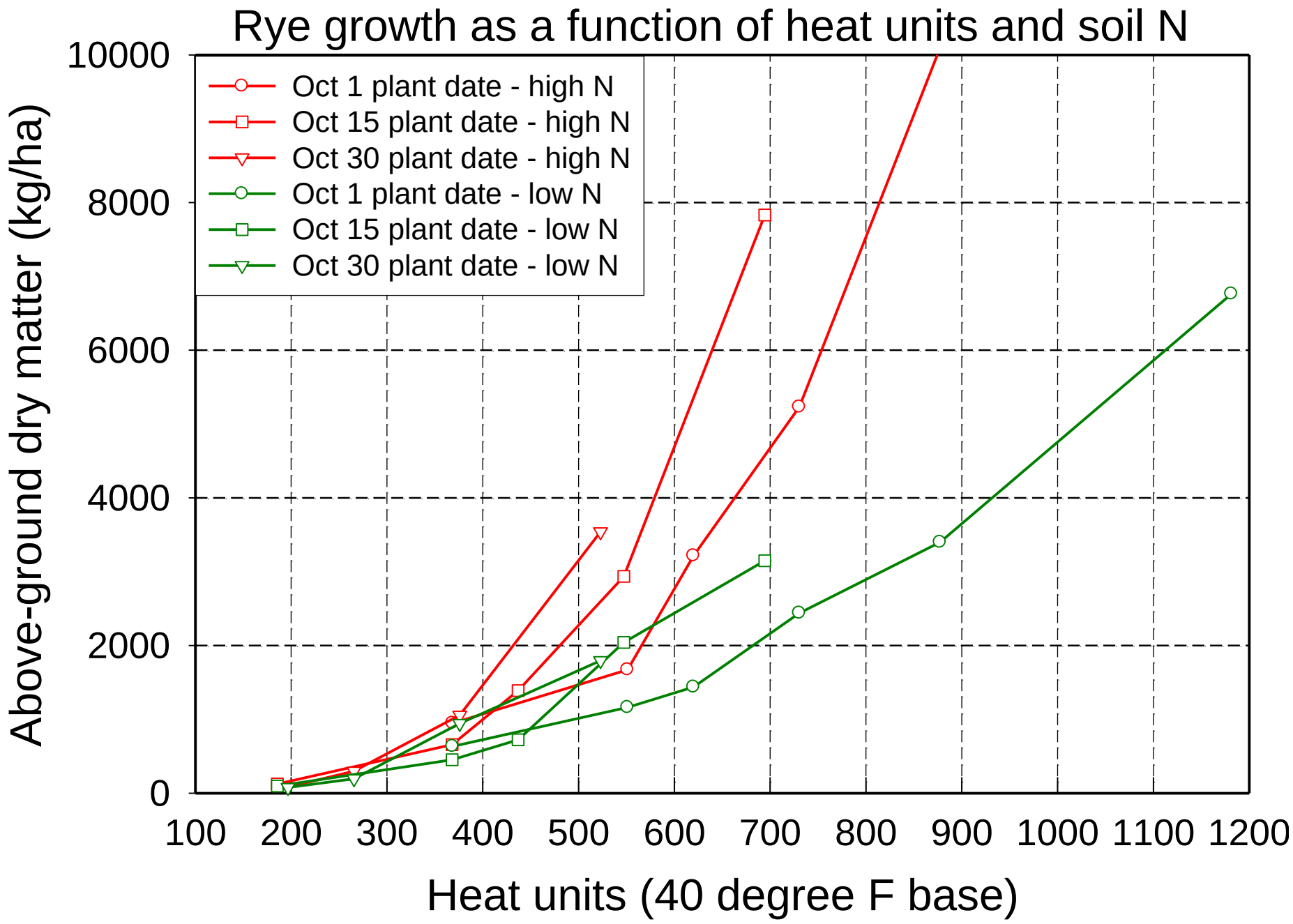
Winter cereals – review effects on nutrient losses

