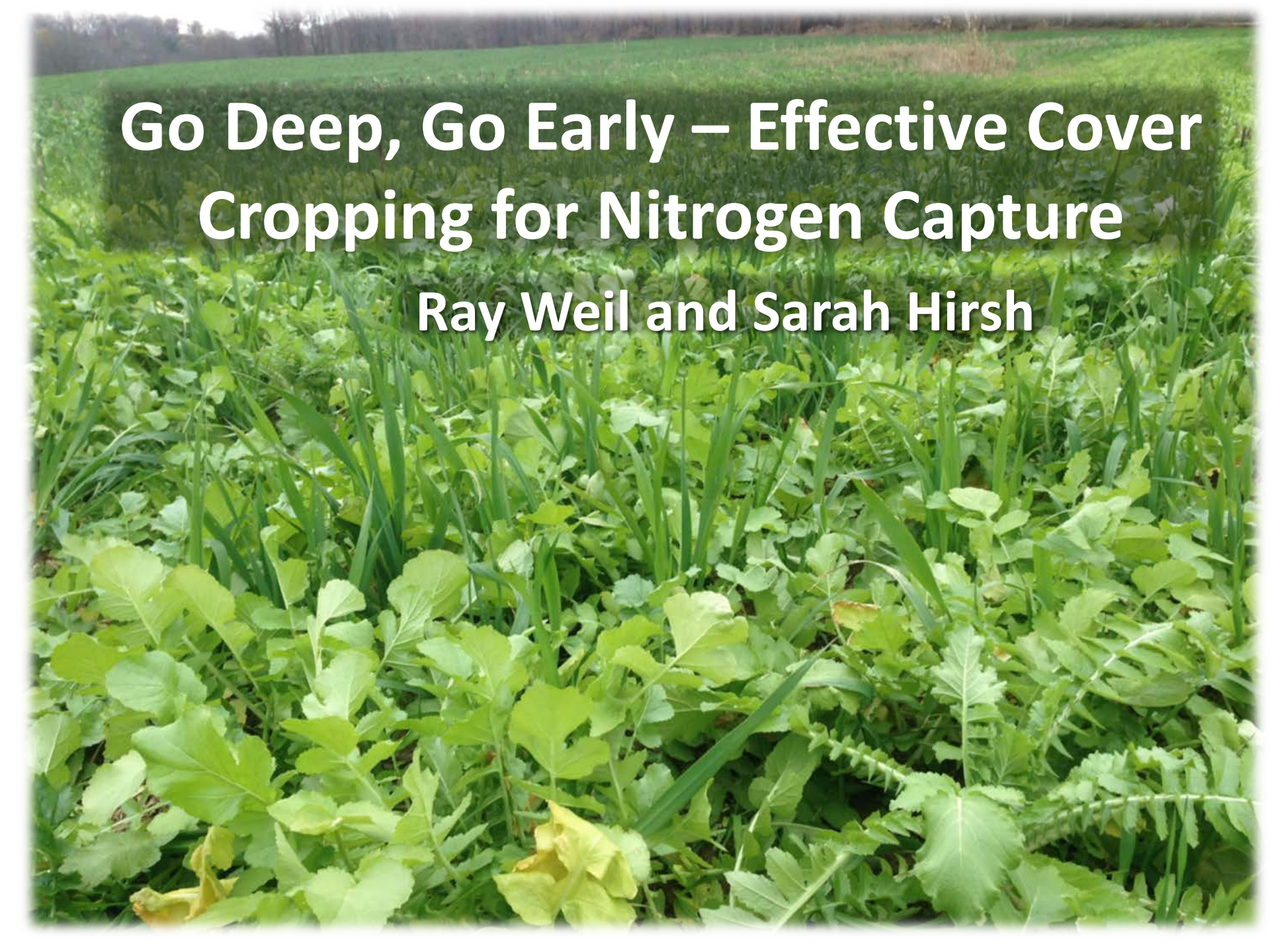
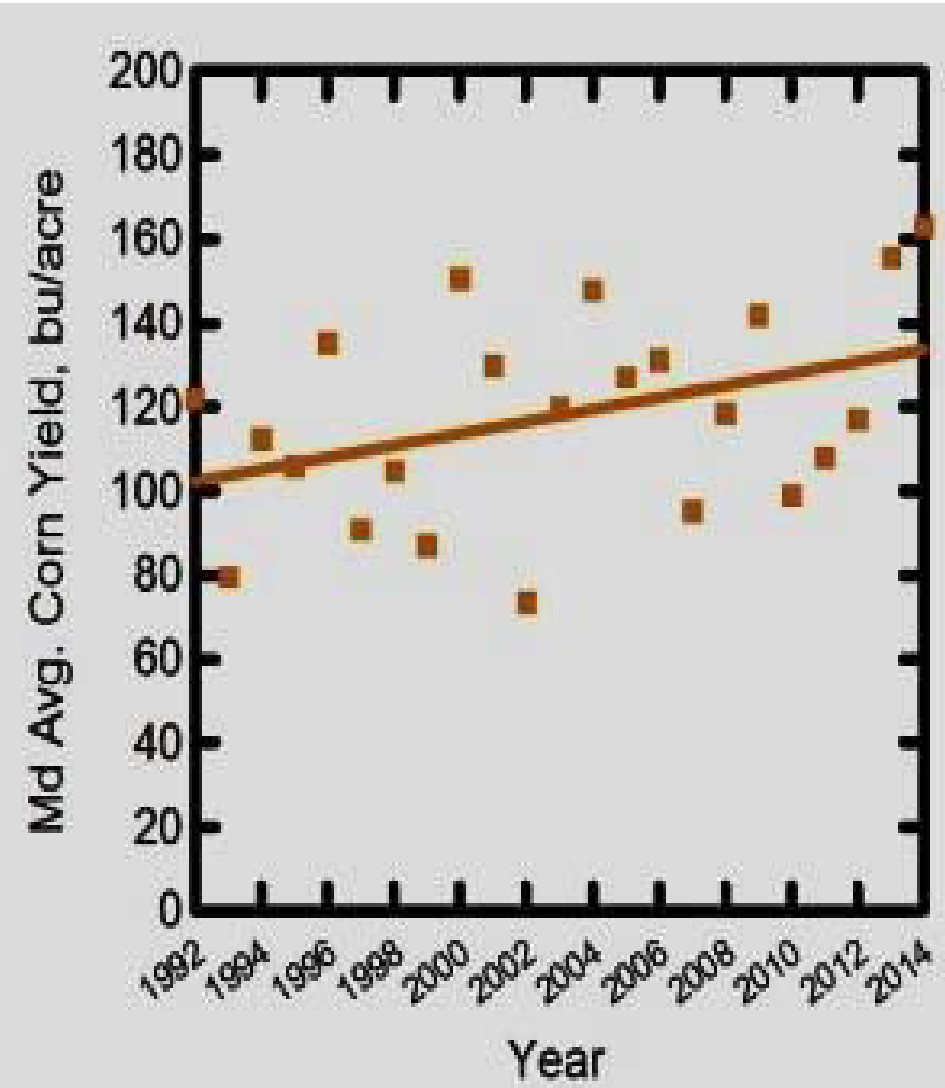

Go Deep, Go Early – Effective Cover Cropping for Nitrogen Capture
Ray Weil and Sarah Hirsh

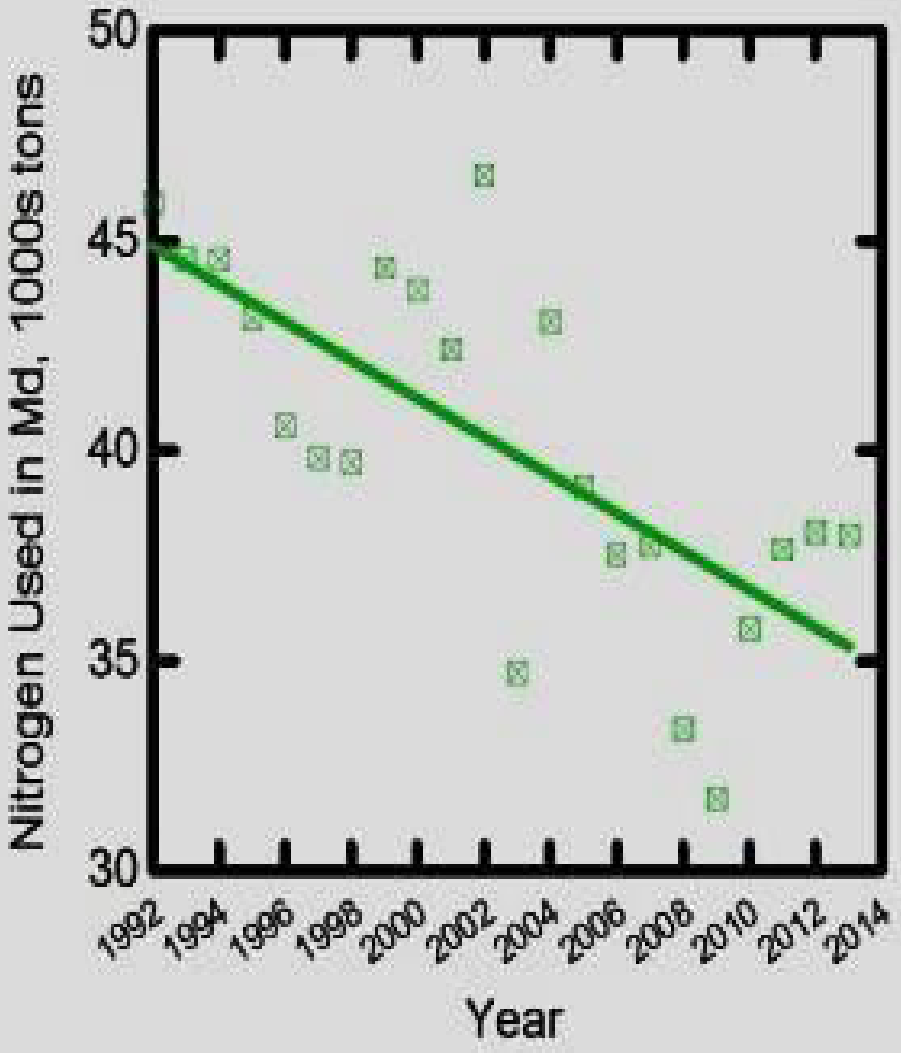
Maryland is way ahead of other states in nitrogen management

