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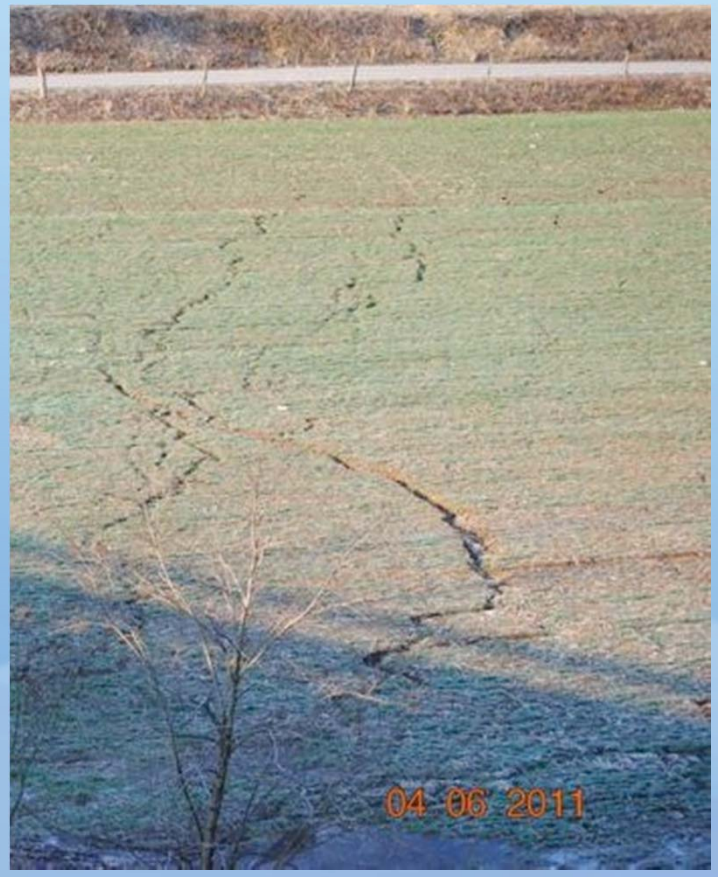
COVER CROP MIXTURES AFTER CORN SILAGE

Penn State Extension

Cover Crops – Why?

- Erosion control
- Water management
- Nutrient retention and recycling
- Soil compaction reduction
- Weed control
- Potential to provide feed



“Without Carrot or Stick”

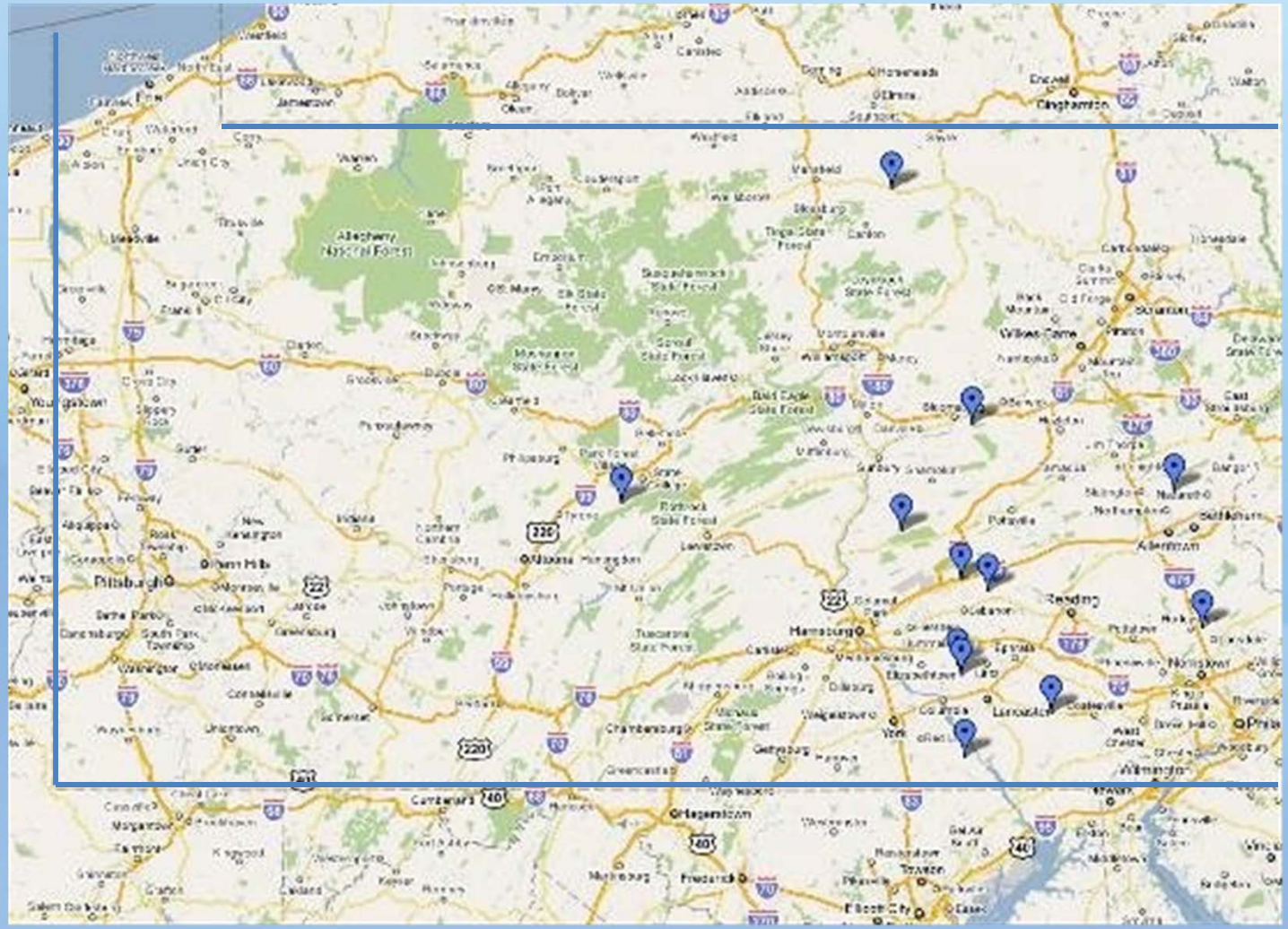
- Stimulate voluntary adoption through education and demonstration
- Using Cooperative Extension System
- Work with 10 small/medium size dairy farms in Chesapeake Bay watershed in Pennsylvania
- Focus on cover crops after corn silage
  - Bare soils + manure = erosion + nutrient loss
  - Early harvest = larger window for cover crops
- Evaluate mixtures of cover crops in small replicated plots
- Farmer evaluates mixture on large scale
- *Active involvement of farmers*
- *Measurement of increase in cover crop adoption using remote sensing data*

Cover crop mixtures

- Search for complementarity

- Soil erosion control and nutrient uptake in fall vs winter vs spring
- Nitrogen fixation potential
- Root system – taproot vs fine roots
- Feed production potential in fall vs spring

Example of Geographic Spread (2010/11)



Without Carrot or Stick Cover Crop Mixtures

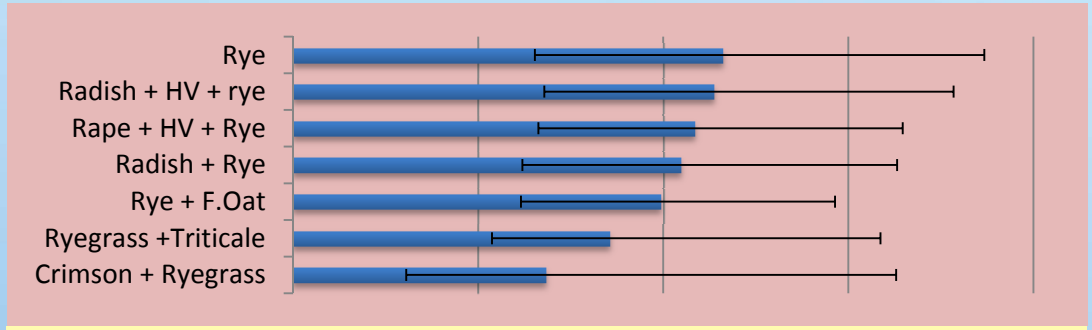
2010/11	2011/12	2012/13
Crimson clover *"Dixie"* + Annual ryegrass *"KB Royal"*	Crimson clover *"Dixie"* + Annual ryegrass *"402 KB"*	Crimson clover *"Dixie"* + Annual ryegrass *"402 KB"*
Annual ryegrass *"KB Royal"* + Triticale *"815"*	Crimson clover *"Dixie"* + Triticale *"815"*	Crimson clover *"Dixie"* + Triticale *"718"*
Cereal rye *"Aroostook"* + Forage Oat *"Jerry"*	Crimson clover *"Dixie"* + Forage oat *"Everleaf"*	Crimson clover *"Dixie"* + Grain oat *"Herculex"*
Rape *"Bonar"* + Hairy vetch + Cereal rye *"Aroostook"*	Annual ryegrass "402 KB"+ Forage oat "Everleaf"	Grain oat *"Herculex"* + Annual ryegrass *"402 KB"*
"Tillage radish" + Hairy vetch + Cereal rye "Aroostook"	Forage oat *"Everleaf"* + Cereal rye *"Aroostook"*	Grain oat *"Herculex"* + Cereal rye *"Aroostook"*
"Tillage radish" + Cereal rye *"Aroostook"*	Grain oat *"Herculex"* + Cereal rye *"Aroostook"*	Grain oat *"Herculex"* + Cereal rye *"Huron"*
Cereal rye *"Aroostook"*	*"Tillage radish"* + Hairy vetch + Cereal rye "Aroostook"	"Tillage radish" + Hairy vetch + Cereal rye "Aroostook"