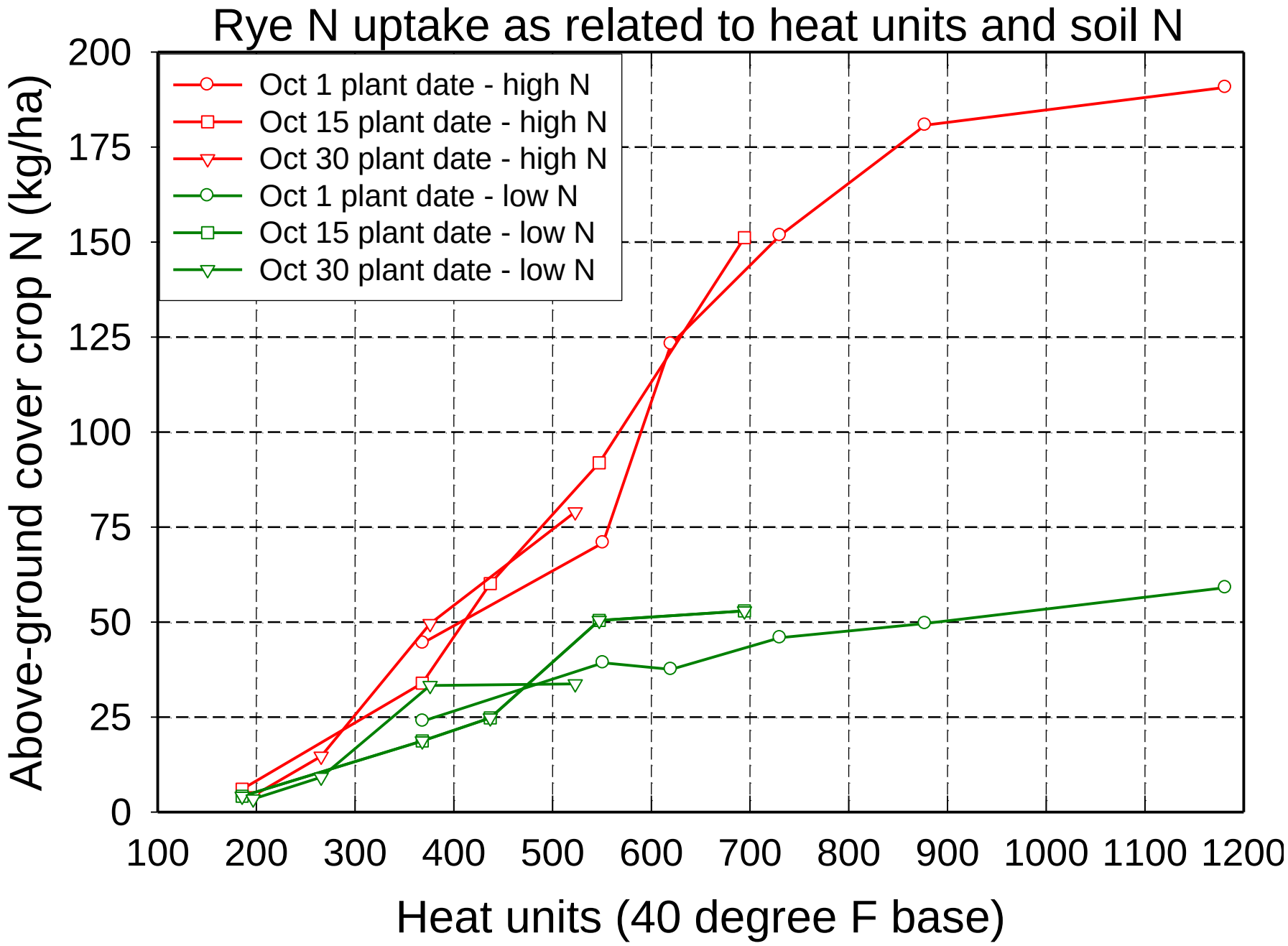
- Erosion – planting can increase erosion potential but once established can reduce erosion potential depending on baseline residue cover. Total effect depends on site erosion potential.
- N leaching – Potential to reduce root zone nitrate pool but N applications to production fields temporarily increase root zone pool and risk of loss. Timing relative to leaching critical.
- Surface runoff dissolved N – Effects on very shallow soil dissolved N pools can reduce runoff dissolved losses. N applications increase losses.
- P – Particulate losses tied to erosion impacts and soil P, dissolved P lots of questions, NT applications???

