Alternative Winter Cover Crops for Virginia

Alternative Winter Cover Crops for Virginia

- Why focus on cover crops?
- Which cover crops?
- When?
- How?
- What's next?

Soil Carbon and Tillage

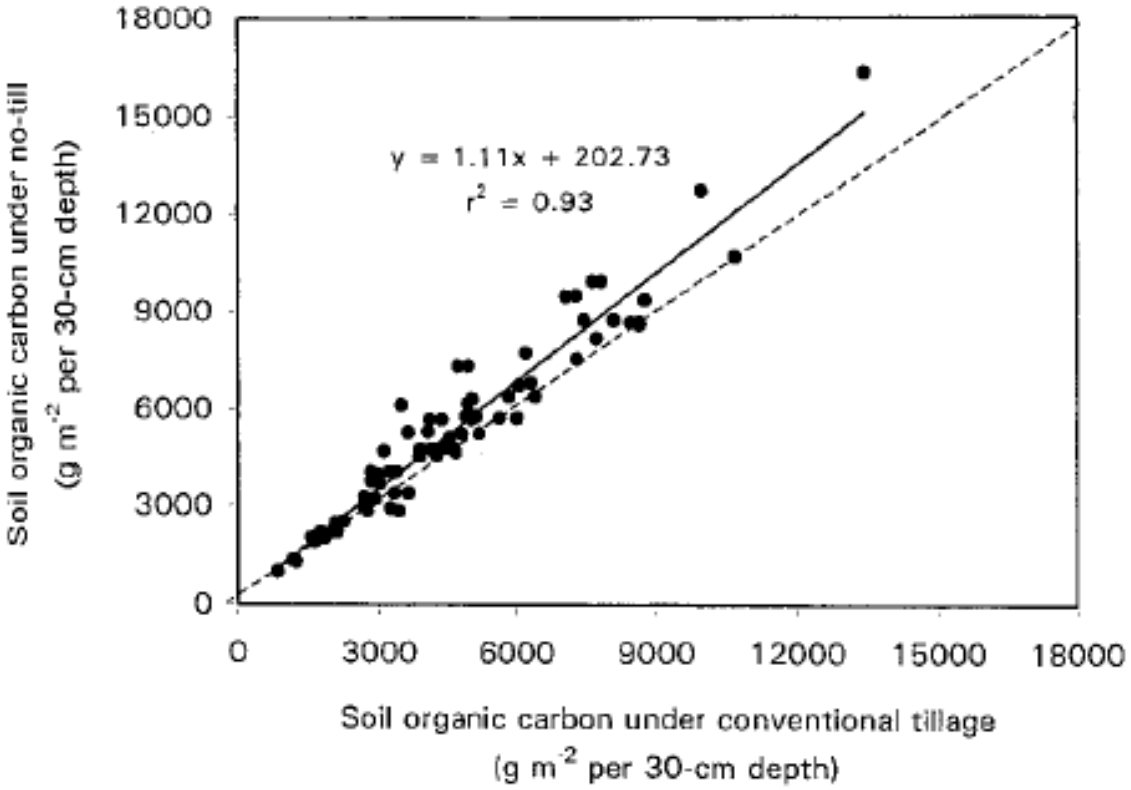
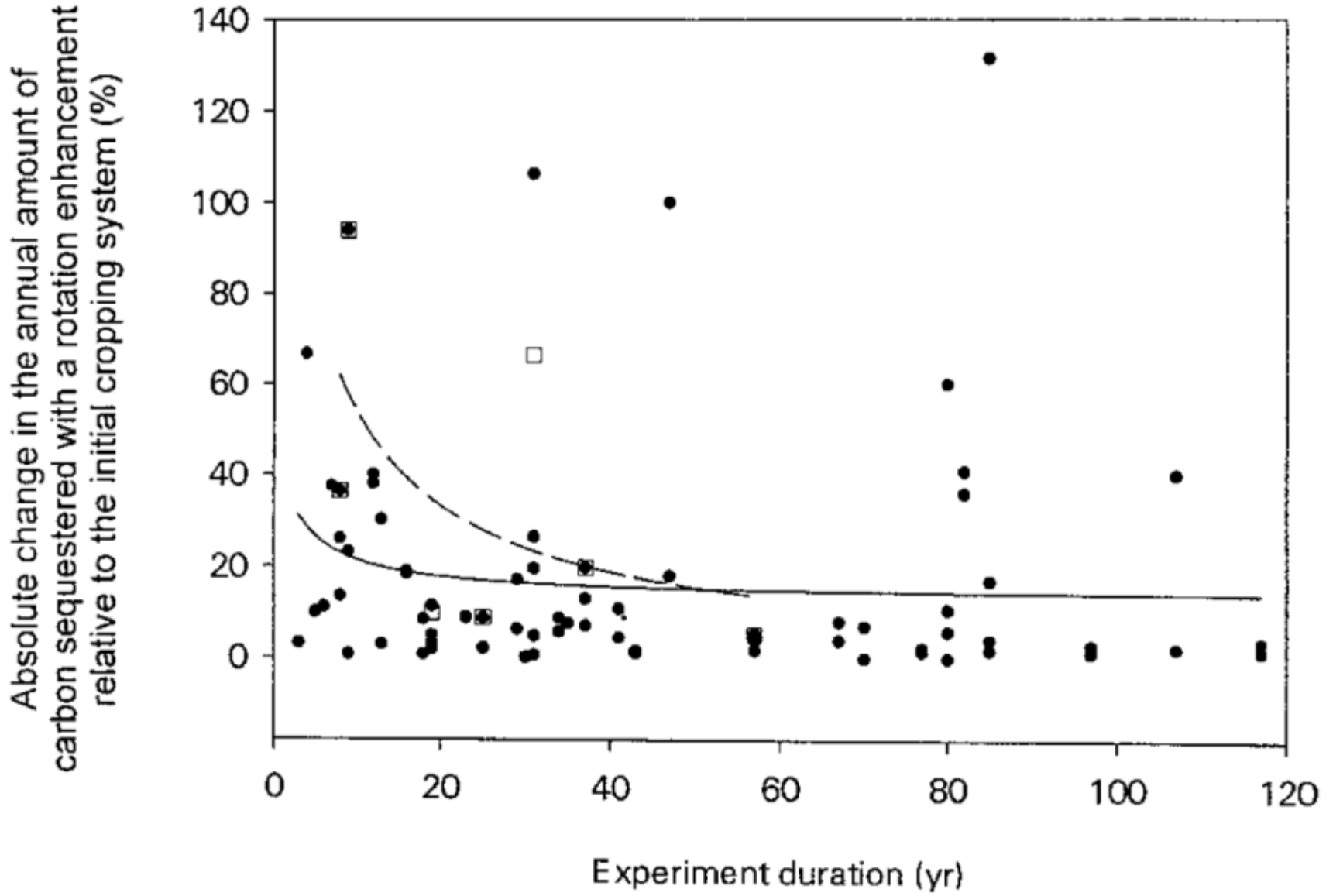


Fig. 3. Comparison of soil organic C (SOC) between conventional tillage and no-till. This analysis includes all tillage experiments except those involving wheat-fallow rotation systems (see text for explanation). Dashed line indicates 1:1 relationship.

West and Post, 2002

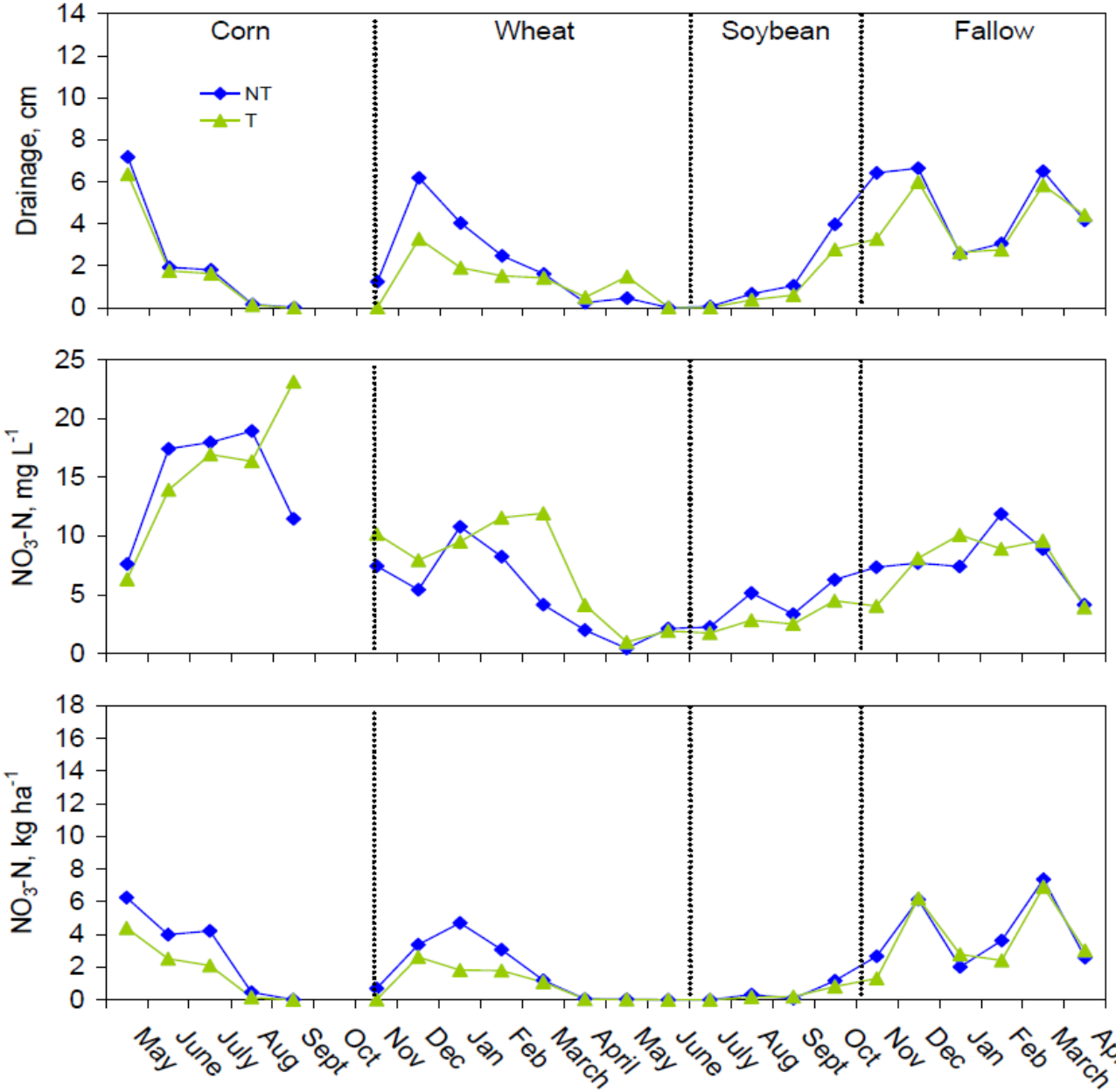
Soil C and Cover Crops



West and Post, 2002

- Cover crops offer the best opportunity to "intensify" our current row crop rotations
- Increase soil organic matter
- Retain and cycle nutrients
- Retain water
- Manage pests?

Altavsita silt loam



Average monthly drainage, NO_3-N concentration and mass lost with no-till or rotational tillage management through the two year crop rotation (2006-2009).

Drainage

- Most of the drainage occurred during periods of low evapotransporation under wheat and fallow crop phases

Concentration NO_3-N

- Concentration of NO_3-N was significantly higher under corn relative to other phases of the rotation

Leaching losses of NO_3-N

- Leaching losses were driven, in large part, by drainage
- Most of the NO_3-N losses occurred during periods of low evapotranspiration

J.T. Spargo, C.H. Sequeira, J.V. Wallace and M.M. Alley (unpublished data)

Figure 7 - Volume of water leached per month through soils under different crops from January 2005 to July 2010. Means with the same latter are not significantly different by F-test (*P* = 0.05).

Water

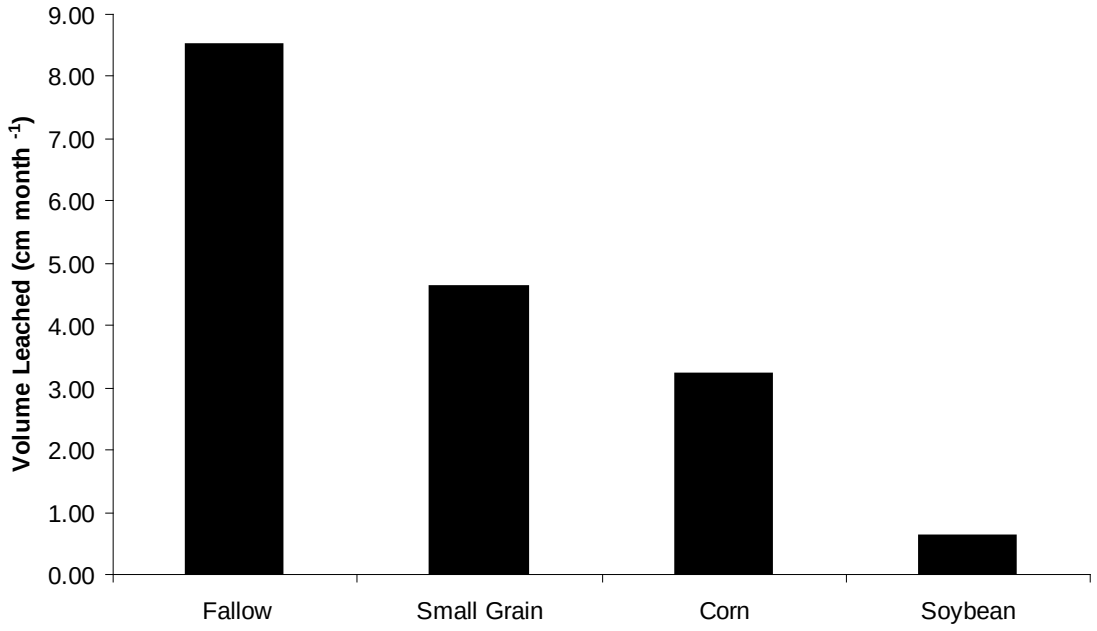
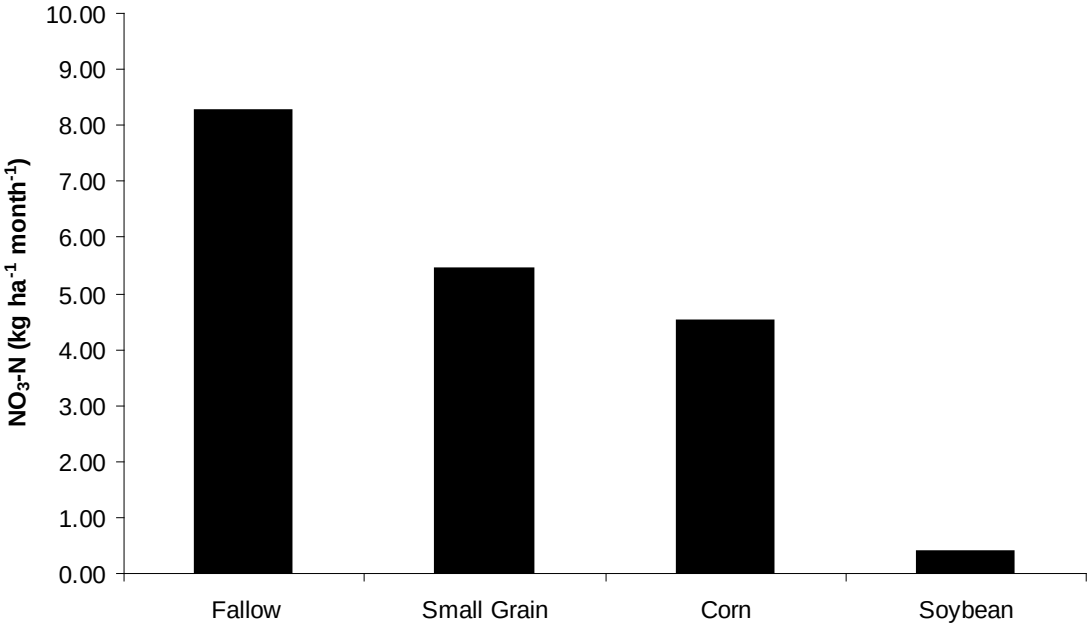
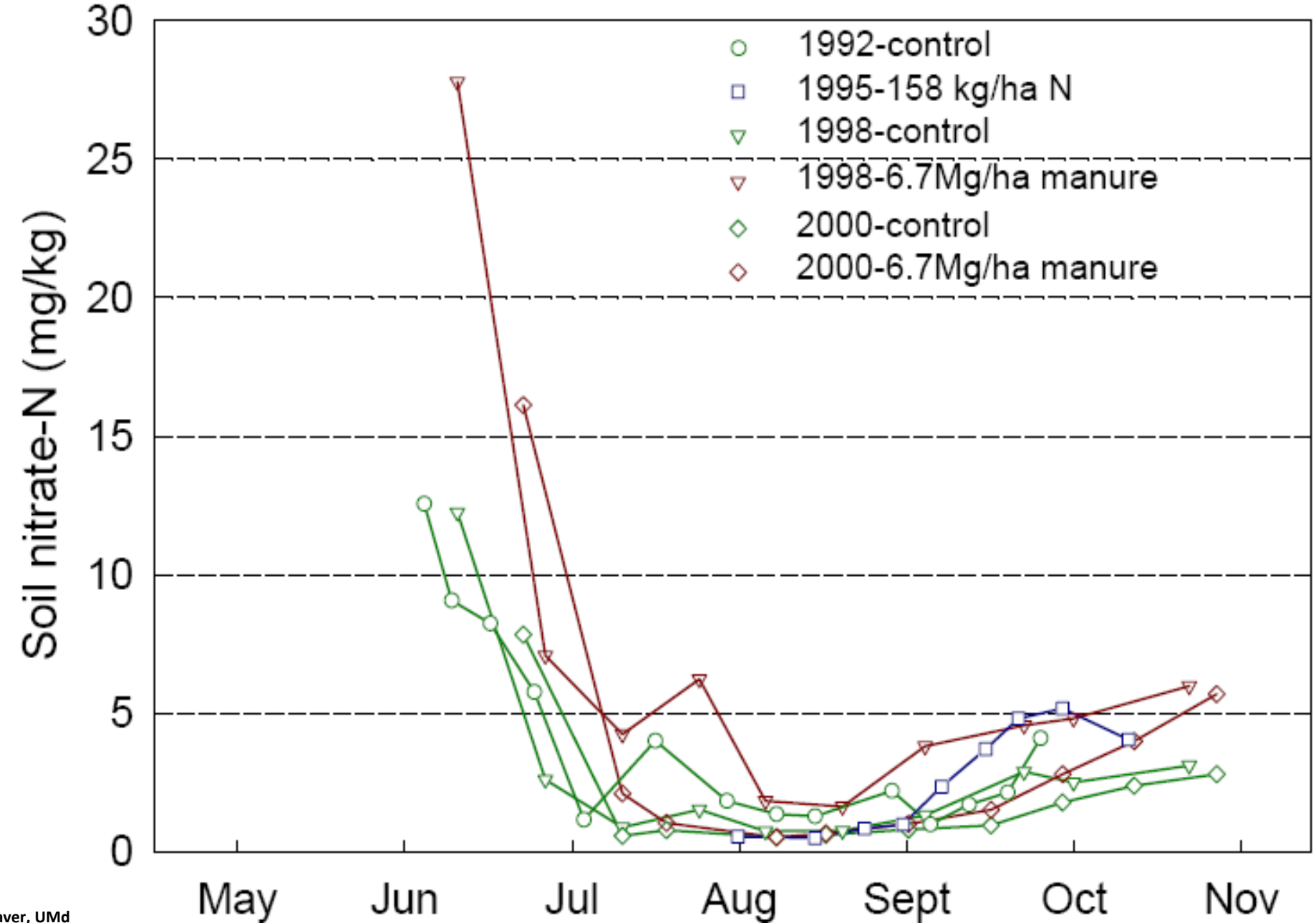