Spring Biomass

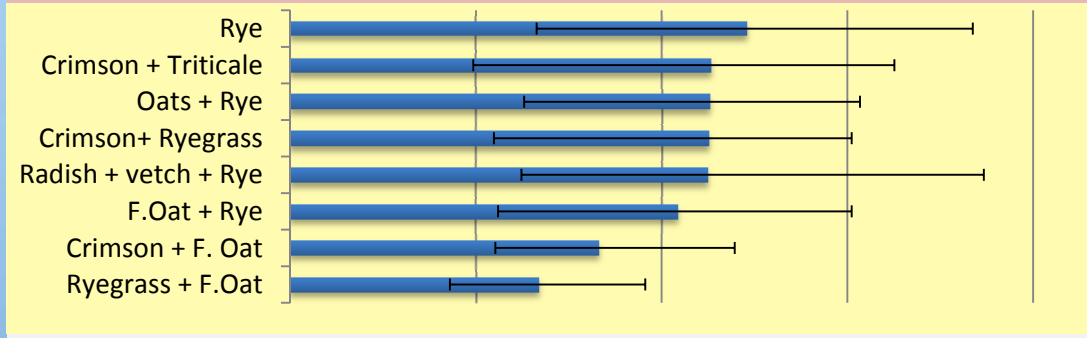
Spring Cover crop Biomass (lbs/A)

Summary of 9-10 annual on-farm cover crop trials in PA

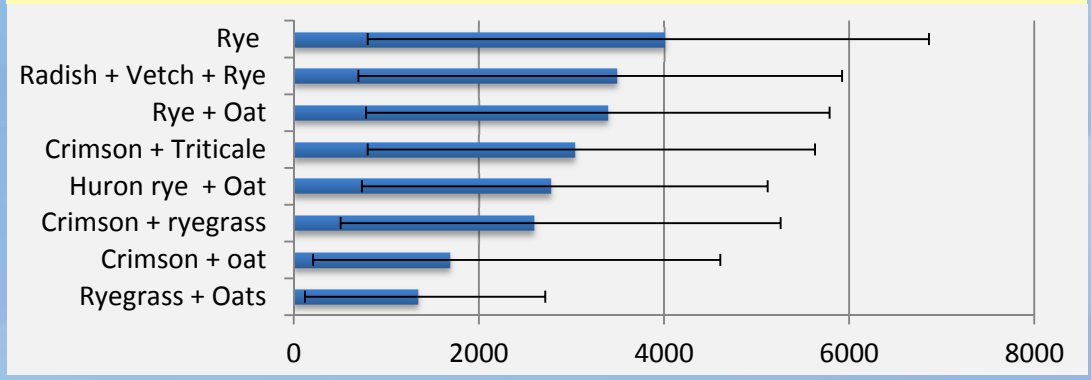
Spring 2011



Spring 2012



Spring 2013



Dry matter (lbs/A), average, minimum and maximum

Calculations based on 4 reps (2011) or 3 reps (2012+2013)

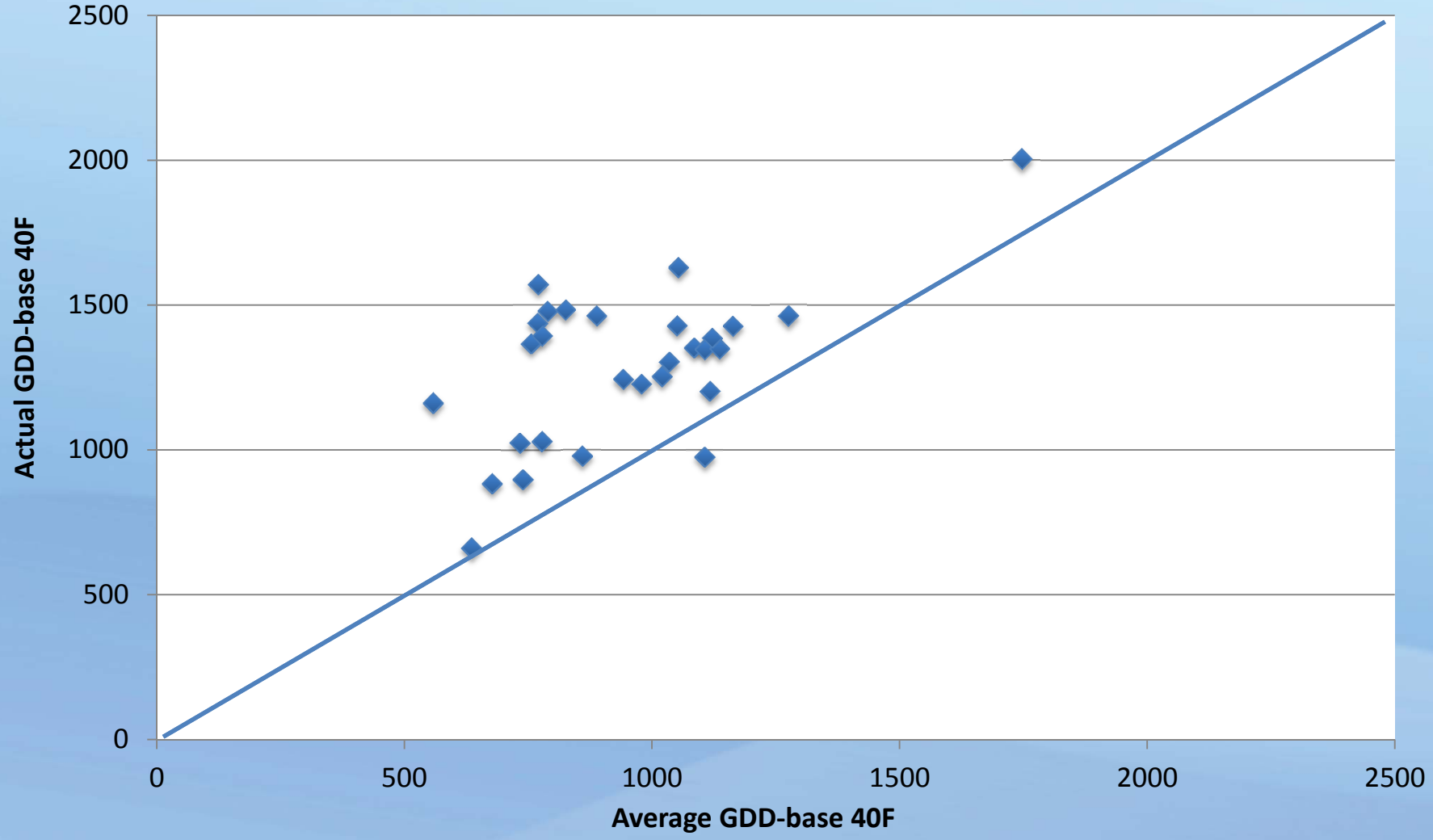
Spring Cover crop Biomass N (lbs/A)

Summary of 9-10 annual on-farm cover crop trials in PA

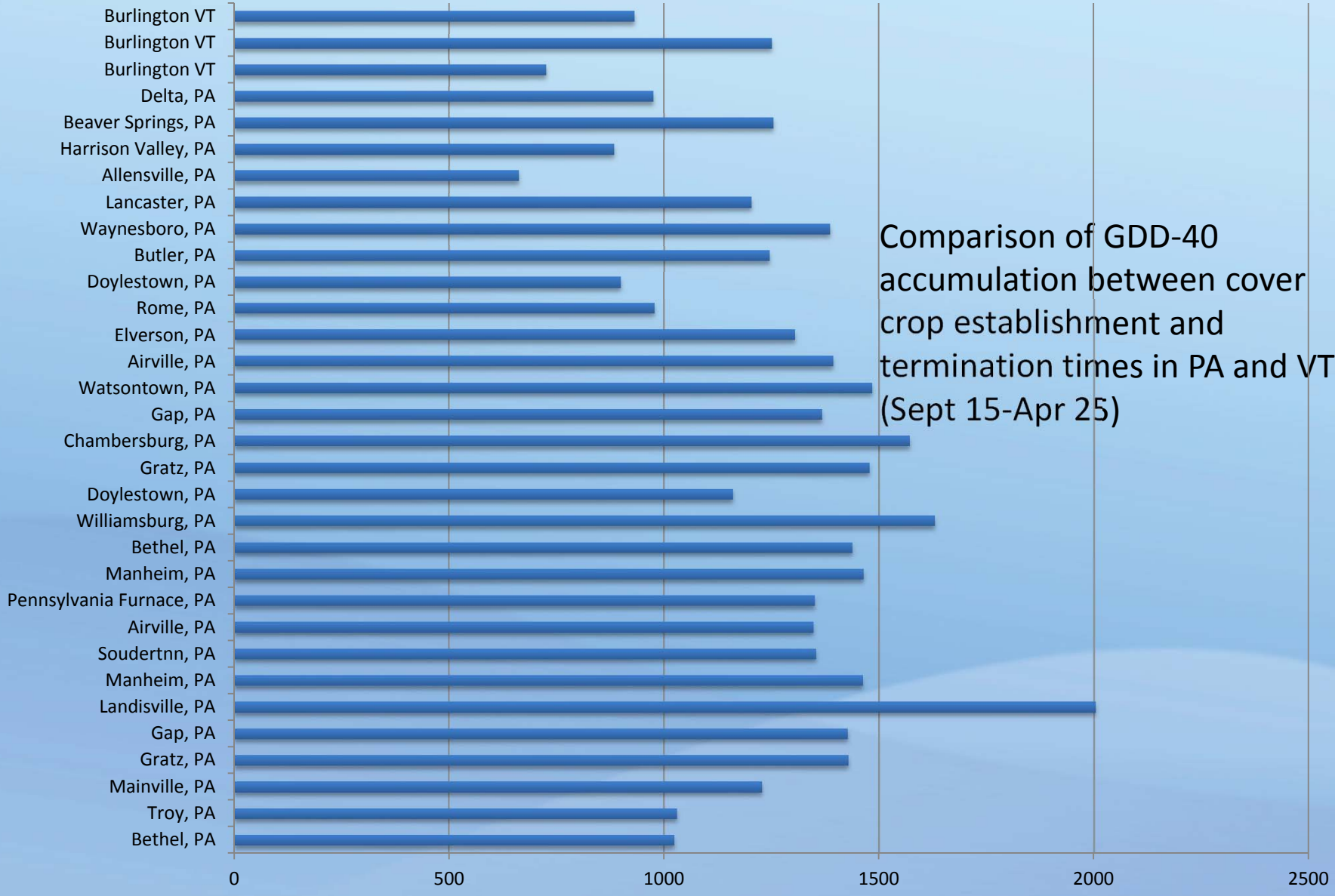
Calculations based on 4 reps (2011) or 3 reps (2012+2013)