- Using less fertilizer with nutrient management plans (1.3 → 0.8-0.9 lb N/bu expected yield)
- Split applications of N
- Soil N tests (PSNT)
- Adapt-N computer model to predict N fertilization needs

https://plantsciences.missouri.edu/nutrientmanagement/nitrogen/images/practices_figure2.jpg

Nitrogen Use and Corn Yield Trends in Maryland



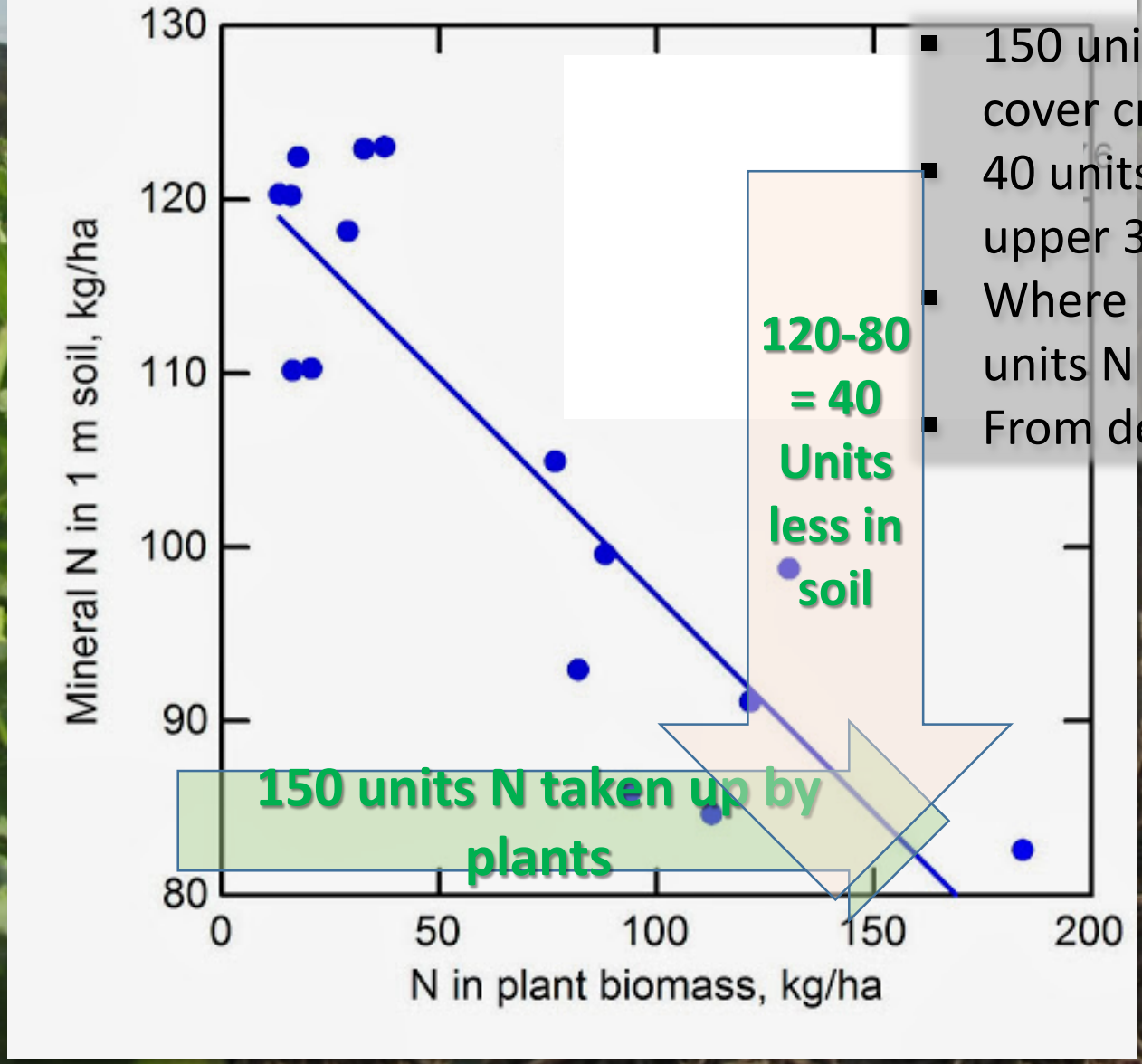


But we still have an inefficient N system

Nitrogen not used by crops = $ loss for farmers and problems for the Bay

Triticale, radish and clover after silage corn

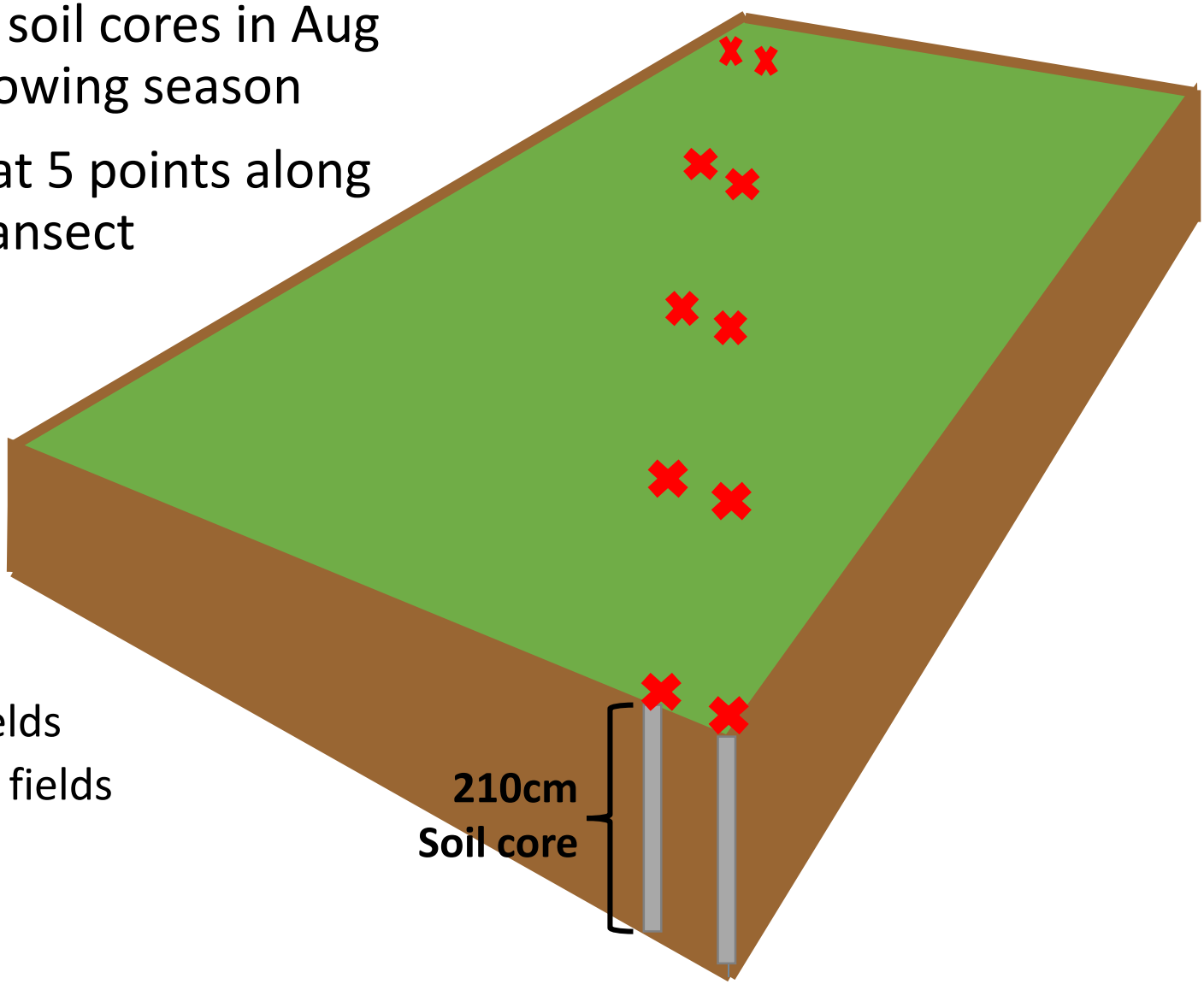
Soil v Plant Shoot Nitrogen Contents (Cover crops and weeds in late November)



- 150 units N taken up by the cover crop
- 40 units N missing from the upper 3 ft of soil
- Where did the other 110 units N come from?
- From deeper soil layers?