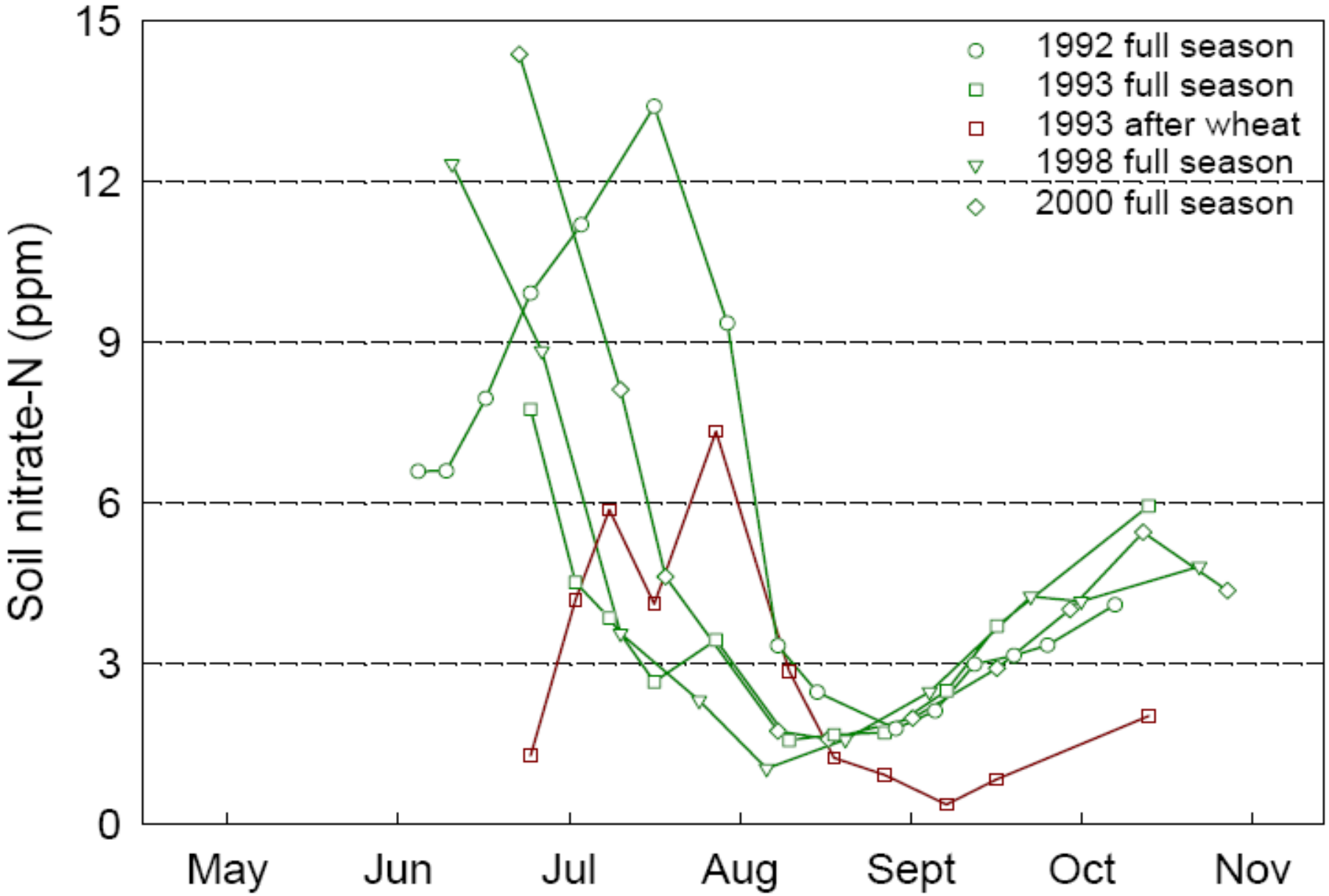
Figure 13 - Amount of NO_3-N leached per hectare per month through till and no-till systems under different crops from November 2005 to July 2010. Means with the same latter are not significantly different by F-test (P = 0.05).

Nitrate



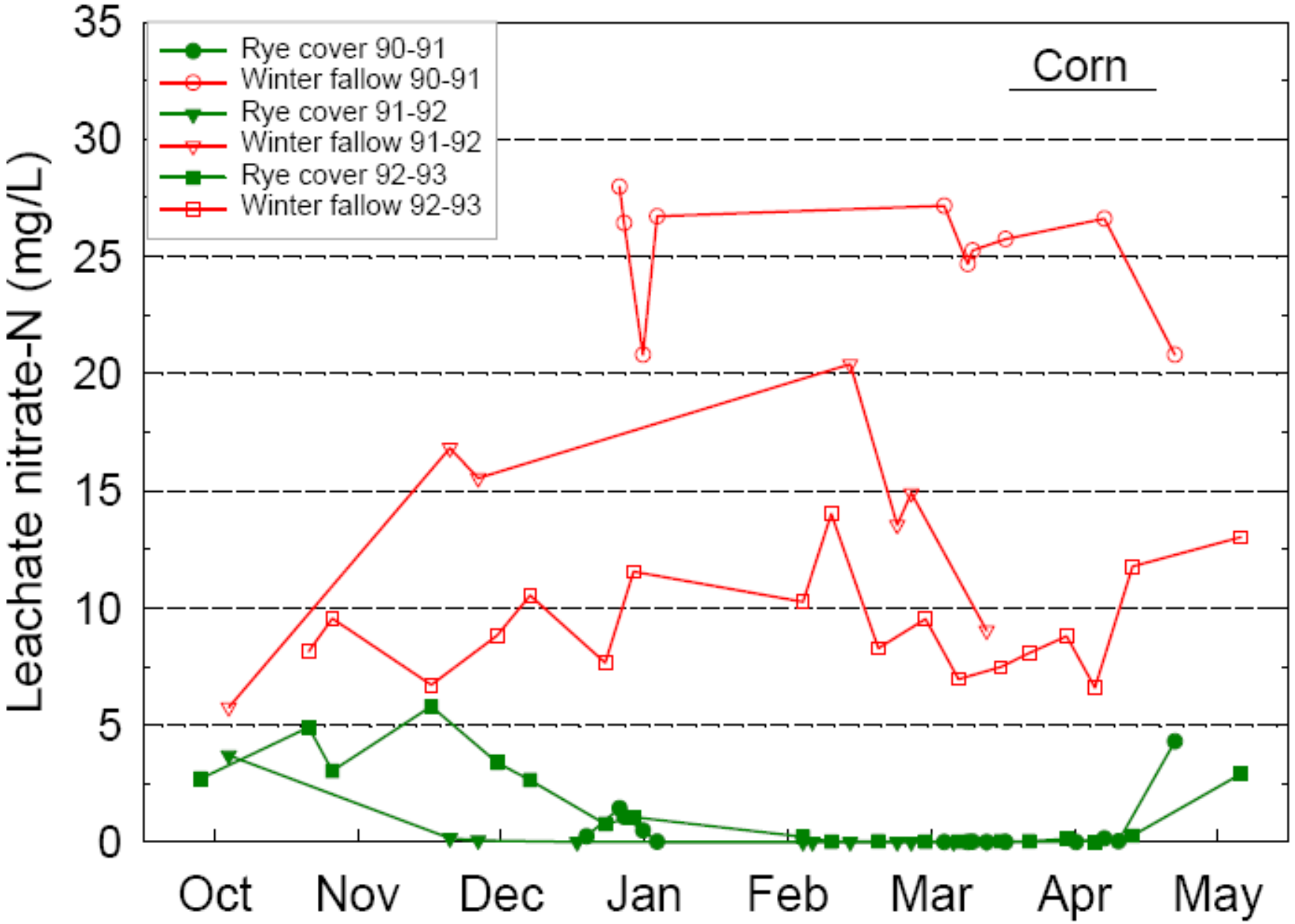

30
25
20
15
10
5
0
Soil nitrate-N (mg/kg)
1992-control
1995-158 kg/ha N
1998-control
1998-6.7Mg/ha manure
2000-control
2000-6.7Mg/ha manure
May
Jun
Jul
Aug
Sept
Oct
Nov

K. Staver, UMd

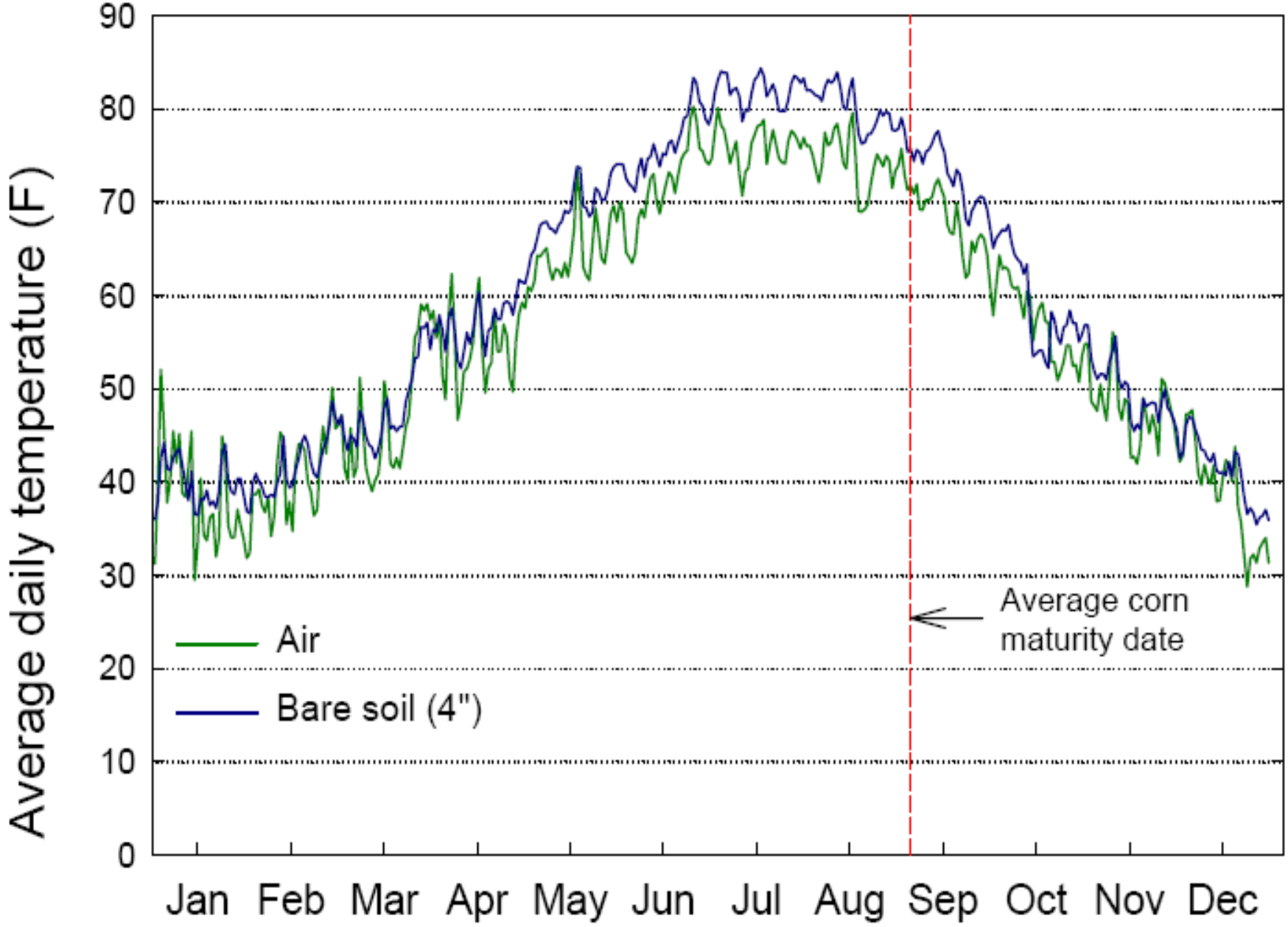

15
12
9
6
3
0
Soil nitrate-N (ppm)
May
Jun
Jul
Aug
Sept
Oct
Nov
1992 full season
1993 full season
1993 after wheat
1998 full season
2000 full season

K. Staver, UMd

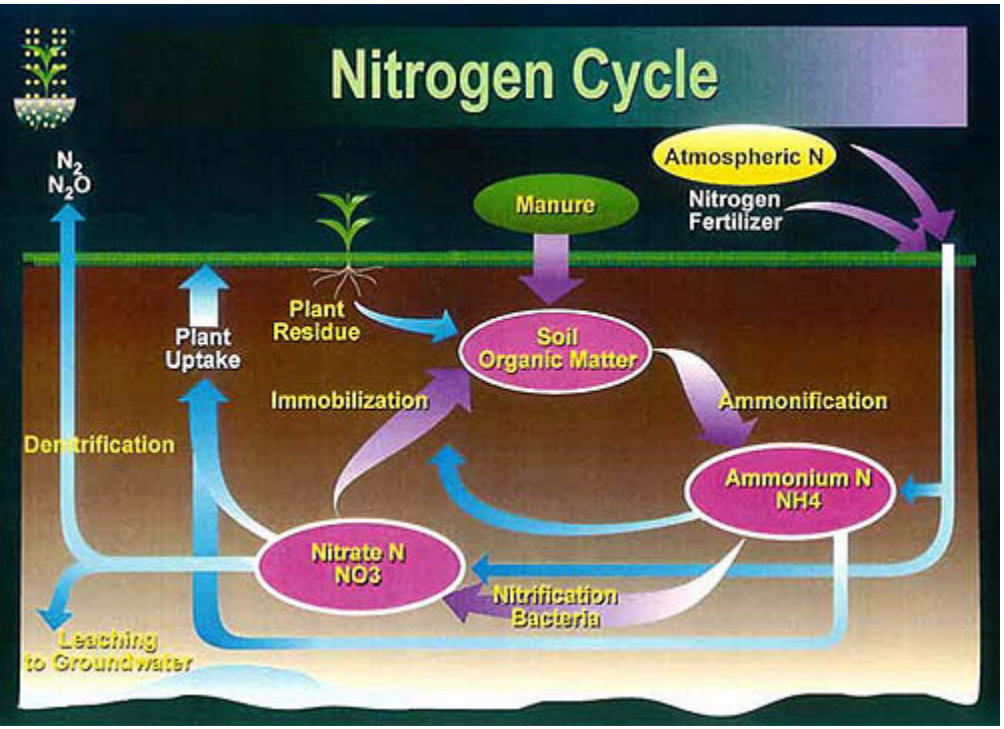
Maryland Research



K. Staver, UMd


Average daily temperature (F)
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Air
Bare soil (4")
Average corn
maturity date

What is a “CYCLE”



a course or series of events or operations that recur regularly and usually lead back to the starting point

Which cover crop(s)?