		Average	Minimum	Maximum
		(lbs/A)		
Spring 2011	Crimson + Ryegrass	70	21	104
	Ryegrass +Triticale	73	41	126
	Rye + F.Oat	76	44	139
	Radish + Rye	82	49	161
	Rape + Vetch + Rye	87	50	169
	Radish + Vetch + rye	89	52	164
	Rye	93	47	182
Spring 2012	Ryegrass + F.Oat	52	21	74
	F.Oat + Rye	69	26	107
	G.Oats + Rye	73	34	97
	Radish + Vetch + Rye	82	39	120
	Rye	84	35	120
	Crimson + F. Oat	103	57	144
	Crimson+ Ryegrass	106	63	140
	Crimson + Triticale	112	65	147
Spring 2013	Ryegrass + G.Oat	31	5	72
	Crimson + G.Oat	54	7	135
	Huron rye + G.Oat	66	16	125
	Rye + G.Oat	66	17	122
	Crimson + Ryegrass	70	18	125
	Radish + Vetch + Rye	79	16	158
	Rye	82	16	176
	Crimson + Triticale	83	23	130

30-yr average vs actual GDD-base 40 in study sites between Corn silage harvest and corn planting time in 2011-2013



Growing degree calculations from
http://www.weather.com/outdoors/agriculture/growing-degree-days/



Comparison of GDD-40 accumulation between cover crop establishment and termination times in PA and VT (Sept 15-Apr 25)

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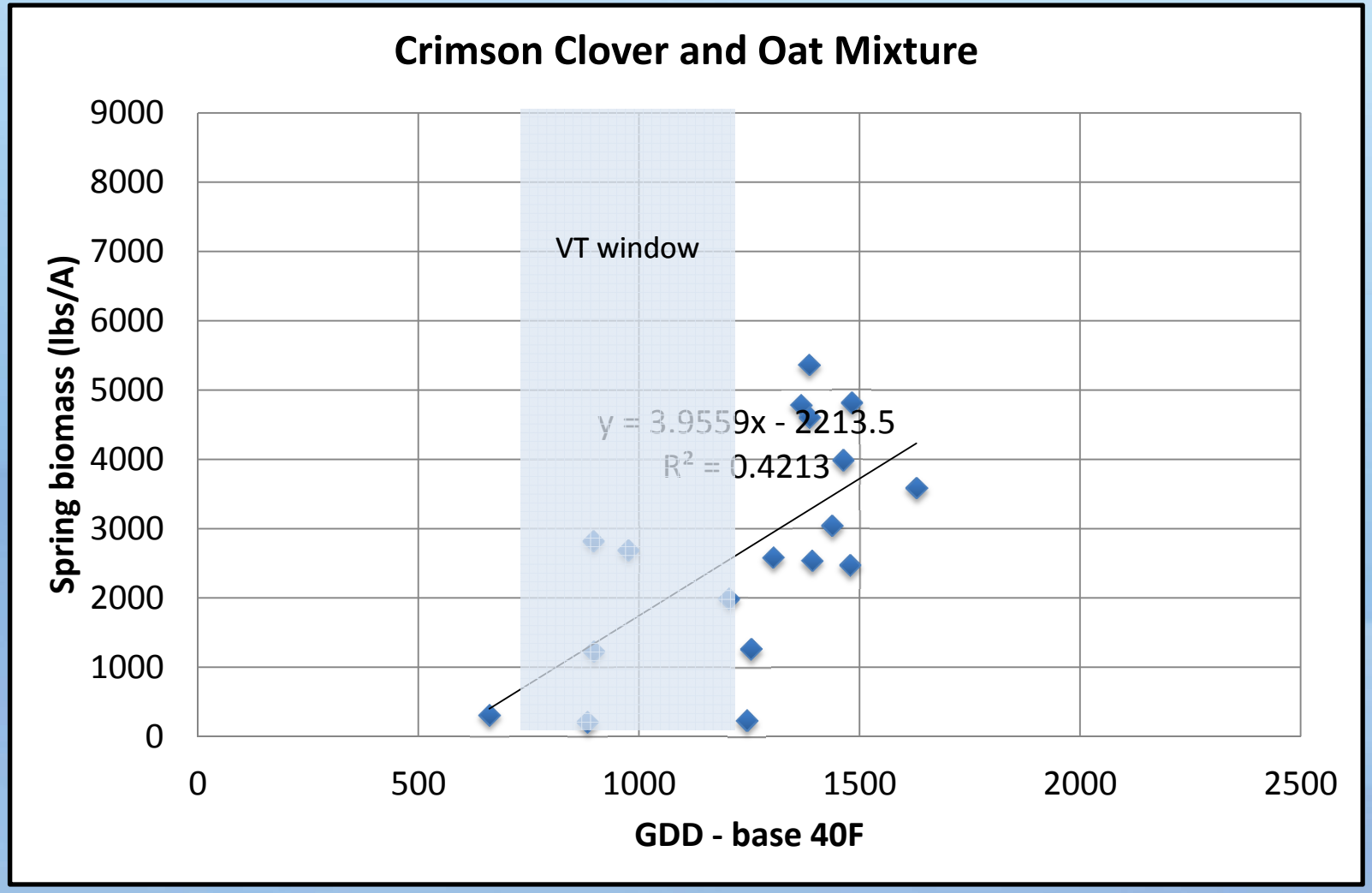
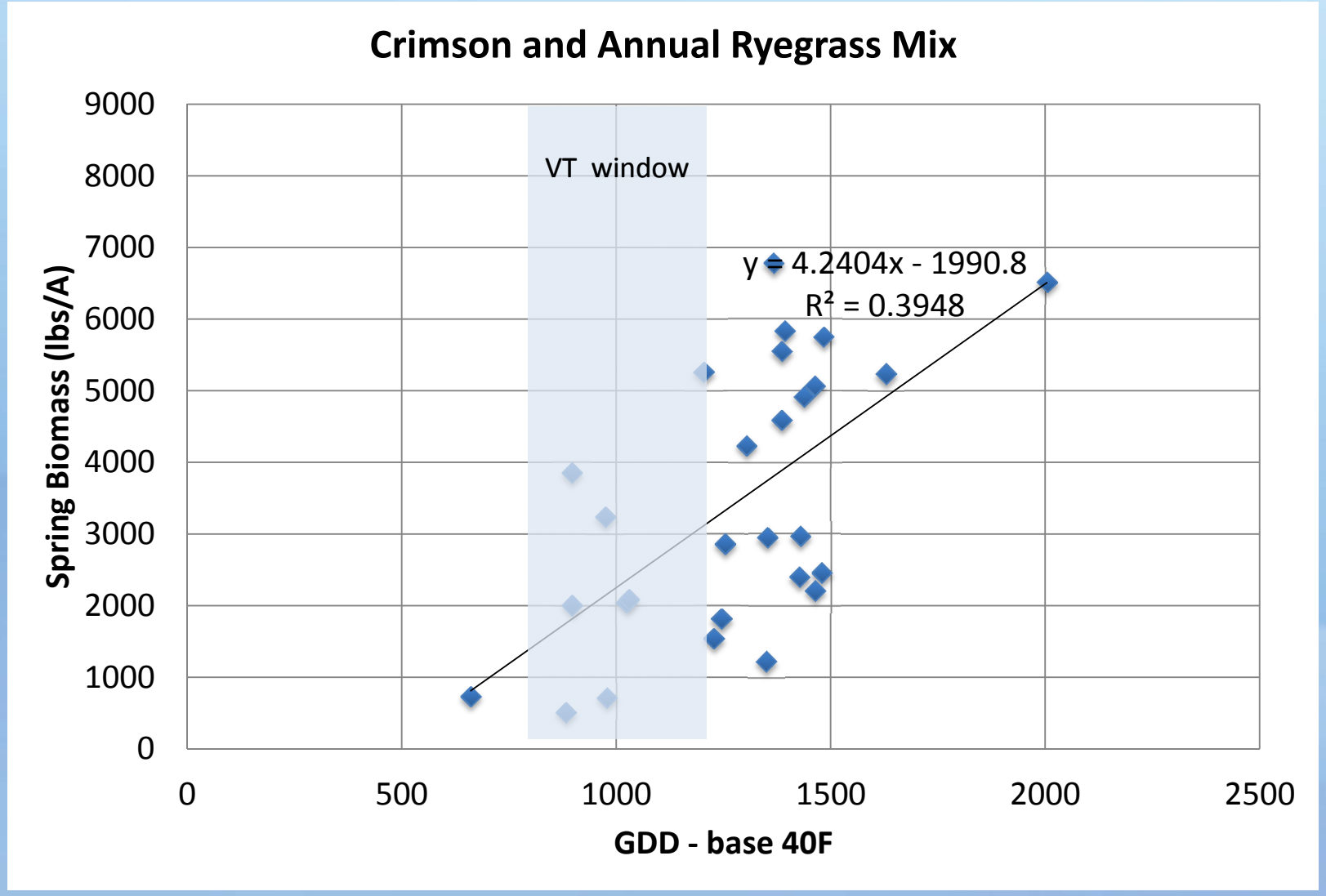
Spring Biomass vs GDD accumulation