Data: Wang and Weil, 2016

- Taking deep soil cores in Aug following growing season
- 2 soil cores at 5 points along a straight transect

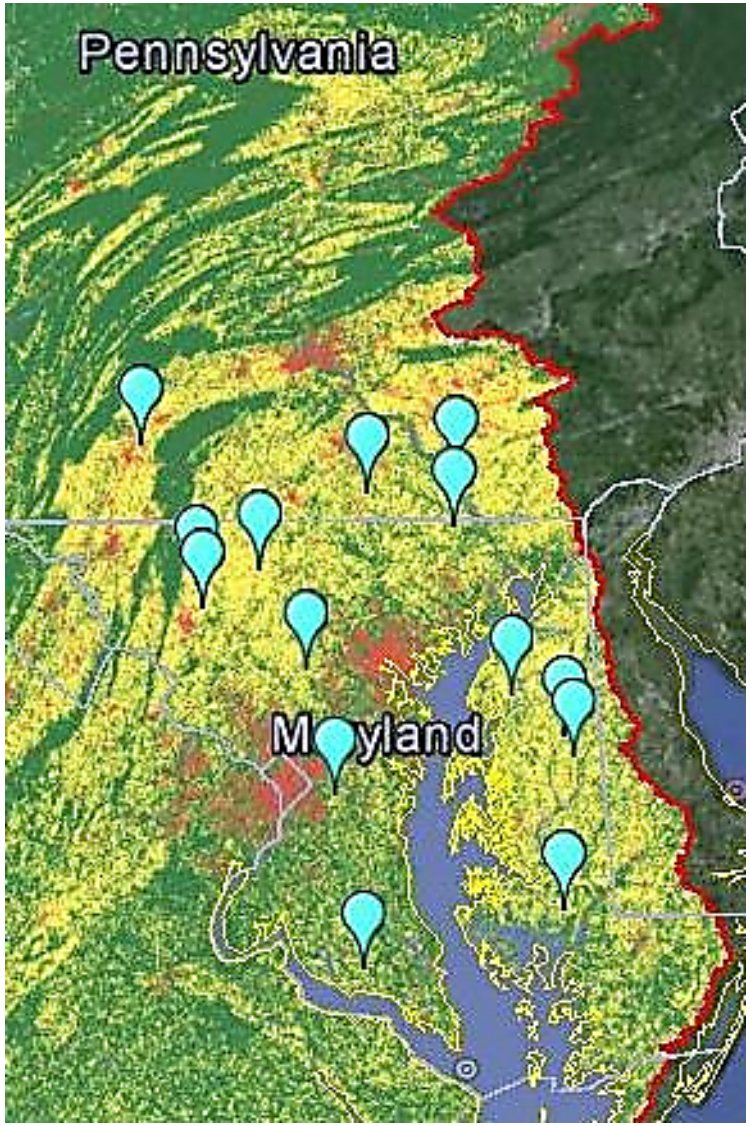


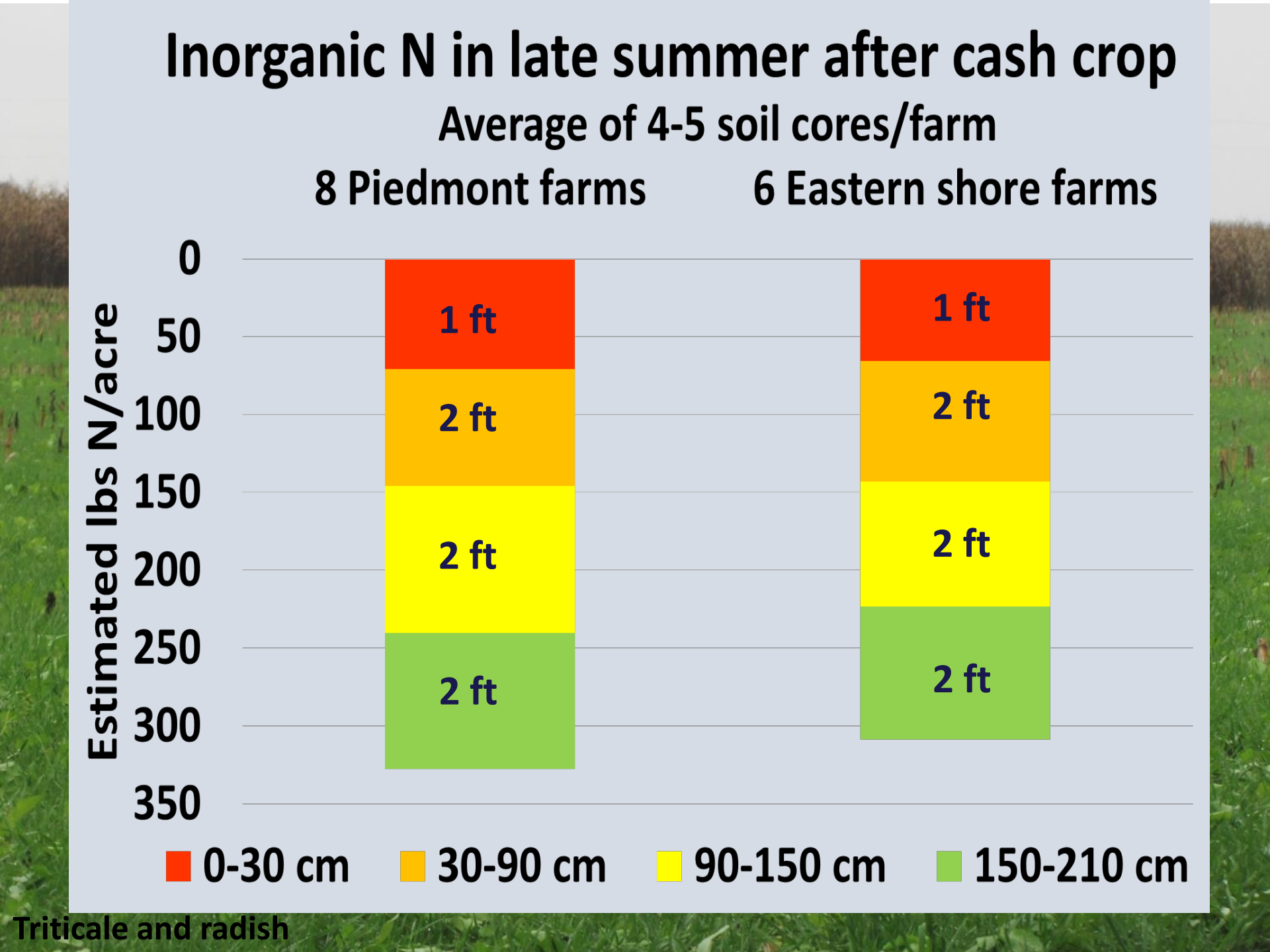
- 3 years
  - 25 corn fields
  - 4 soybean fields

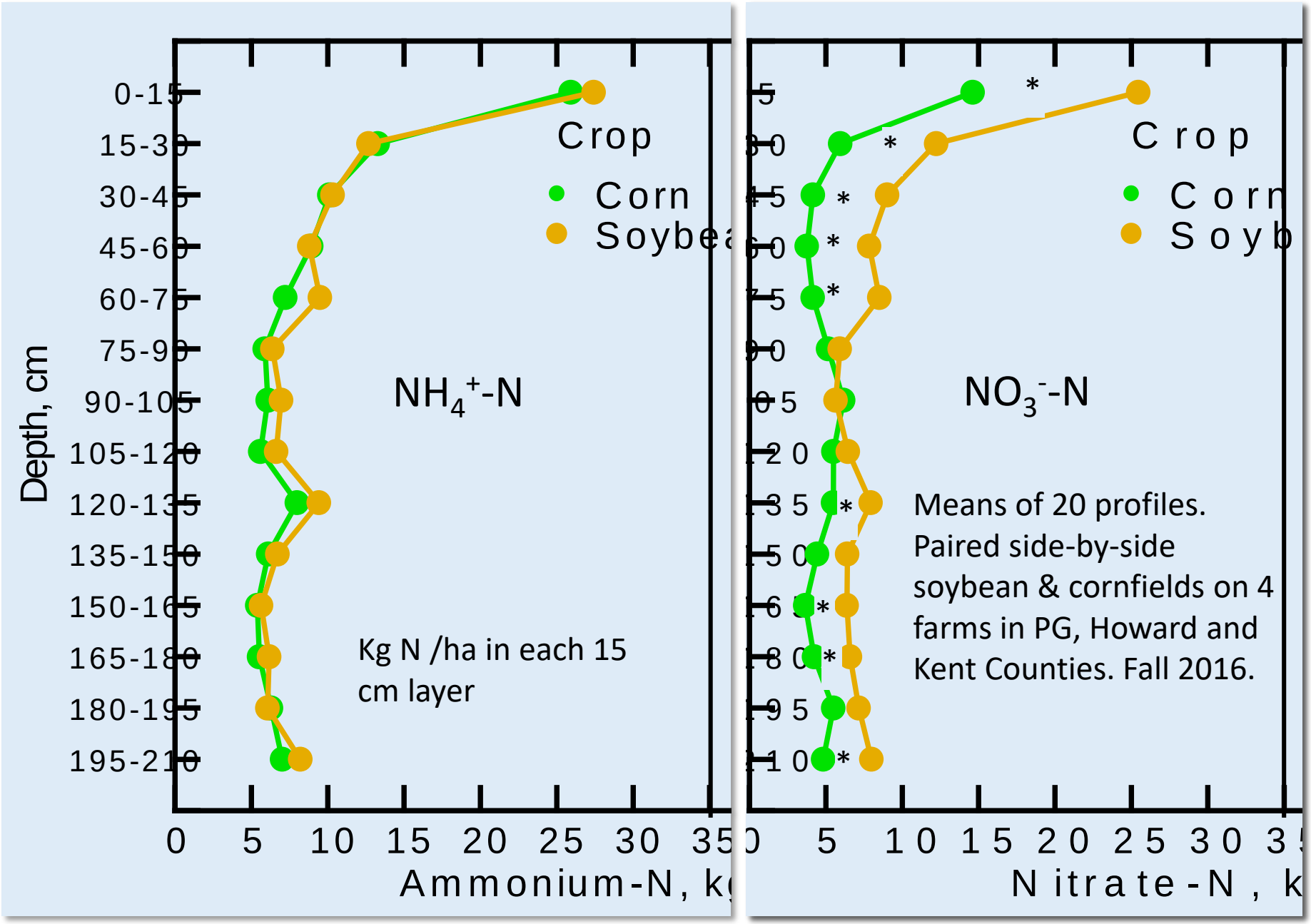
Hand-driven Veihmeyer probe beats hydraulics for 7 ft cores