Table 8. Average Values for Cover Crop Biomass, N Content, and C/N Ratio.

Cover Crop	Biomass	N Content	C/N ratio	Observations
	--Mg/ha--	--kg N/ha--		
Hairy Vetch	4.0	151	12	15
Crimson Clover	4.8	129	16	12
Austrian Winter Pea	3.5	127	12	6
Bigflower Vetch	3.1	101	14	4
Rye	4.7	52	43	9
Wheat	2.6	42	26	5
Rye+Hairy Vetch	8.3	157	23	2

Vaughan, 1994

Which cover crop(s)?

- Scavenge N / Reduce Leaching
- Fix N For the Following Crop
- Suppress Weeds
- Break Pest or Disease Cycles
- Cover Soil / Prevent Erosion
- Reduce Compaction / Improve Soil Structure
- Water Management
- Forage

Species Demonstrations

- Early Cover Hairy Vetch
- Common Vetch
- Wooly pod vetch (Lana)
- Crimson Clover
- Austrian Winter Peas

- Sweet Lupins
- Tillage Radish
- Phacelia

- Rye
- Barley
- Ryegrass
- Spring oats

- Barley+Crimson+tillage radish
- Rye+Vetch+Pea+tillage radish
- Rye+ryegrass+tillage radish
- Spring oats+canola
- Spring oat+tillage radish
- Spring oat + barley
- Barley+Crimson+Woolly Pod Vetch+Peas +tillage radish+canola
- Ryegrass+Crimson+Woolly Pod Vetch+Peas +tillage radish+canola


barley
115


Early Cover Hairy
Vetch
112


Tillage Radish

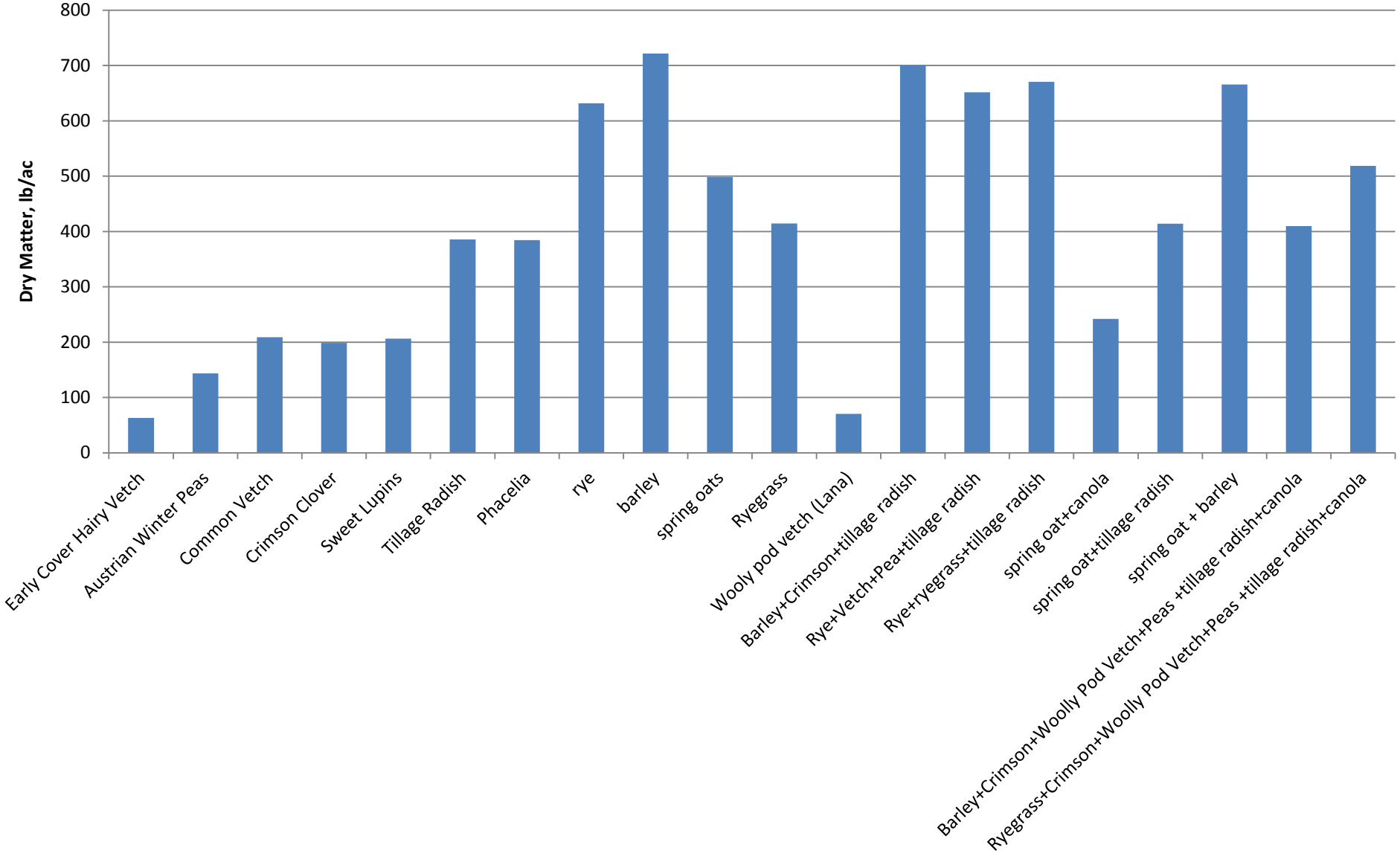

Ryegrass
111


Crimson
Clover
104


Spring oat +
canola


Phacelia
122

Fall / December

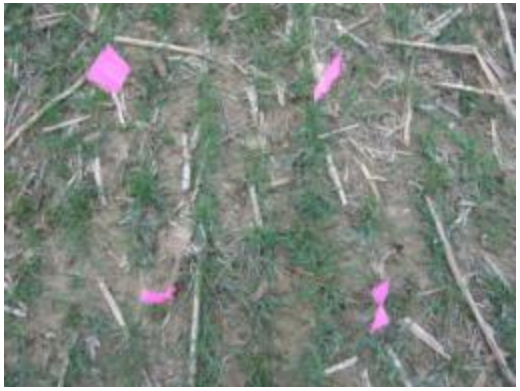


Rye Biomass

199 lb/ac

390 lb/ac

796 lb/ac

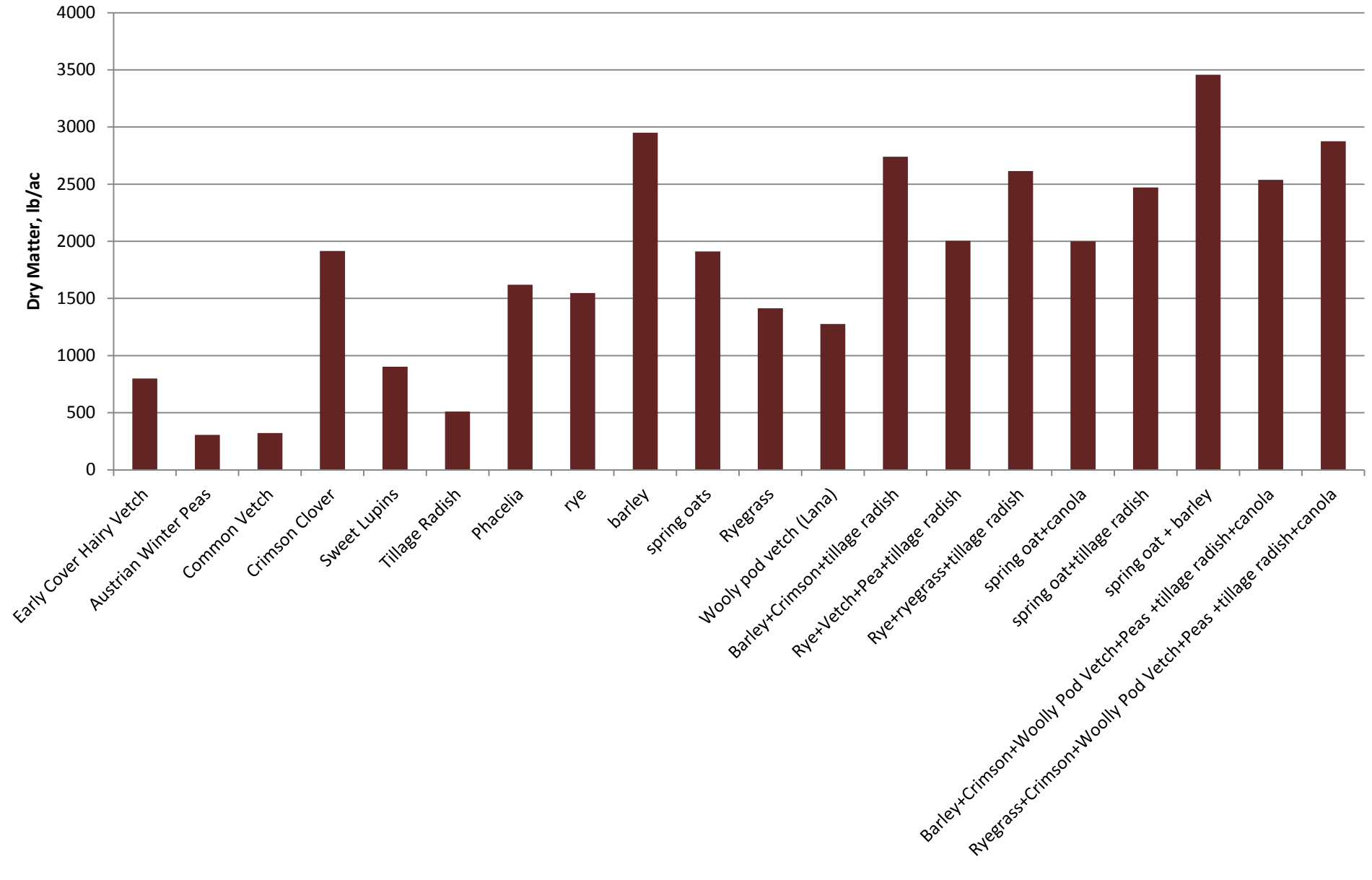


1100 lb/ac

2100 lb/ac

3490 lb/ac

March


Dry Matter, lb/ac
4000
3500
3000
2500
2000
1500
1000
500
0
Early Cover Hairy Vetch
Austrian Winter Peas
Common Vetch
Crimson Clover
Sweet Lupins
Tillage Radish
Phacelia
rye
barley
spring oats
Ryegrass
Wooly pod vetch (Lana)
Barley+Crimson+tillage radish
Rye+Vetch+Pea+tillage radish
Rye+ryegrass+tillage radish
spring oat+canola
spring oat+tillage radish
spring oat + barley
Barley+Crimson+Woolly Pod Vetch+Peas +tillage radish+canola
Ryegrass+Crimson+Woolly Pod Vetch+Peas +tillage radish+canola

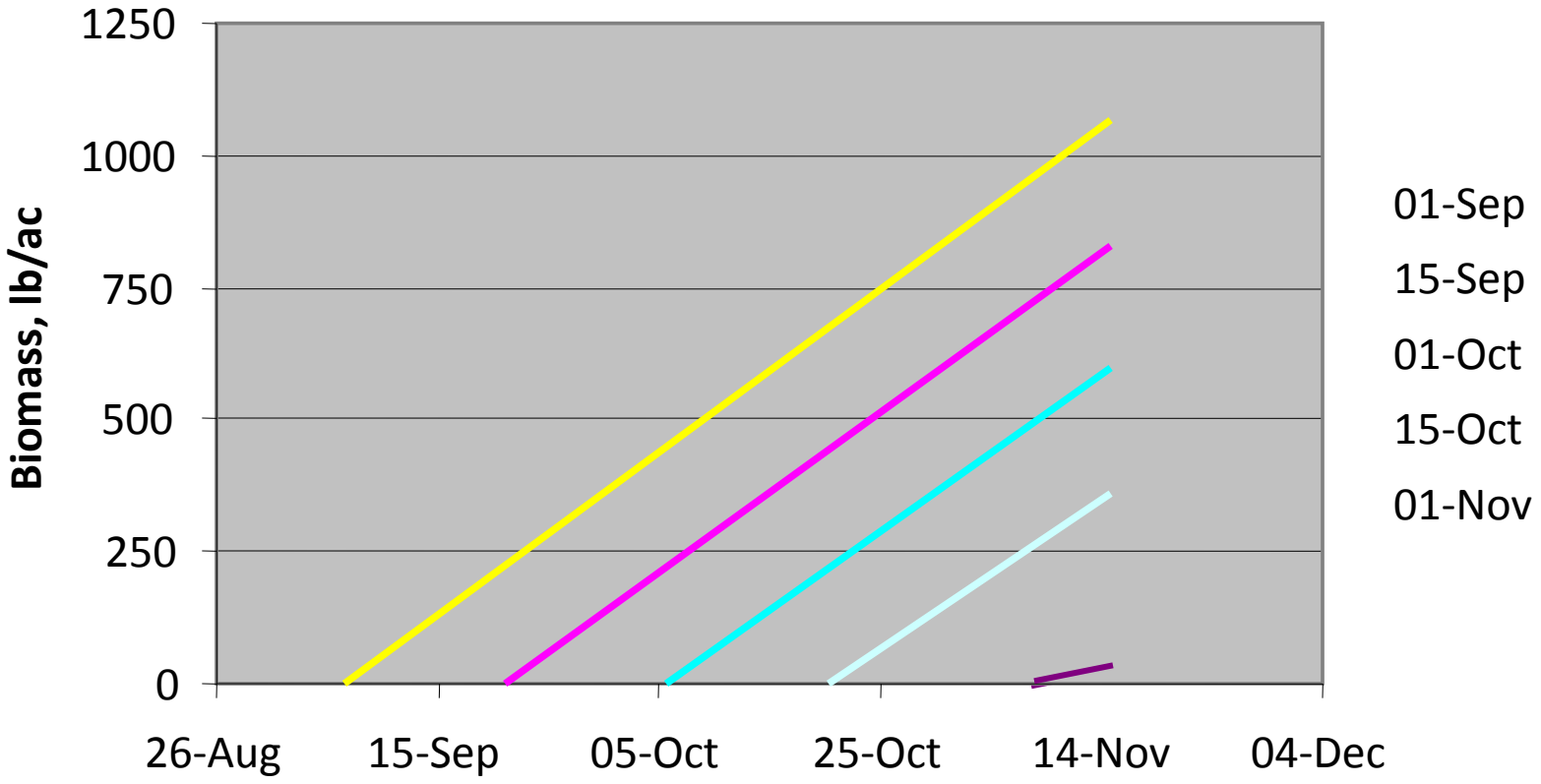
Summary

- Fall growth
  - Rye, barley, and mixtures with them
  - Radish, phacelia, and spring oats
- Spring growth
  - Rye, barley, and mixtures with them
  - Vetch and clover (depending on termination)

