October 15

September 15

Cover Crop Seeding Dates and Seeding Rates

Cover crops for soil health: A northeast SARE professional development workshop
March 29, 2016

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Cover crop seeding rates and dates

- Previous research on cereal rye in PA and MD
- New research on hairy vetch across the Northeast
- Exploring seeding rates and dates in the classroom

Why care about rates and dates?

- Major impact on cover crop performance, biomass production, and ecosystem services
- Using optimal practices can save farmers money and increase their satisfaction with cover crops

Cereal rye seeding rates and dates

Critical planting dates of cereal rye to ensure maximum potential nitrogen accumulation

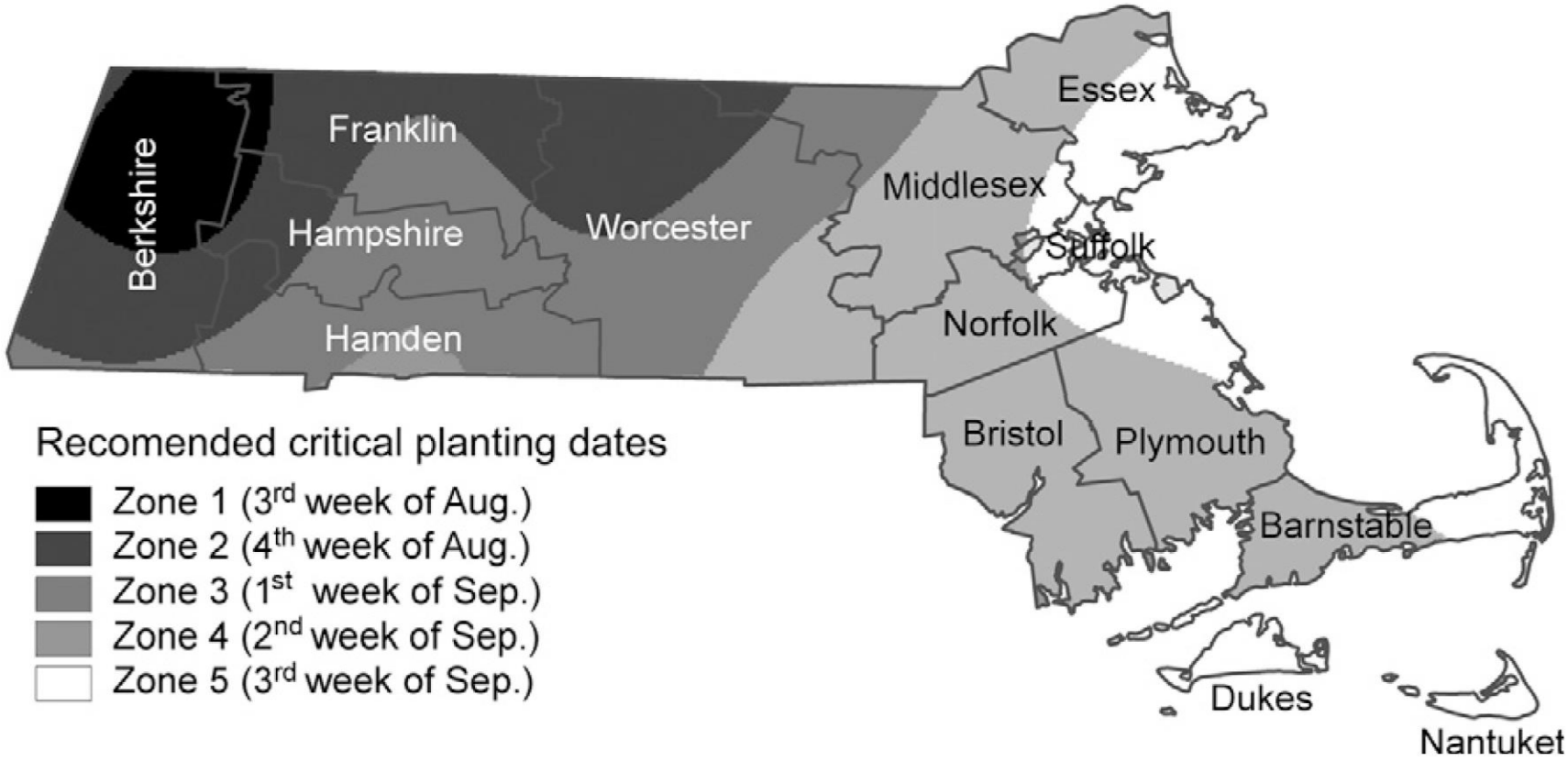


Fig. 3. Critical planting zones for a winter rye cover crop in Massachusetts. The model-recommended planting date is different for each zone and is based on its temperature (growing degree days) regime.

Farsad, Ali, et al. "Spatial modeling of critical planting date for winter rye cover crop to enhance nutrient recovery." *Agronomy journal* 103.4 (2011): 1252-1257.

Cereal rye for organic no-till

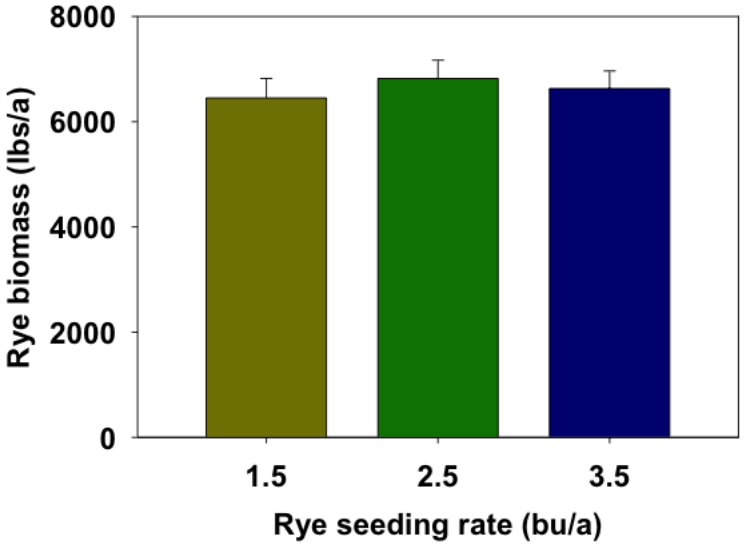
- 3 rye seeding rates x 3 fertility rates
  - PA and MD in 2008 and 2009

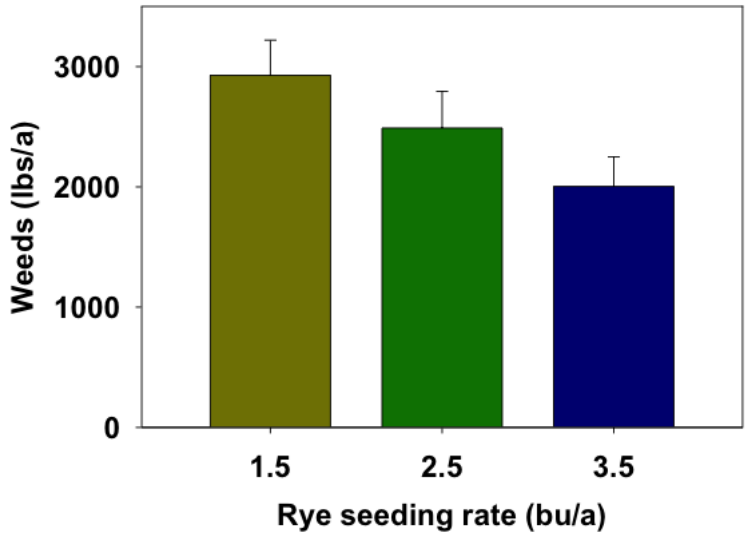
- **Questions**
  - Does increasing soil fertility and rye seeding rate increase rye biomass?
  - Does increased rye biomass improve weed suppression?

- **Increasing soil fertility**
  - Increased biomass but did not improve weed suppression

Increasing rye seeding rate

- No affect on rye biomass
- Decreased weeds, due to better ground cover

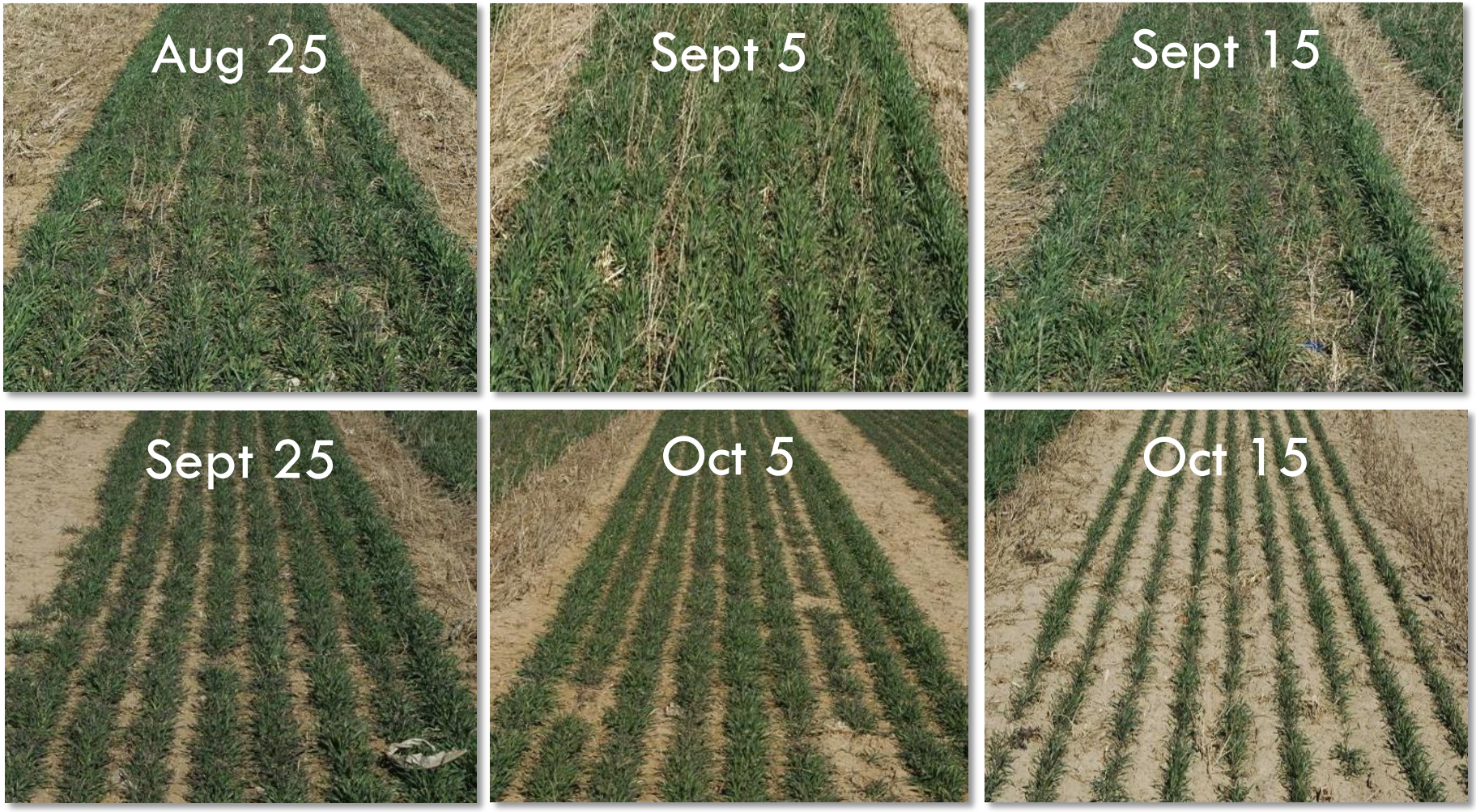




Ryan, MR, WS Curran, AM Grantham, LK Hunsberger, SB Mirsky, DA Mortensen, EA Nord, and DO Wilson. 2011. Effects of seeding rate and poultry litter on weed suppression from a rolled cereal rye cover crop. *Weed Science* 59:438–444.