Veihmeyer, F.J. 1929. An improved soil sampling tube. Soil Science 27:147-152.

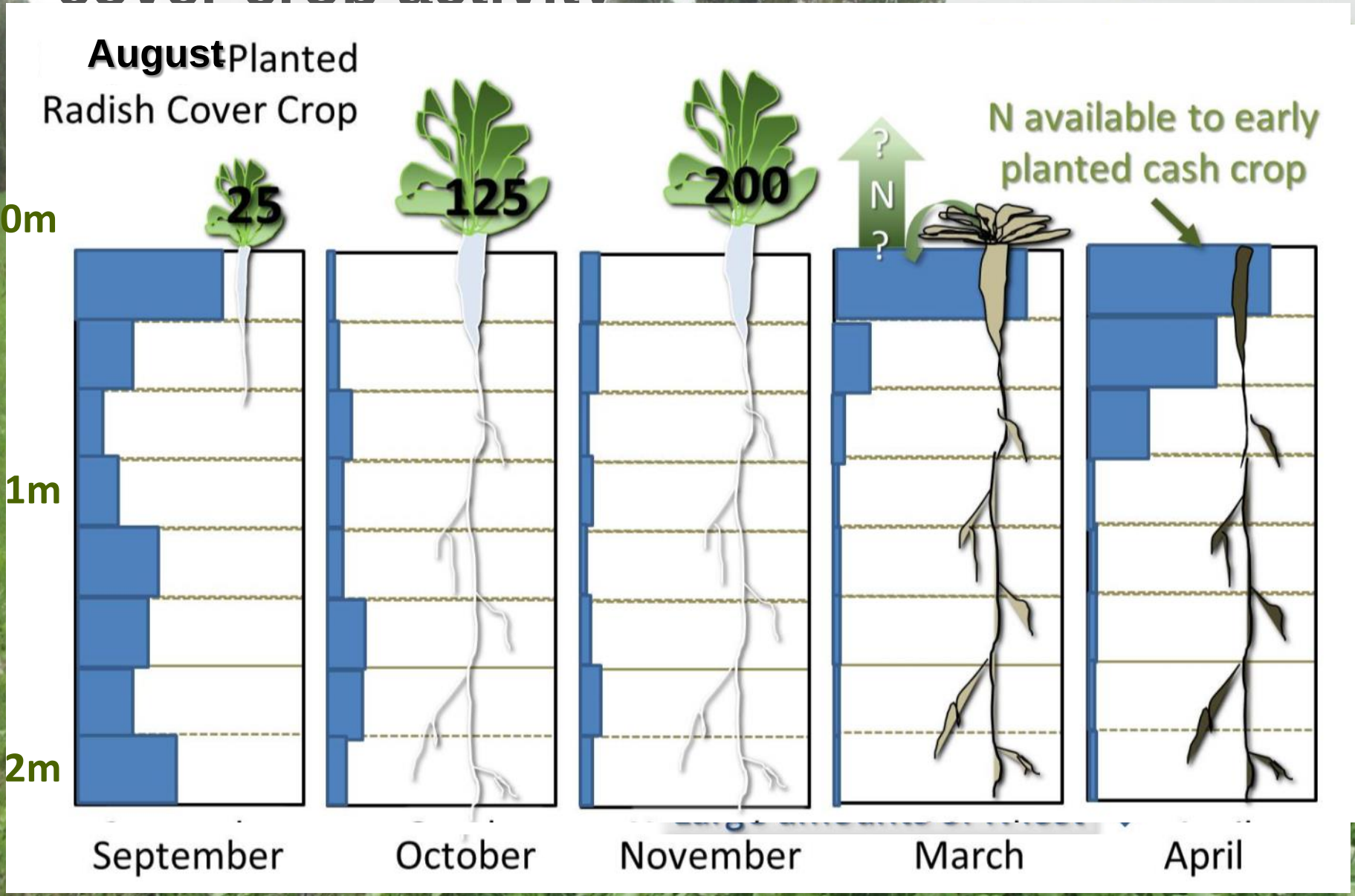
Sampling sites 2014




Inorganic N in late summer after cash crop
Average of 4-5 soil cores/farm
8 Piedmont farms
6 Eastern shore farms
Estimated lbs N/acre
0
50
100
150
200
250
300
350
1 ft
2 ft
2 ft
2 ft
1 ft
2 ft
2 ft
2 ft
0-30 cm
30-90 cm
90-150 cm
150-210 cm
Triticale and radish

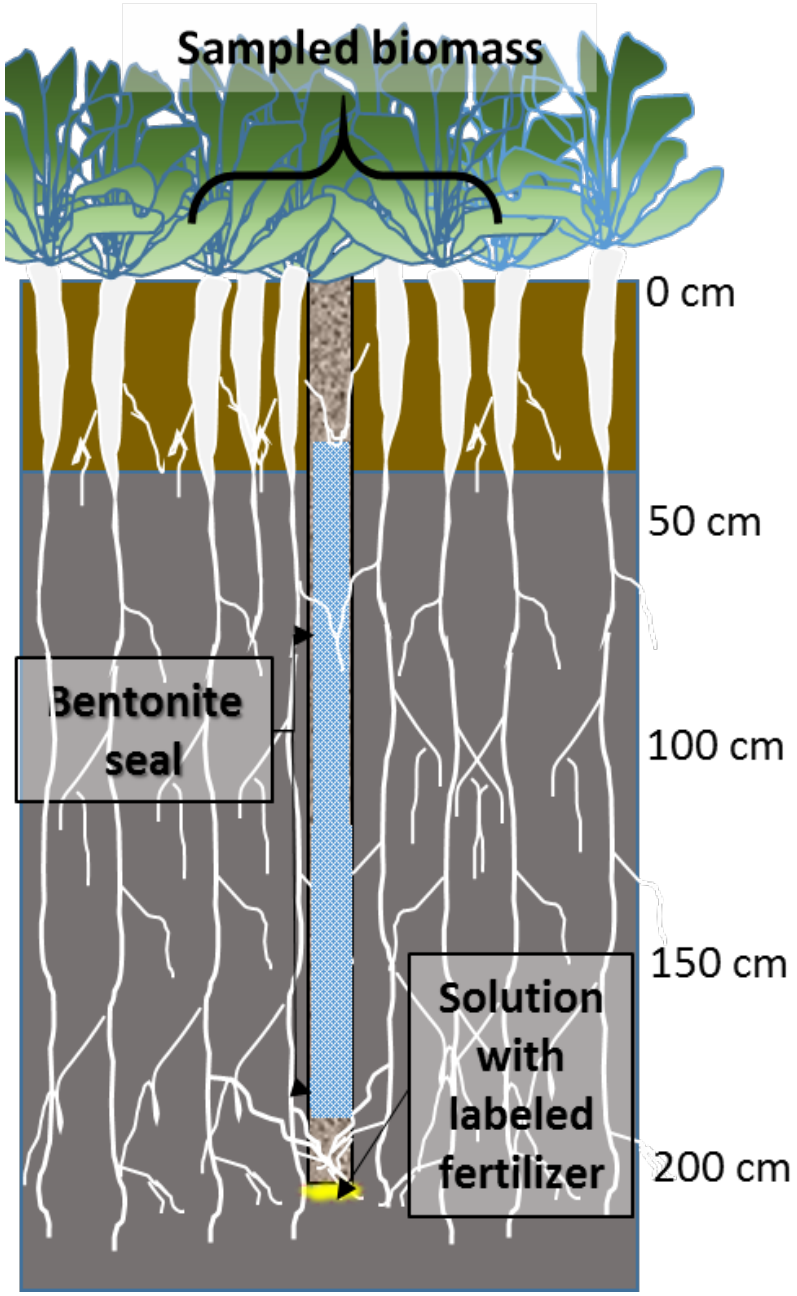

Depth, cm
0-15
15-30
30-45
45-60
60-75
75-90
90-105
105-120
120-135
135-150
150-165
165-180
180-195
195-210
0
5
10
15
20
25
30
35
Ammonium-N, kg
Crop
Corn
Soybean
NH4+-N
Kg N /ha in each 15 cm layer
0
5
10
15
20
25
30
35
Nitrate-N, kg
Crop
Corn
Soyb
NO3--N
Means of 20 profiles.
Paired side-by-side soybean & cornfields on 4 farms in PG, Howard and Kent Counties. Fall 2016.