Summary

- Canola deserves a look
- Mixtures were surprisingly good

Planting Date Affects Fall Growth



Mar 22, 2006

Rye+Vetch Early

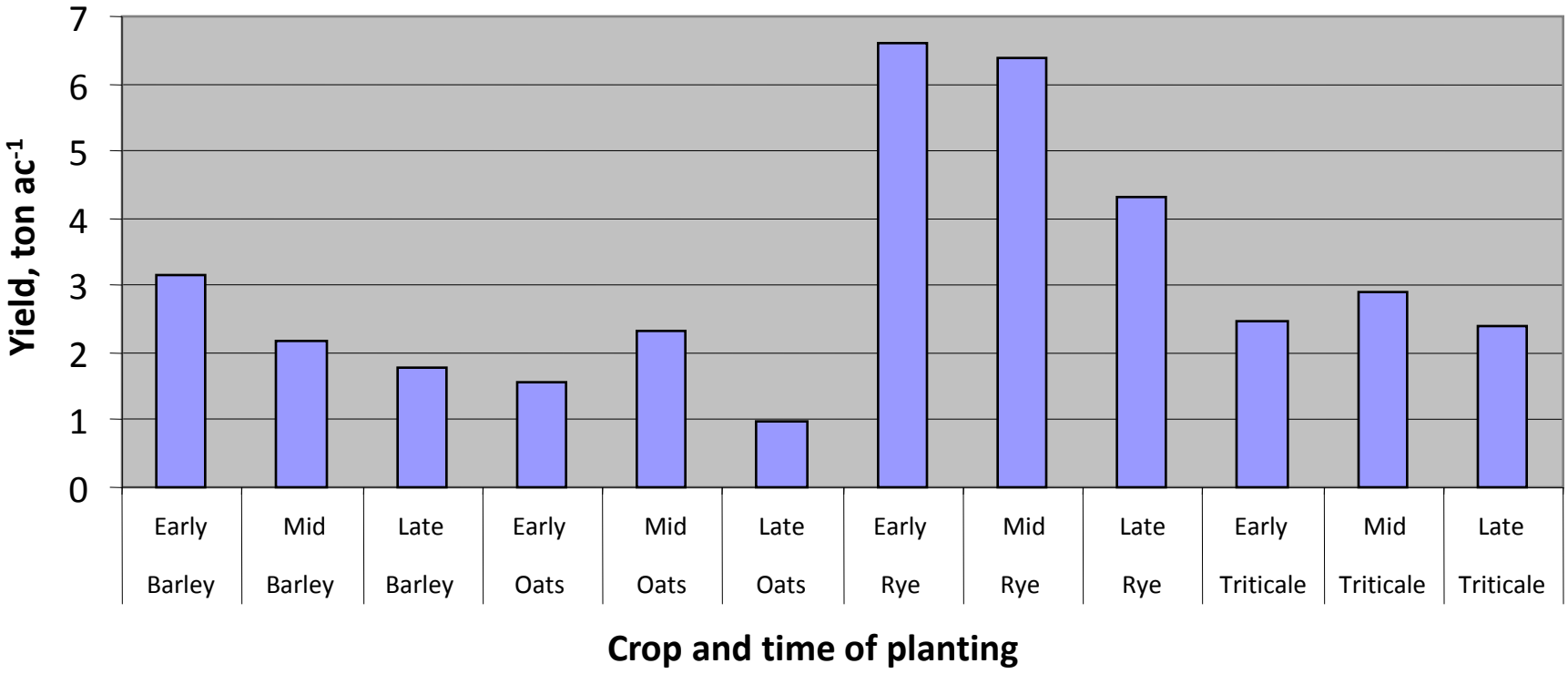
Rye+Vetch Late

Oats Late

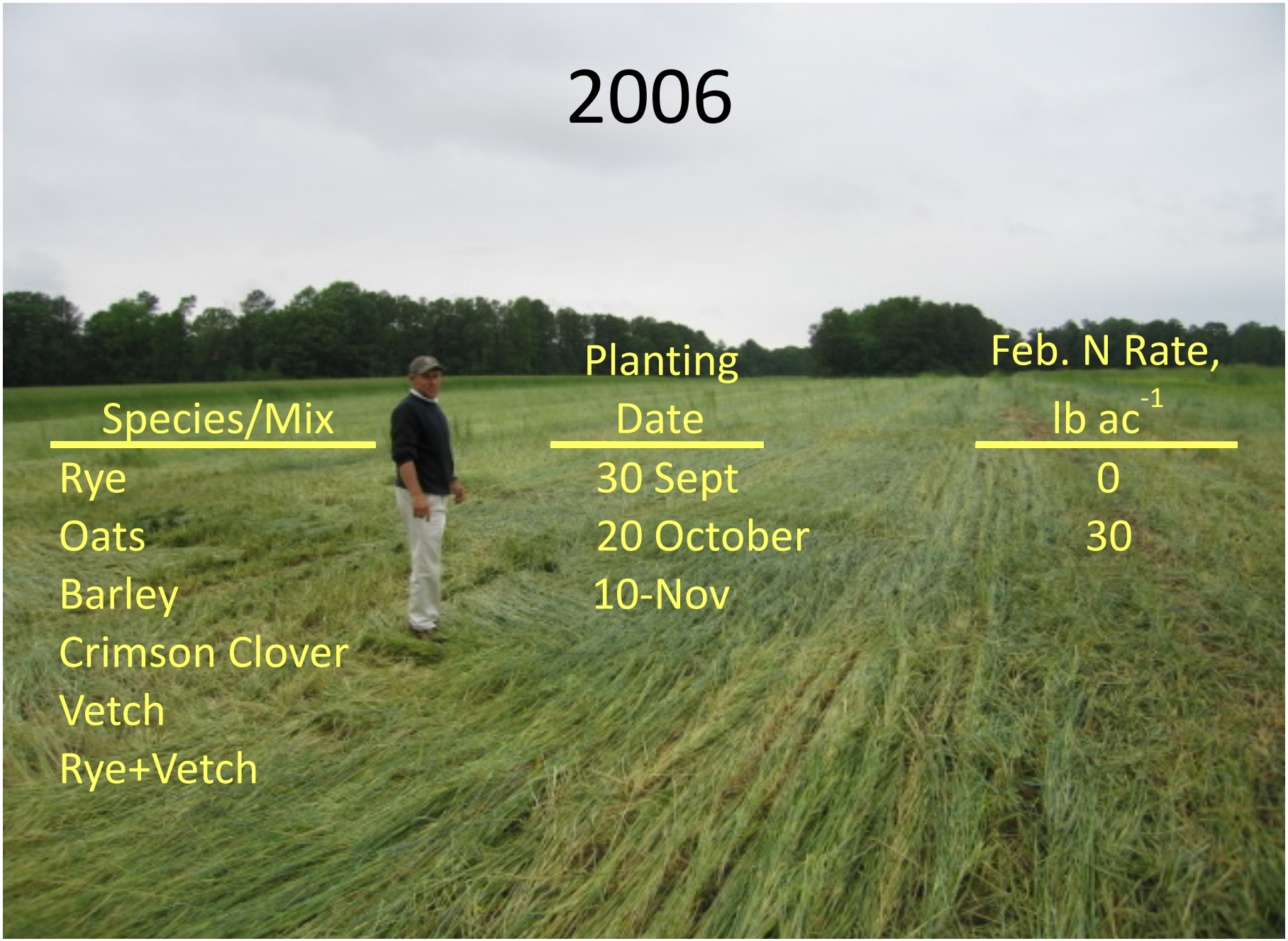
2005

Species/Mix	Planting Date	Feb. N Rate, lb ac^{-1}
Rye	4 October	0
Oats	18 October	25
Barley	10-Nov	50
Triticale		

2005

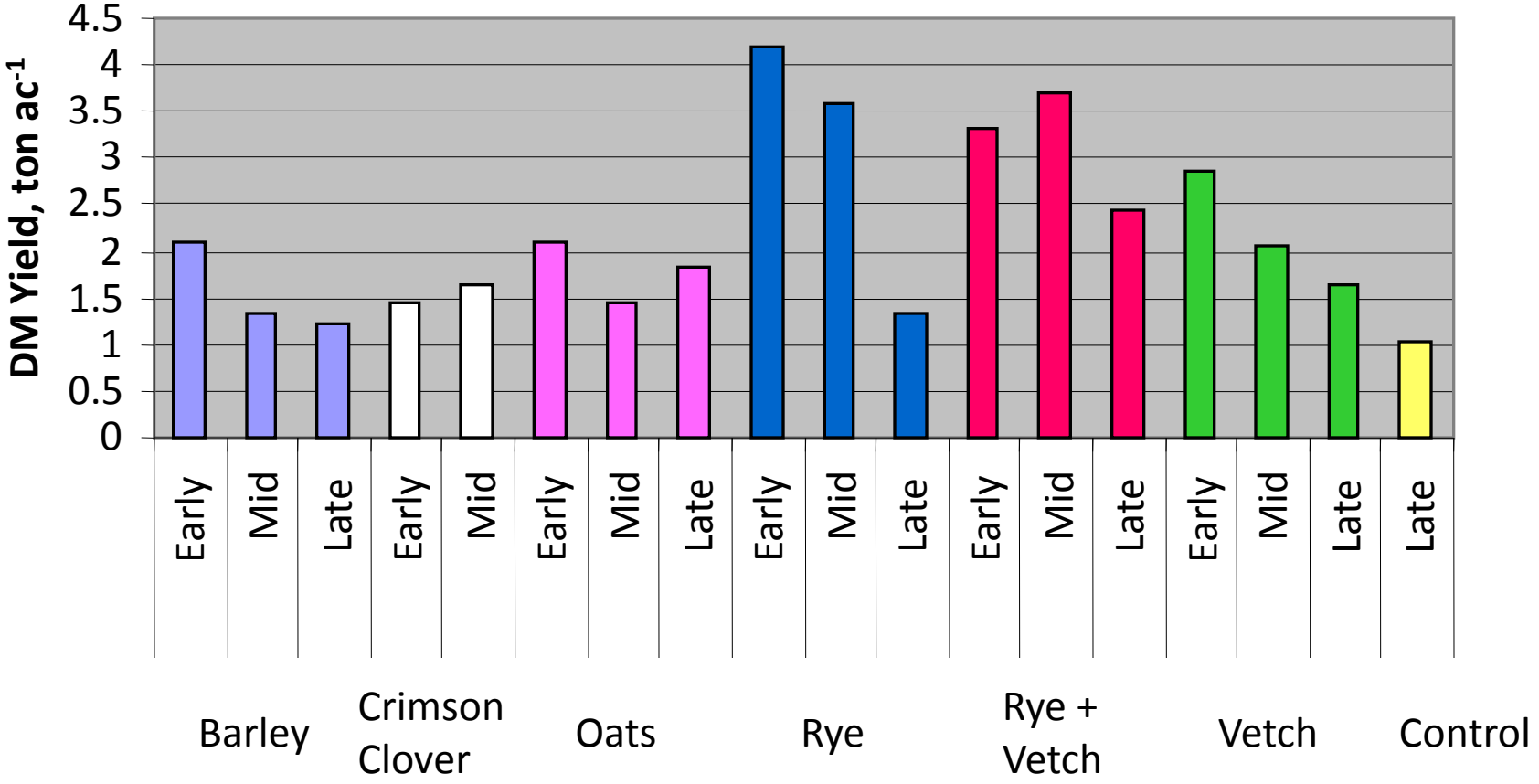

Yield, ton ac-1
0
1
2
3
4
5
6
7
Early Barley
Mid Barley
Late Barley
Early Oats
Mid Oats
Late Oats
Early Rye
Mid Rye
Late Rye
Early Triticale
Mid Triticale
Late Triticale
Crop and time of planting

2006

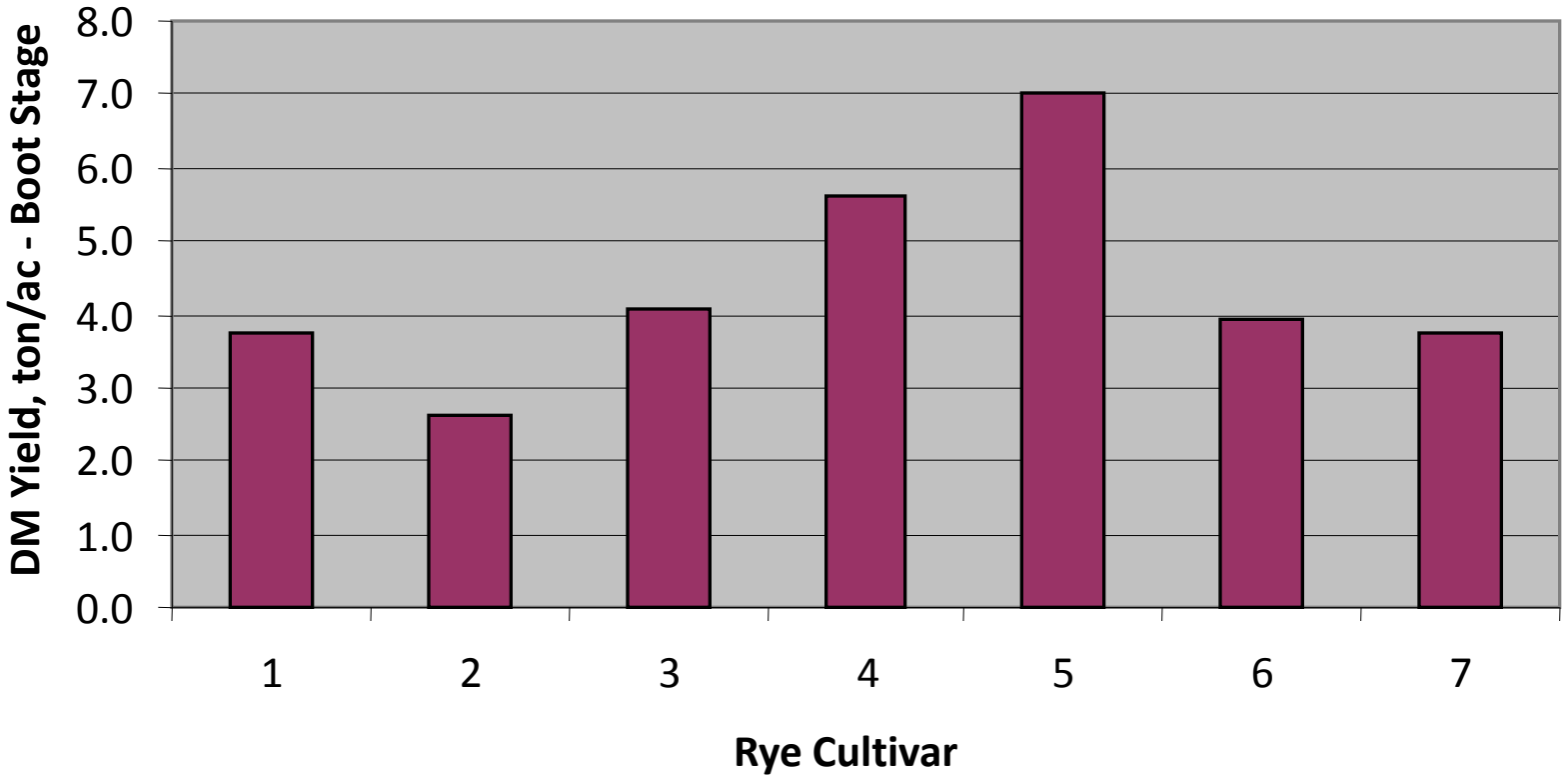


Species/Mix	Planting Date	Feb. N Rate, lb ac^{-1}
Rye	30 Sept	0
Oats	20 October	30
Barley	10-Nov	
Crimson Clover		
Vetch		
Rye+Vetch		

2006

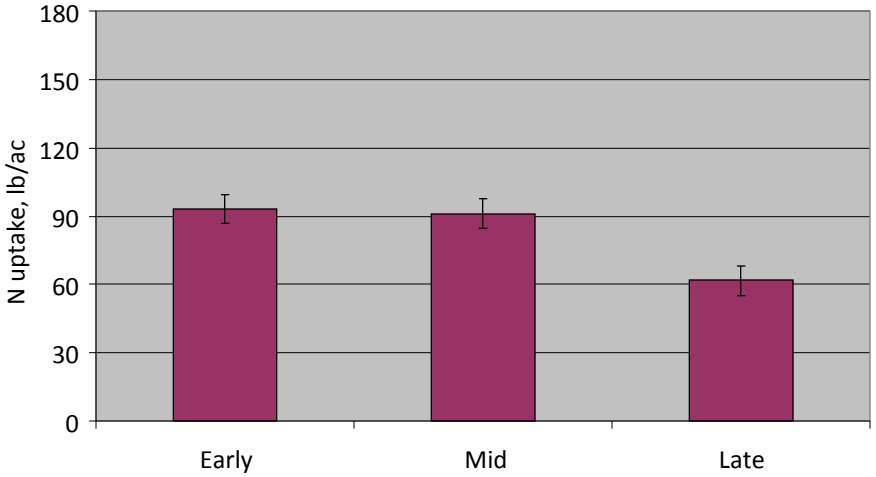

DM Yield, ton ac-1
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Early
Mid
Late
Early
Mid
Early
Mid
Late
Early
Mid
Late
Early
Mid
Late
Early
Mid
Late
Late
Barley
Crimson Clover
Oats
Rye
Rye + Vetch
Vetch
Control