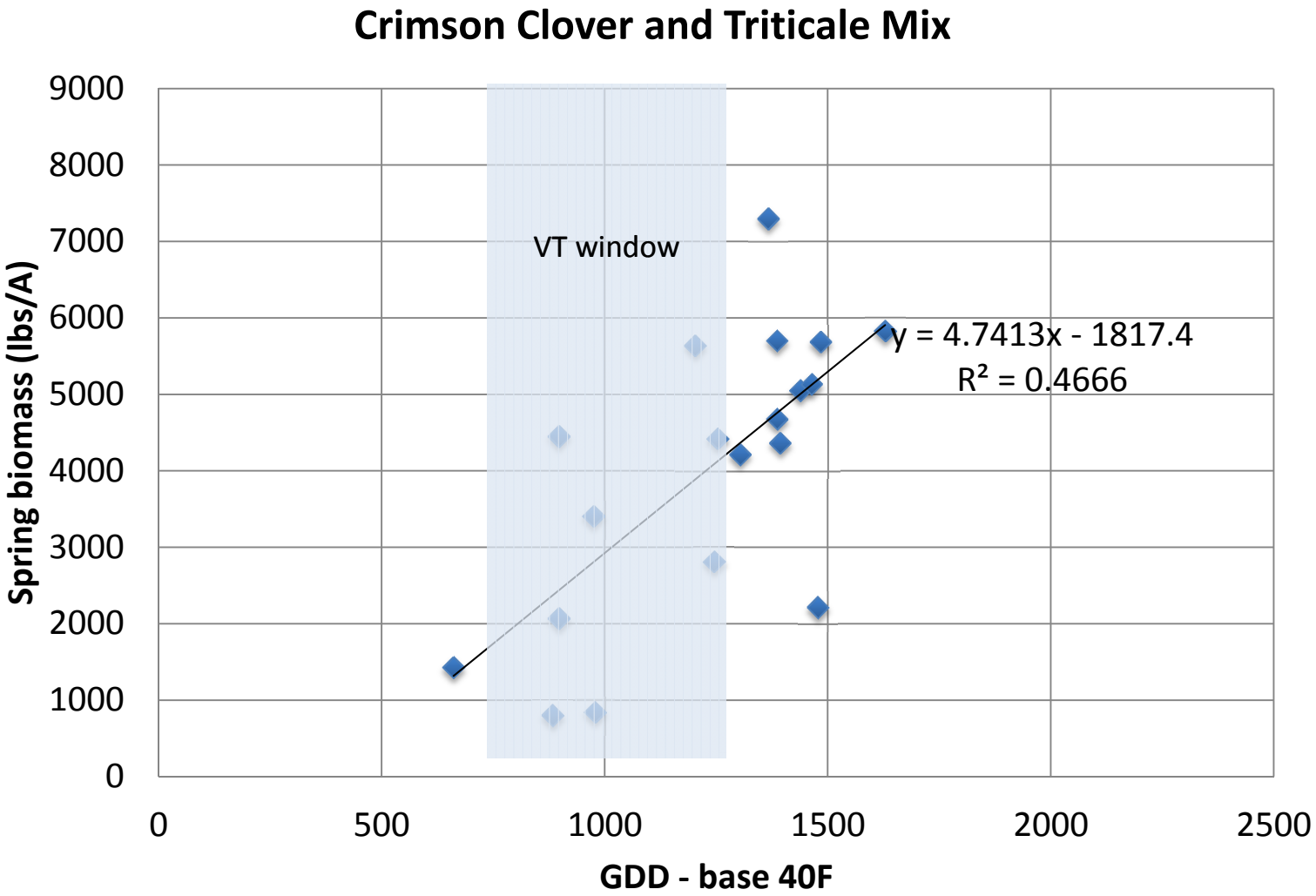
Mid-May picture of crimson clover established with oats in late August in Central Pennsylvania