EARLY planting is essential for fall cover crop activity



L N
tr t
h
cr

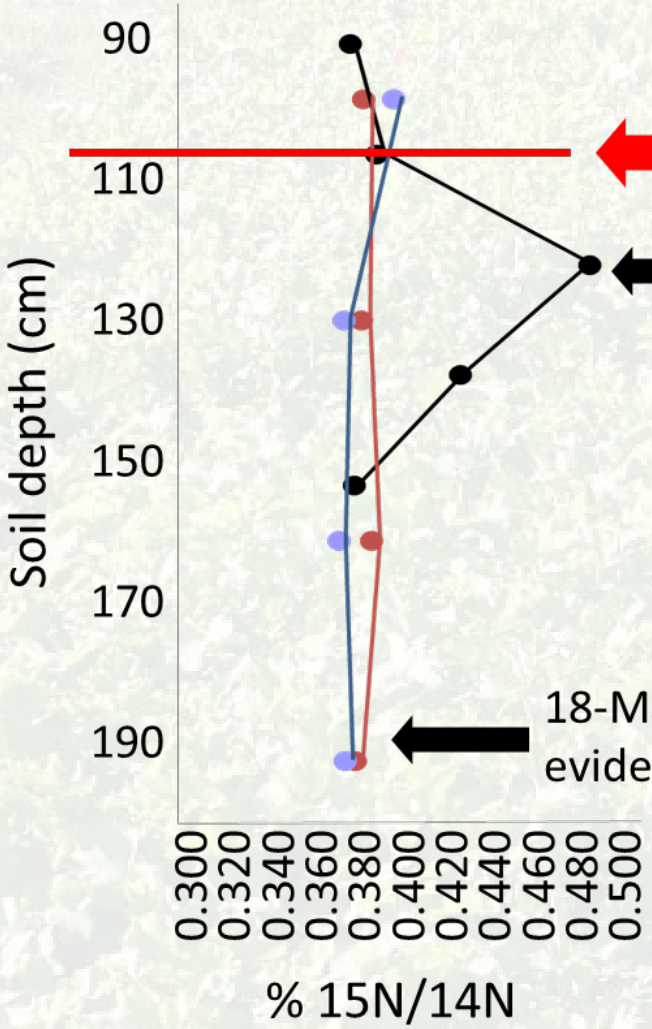

POTASSIUM NITRATE
(15N, 99%)
NLM-765-1
PSO #:15D-591
Lot #:
May intensify fire. Oxidizer. May be
swallowed. Causes eye irritation.
respiratory irritation. Causes


Sampled biomass
0 cm
50 cm
100 cm
150 cm
200 cm
Bentonite seal
Solution with labeled fertilizer

Tracing depth from which cover crops take up N

- Buried 15-N labeled potassium nitrate (15-N, 99%) as a tracer
  - Year 1: 100 cm or 200 cm
  - Year 2: 60 cm, 120 cm, or 180 cm
- Planted cover crops “early” (1-Sep) or “late” (1-Oct)
  - Forage radish
  - Rye
  - 2-way mix (radish, rye)
  - 3-way mix (radish, rye, Crimson clover)
- Assessed 15-N content in cover crop biomass in November and May

Leaching of N in soil



Placed 15-N isotope early Sept at 1 m depth

7-Dec soil cores showing 15-N signal ~120 cm

18-May soil cores showing no evidence of 15-N down to 210 cm

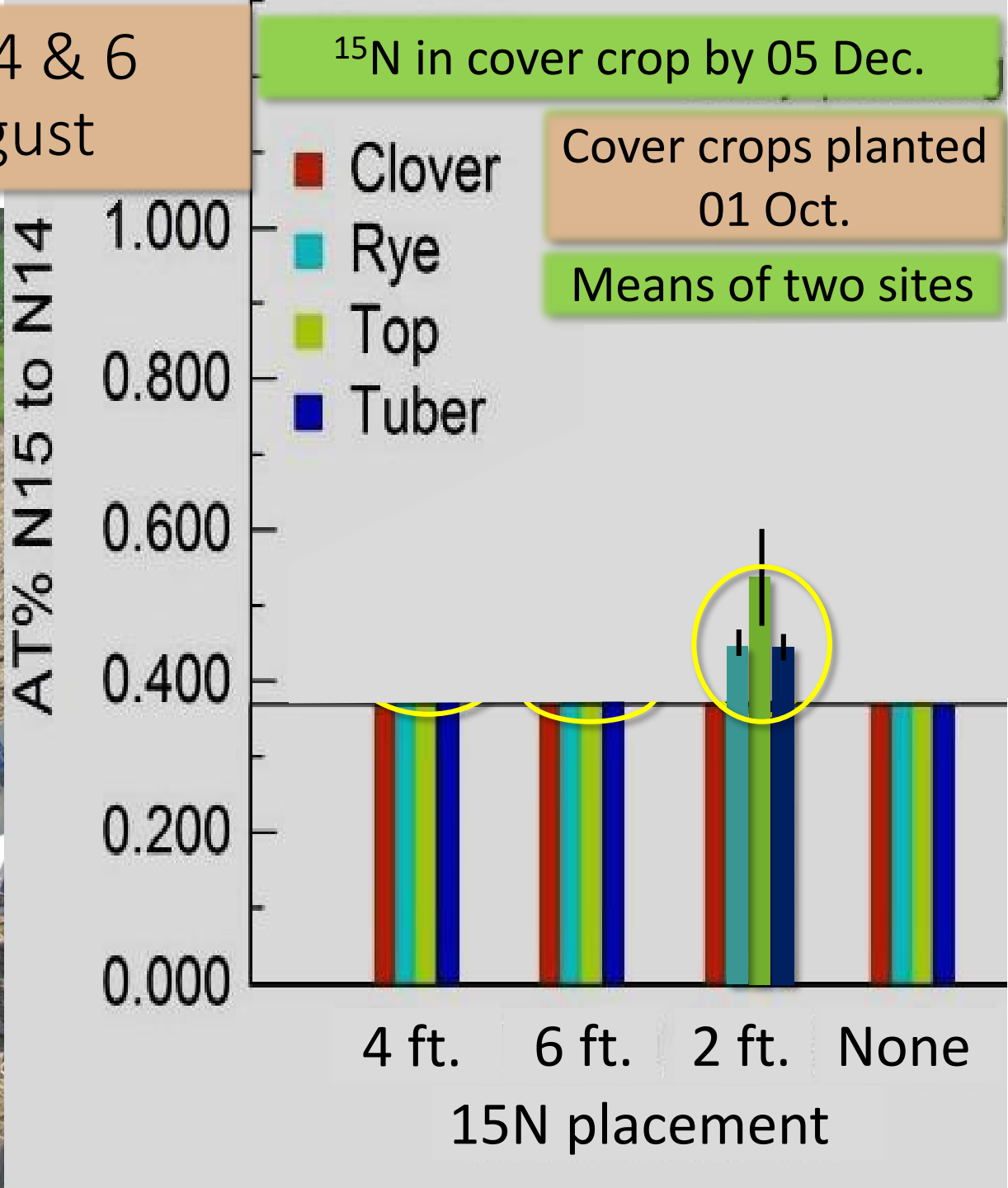
- Fall 2 reps at sandy site
- Spring 3 reps at sandy site and 3 reps at clayey site