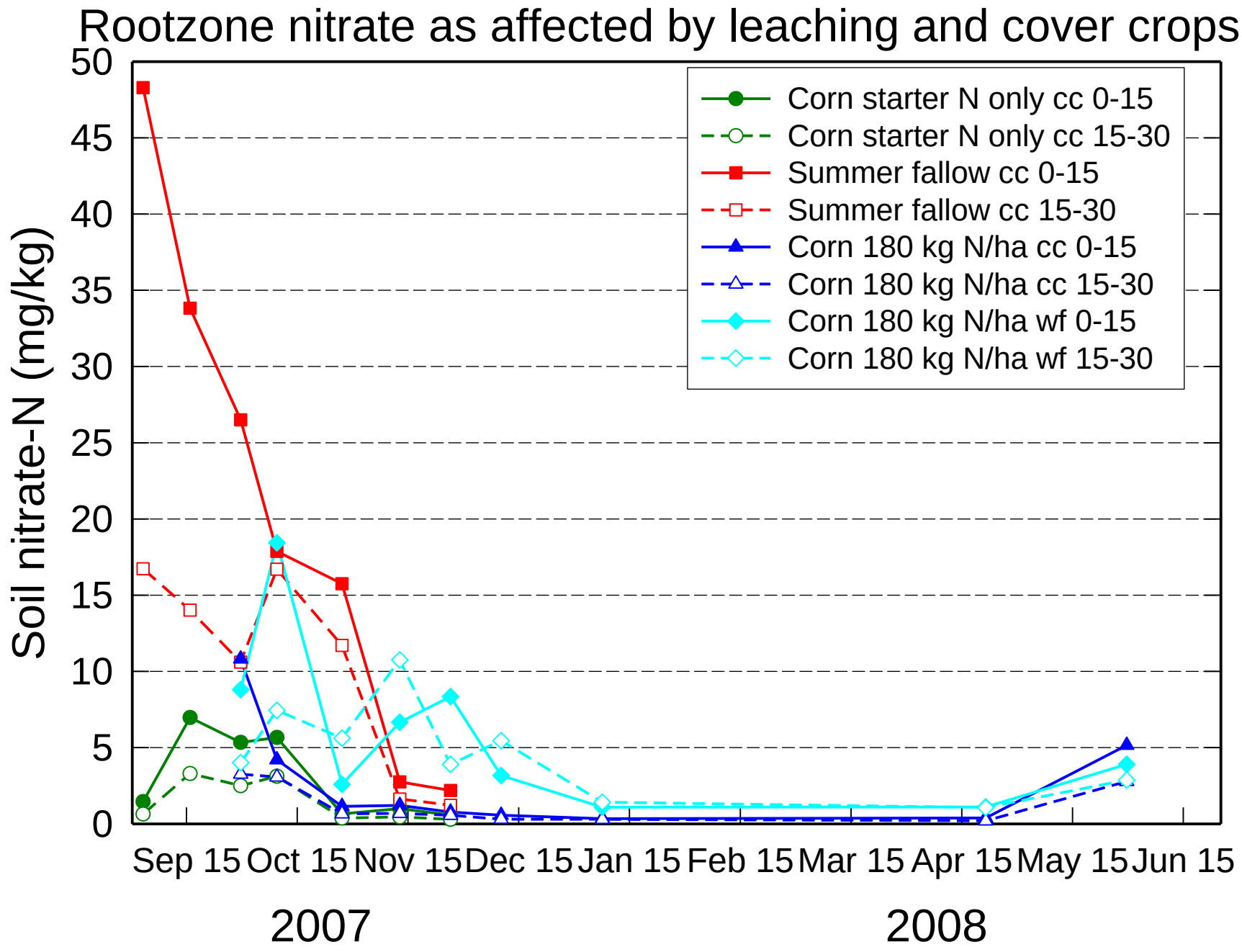
MD Eastern Shore winter cereal recollections