Spring picture of crimson clover/oat in spring where oat was very competitive

Spring Biomass vs GDD accumulation



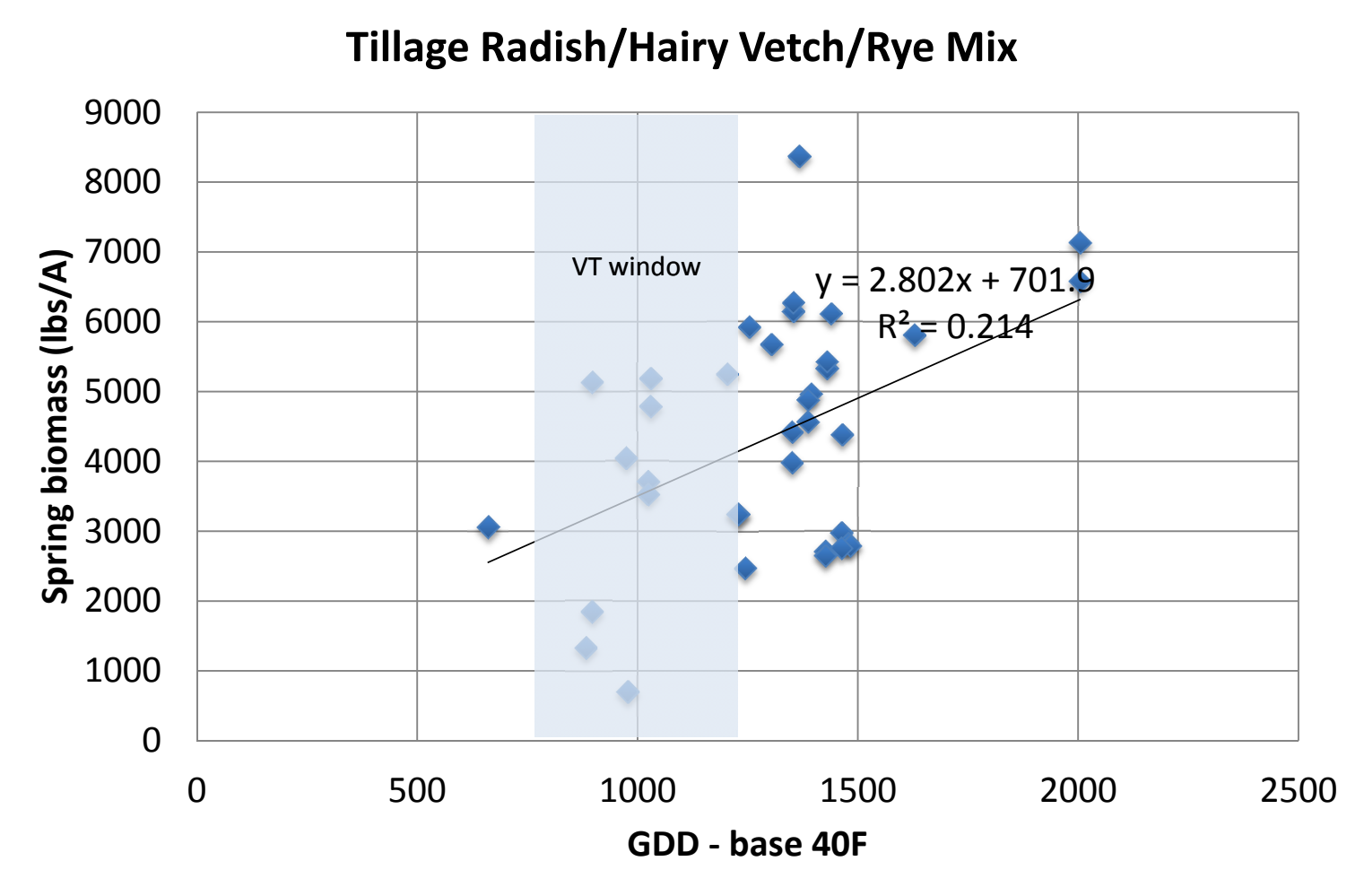
Spring Biomass vs GDD accumulation



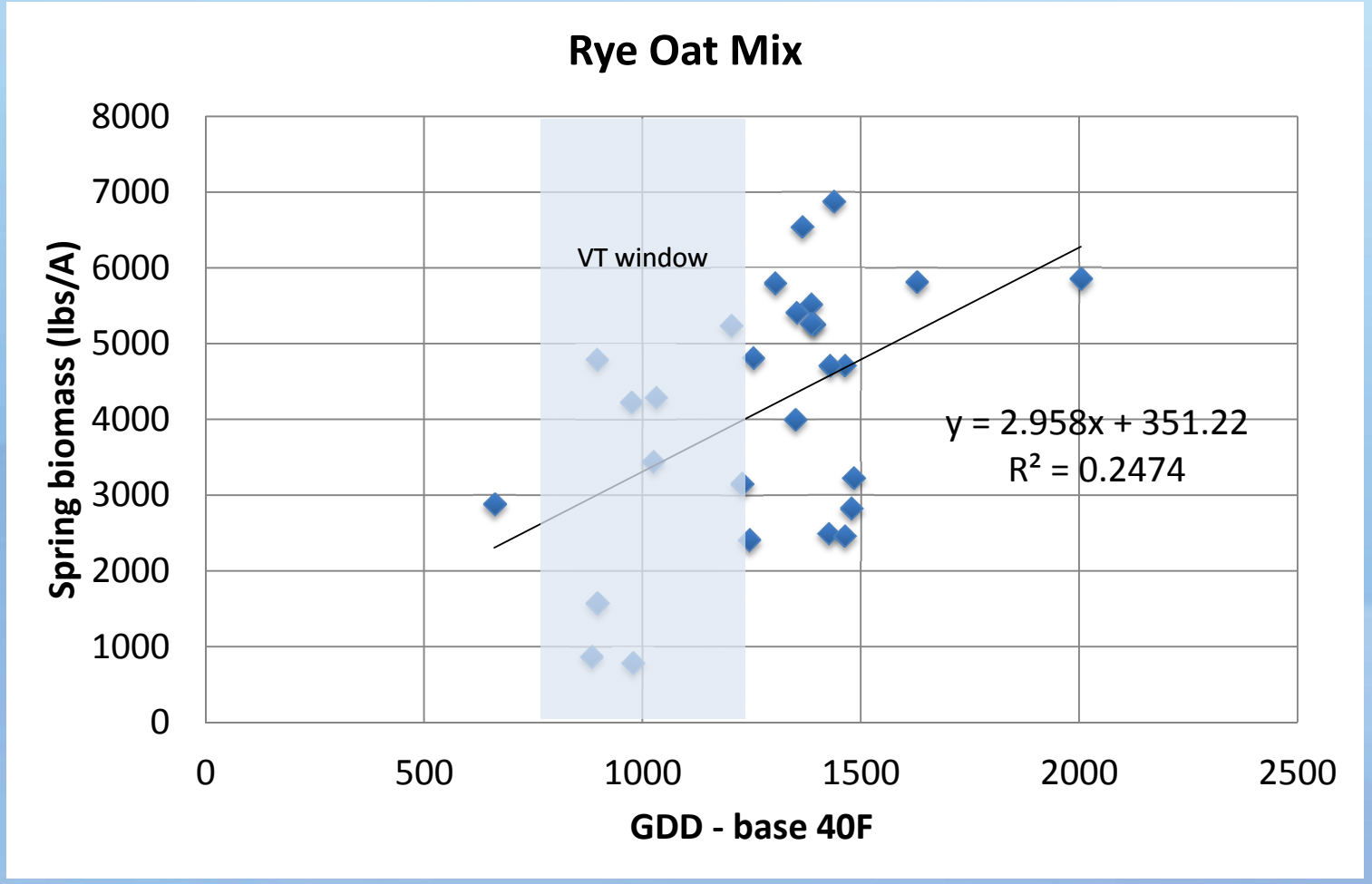

Crimson clover/annual ryegrass
Crimson clover/triticale


Ryegrass interseeded into corn
Ryegrass/red clover interseeded into corn