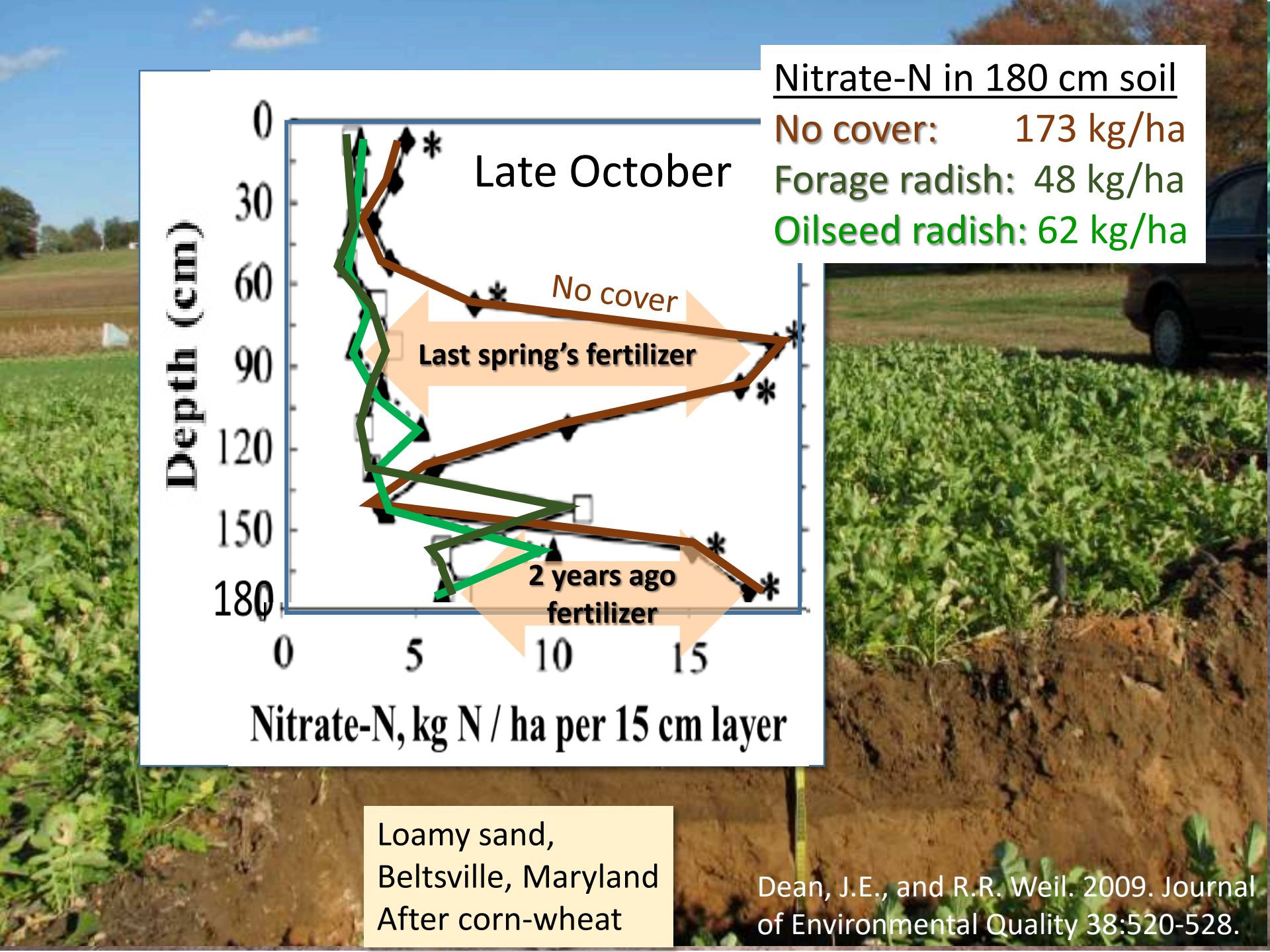
^{15}N tracer Placed 2, 4 & 6 feet deep in late August

^{15}N in cover crop by 05 Dec.

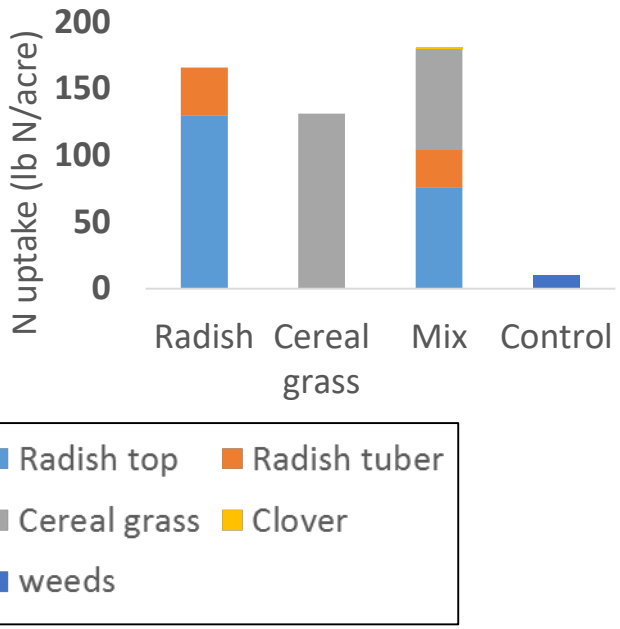
Cover crops planted 01 Oct.

Means of two sites

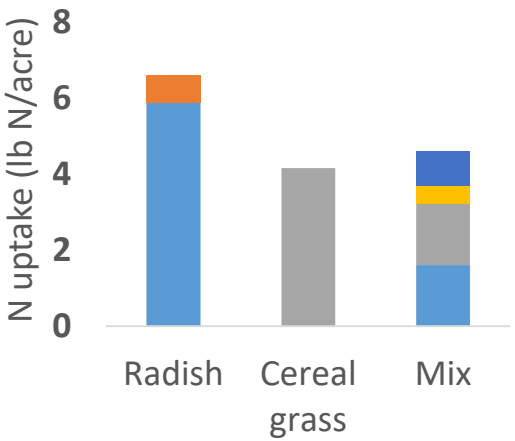


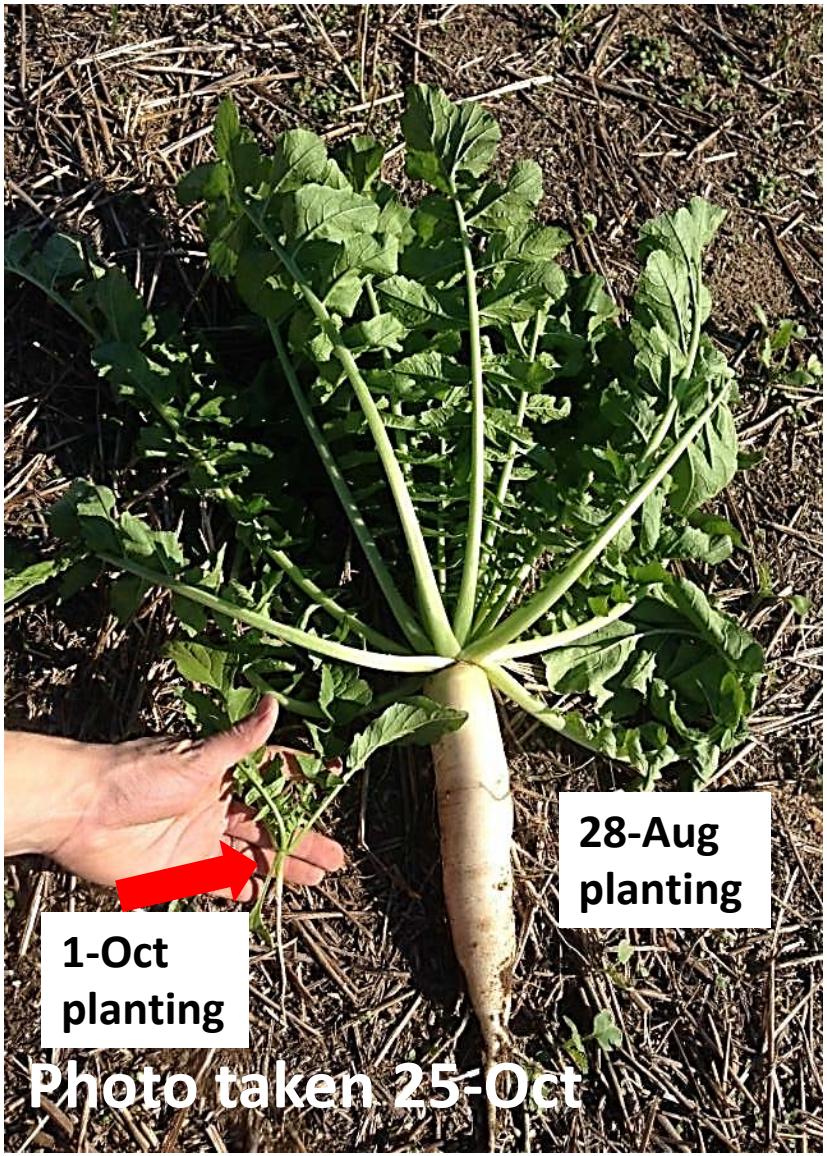

Nitrate-N in 180 cm soil
No cover: 173 kg/ha
Forage radish: 48 kg/ha
Oilseed radish: 62 kg/ha
Late October
No cover
Last spring's fertilizer
2 years ago fertilizer
Depth (cm)
0
30
60
90
120
150
180
0
5
10
15
Nitrate-N, kg N / ha per 15 cm layer
Loamy sand,
Beltsville, Maryland
After corn-wheat
Dean, J.E., and R.R. Weil. 2009. Journal of Environmental Quality 38:520-528.