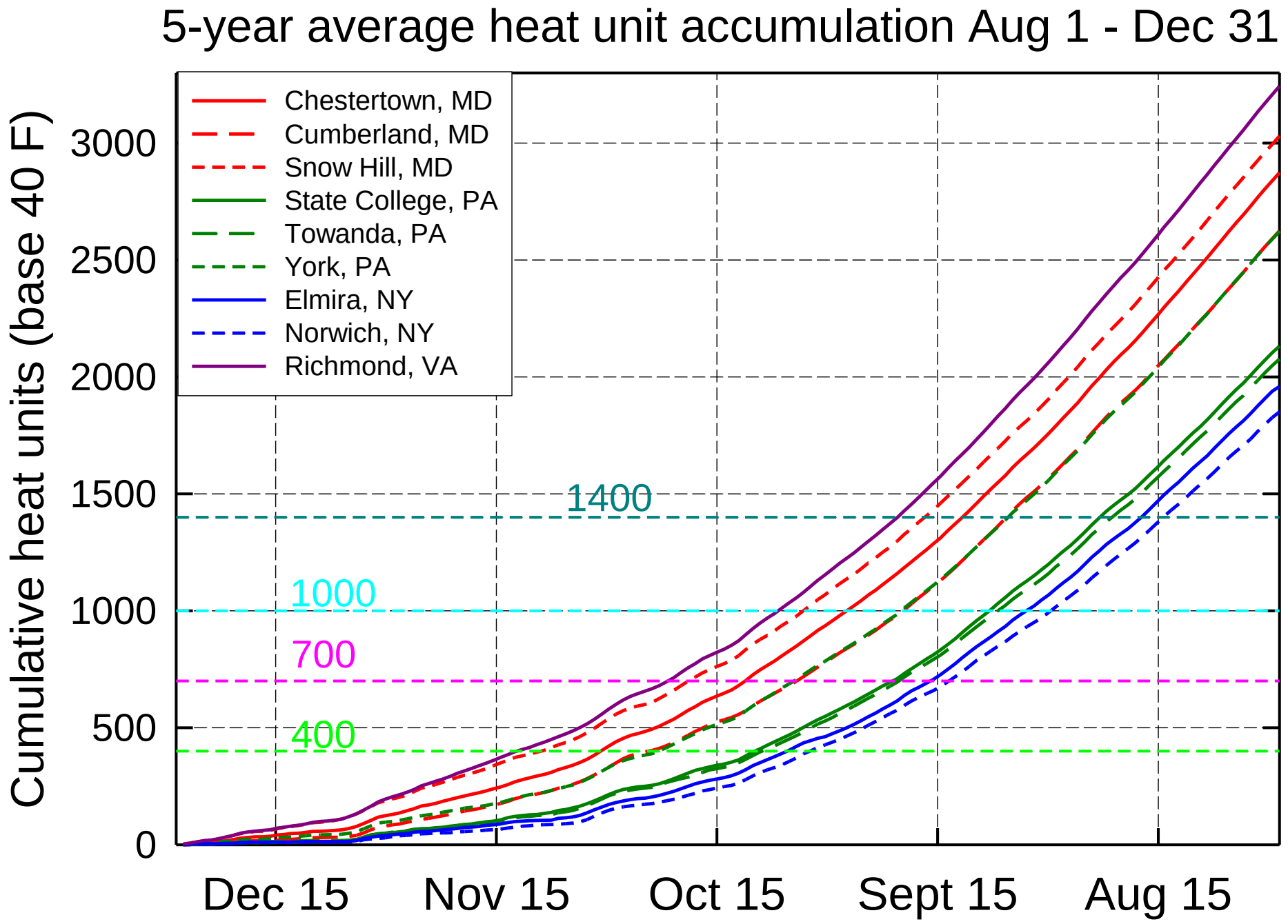
- 1985 – Almost all wheat/barley following corn using conventional tillage. Now 30-40% following single crop sb. Now, much less tillage, more NT and VT.
- 1985 Fall fertilizer – 30-40lb N & 50 lb P_2O_5 + K spread between plowing and disking.
- Remainder of N spread as soon as field conditions allowed after January 1. Freeze up not green up!
- Now, no fall N after sb but no difference in spring.
- Splitting spring N started around 1990.
- Fall N 70-80% of growers before commodity cc program, now about 10%.