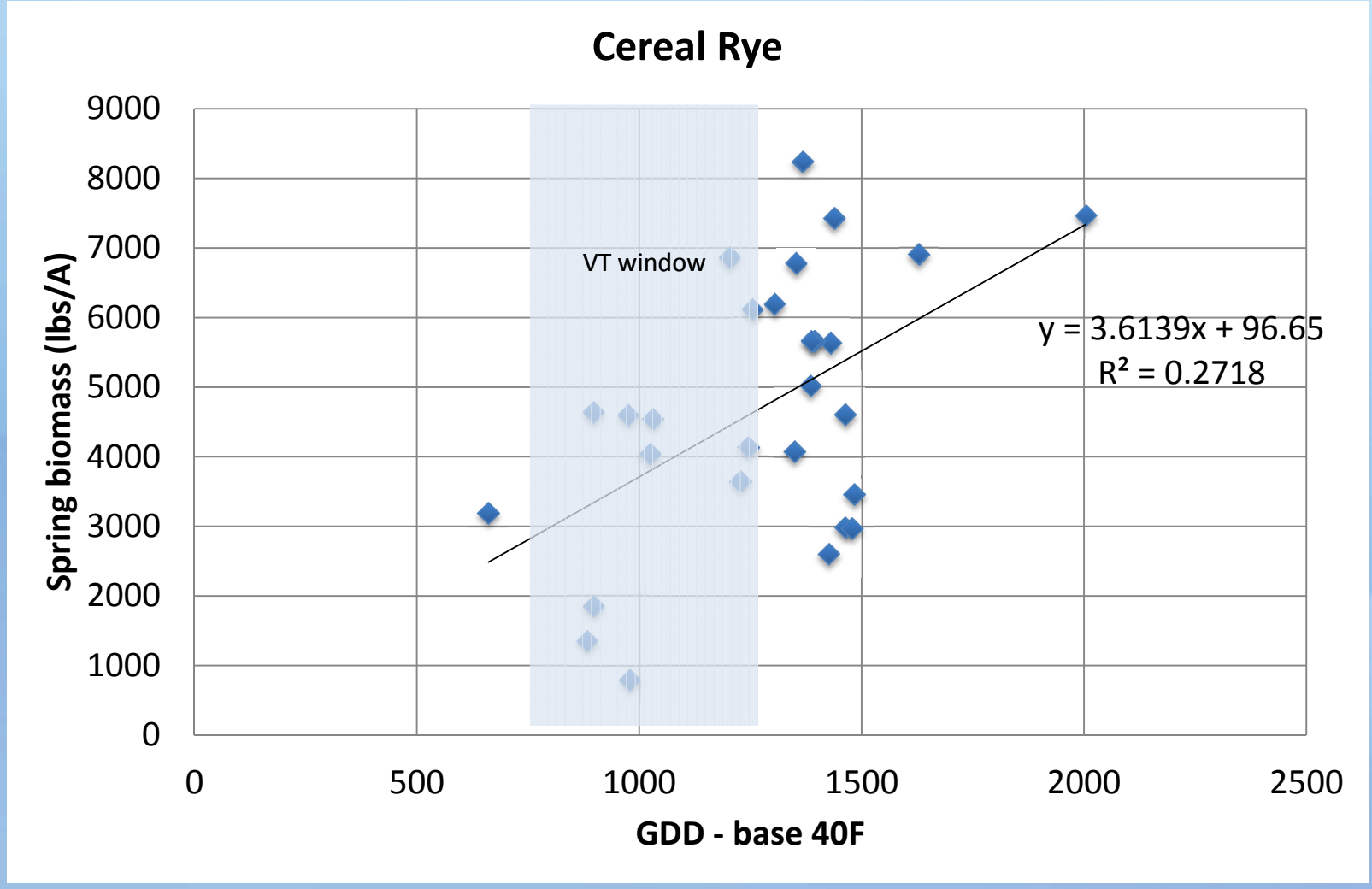
Spring Biomass vs GDD accumulation



Spring Biomass vs GDD accumulation



Spring Biomass vs GDD accumulation



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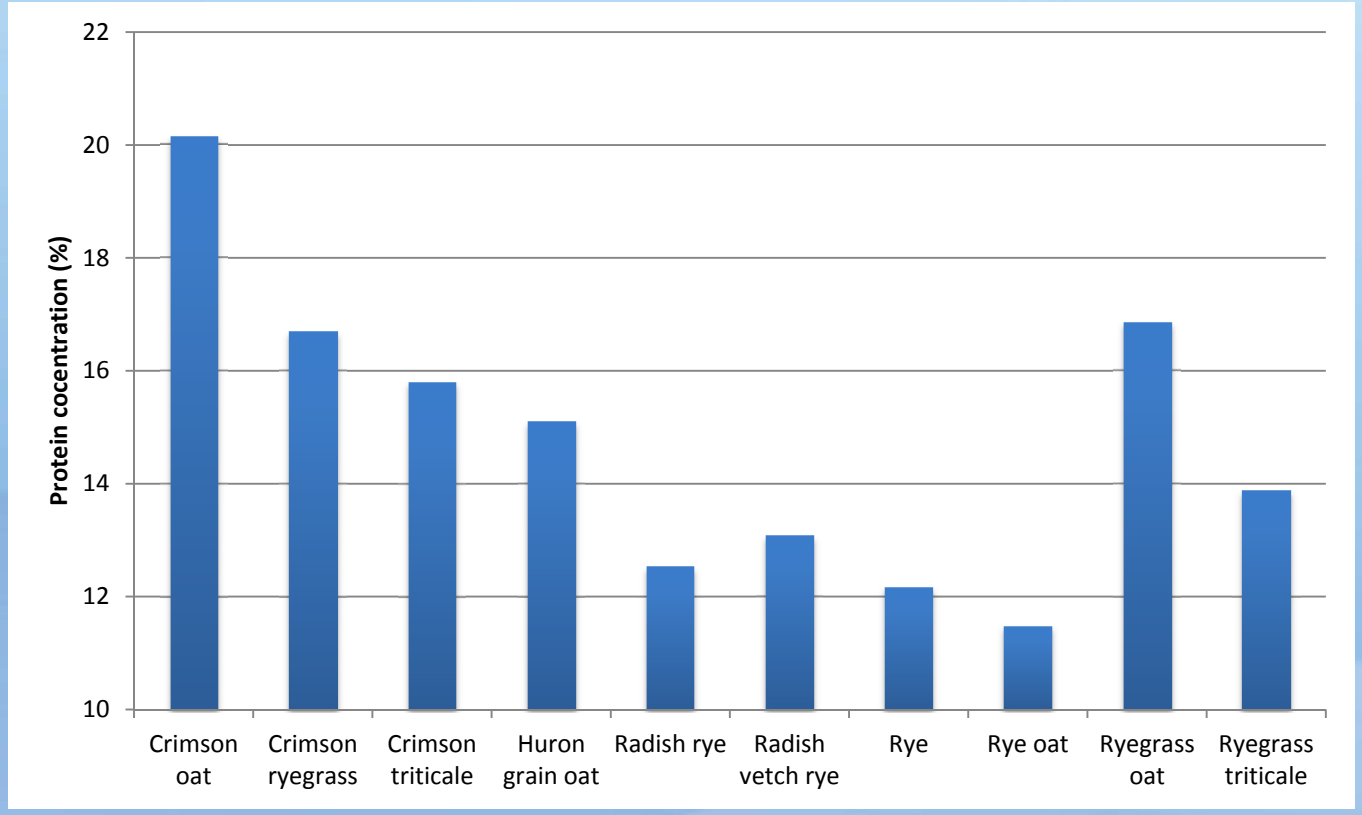
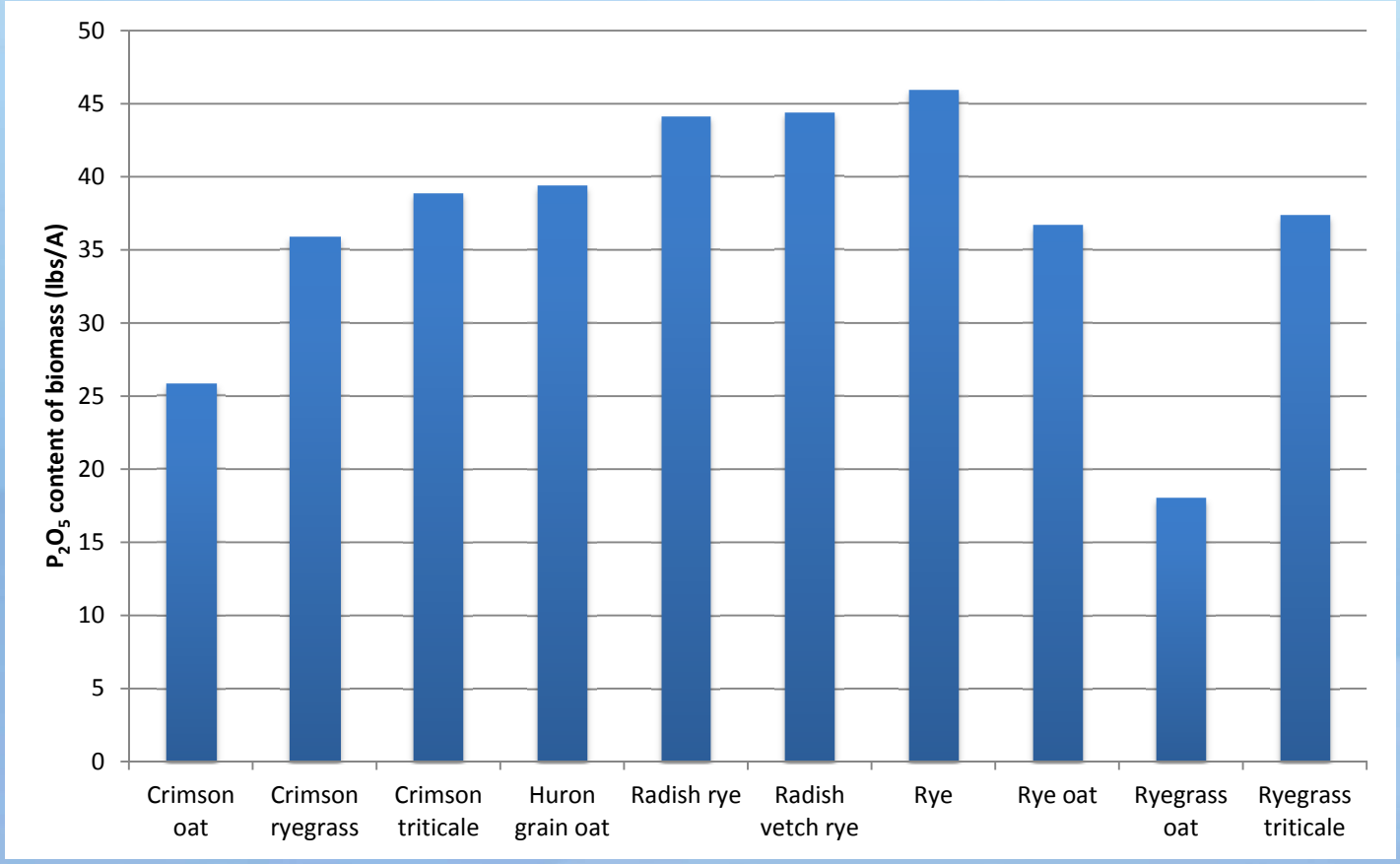
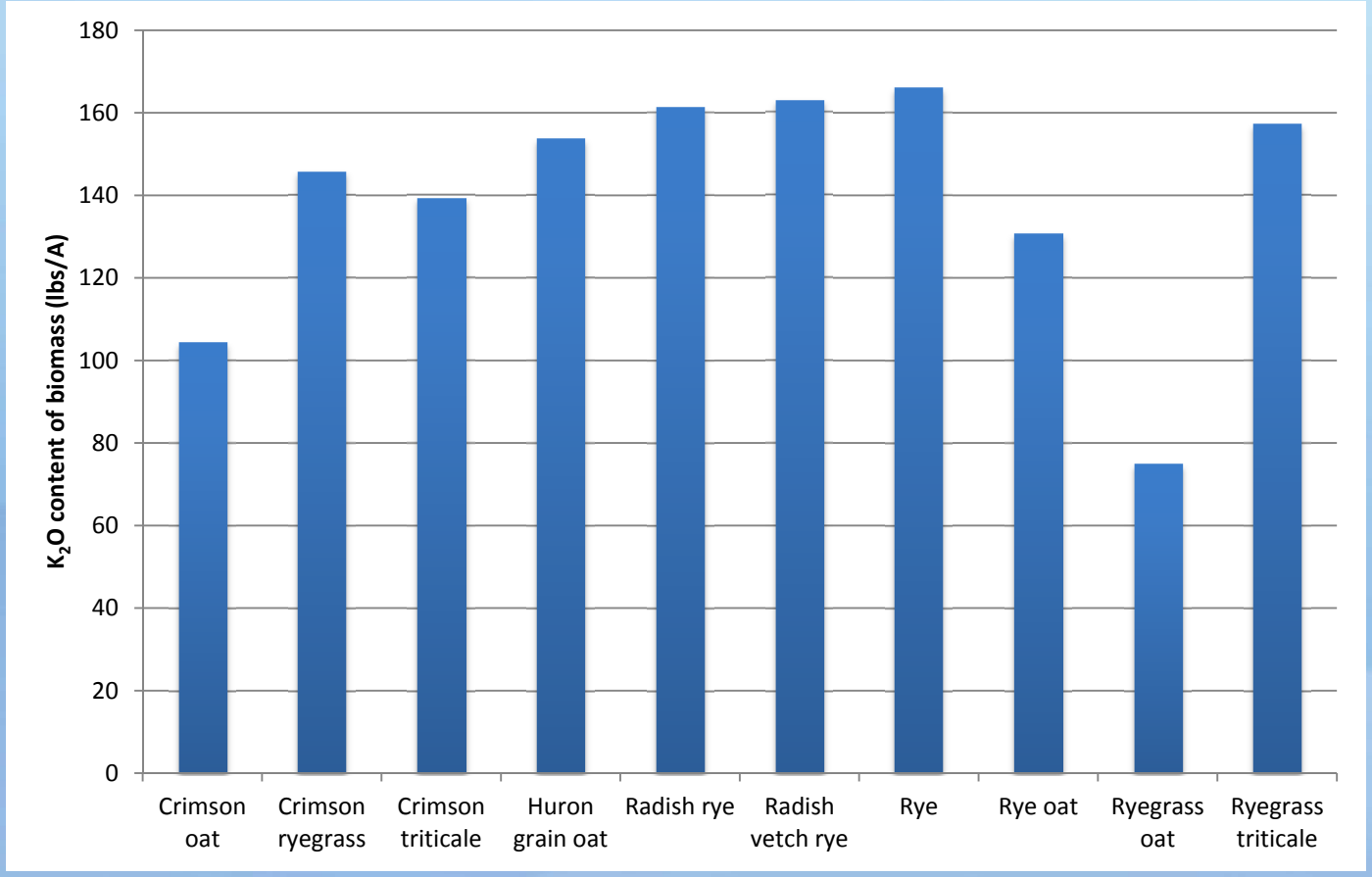
Average Protein concentration