Planted 2-Sept 2015 (Lancaster Co, PA)



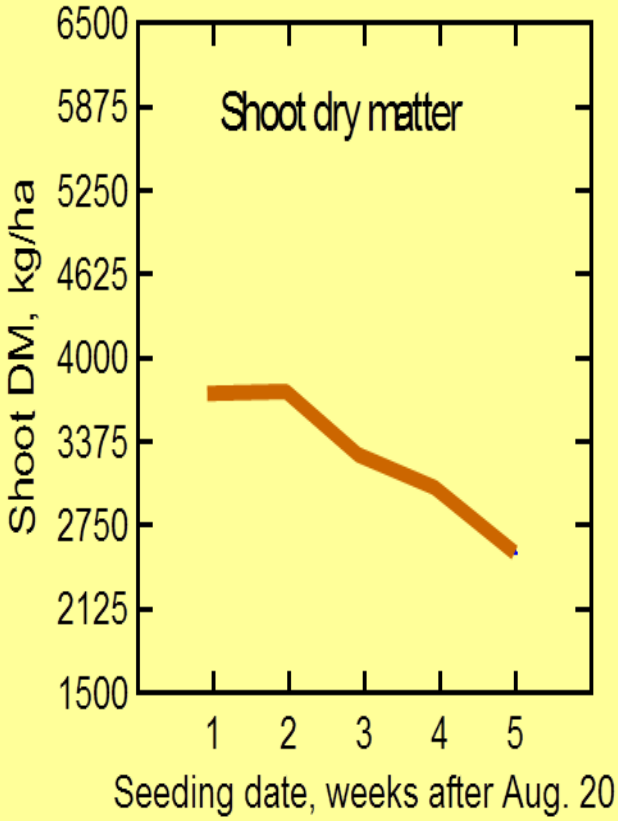
Planted 5-Oct 2014 (Prince George Co, MD)

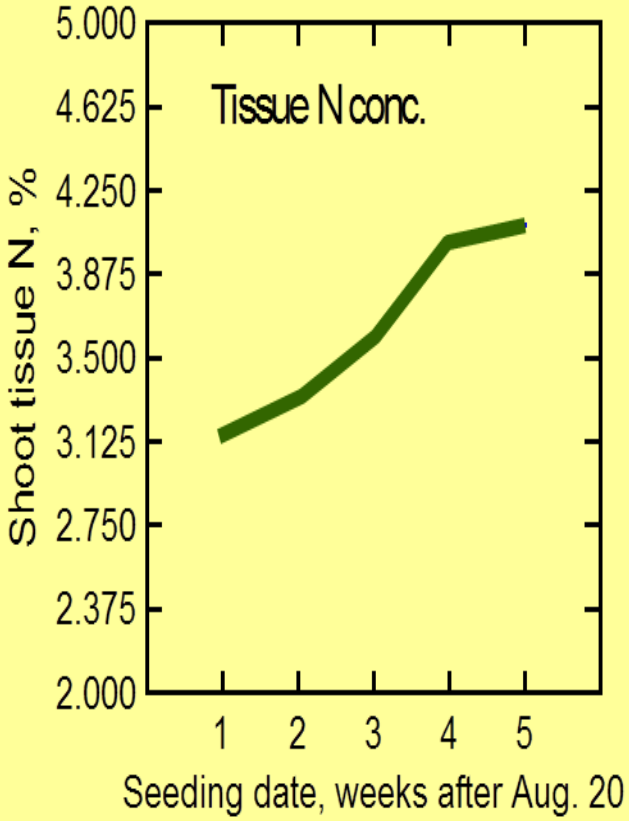


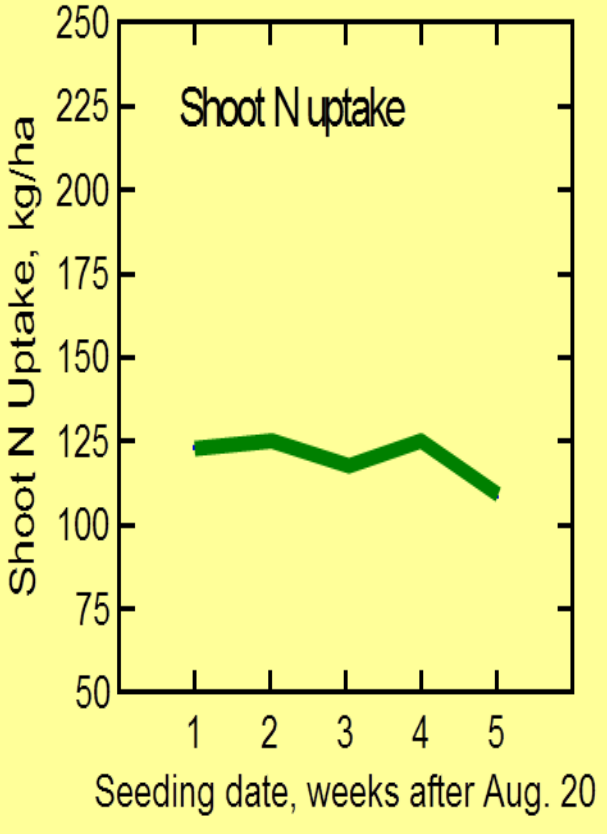

28-Aug
planting
1-Oct
planting
Photo taken 25-Oct

A few weeks later planting reduces weed suppression and biodrilling but not nitrogen capture.

Effect of seeding date on forage radish growth & N uptake in fall

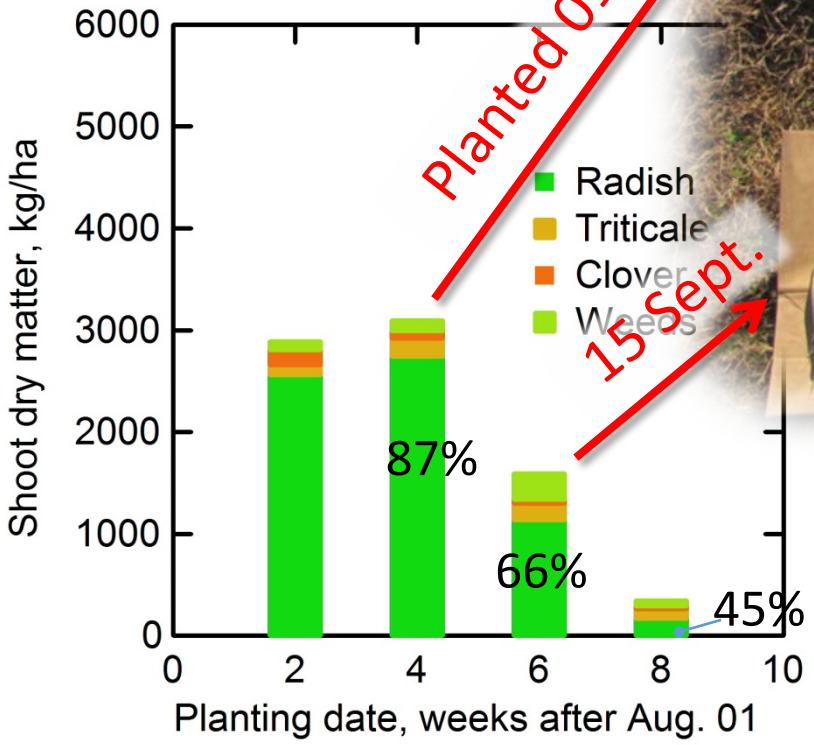






Means of 3 sites

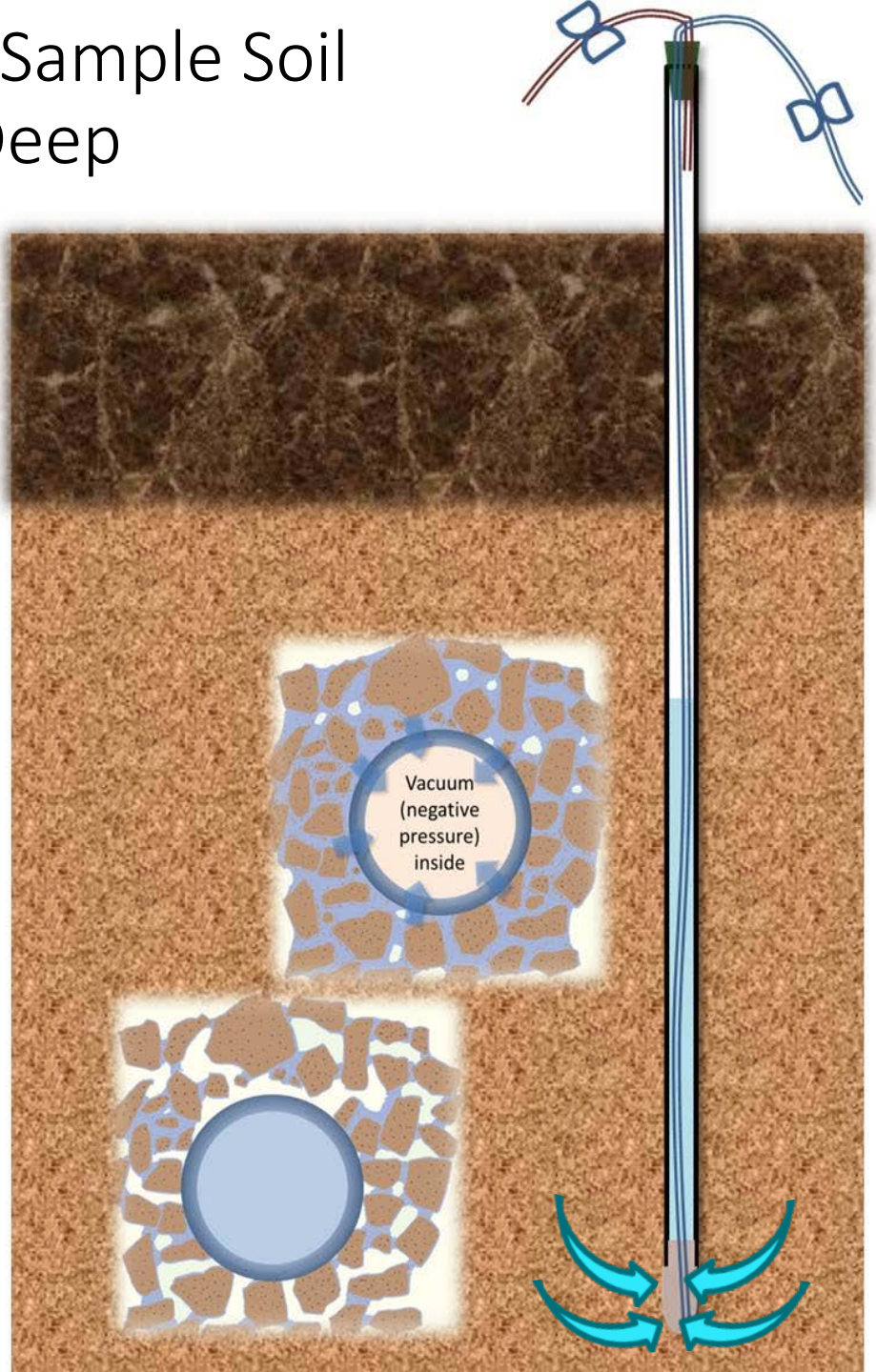
3 lbs Radish
22 lbs Triticale
5 lbs Crimson Clover



Cover crop mixes: the proportions you sow may *not* be what you see.