Some Rye is better adapted

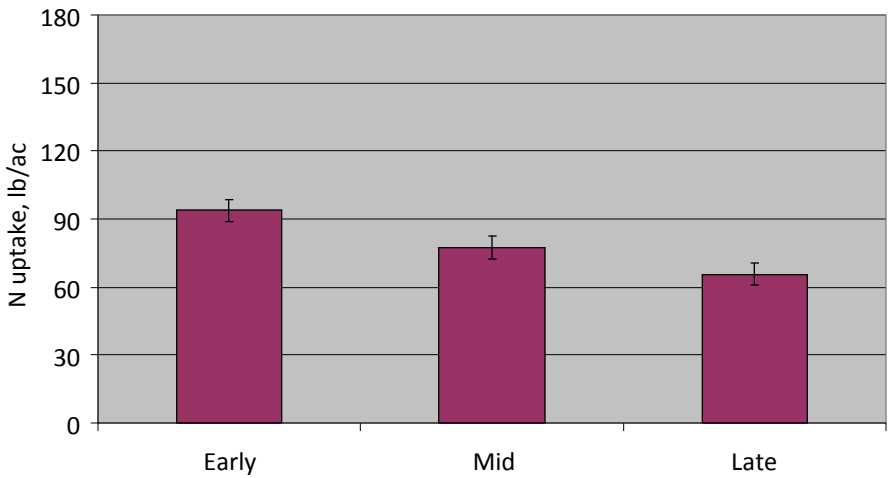


Nitrogen Uptake

- 2005

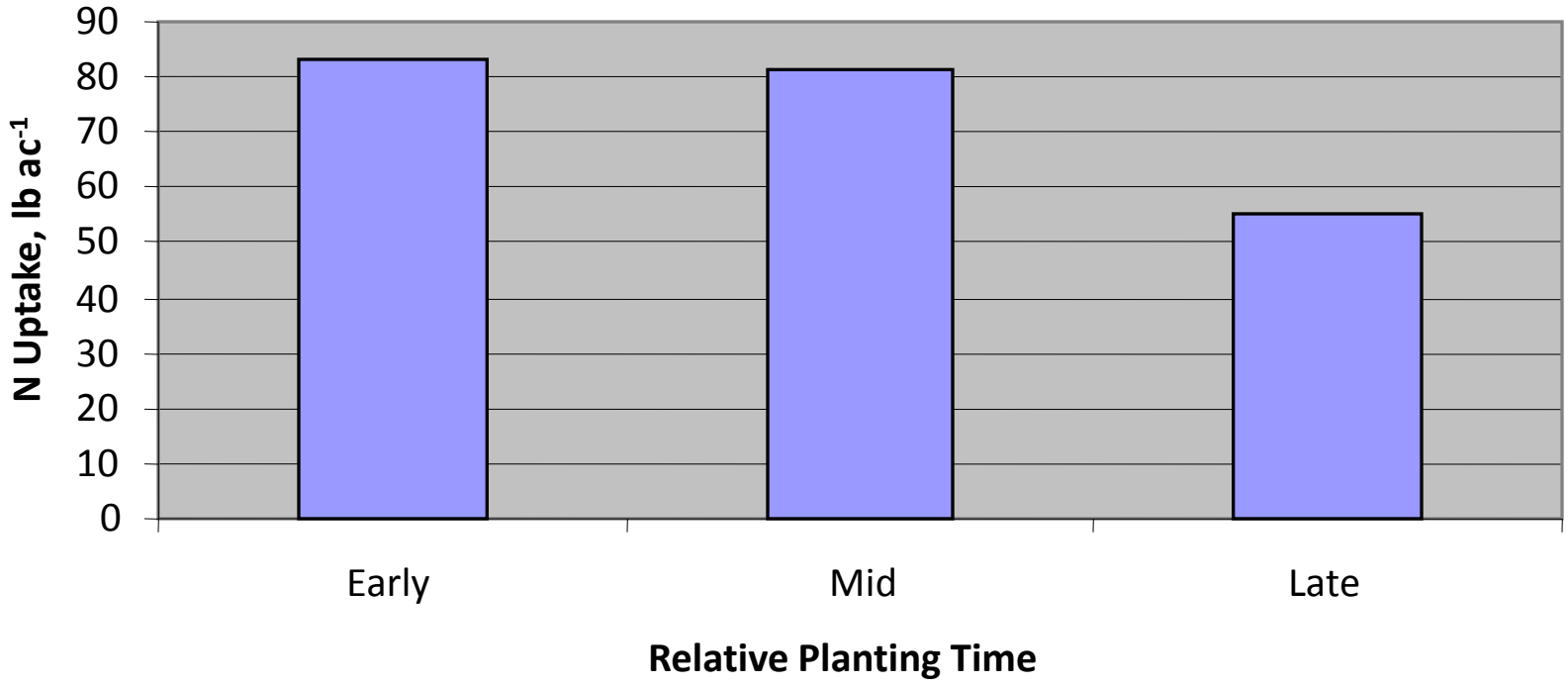


- 2006

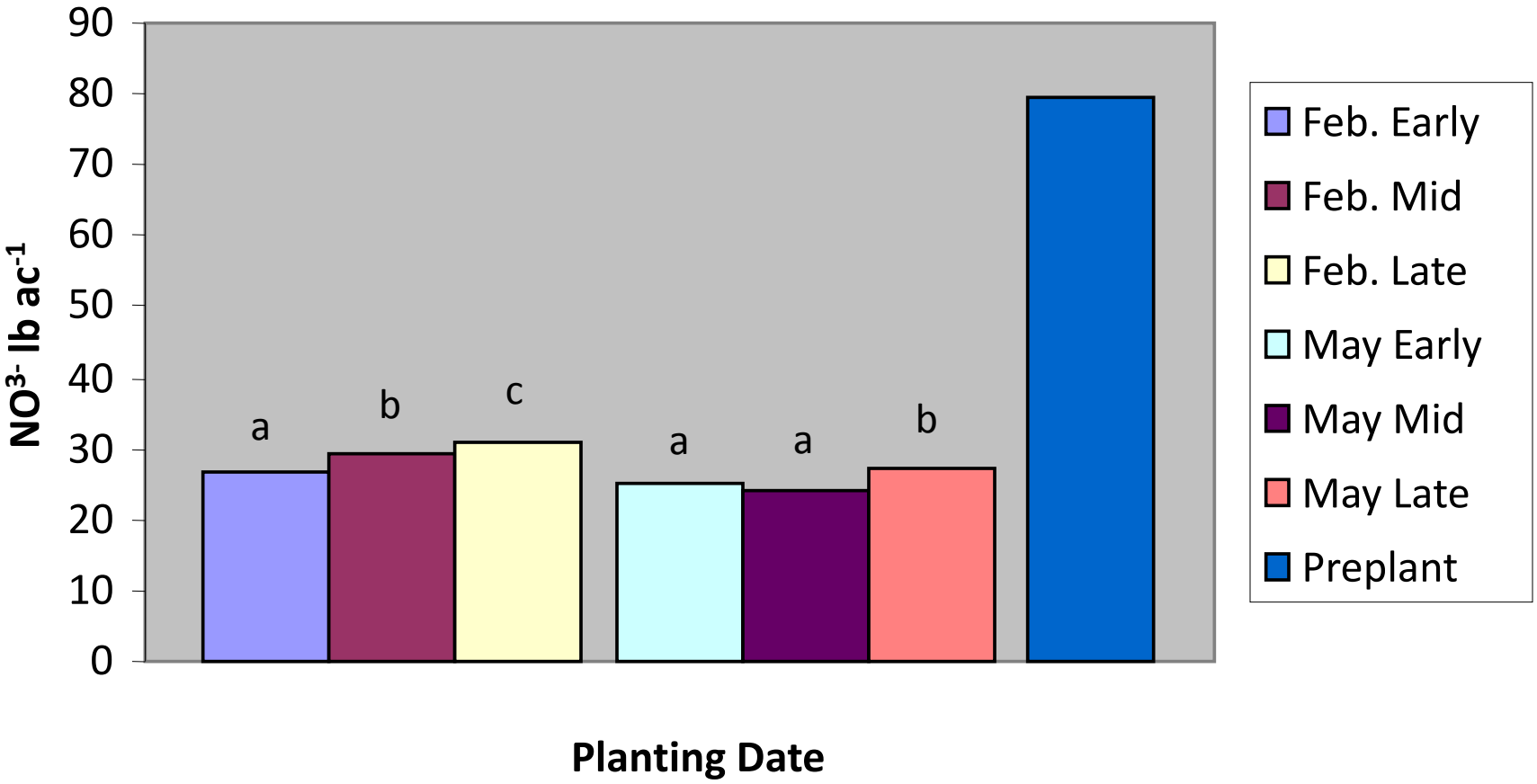


2005

Uptake potential is reduced with delayed planting!!!

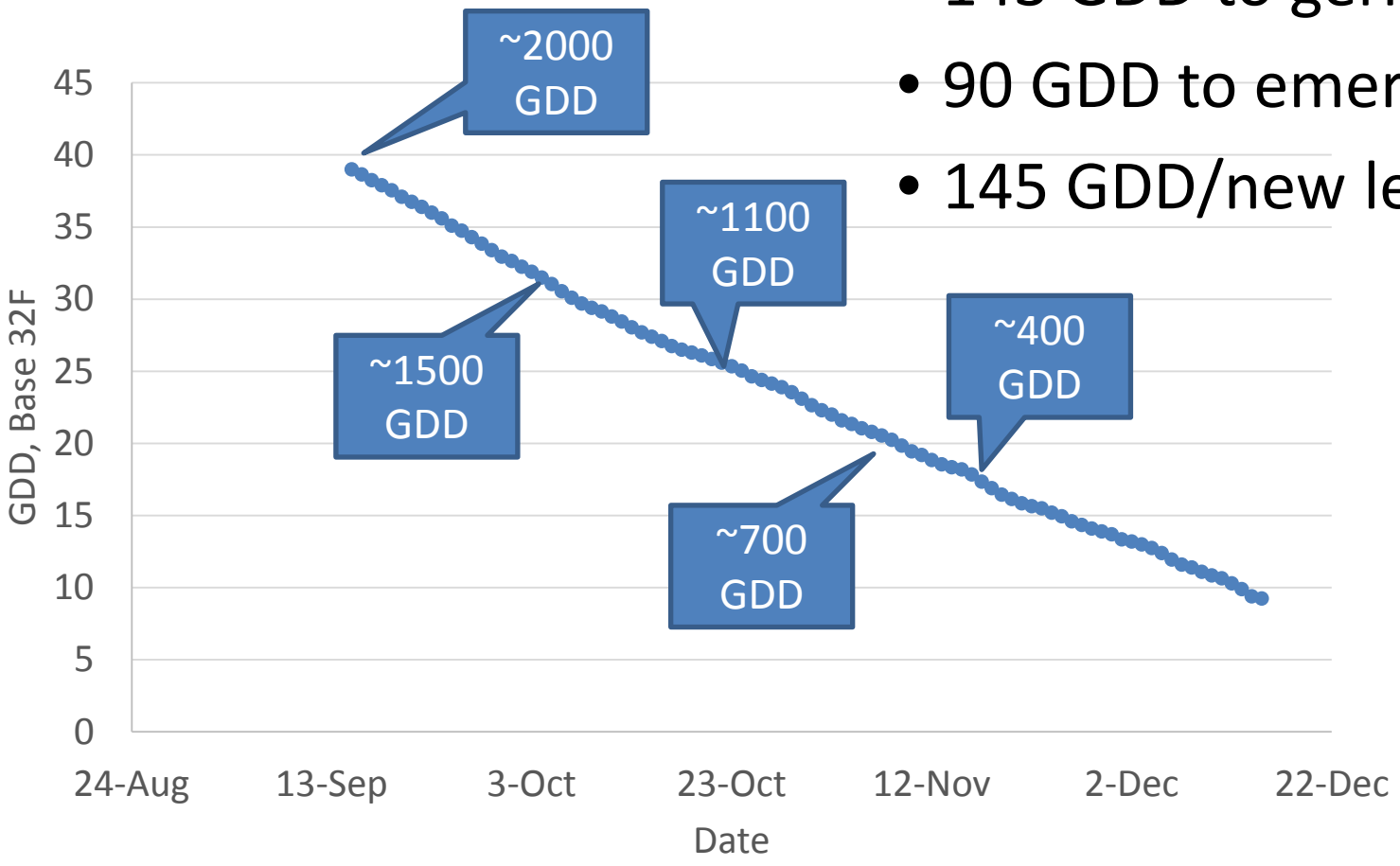


2006 Soil Nitrate

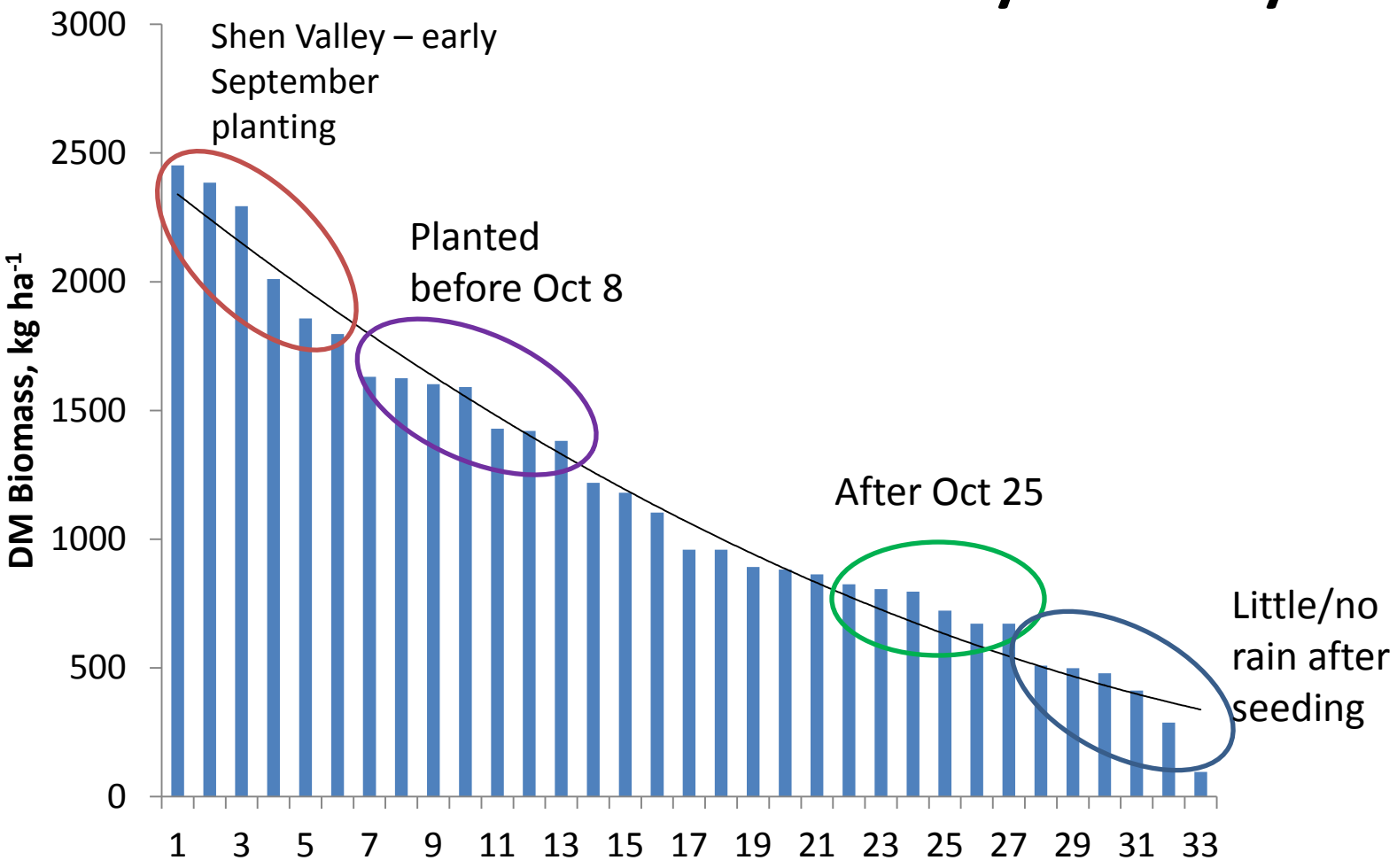


Very Early Planting – to Dec 15

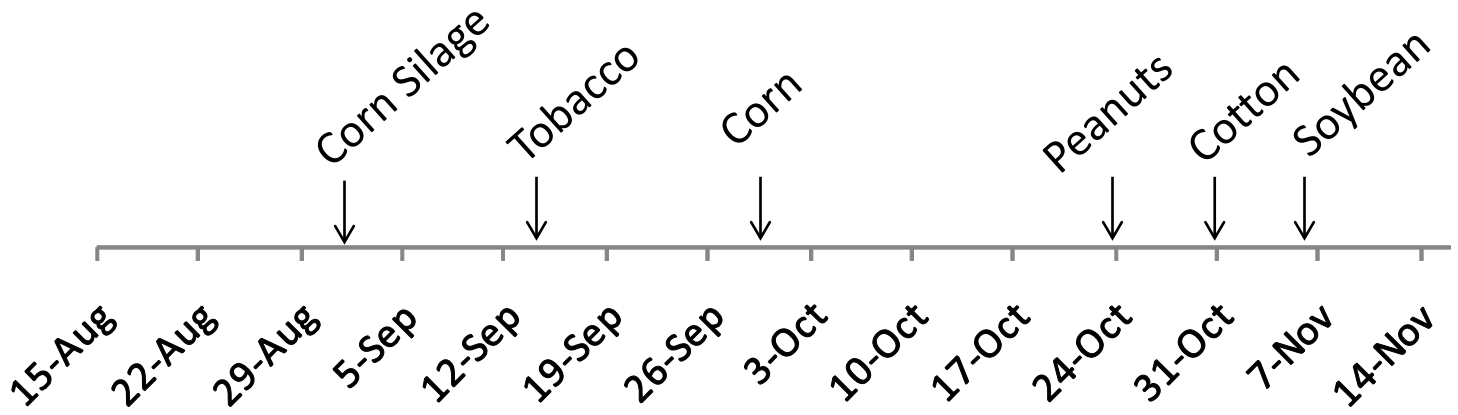
- 143 GDD to germinate
- 90 GDD to emerge
- 145 GDD/new leaf