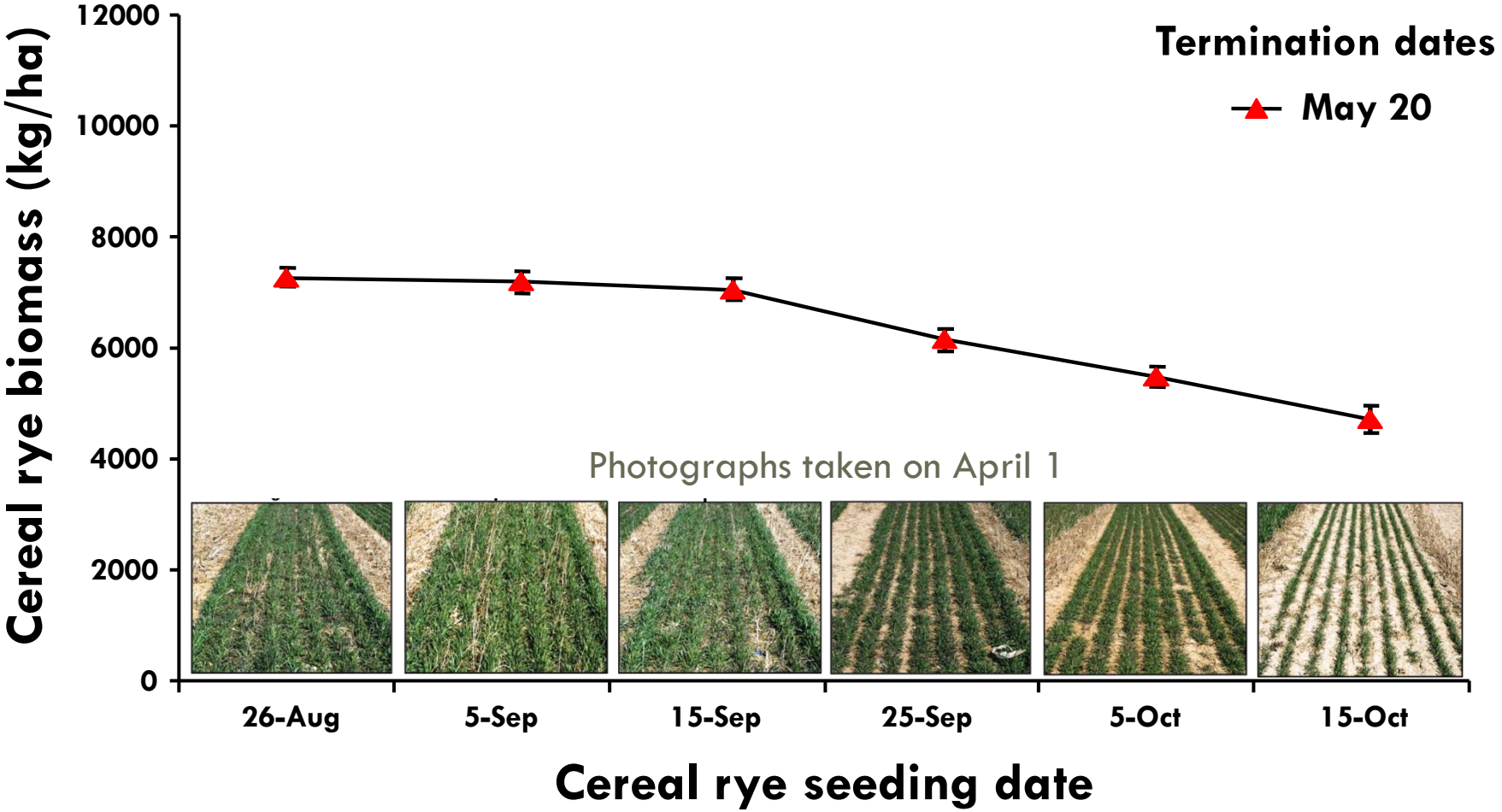

Oct. 15
Sept. 15

Ground cover on April 1 across rye seeding dates (2.5 bu/a on 7.5 inch rows)



Mirsky, SB, WS Curran, DA Mortensen, MR Ryan, and DL Shumway. 2009. Control of cereal rye with a roller/crimper as influenced by cover crop phenology. *Agronomy Journal* 101:1589-1596.

Effects of seeding and termination dates



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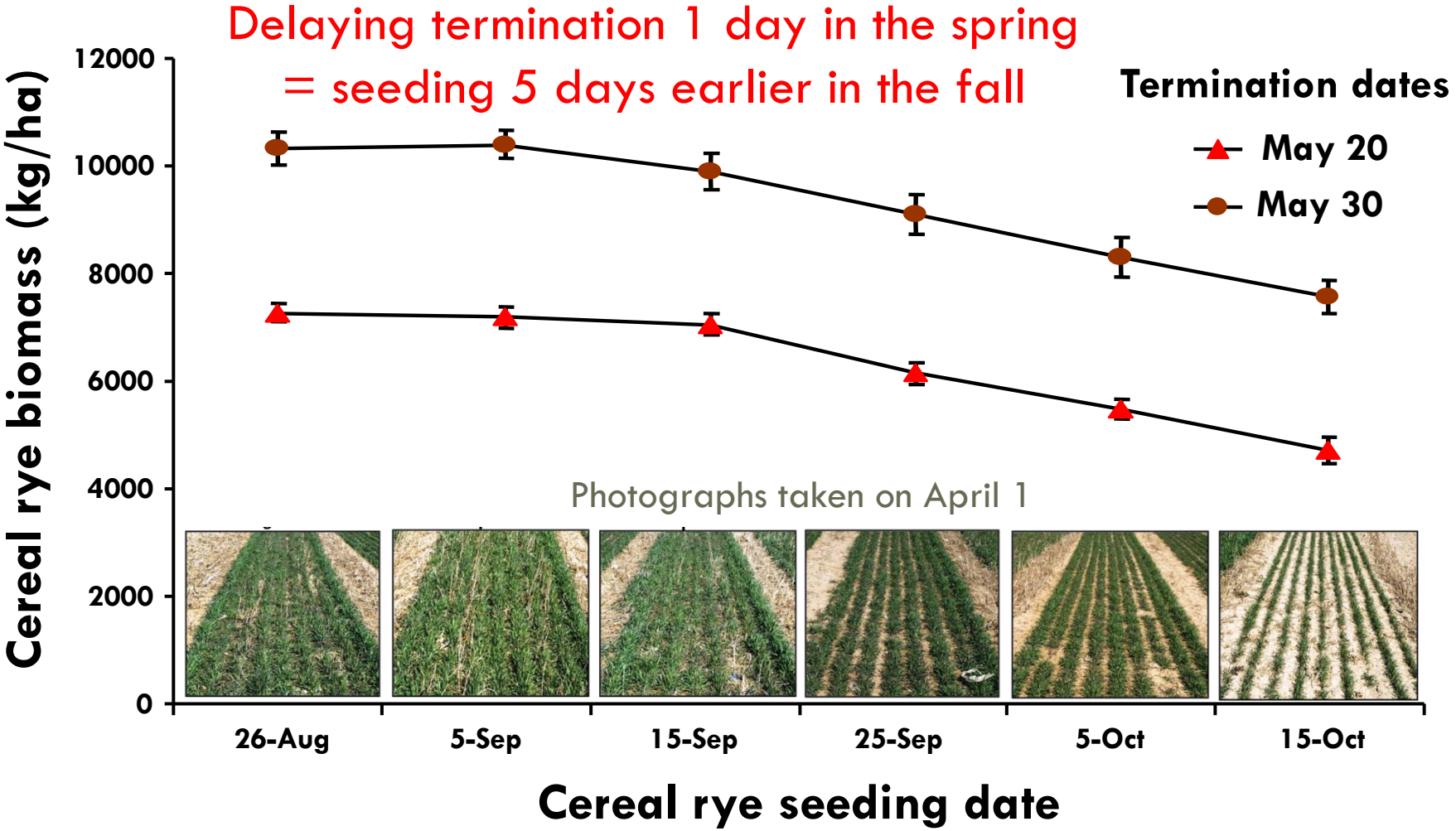
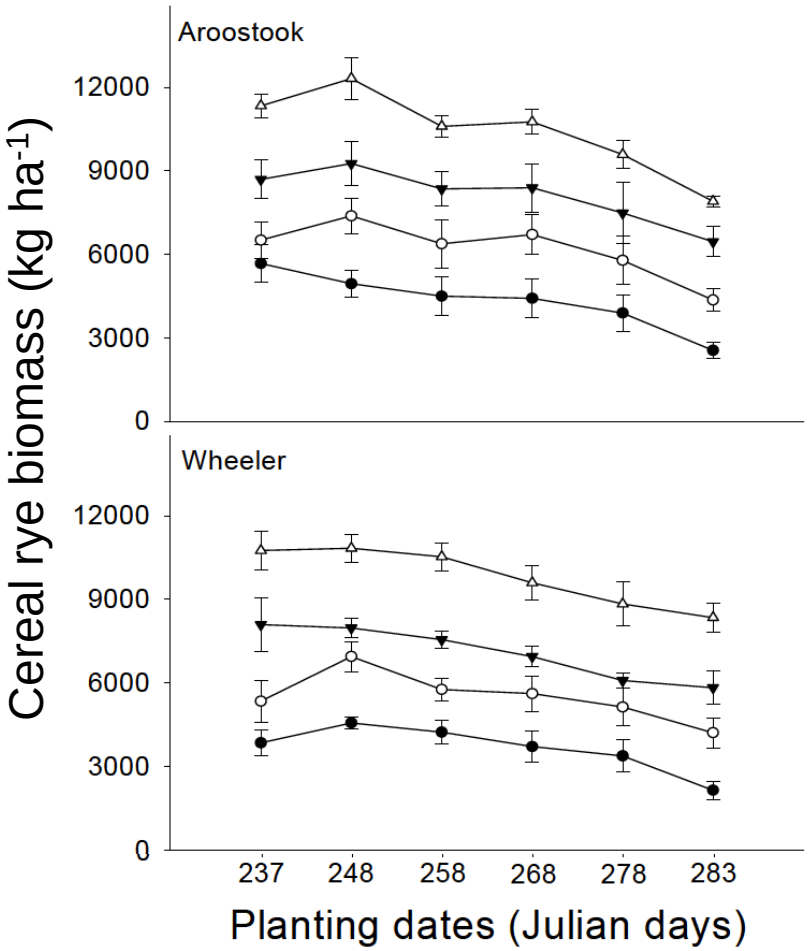


Mirsky, SB, WS Curran, DA Mortensen, MR Ryan, and DL Shumway. 2009. Control of cereal rye with a roller/crimper as influenced by cover crop phenology. *Agronomy Journal* 101:1589-1596.