MD State totals
Dairy cows
Corn silage
Haylage exc. alfalfa
Harvested acres/Dairy cows
100000
80000
60000
40000
20000
0
1997
2002
2007
2012
NASS Ag Census


Rye growth as a function of heat units and soil N
Above-ground dry matter (kg/ha)
10000
8000
6000
4000
2000
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Heat units (40 degree F base)
Oct 1 plant date - high N
Oct 15 plant date - high N
Oct 30 plant date - high N
Oct 1 plant date - low N
Oct 15 plant date - low N
Oct 30 plant date - low N


Rye N uptake as related to heat units and soil N
Above-ground cover crop N (kg/ha)
Heat units (40 degree F base)
Oct 1 plant date - high N
Oct 15 plant date - high N
Oct 30 plant date - high N
Oct 1 plant date - low N
Oct 15 plant date - low N
Oct 30 plant date - low N
0
25
50
75
100
125
150
175
200
100
200
300
400
500
600
700
800
900
1000
1100
1200


Rootzone nitrate as affected by leaching and cover crops
Soil nitrate-N (mg/kg)
50
45
40
35
30
25
20
15
10
5
0
Sep 15
Oct 15
Nov 15
Dec 15
Jan 15
Feb 15
Mar 15
Apr 15
May 15
Jun 15
2007
2008
Corn starter N only cc 0-15
Corn starter N only cc 15-30
Summer fallow cc 0-15
Summer fallow cc 15-30
Corn 180 kg N/ha cc 0-15
Corn 180 kg N/ha cc 15-30
Corn 180 kg N/ha wf 0-15
Corn 180 kg N/ha wf 15-30


5-year average heat unit accumulation Aug 1 - Dec 31
Cumulative heat units (base 40 F)
3000
2500
2000
1500
1000
500
0
Chestertown, MD
Cumberland, MD
Snow Hill, MD
State College, PA
Towanda, PA
York, PA
Elmira, NY
Norwich, NY
Richmond, VA
1400
1000
700
400
Dec 15
Nov 15
Oct 15
Sept 15
Aug 15

1. Modify efficiencies for mixtures based on new data from PSU and VT, probably a little higher.
   - 5.3.2 approach average grass and legume values.
   - At lower grass planting rates evidence of compensatory nitrate uptake, i.e., more uptake per plant, so reduction of nitrate uptake is not as great as cut in planting rate (to a point).
   - Grass/legume mixtures tend not to be killed as early in the spring as pure grass cover crops to allow more N fixation by legume component suppressing soil nitrate concentrations later into the spring.

2. Modify table to apply to cropland where manure is fall applied, mostly corn silage.

- 5.3.2 definition of traditional cover crop does not allow fall manure application.
- Many operations do not have 365 day manure storage capacity; fall manure applications unavoidable and can sharply increase soil nitrate.
- Cover crops can result in large load reductions because of high potential for losses.
- But because of increased soil nitrate pool, cover crop efficiencies will be less than 5.3.2 values.

3. Modify table to apply to winter cereal fields (commodity) with no fall nutrients applied.
   - Only considering fall management, spring management too complicated. Baseline info critical but not panels charge.
   - Eliminating fall N application means all nitrate uptake is scavenging soil N following previous crop; functions like a traditional cover crop for autumn/early winter.
   - Effect applied the same as traditional cover crop to land use where planted, mostly corn and soybean.
   - Efficiencies will be less than for traditional cover crop because only applied to part of fall-winter period.
   - Other effects addressed in winter cereal land use (Jan-Dec).

Some Issues (panel will not deal with all)

- Fall establishment of winter cereals currently not represented in P6 land uses; tillage and nutrients?
- Erosion and P benefits will need to be done with modeling or very thin literature/bpj combo. Erosion potential and soil P concentration highly site specific and critical to estimating cc effects.
- Identifying baselines essential for estimating change in behavior and nutrient losses. Simple for traditional cc, much more complicated for others.