Average Phosphorus content in biomass



Average potash content



Outreach Activities

- 55 Spring and winter cover crop walks
- 1150 participants (incl. many Anabaptist)
- Many in-door presentations
- Field Crop Newsletter articles
- Interviews and articles in trade journals

Determination of Project Impact: Increase in cover crop after corn using remote sensing

Imagery dates and percent coverage of each county

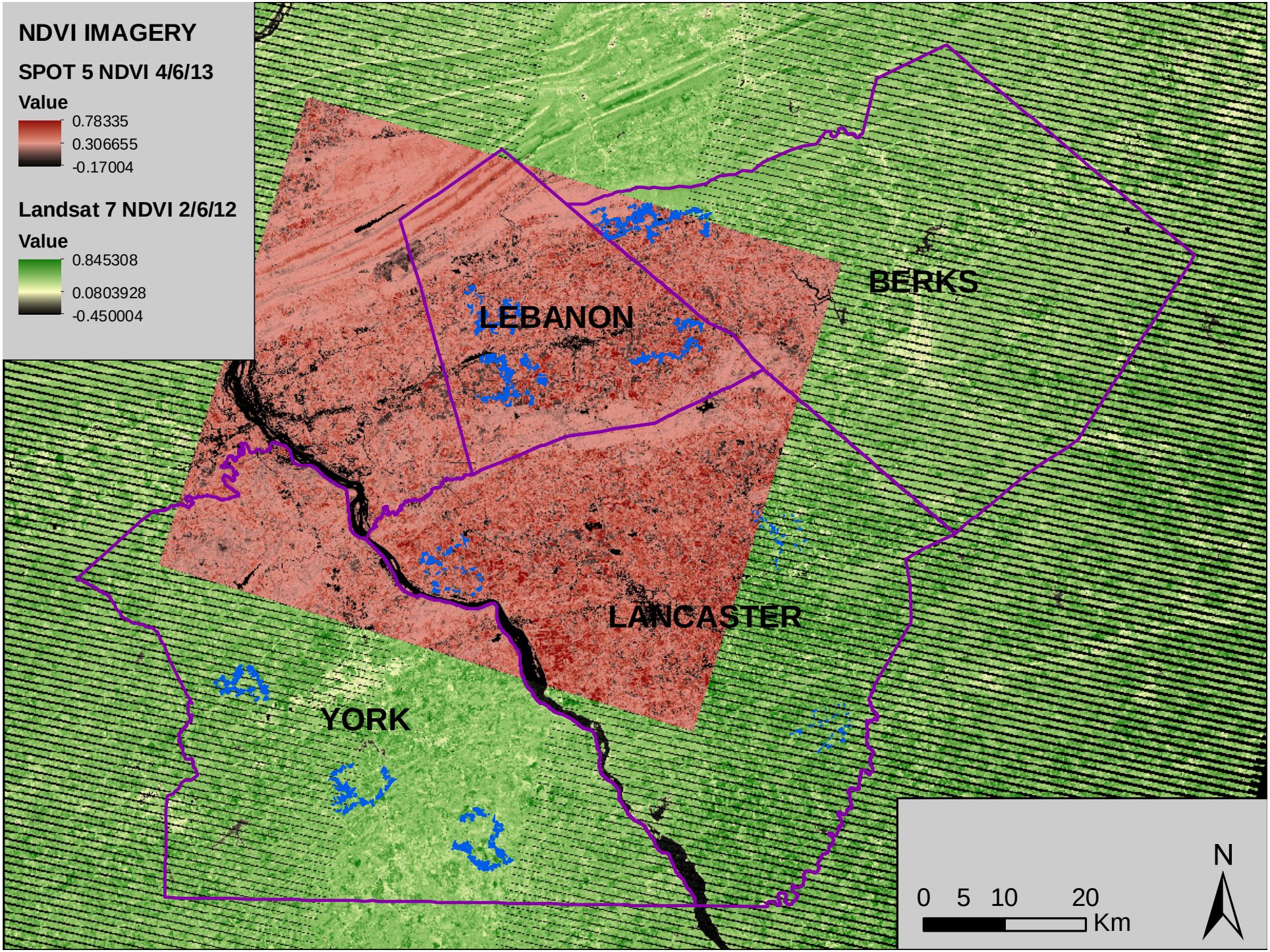
YEAR	IMAGE_DATE	GDD0 *	SENSOR	Berks	Lancaster	Lebanon	York
2009-10	3/20/2010	876	L7	75.2	85.8	96.8	91.8
2010-11	3/7/2011	713	L7	76.0	88.1	75.2	74.2
2011-12	2/6/2012	865	L7	80.5	87.6	96.5	91.0
2012-13	4/6/2013	895	SPOT 5	15.3	49.4	99.8	20.5

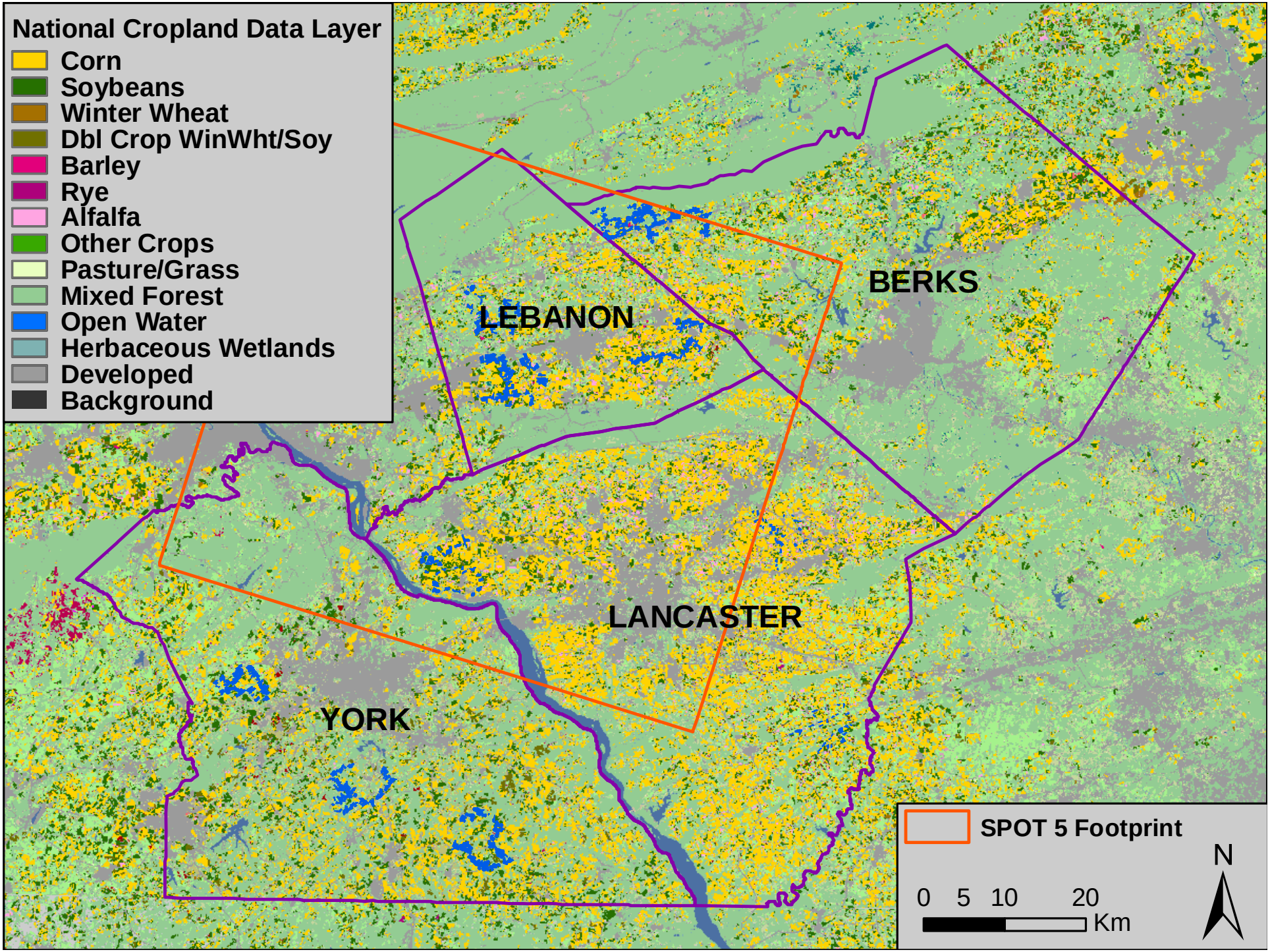
*GDD0 is the accumulated growing degree between October 1st and the image date

We selected the best available springtime imagery for each year. In 2012-13 all Landsat images were cloudy, so a SPOT image was used.