Effects of planting date on cereal rye

Treatment	Biomass	
	---- kg ha^{-1} ----	
Crop		
Aroostook	7259	a
Wheeler	6508	b
Rye/Hairy vetch	6876	ab
Planting Date		
August 25	7880	a
September 5	7904	a
September 15	7161	b
September 25	7016	b
October 5	6260	c
October 15	5066	d
Termination Date		
May 1	4051	a
May 10	5809	b
May 20	7599	c
May 30	10,066	d



Mirsky, SB, WS Curran, DA Mortensen, DL Shumway, and MR Ryan. 2011. Timing of cover crop management effects on weed suppression in no-till planted soybean using a roller-crimper. *Weed Science* 59:380–389.

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May 30	10,066	d

Although higher seeding rates did not increase cereal rye biomass, weed suppression was better

Increased biomass (and services) by about 50% when planting cereal rye in early September compared to mid-October

Mirsky, SB, WS Curran, DA Mortensen, DL Shumway, and MR Ryan. 2011. Timing of cover crop management effects on weed suppression in no-till planted soybean using a roller-crimper. *Weed Science* 59:380–389.

Hairy vetch seeding rates and dates

Hairy vetch project collaborators

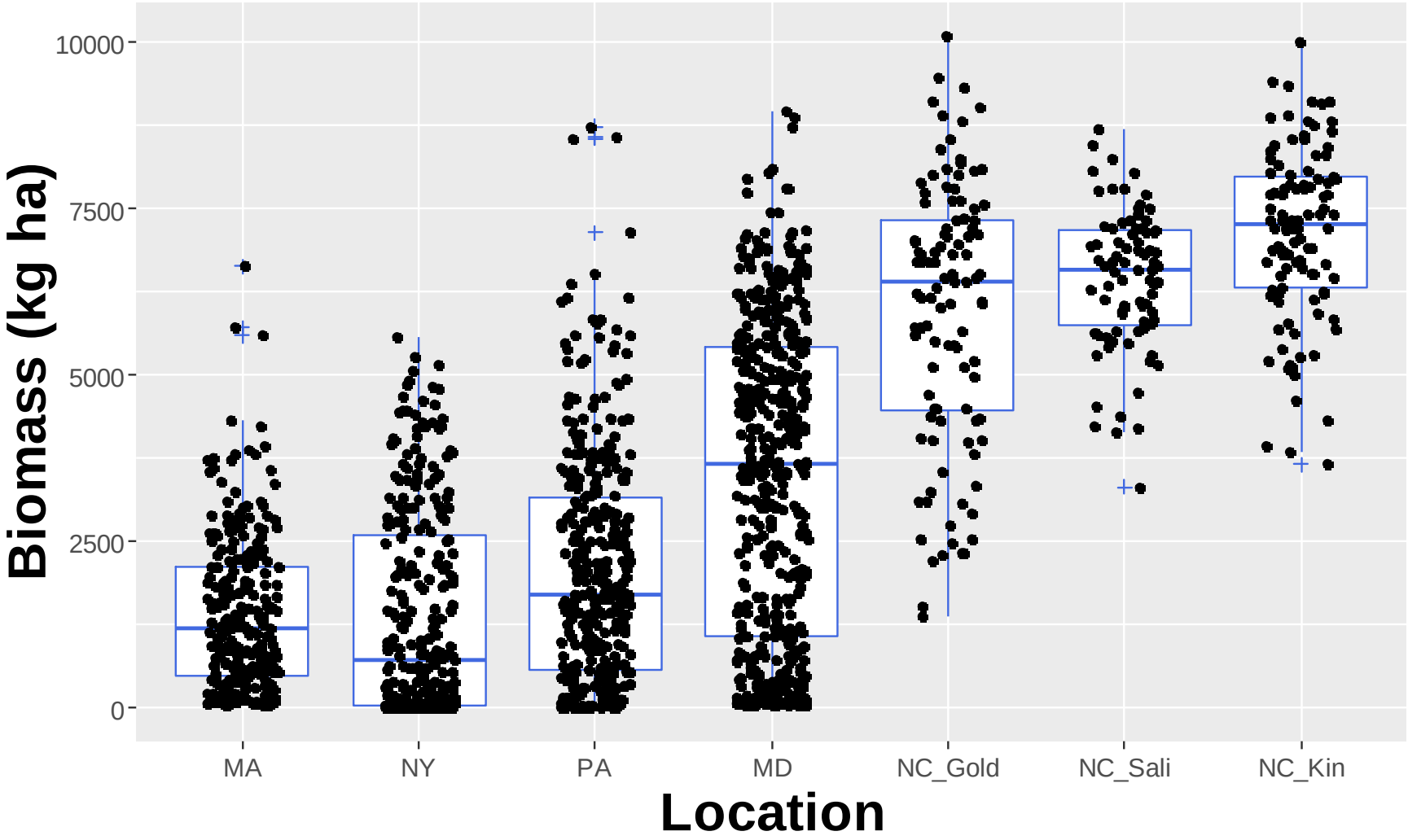
- **USDA hardiness zone 5a to 8a**
  - Steven Mirsky, USDA-ARS BARC
  - Chris Reberg-Horton, NC State
  - Bill Curran, Penn State
  - John Spargo, Penn State
  - Masoud Hashemi, UMass

- **Analysis and writing**
  - Victoria Ackroyd, postdoc at USDA-ARS BARC
  - Stéphane Cordeau, visiting scientist from INRA, France

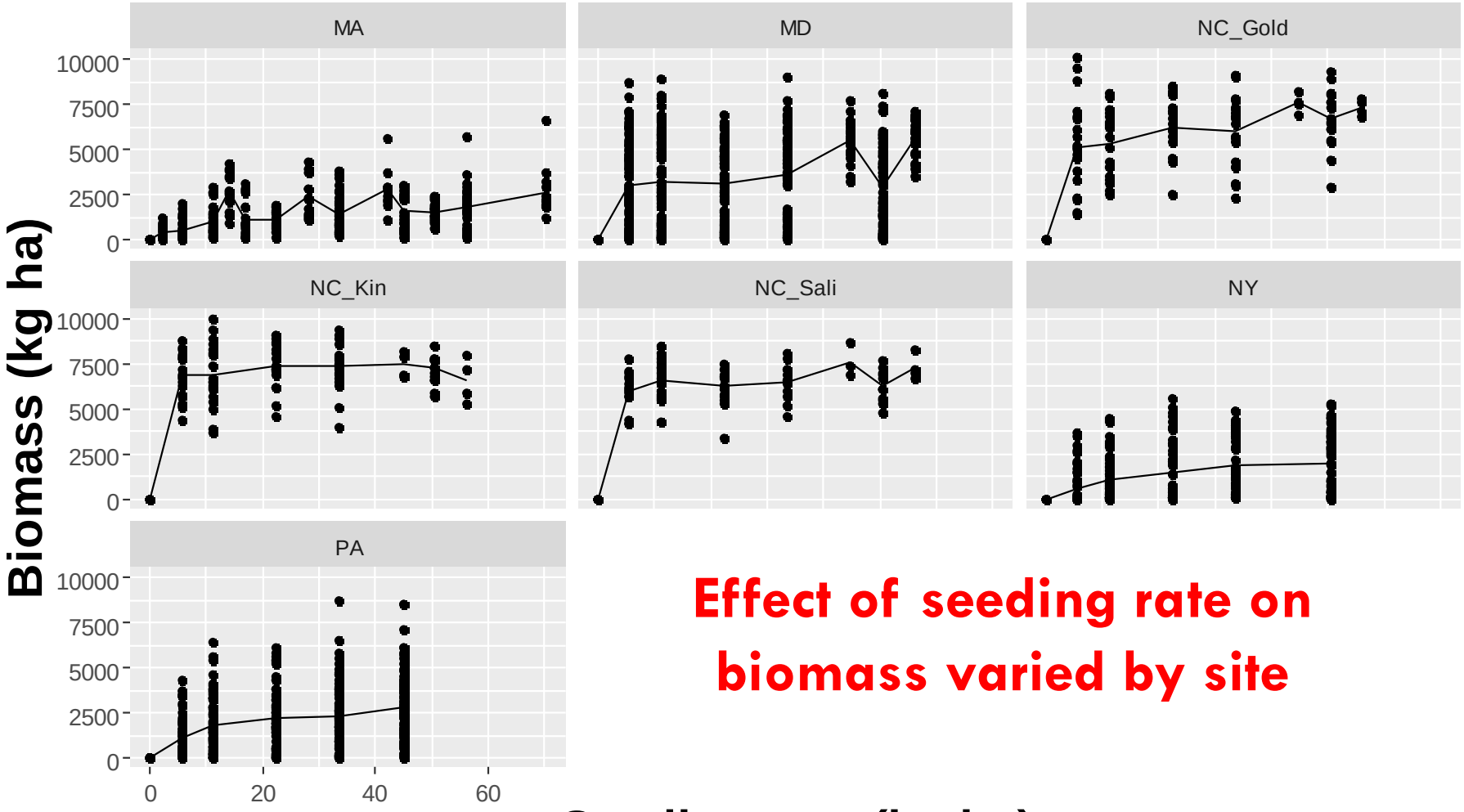
Hairy vetch seeding rate x date

- Tested effects of seeding rates and dates on biomass production
- 5 states: Massachusetts, New York, Pennsylvania, Maryland, and North Carolina
- Drill seeded into a tilled seedbed at multiple rates ranging from 5 to 45 lbs/a
- Same seed at all sites (Steve Groff); inoculated
- Biomass sampled at multiple times (conventional, intermediate, and 50% flowering)