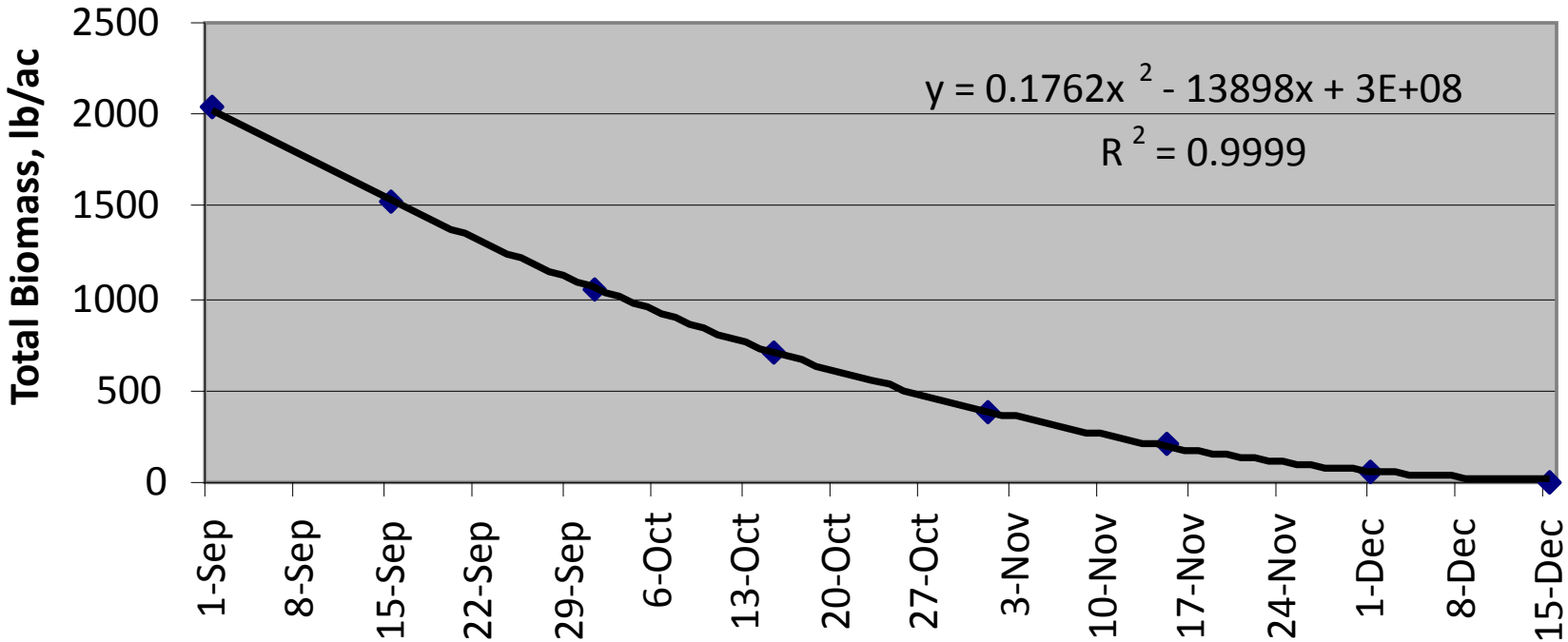


Rye Only

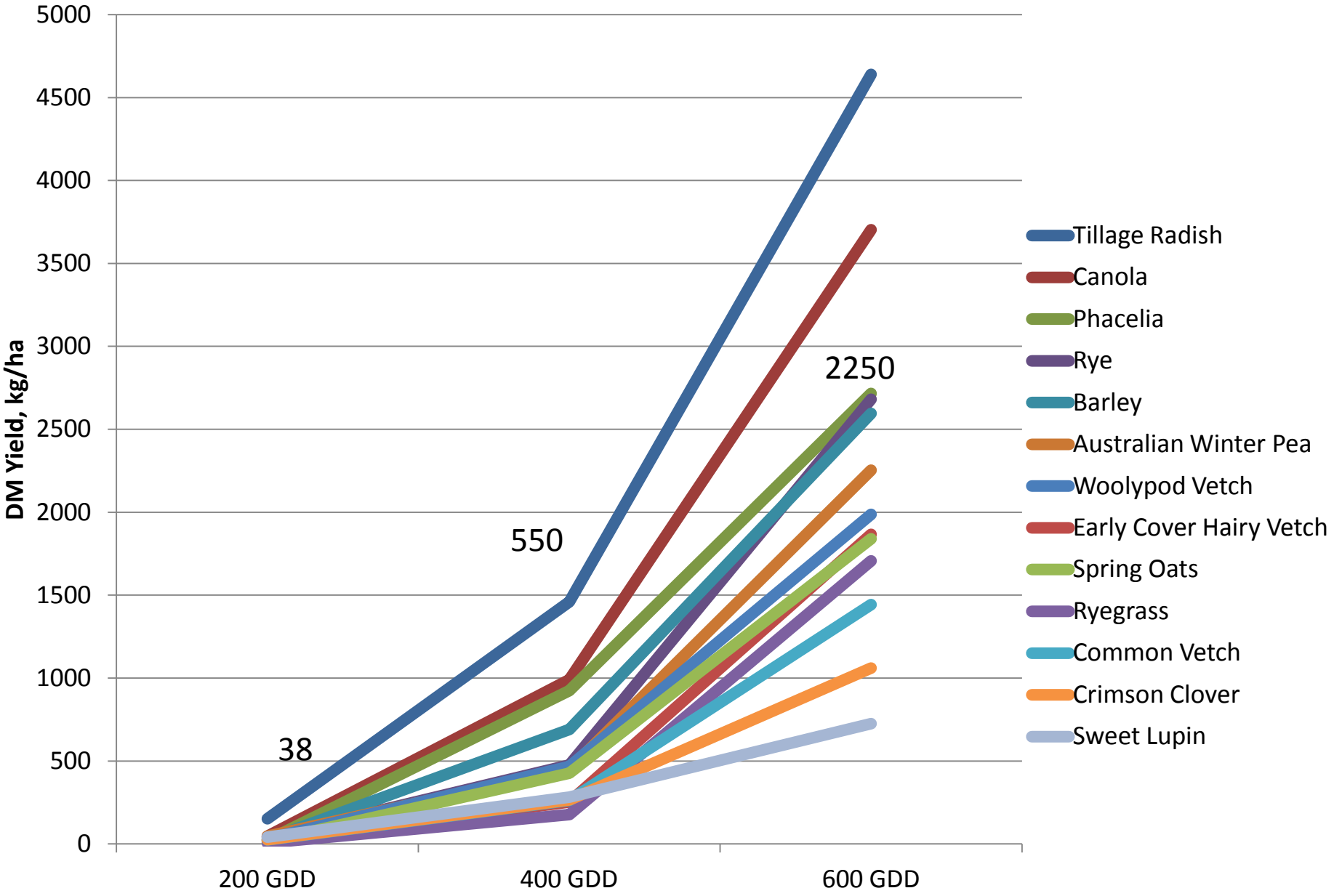

Shen Valley – early September planting
Planted before Oct 8
After Oct 25
Little/no rain after seeding
DM Biomass, kg ha-1
3000
2500
2000
1500
1000
500
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33

Various Crops – 50% Harvested, VASS





Growth Response to Temperature

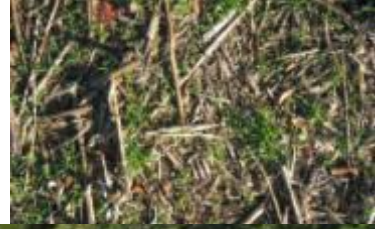


Seeding Methods

- We basically looked at everything with an emphasis on aerial and broadcast seeding methods

2009 Plots

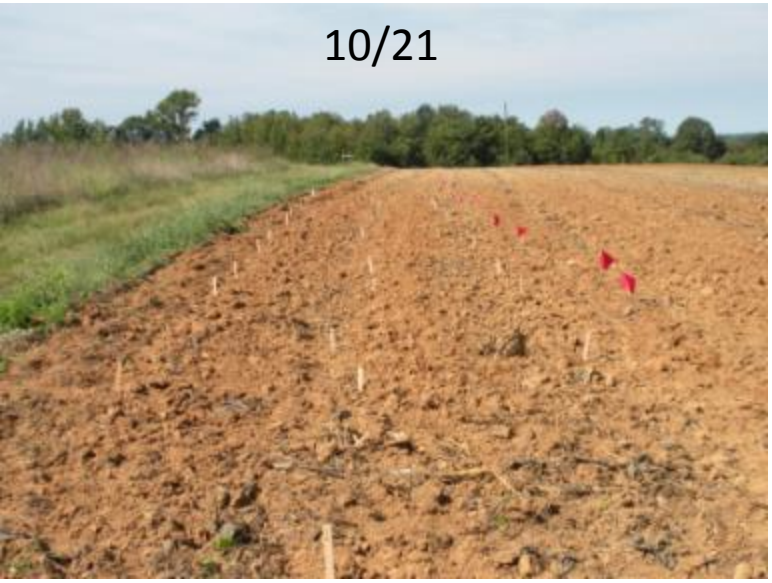
Cover Crop	Rate
Rye (assumes 56 lb/bu)	3 bu/ac
Barley (assumes 48 lb/bu)	3 bu/ac
Crimson Clover	20 lb/ac
Vetch	20 lb/ac
Rye+Crimson Clover	2 bu + 10 lb/ac
Rye+Vetch	2 bu + 10 lb/ac



Site	Seeding Date	Previous Crop	Conditions
Halifax	21-Oct	Corn	Tilled
Middlesex	1-Oct	Soybean	Before leaf drop
Greensville	28-Oct	Soybean	After leaf drop
Prince George	14-Oct	Soybean	30% leaf drop
Essex	2-Oct	Corn, 160 bu/ac	Stalks bushogged
Northumberland	6-Oct	Soybean	Before leaf drop

Seeding Date	Previous Crop	Conditions
21-Oct	Corn	Tilled

Halifax

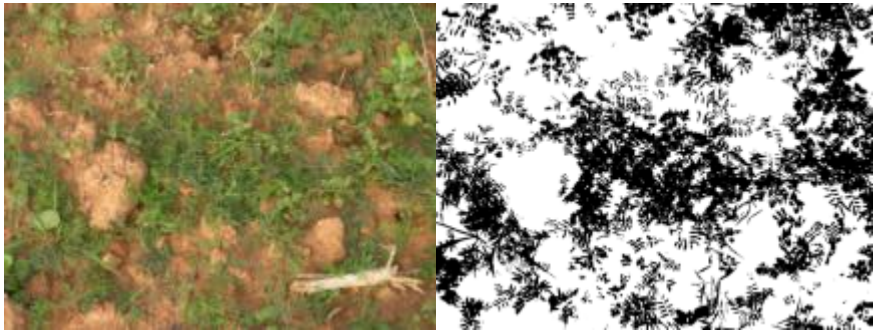


Seeding Date	Previous Crop	Conditions
21-Oct	Corn	Tilled

Halifax, 11/18

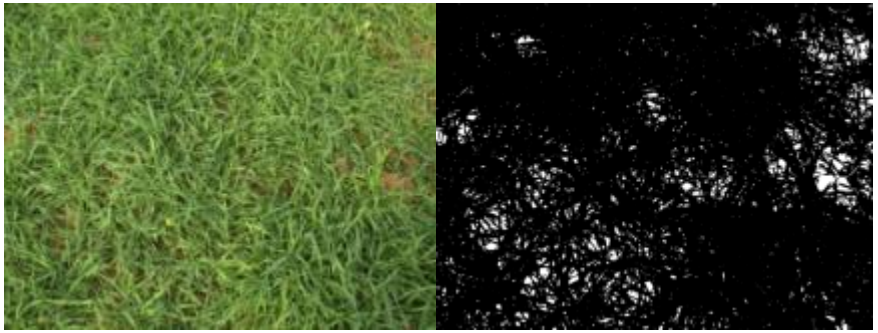
Rye, 97.5%

Vetch, 36%

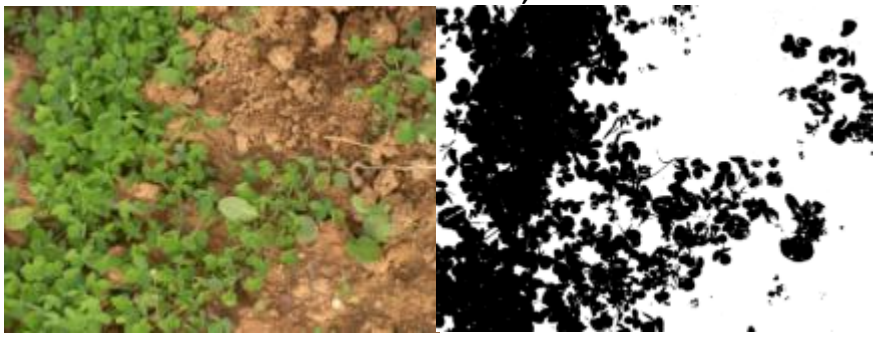


Barley, 90%

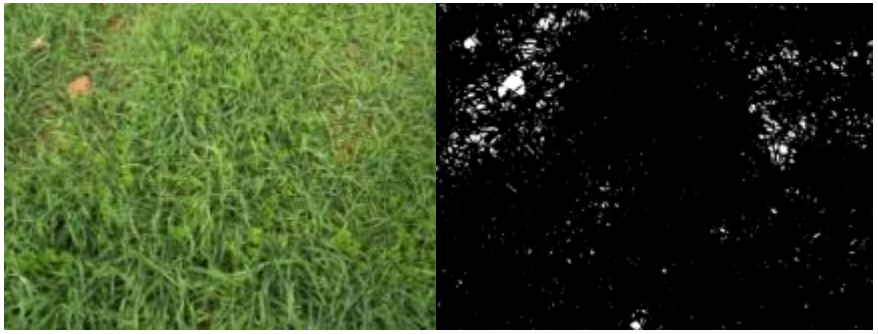
Rye+Vetch, 94%



Crimson Clover, 44.6%



Rye+Clover, 97%



Seeding Date	Previous Crop	Conditions
1-Oct	Soybean	Before leaf drop

11/30






Middlesex,

Rye: 20-25%
Barley: 90-100%
Clover: 50-60%
Vetch: 40-50%
Rye + Vetch: 35-40%
Rye + Clover: 10-20%

Seeding Date	Previous Crop	Conditions
14-Oct	Soybean	30% leaf drop

Prince George

- Seeded into double-crop soybeans with straw left on field from wheat harvest
- Seeded October 14, 2009
- Soybeans had approximately 30-40% leaf drop
- Rainfall occurred on October 15
- Soybeans harvested November 30
- Sandy loam soil types
- Pictures 12-1-09
- I would consider this seeding a failure at this site.


Aerial seeding plots
12-1-09

Essex

Seeding Date	Previous Crop	Conditions
2-Oct	Corn, 160 bu/ac	Stalks bush hogged

Treatments planted on October 2nd. Good soil moisture at the time of planting, but no rain for about 12 days after planting. Rye started germinating very quickly and some of it was up in 7 days or so. Barley was close behind. Took longer for the vetch and clover to germinate.