Landsat 7 (L7) has a scan line error that results in a portion of the imagery being lost; this is concentrated in the outer edges of the imagery, and is assumed to be otherwise random.

The SPOT image is small, and is centered over the Conewago. It therefore preferentially sampled portions of Berks (biased toward cropland) and York (biased toward forest)


NDVI IMAGERY
SPOT 5 NDVI 4/6/13
Value
0.78335
0.306655
-0.17004
Landsat 7 NDVI 2/6/12
Value
0.845308
0.0803928
-0.450004
BERKS
LEBANON
LANCASTER
YORK
0 5 10 20
Km
N


National Cropland Data Layer
Corn
Soybeans
Winter Wheat
Dbl Crop WinWht/Soy
Barley
Rye
Alfalfa
Other Crops
Pasture/Grass
Mixed Forest
Open Water
Herbaceous Wetlands
Developed
Background
LEBANON
BERKS
LANCASTER
YORK
SPOT 5 Footprint
0 5 10 20
Km
N

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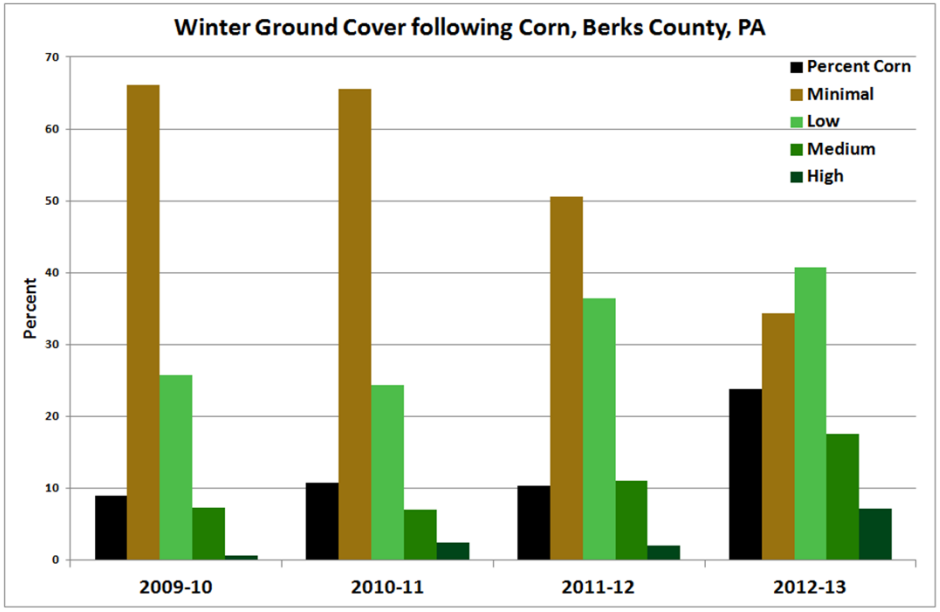

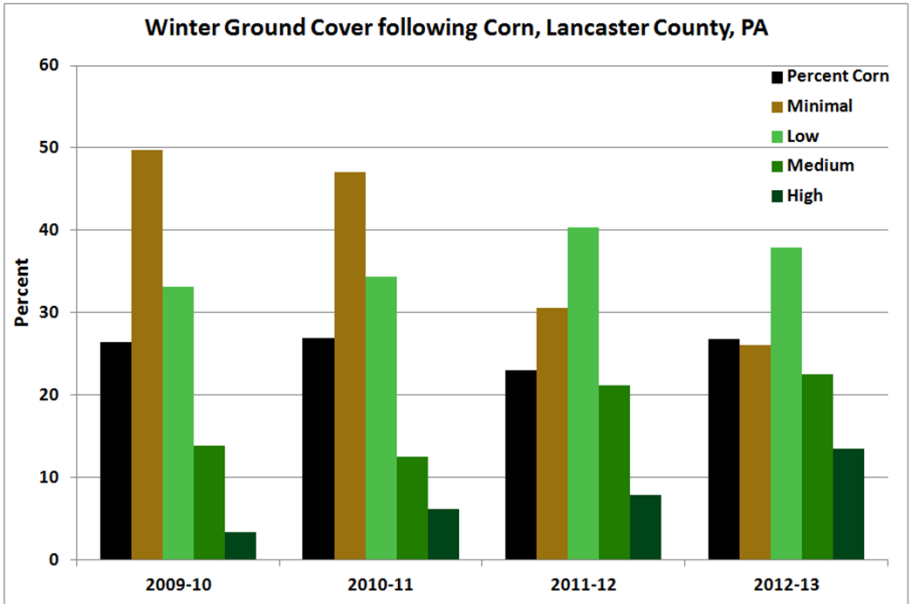

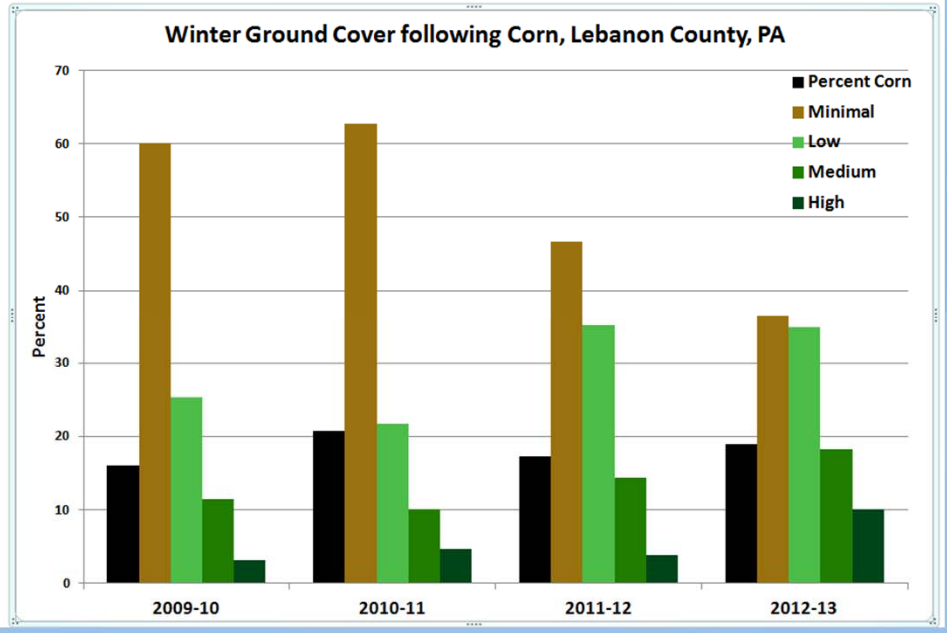

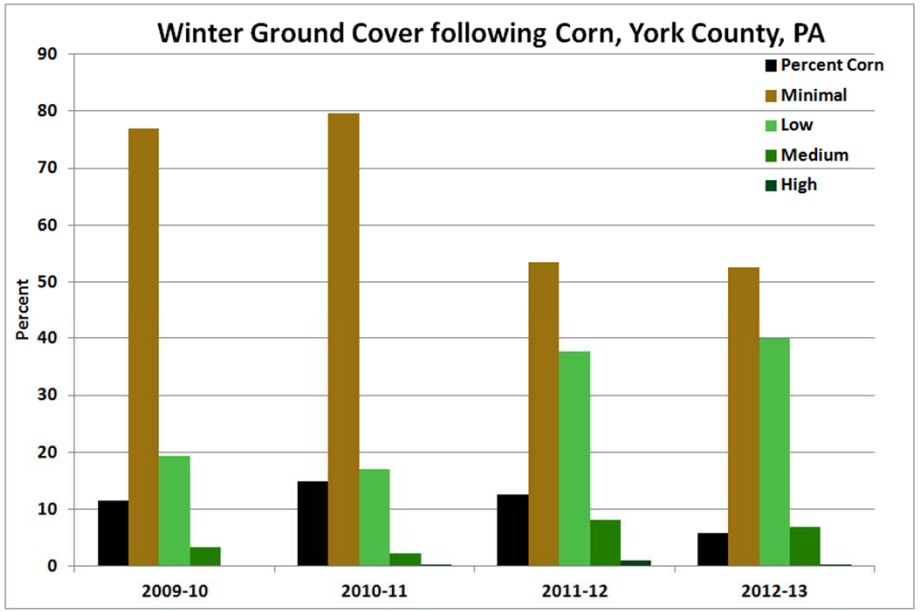

Conclusions

- Recent temperatures appear to have increased respective to past
- This opens new opportunities for cover crops and double cropping of forages after corn silage
- Rye most productive, but other species have higher protein concentrations
- Ryegrass and triticale mixtures with crimson clover look promising
- Substantial nutrient uptake means more intensive nutrient cycling and protection from losses.
- Pennsylvania farmers are moving on the opportunity – resulting in dramatically increased use of cover crops