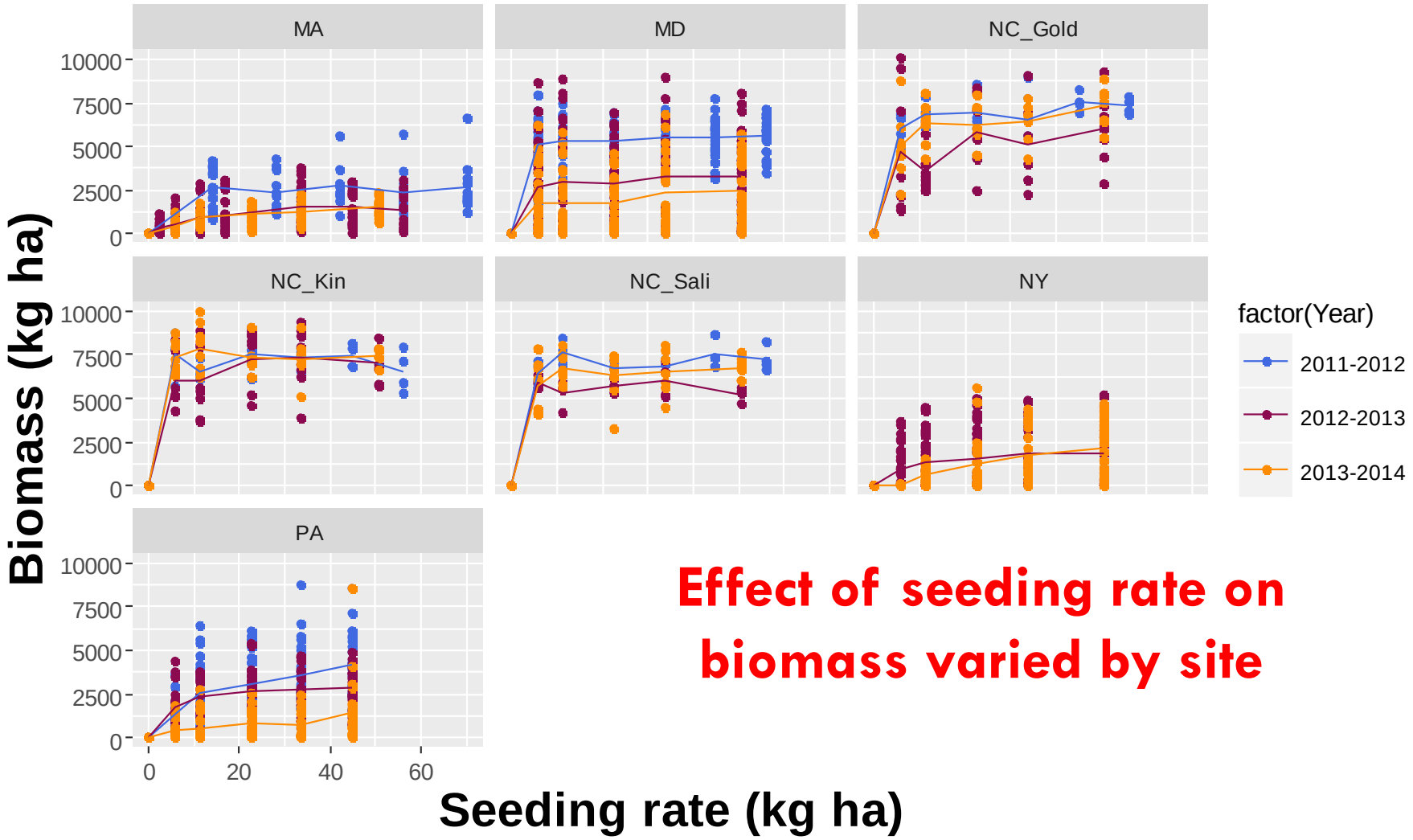

Emily Reiss helping
sample hairy vetch in NY
on May 17, 2013



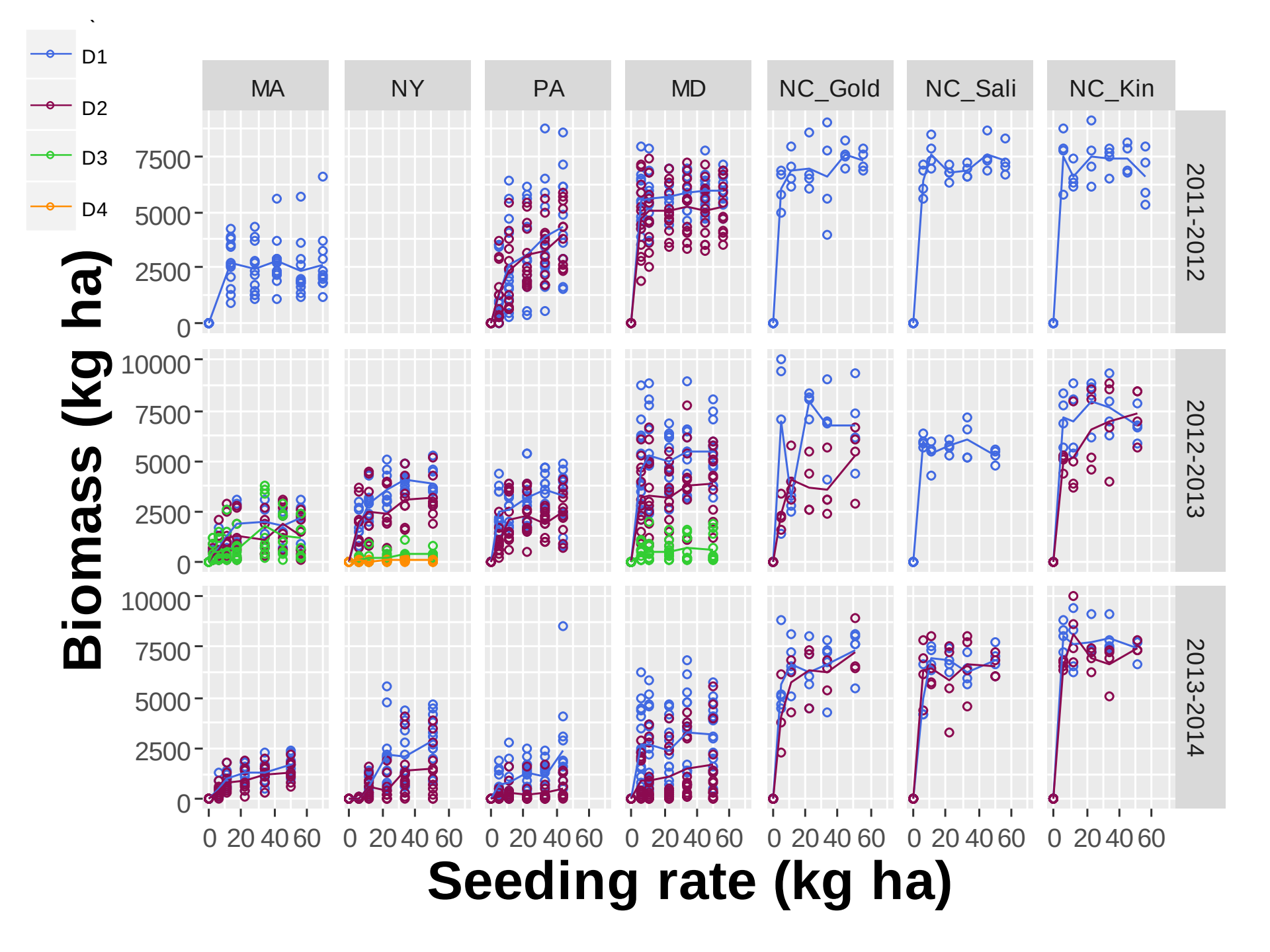
Wide range of biomass within and across sites; biomass production increased with decreasing latitude