11/30

Rye

Barley

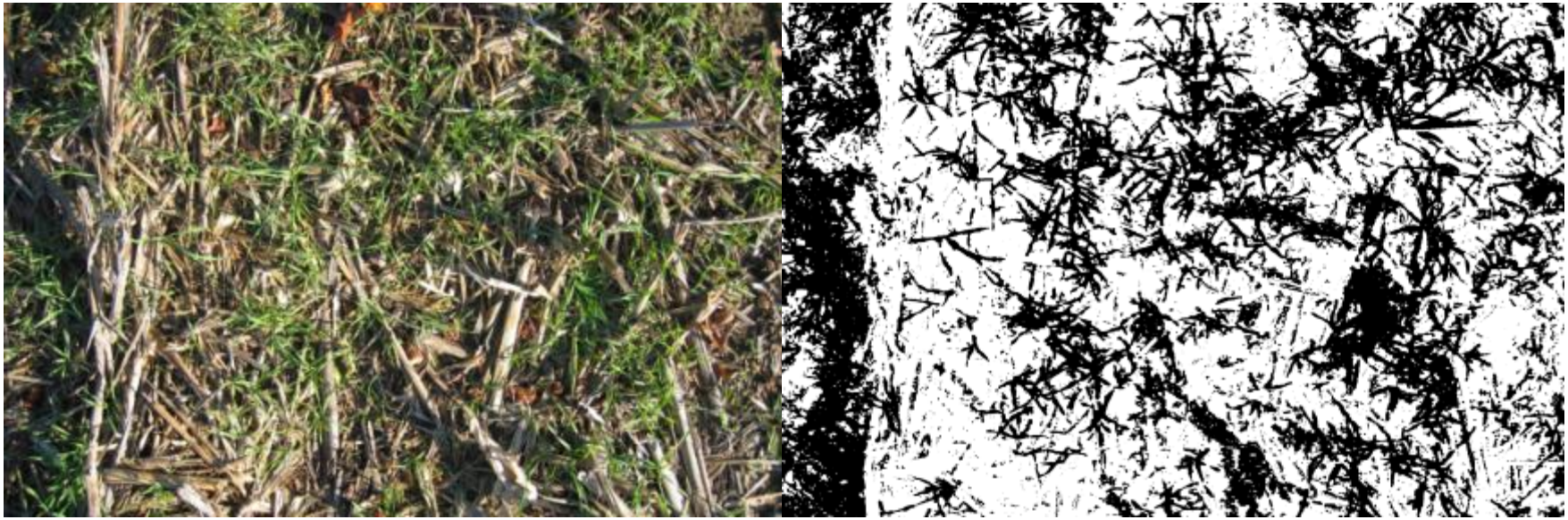
Clover

Vetch

Rye+Clover

Rye+Vetch

Rye 42.4%



Barley, 40.1%

Seeding Date	Previous Crop	Conditions
6-Oct	Soybean	Before leaf drop

Northumberland

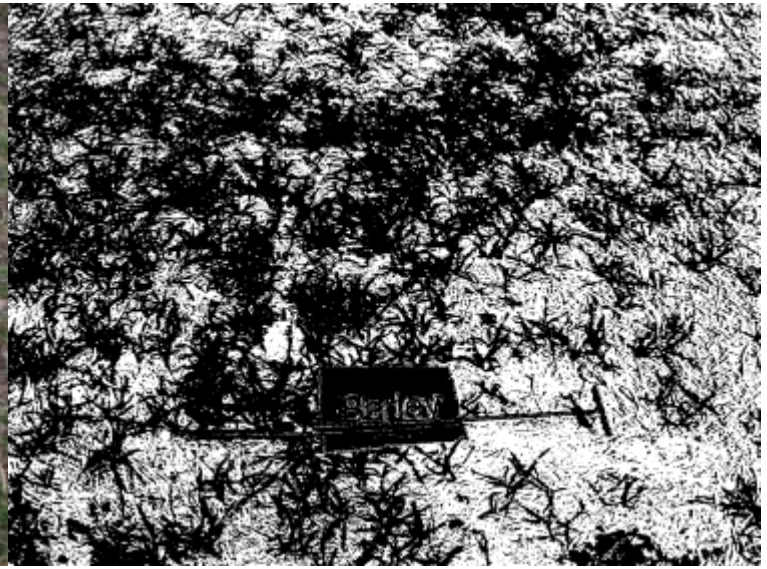
The plot was planted October 6. Weather at that time and since has been unusually warm and wet; if there was ever a fall when seed would sprout without good soil contact, it was this one.

Seeding Date	Previous Crop	Conditions
6-Oct	Soybean	Before leaf drop

Northumberland, 11/30

42.4%

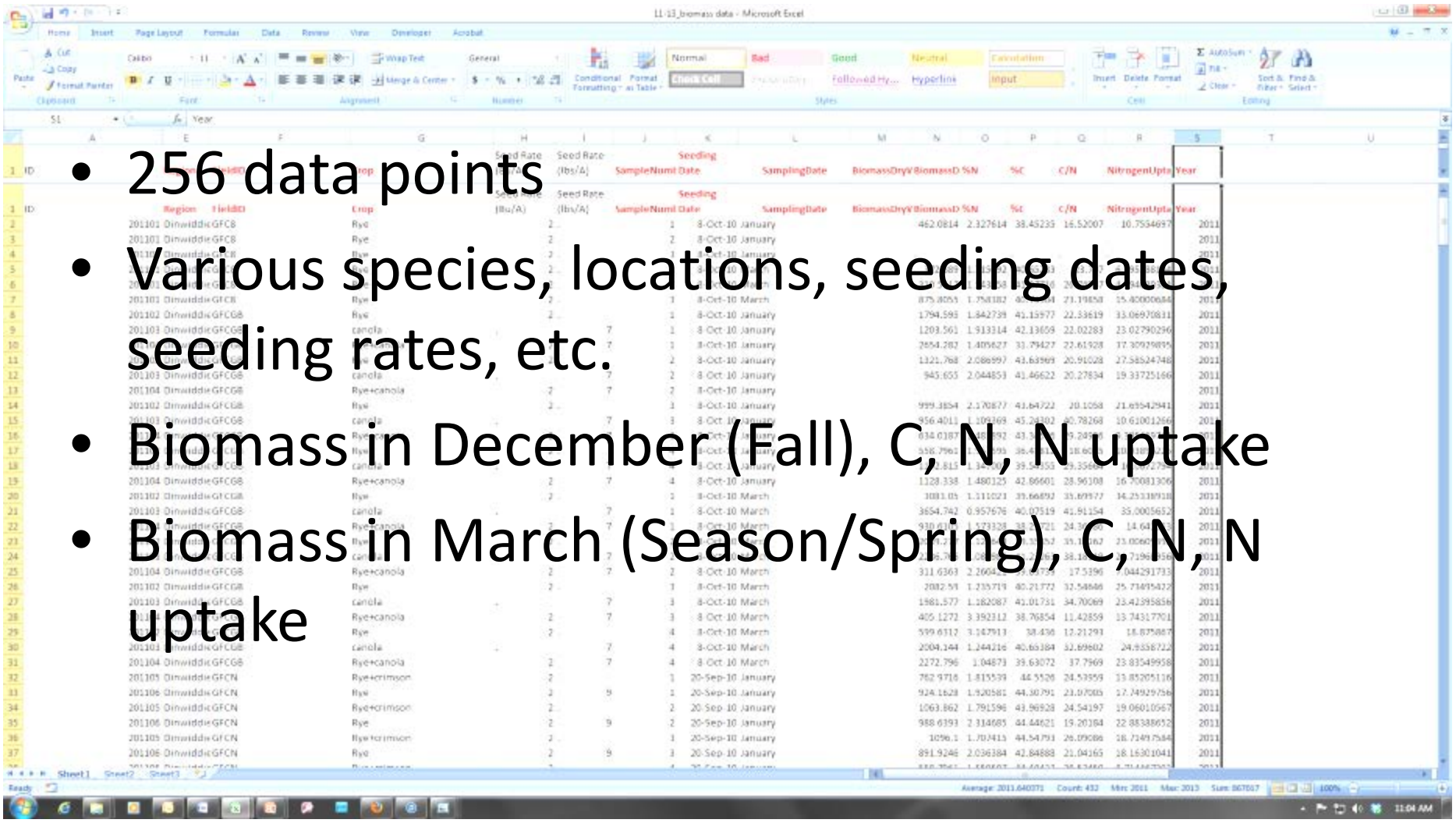
60.6%



Initial Observations

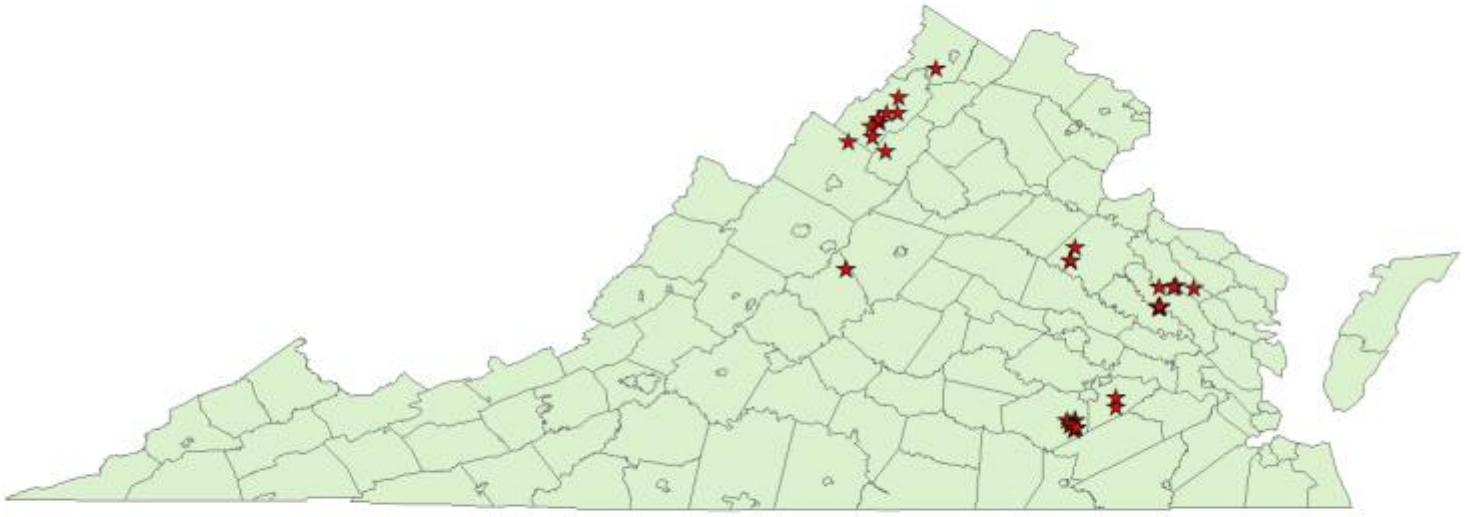
- Early establishment and early-season growth are key.
  - How much growth do we need?
- Crimson clover needs to be seeded earlier
  - Also Vetch?
- Mixes need to either: 1)include more legume seed or; 2) include less small grain

Aerial/Broadcast Seeding “Success”



- 256 data points
- Various species, locations, seeding dates, seeding rates, etc.
- Biomass in December (Fall), C, N, N uptake
- Biomass in March (Season/Spring), C, N, N uptake

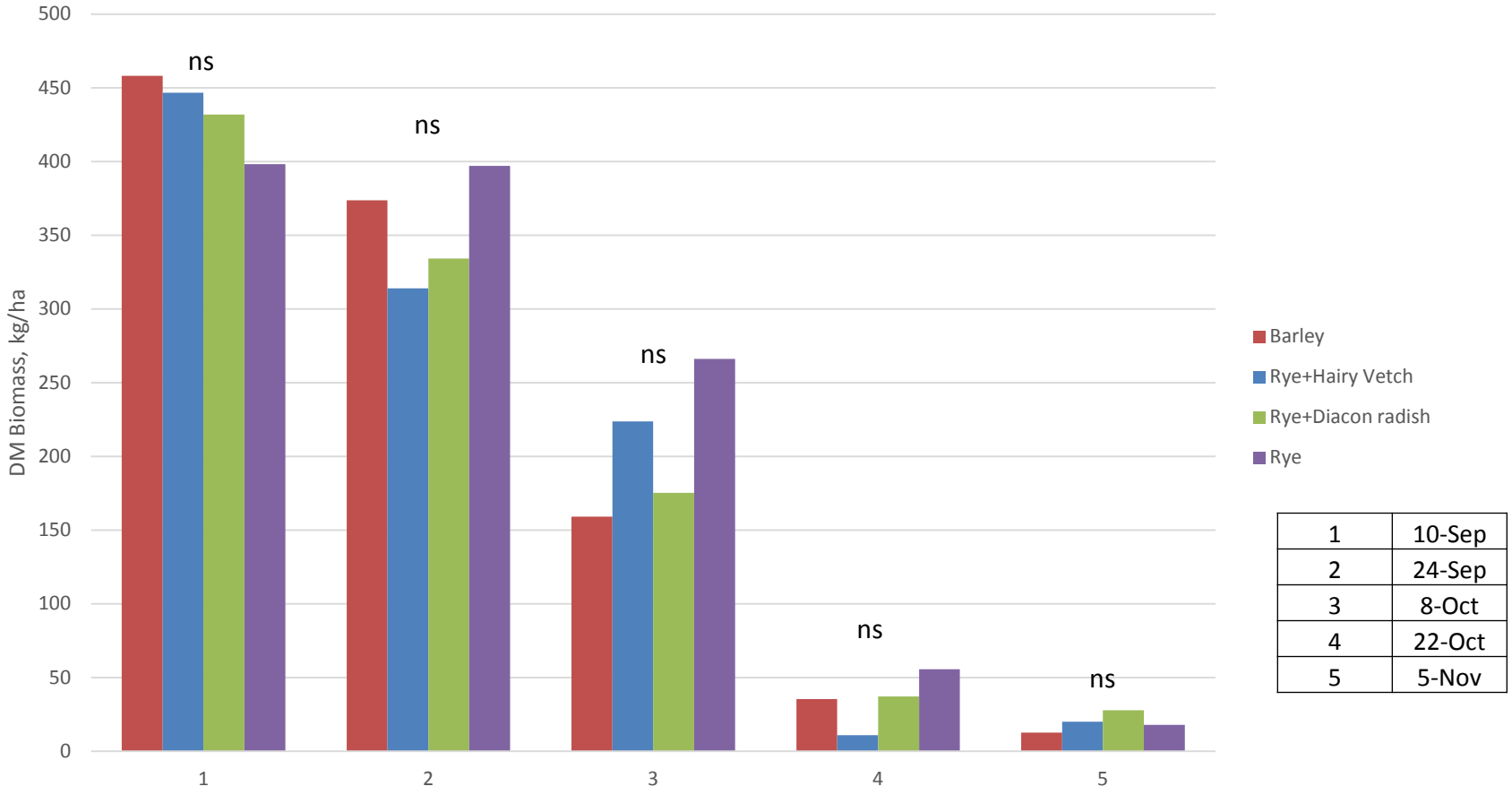
Aerial/Broadcast Seeding “Success”



Aerial/Broadcast Seeding “Success”

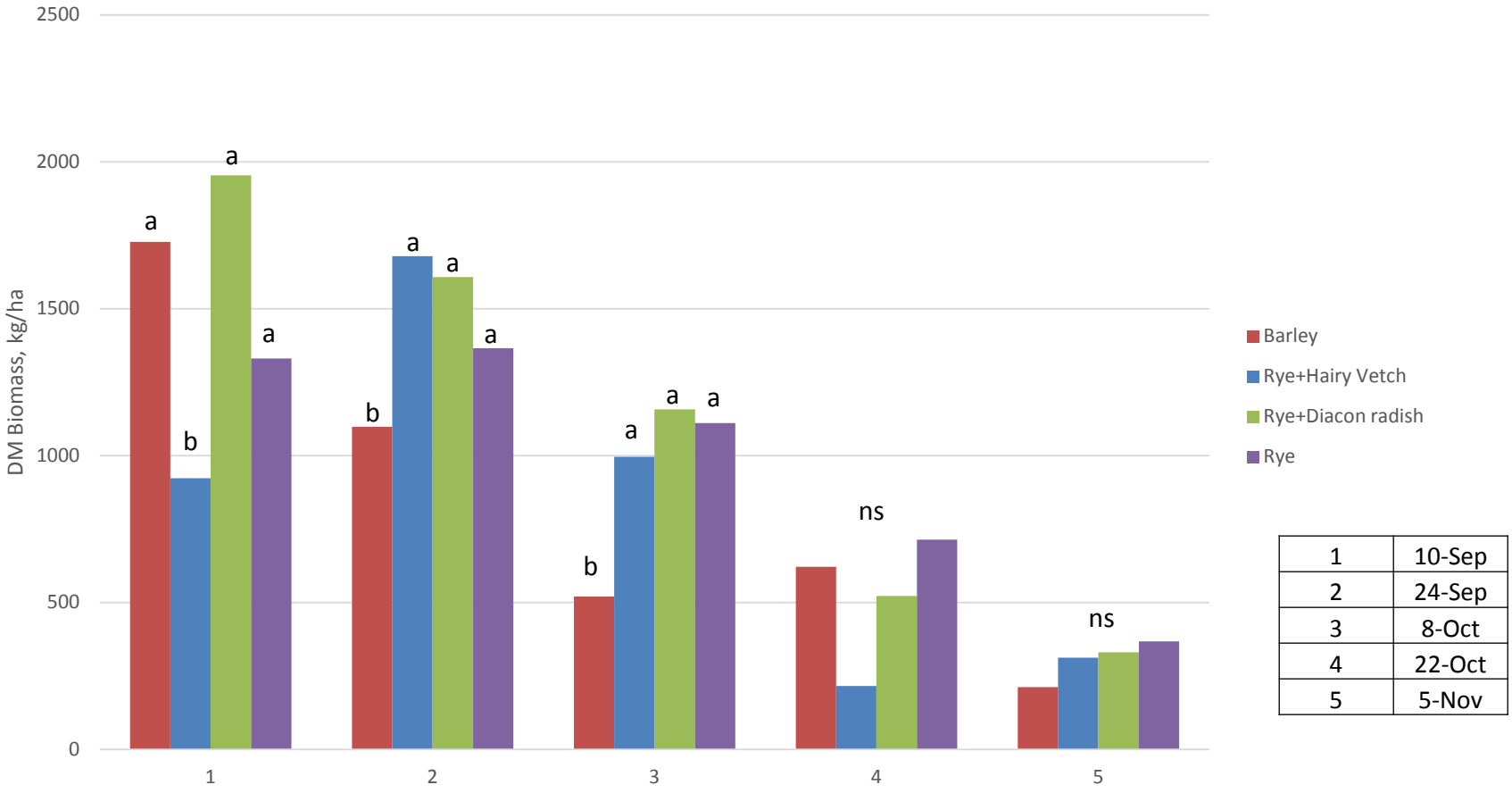
Dry Matter, lb/ac in December	All types	Rye only	Legumes
	------% of samples------		
<200 lb/ac	40%	9%	75%
<800 lb/ac	46%	29%	92%
>800 lb/ac	54%	61%	8%