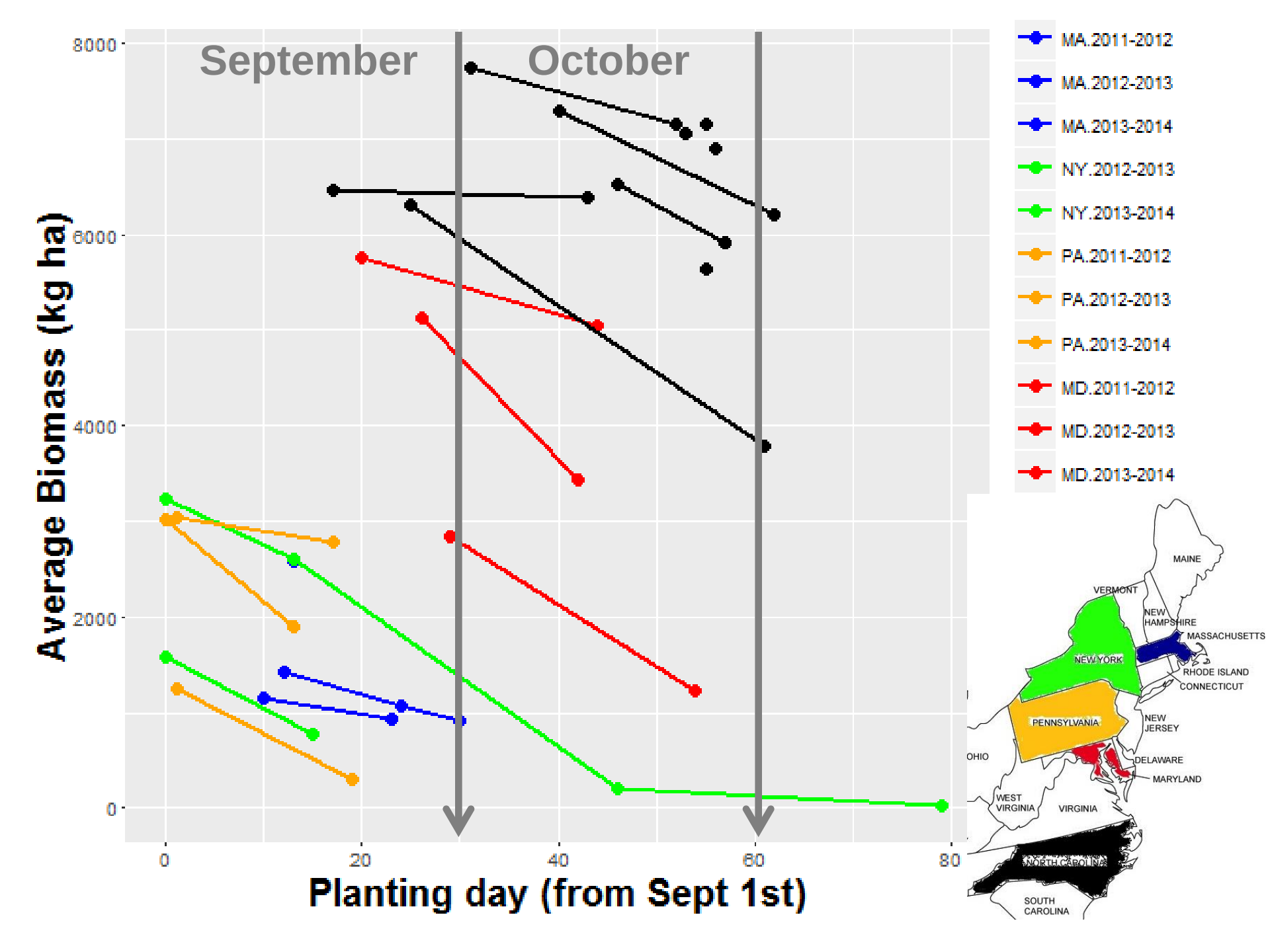


Effect of seeding rate on biomass varied by site

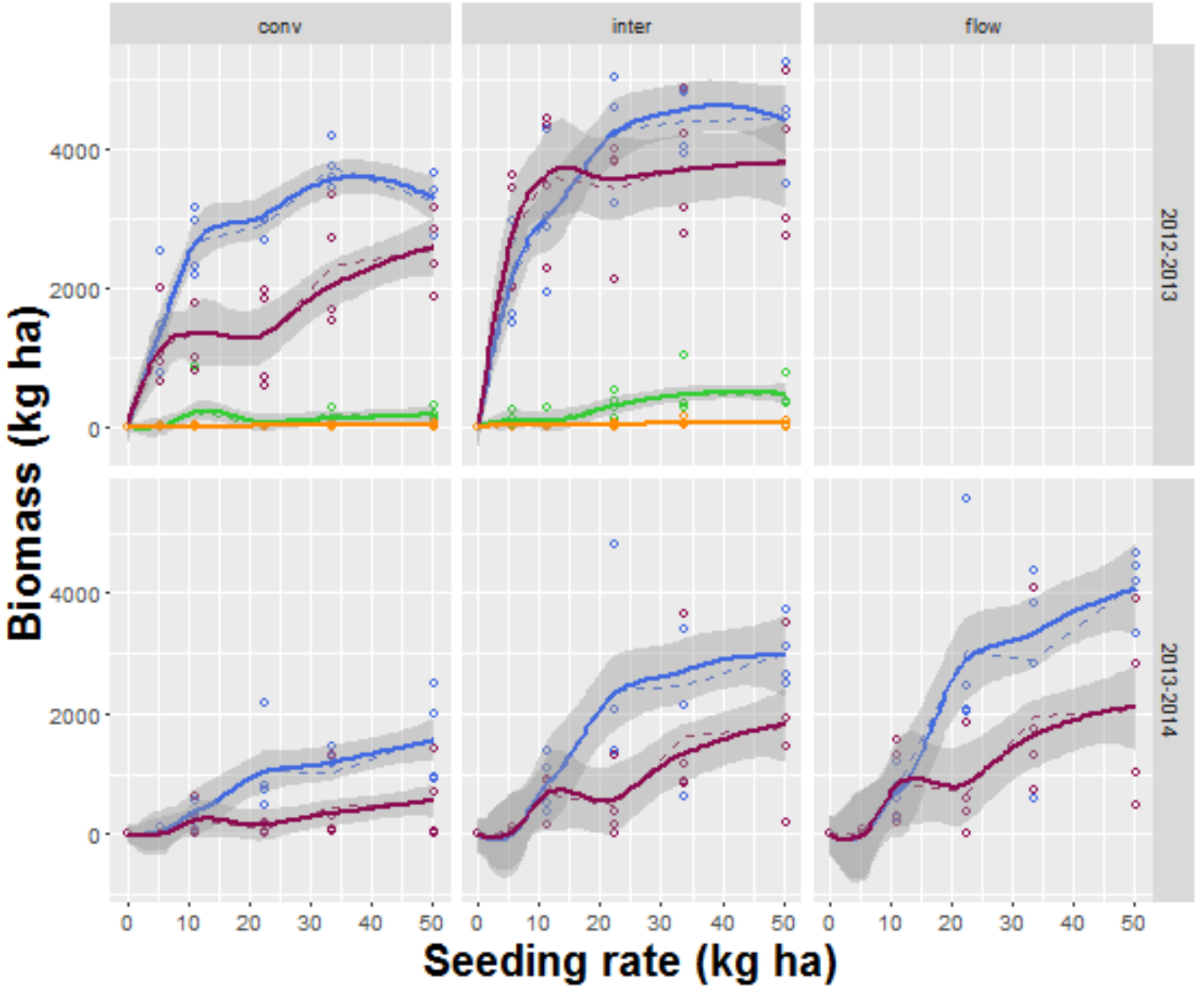


Effect of seeding rate on biomass varied by site


D1
D2
D3
D4
MA
NY
PA
MD
NC_Gold
NC_Sali
NC_Kin
2011-2012
2012-2013
2013-2014
Biomass (kg ha)
0
2500
5000
7500
10000
0 20 40 60
Seeding rate (kg ha)


September
October
Average Biomass (kg ha)
Planting day (from Sept 1st)
8000
6000
4000
2000
0
0
20
40
60
80
MA.2011-2012
MA.2012-2013
MA.2013-2014
NY.2012-2013
NY.2013-2014
PA.2011-2012
PA.2012-2013
PA.2013-2014
MD.2011-2012
MD.2012-2013
MD.2013-2014
MAINE
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
NEW YORK
RHODE ISLAND
CONNECTICUT
PENNSYLVANIA
NEW JERSEY
OHIO
DELAWARE
MARYLAND
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA

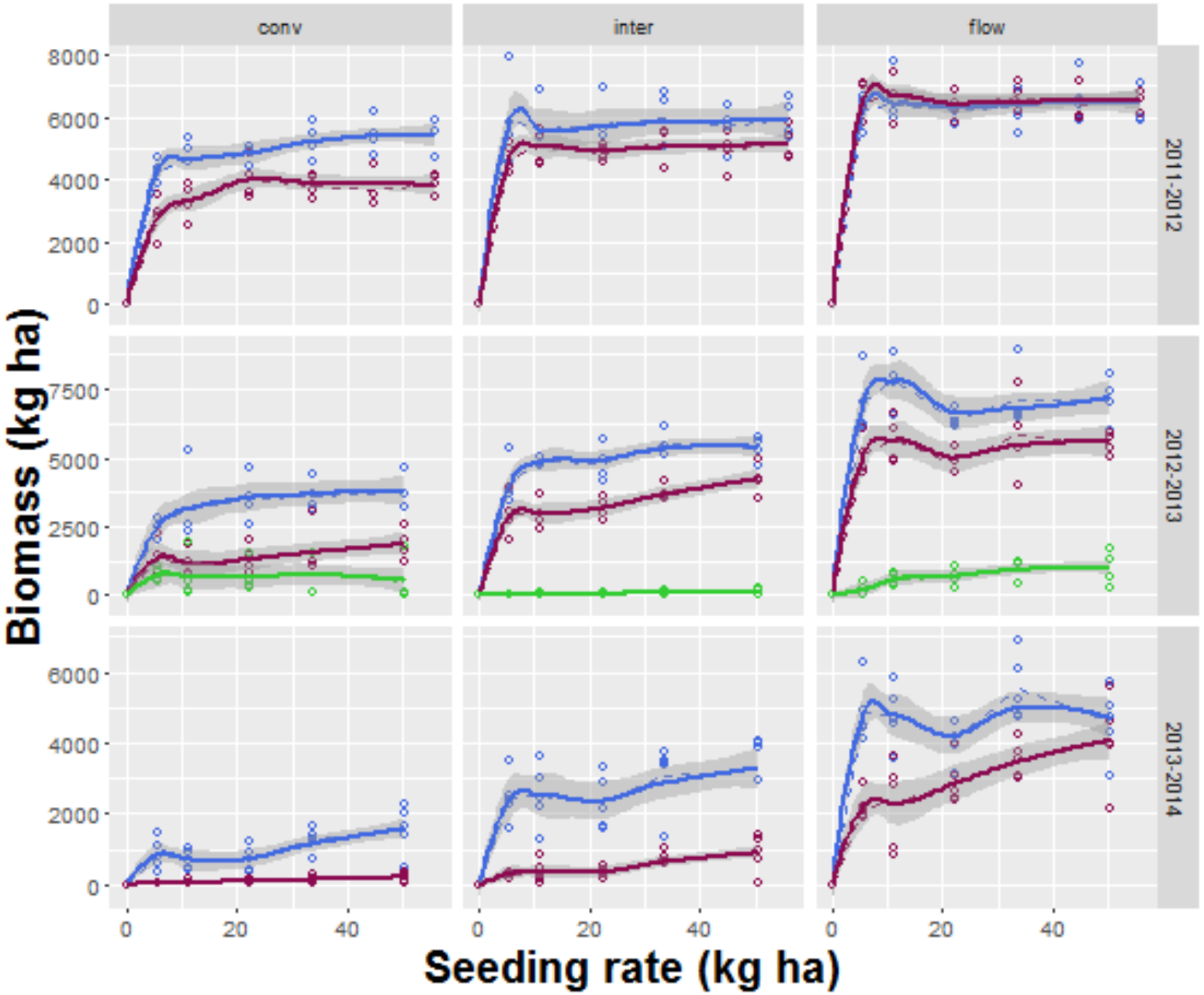
New York



2012
Aug 31
Sept 14
Oct 17
Nov 19

2013
Aug 27
Sept 16

Maryland

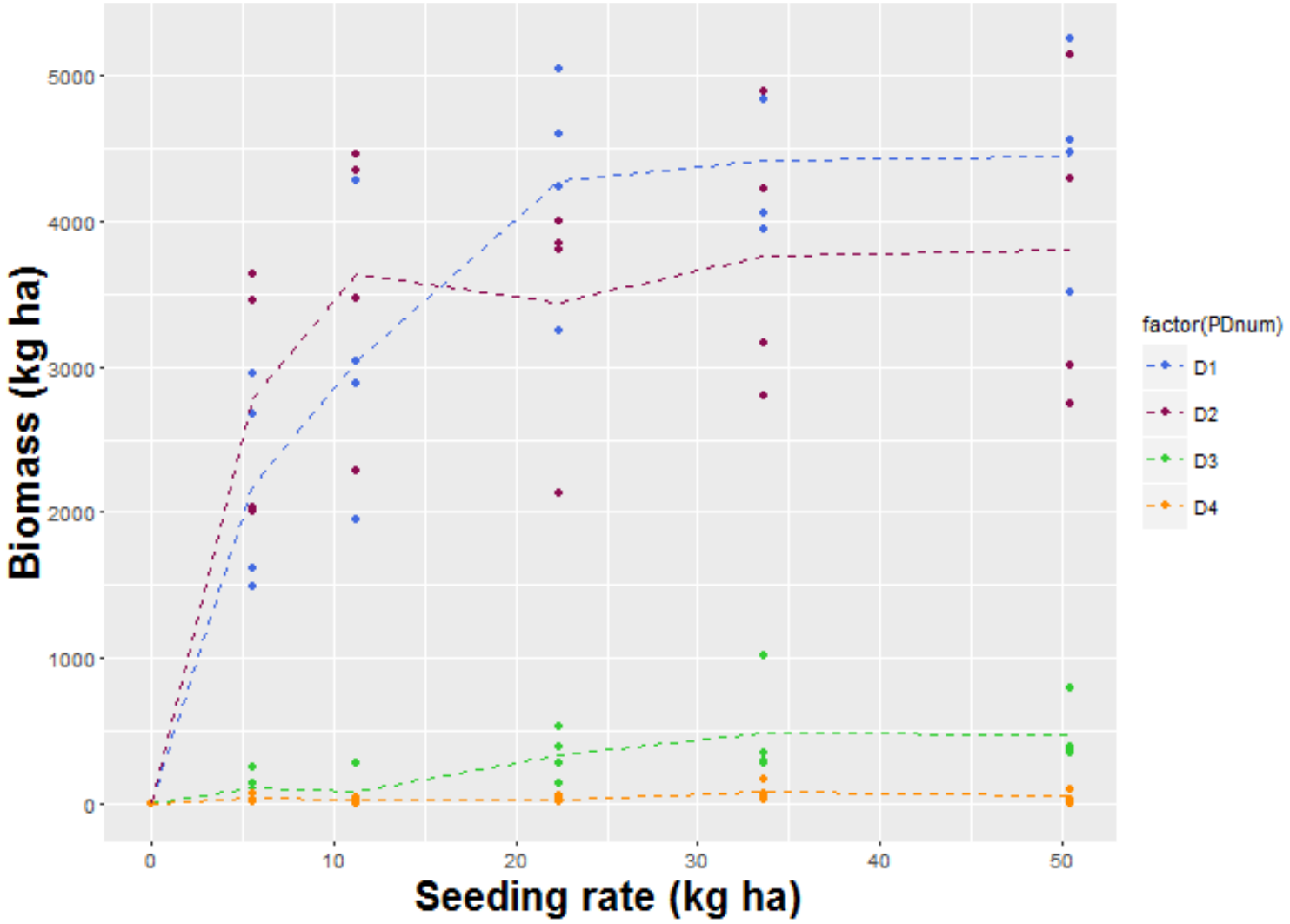


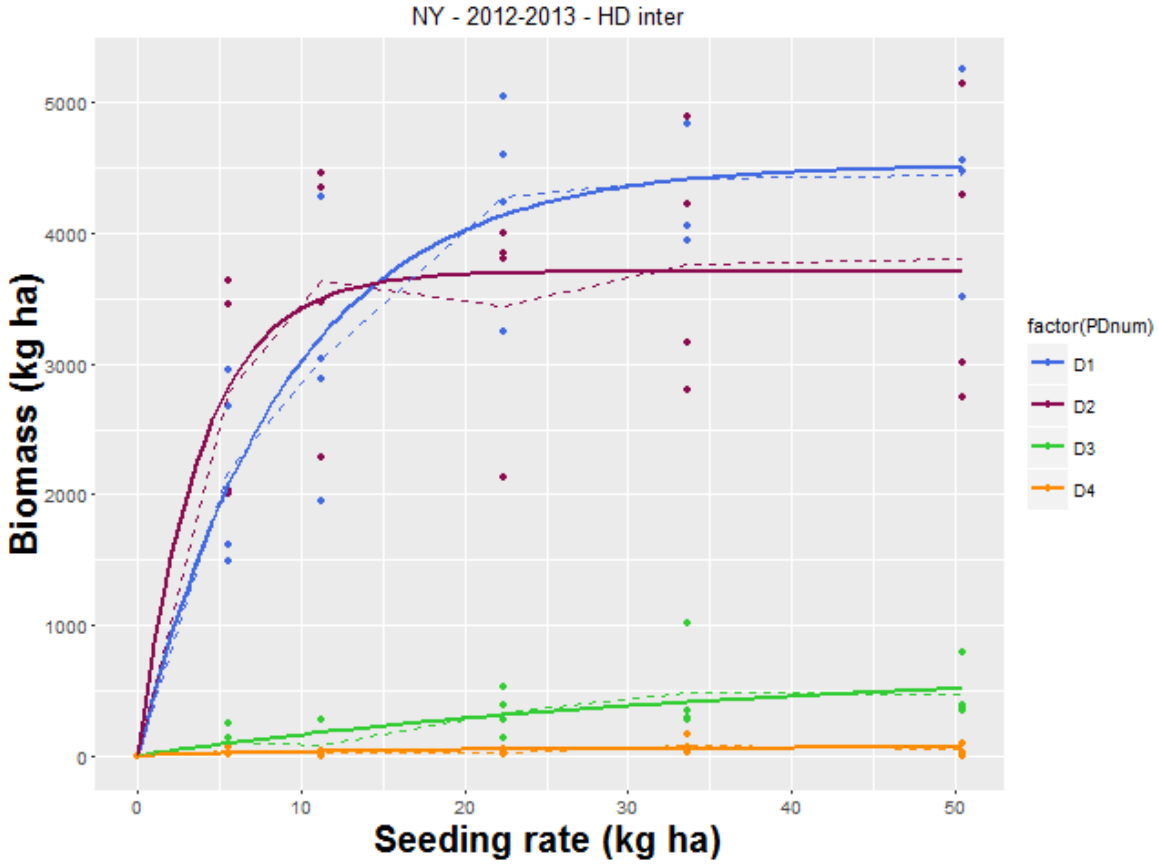
2011
Sept 21
Oct 15

2012
Sept 26
Oct 13
Jan 30*

2013
Sept 30
Oct 25

New York (2012-2013) Intermediate





Anova	P-value
Asym.PD	<0.001
lrc.PD	<0.001

Date	Asymptote (kg/ha)	lrc
D1	4523	-2.2
D2	3706	-1.4
D3	702	-3.6
D4	65	-2.8

Asymptote and slope differed by seeding dates within this site-year

Hairy vetch summary and next steps

- Hairy vetch seeding rate is more important in northern sites and when planting late
- Further examine relationship between seeding rates and dates and quantify compensatory effects
- Determine base temperature (optimization) and develop GDD model for biomass production
- Improve seeding rate and date recommendations, and create map of Northeast showing optimal dates

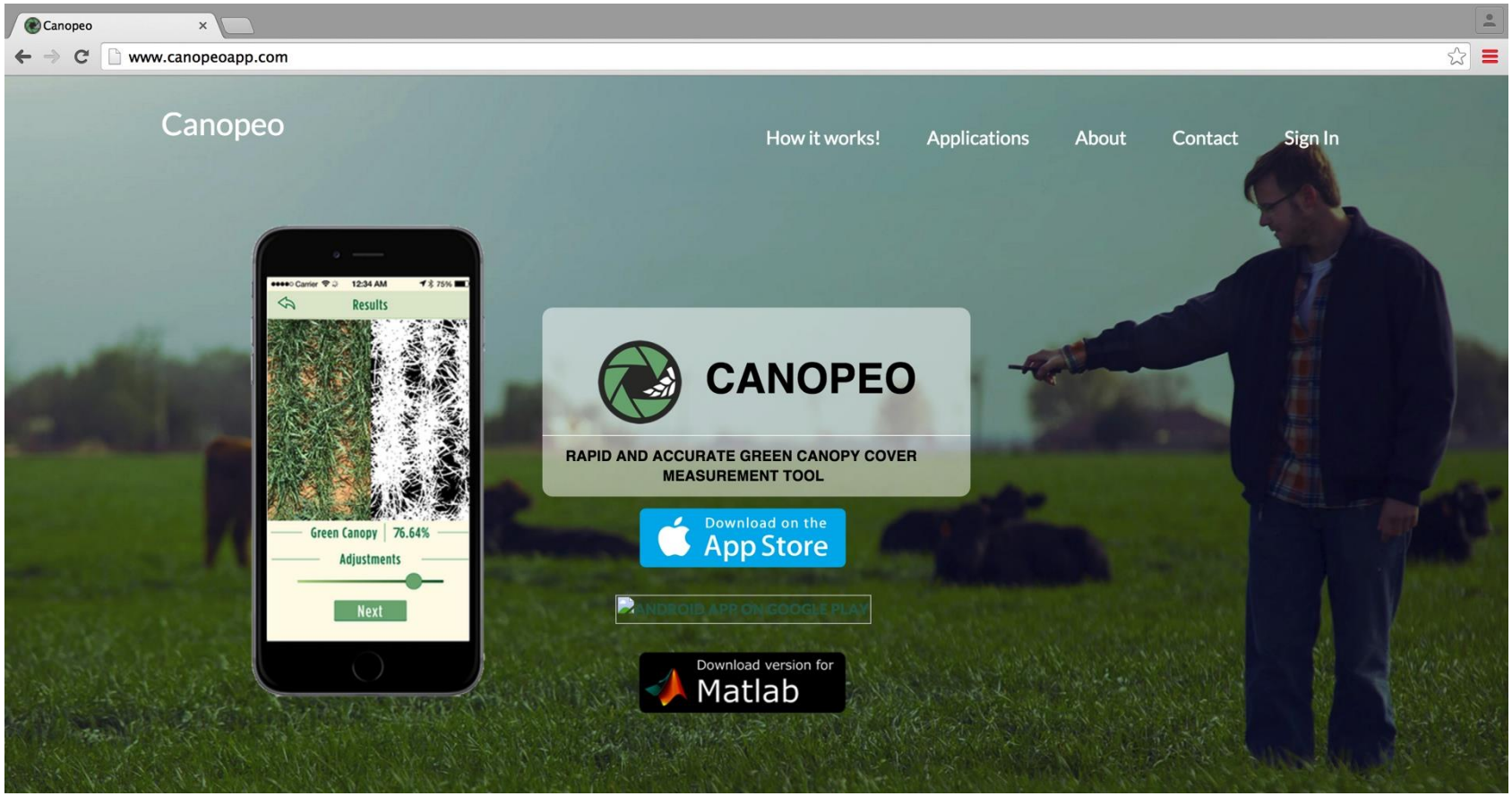
Rates and dates in the classroom

Types of cover crops

- **Catch crops** cycle nutrients
  - Cereal rye, triticale, and oats, etc.
  - Prevent nitrogen from leaching, decrease erosion and phosphorus loss
- **Green manures** provide nitrogen to following crop
  - Hairy vetch and red clover (non-legumes?)
  - Fix nitrogen via symbiotic relationship with *Rhizobium* bacteria
- **Smother crops** grow fast
  - Buckwheat and sorghum sudangrass
  - Compete against weeds through intense shading
- **Biofumigant crops** contain pest suppressing compounds
  - Mustard, radish, sorghum sudangrass
  - Glucosinolates, isothiocyanates, suppress pests (disease and nematodes)