Planting date effects on cover crop biomass – December 10



1	10-Sep
2	24-Sep
3	8-Oct
4	22-Oct
5	5-Nov

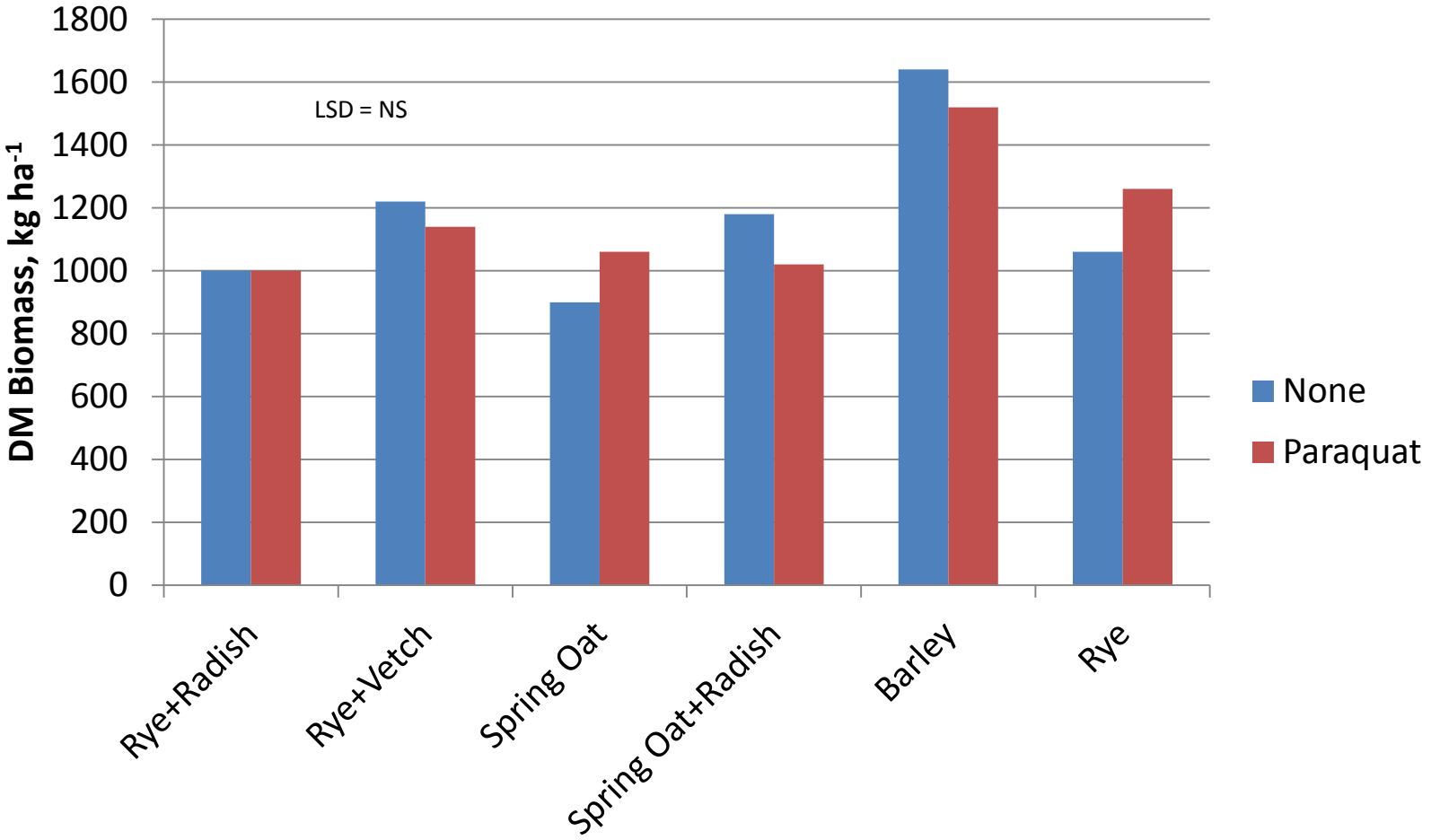
Planting date effects on cover crop biomass – Termination (early April)



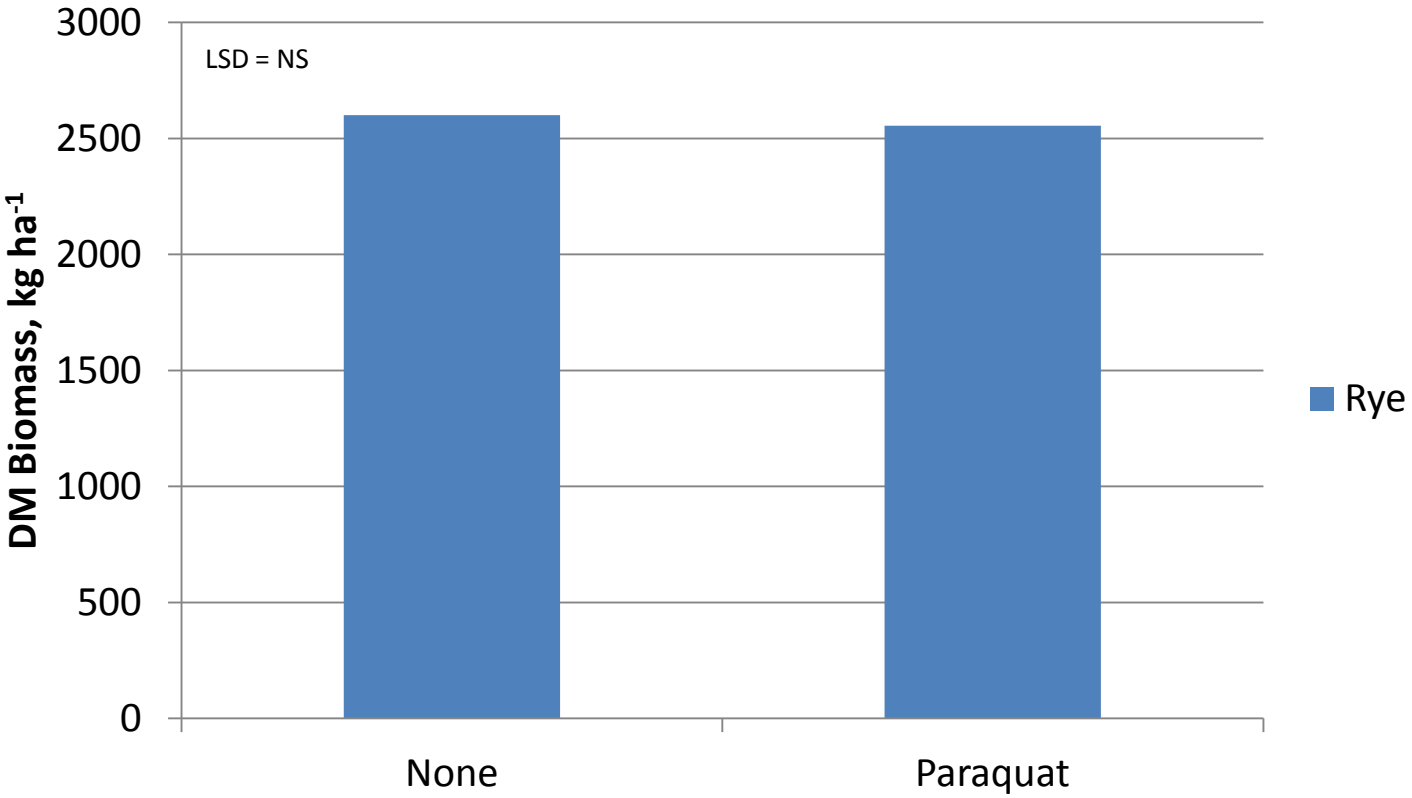
1	10-Sep
2	24-Sep
3	8-Oct
4	22-Oct
5	5-Nov

Natural Leaf Drop Vs. Chemical Defoliation, Suffolk

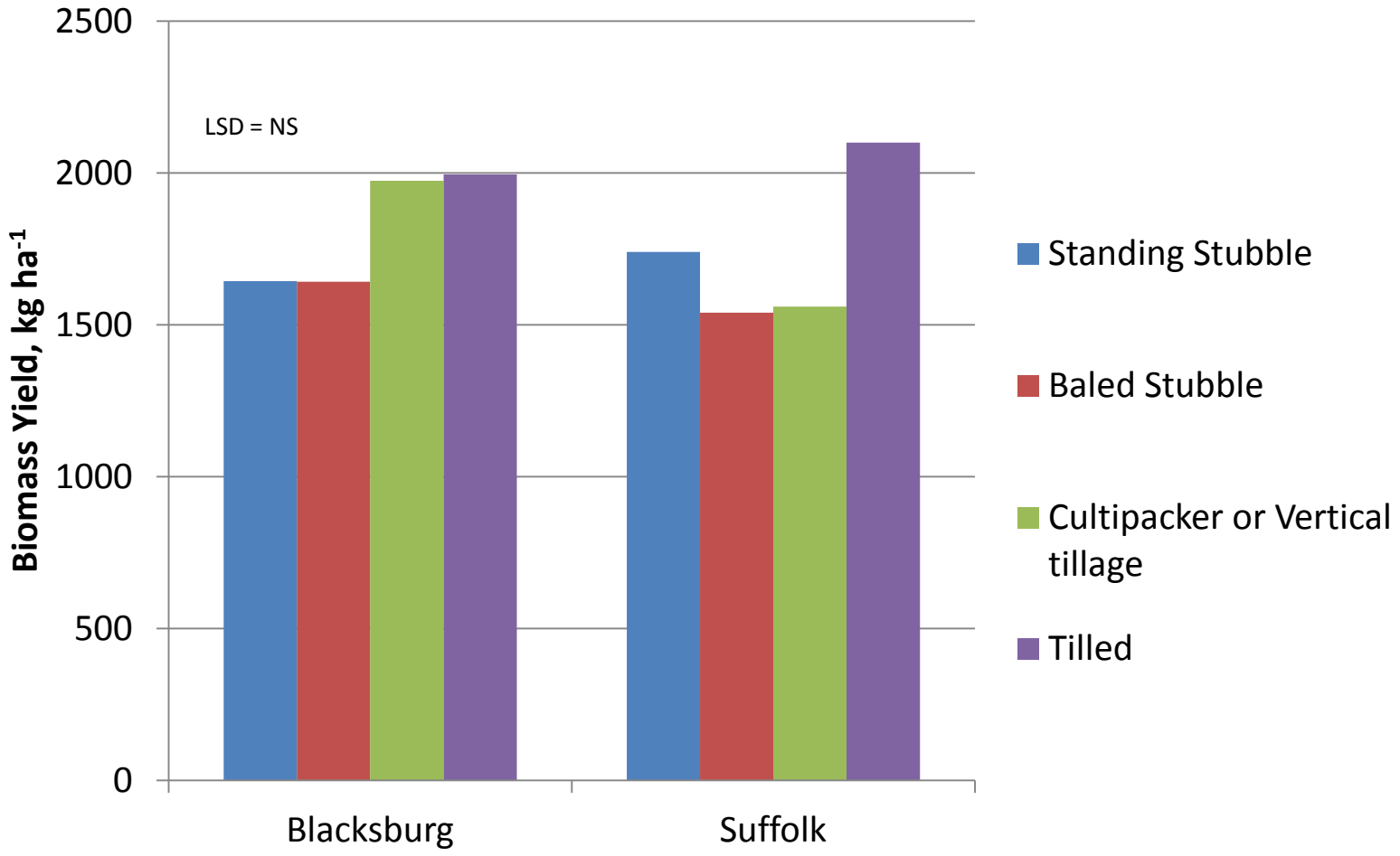
(Dual + Prowl PRE fb Roundup + FirstRate POST to Soybean)



Natural Leaf Drop Vs. Chemical Defoliation, Blacksburg

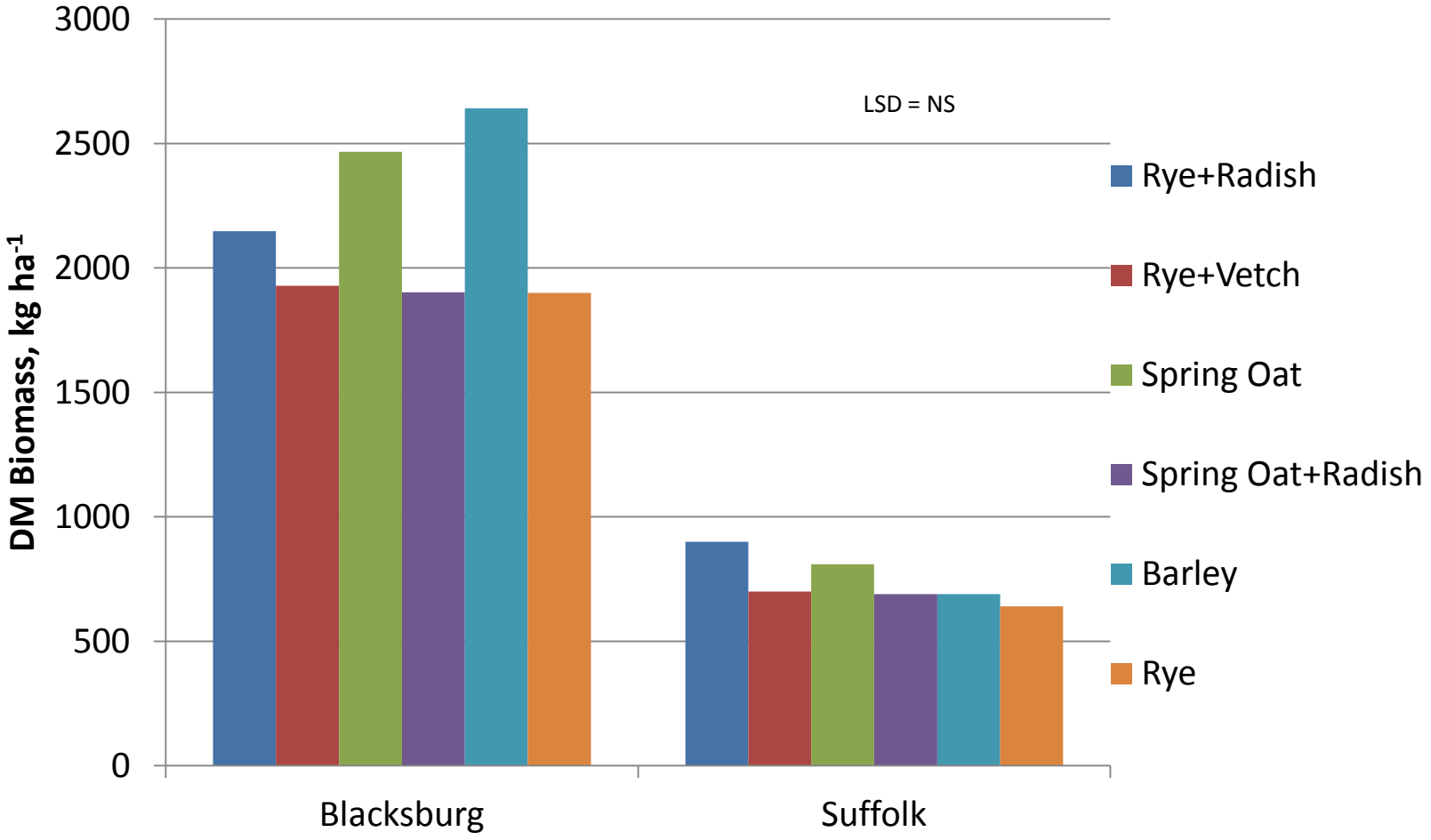


Wheat Stubble Management Effects on Winter Cover Establishment



Cover Crop Species for Broadcast Seeding into Soybean Canopy

(Dual + Prowl PRE fb Roundup + FirstRate POST to Soybean in Suffolk)



Common soybean herbicide rotation restrictions

	Annual Ryegrass	Wheat	Clover	Vetch	Radish	Oats	Cowpea	Buckwheat	Alfalfa	Forage Sorghum	Pearl Millet	Max Rotation	Comments
Soybean Herbicides	---------- Replant Interval (Months) ----------												
Authority First/Sonic	30	4	30	30	30	12	12	30	12	12	30	30	
Authority MTZ	18	4	18	18	18	18	18	18	12	18	18	18	Sorghum can be planted after 12 months if Authority MTZ was applied at 20 oz/A or less
Canopy	4	4	12	30	30	30	12	30	10	12	30	30	
Classic	3	3	12	30	30	3	9	30	12	9	30	30	
Extreme	40	3	4	40	40	18	0	40	4	18	40	40	
Firstrate	18	4	18	18	18	9	9	18	9	9	18	18	
Optill PRO	40	4	9	40	40	18	4	40	9	18	40	40	
Valor XLT	4	4	18	30	30	30	12	30	12	10	30	30	
Dual II Magnum	12	4.5	9	0	0	4.5	0	NS	4	0	12	12	To avoid injury in clover, do not apply more than 1.9 lb ai/A (2 lb/A) in previous crop
Warrant	NL	4	9	9	NL	NS	NS	NS	9	0	NS	NL	NS= Next season, NL=Not listed on Label