Measuring ground cover from cover crops at different seeding rates

Canopeo for Fractional Ground Cover

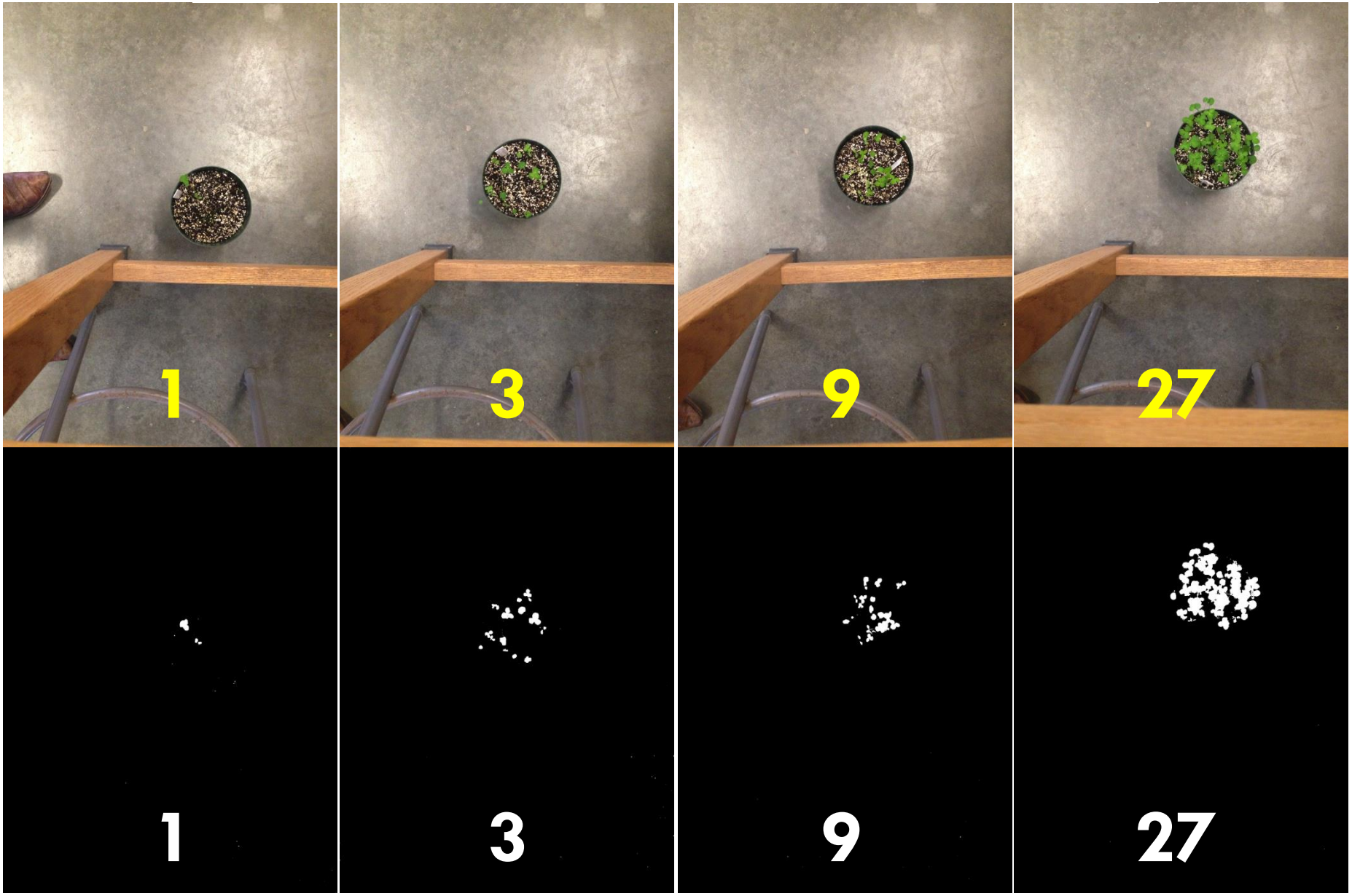


http://www.canopeoapp.com/

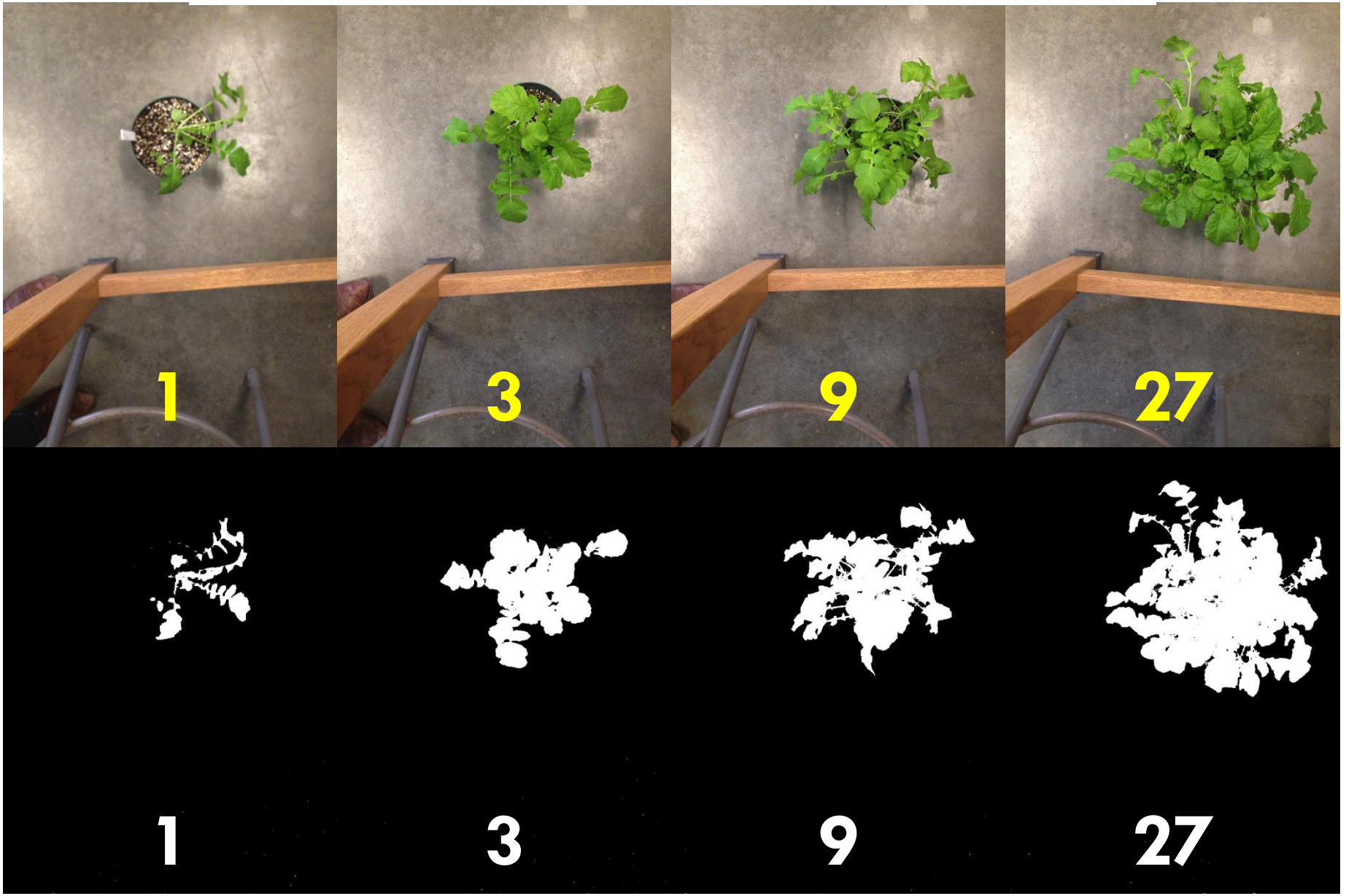
Seeding rates in the classroom

- Lab activity in *Sustainable Soil and Crop Management* at Cornell University
- 4 cover crop species
  - Buckwheat, forage radish, cereal rye, red clover
- 5 seeding rates
  - 1, 3, 9, and 27 seeds/pot + recommended rate
- Seeded 3 weeks before sampling in greenhouse
- Measured height, biomass, and ground cover (Canopeo)

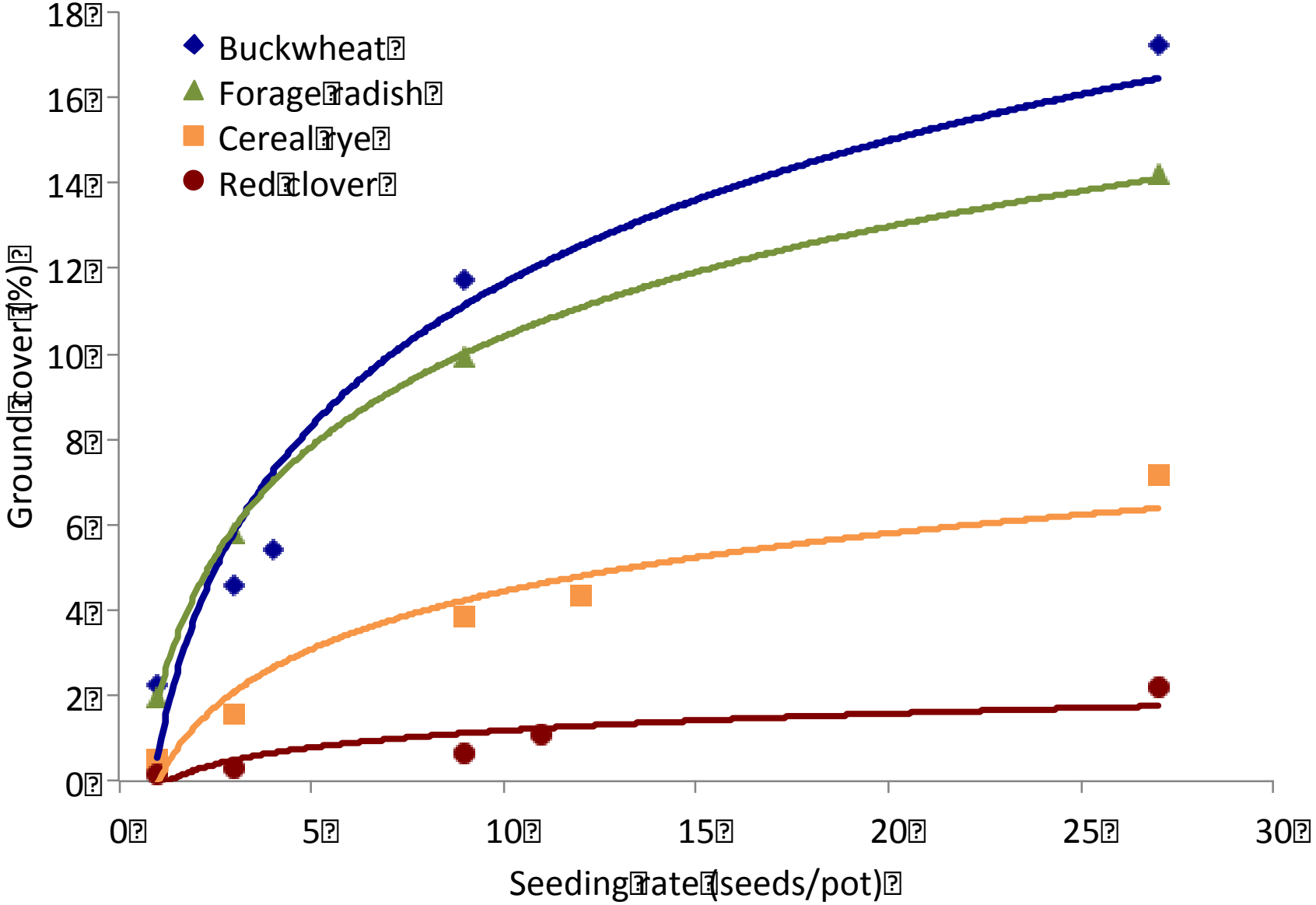
Red clover



Forage radish

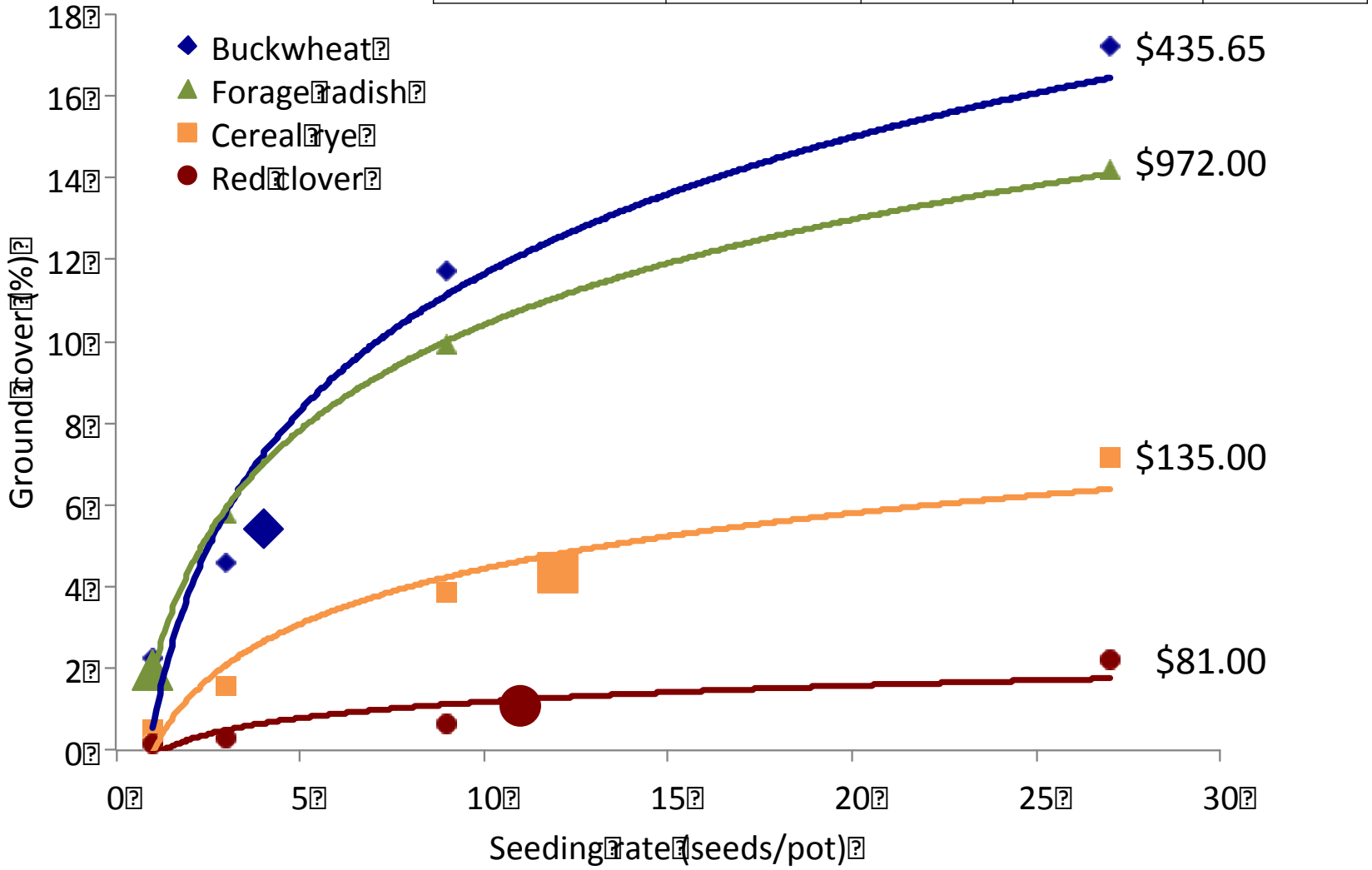


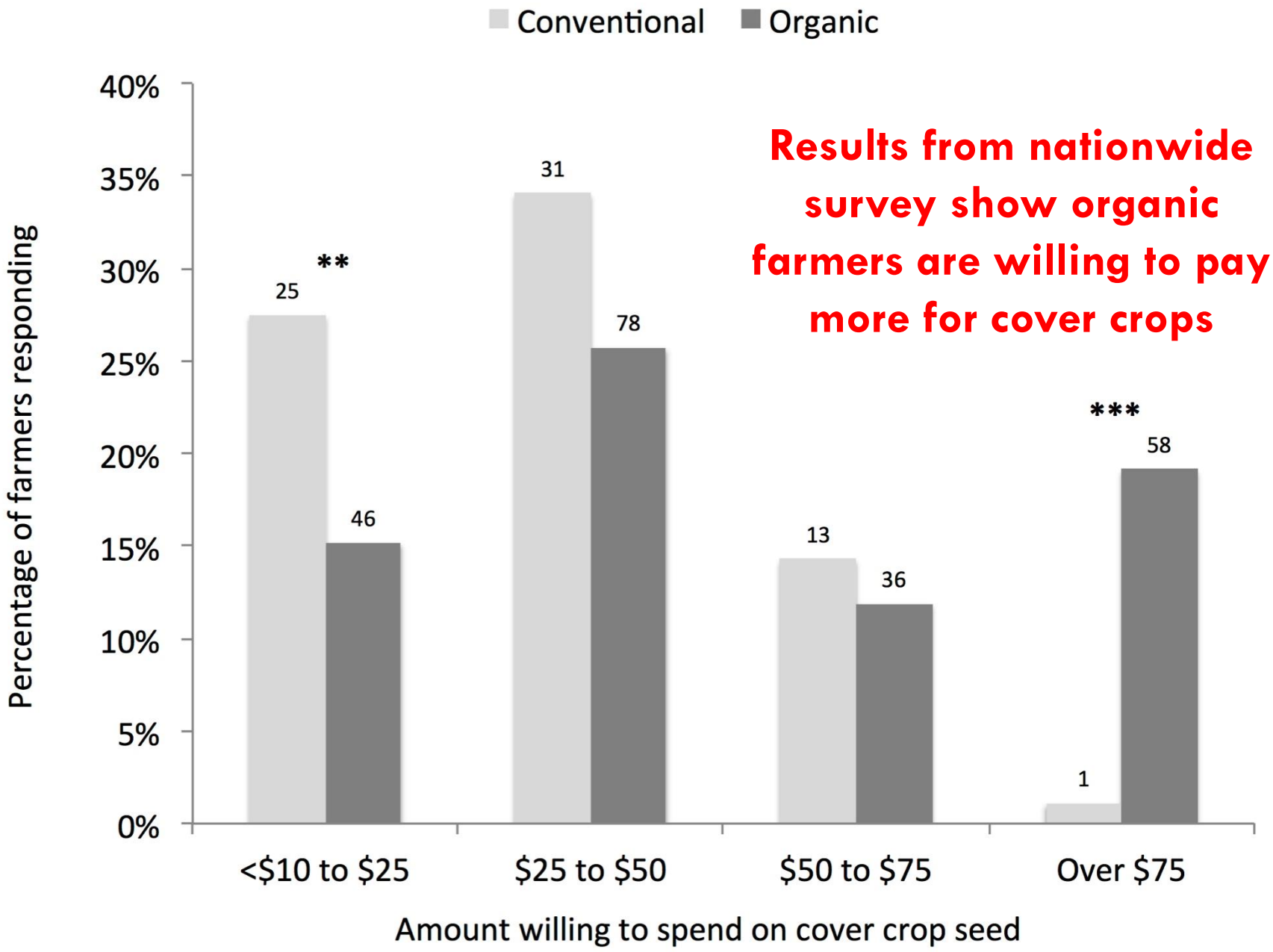
Relative cover at 3 weeks after seeding



Buckwheat, greatest cover for lowest cost

Name	$/lb	$/acre	Target (lb/a)	Seeds/pot
Buckwheat	$1.10	$64.54	60	4
Forage Radish	$3.00	$36.00	12	1
Cereal Rye	$0.50	$60.00	120	12
Red Clover	$3.30	$33.00	10	11





Results from nationwide survey show organic farmers are willing to pay more for cover crops

Wayman, S., L. Kissing Kucek, S. Mirsky, V. Ackroyd, S. Cordeau, and M. Ryan. Cover Crop Practices and Germplasm Improvement Priorities Differ Between Organic and Conventional Farmers. *In Preparation.*

Using seeding rate and dates as a tool

- Ability to manage services with seeding rates depends on type of cover crop
  - Smother crops vs. catch crops
- Need to consider economics
  - Conventional vs. organic
  - Commodity vs. high values crops
- Adaptive management
  - Potential to reduce seeding rates when planting early
  - Increase seeding rates when planting late


Thank you
Visit our website:
scslabcu.wordpress.com