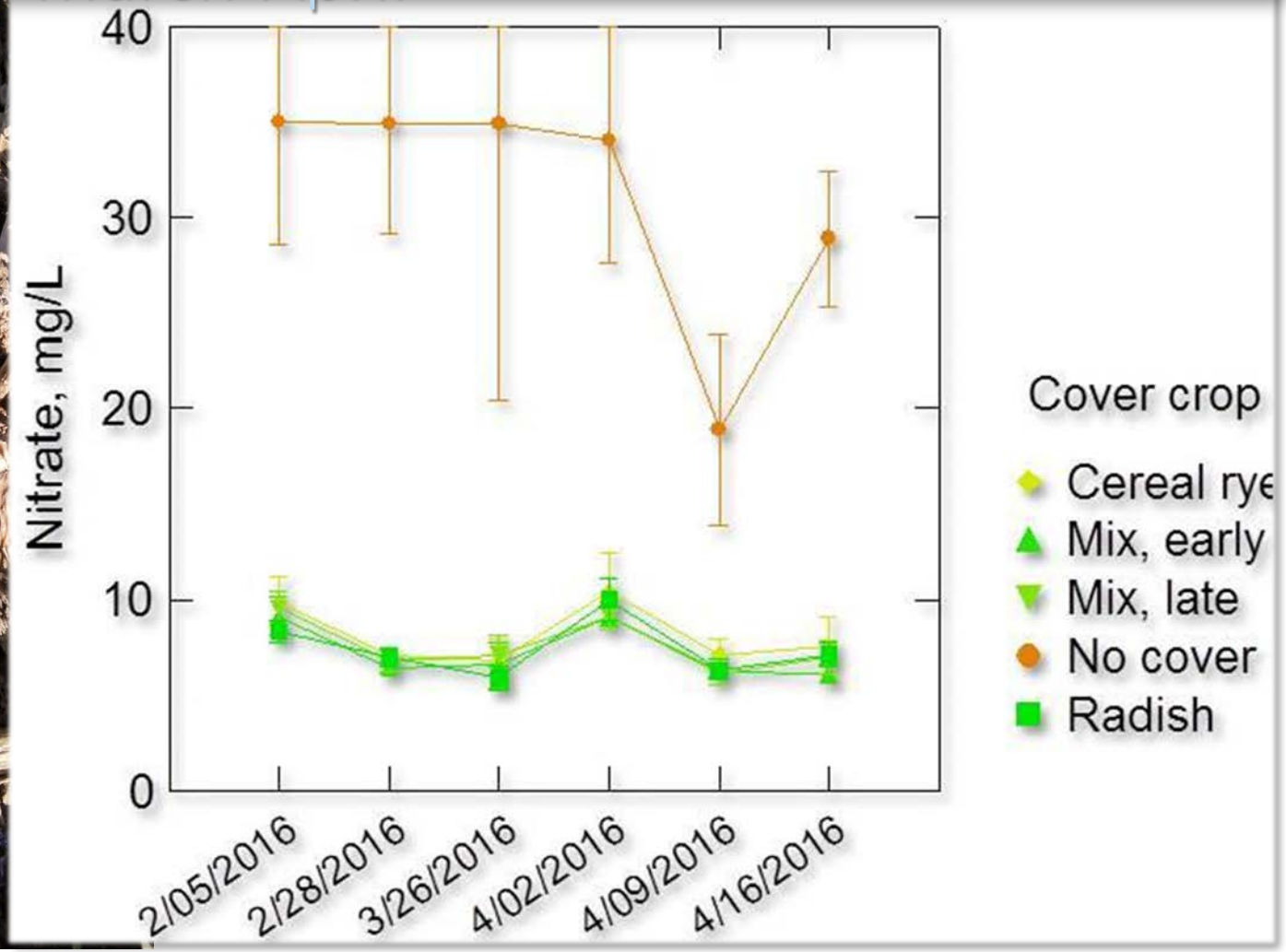
Field Suction Lysimeters Sample Soil Pore Water 4 ft Deep

- Data collected from February - April
- 3 replications 60’ x 300’ plots
- Covers planted 15 Sept.
  1. **No cover**
  2. **Sole rye**
  3. **Sole radish**
  4. ***Triticale*, radish, & clover mixture**
  5. ***Triticale*, radish, & clover mixture, planted two weeks later**

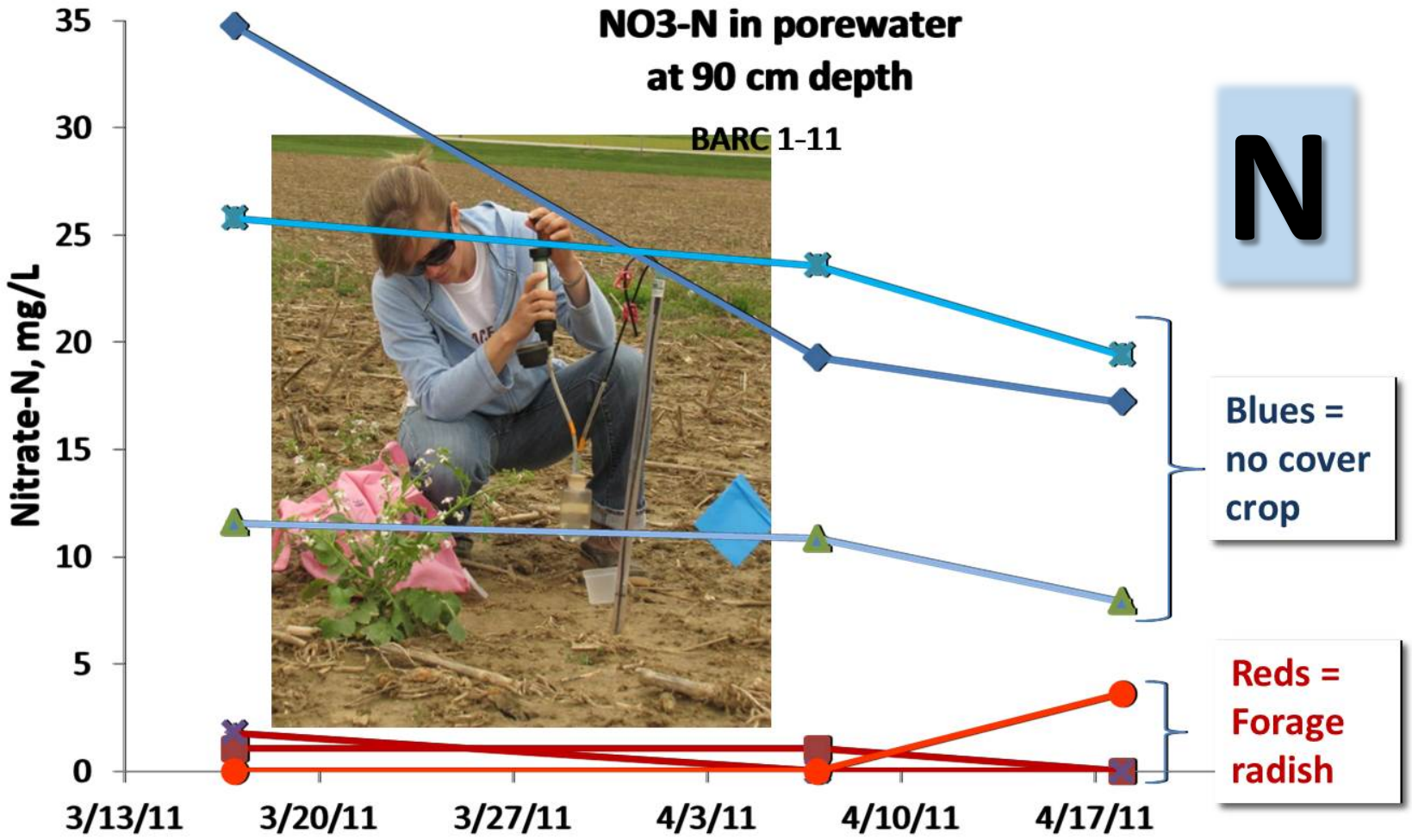



Lysimeter tube
Crop residue
Grassy weeds
Clay seal
Worm casts
Decayed radish root

Even cover crop frost-killed in December impacted pore-water **nitrate at 120 cm deep** in February-March-April



By March-April, radishes were long dead and its residue mainly gone, but its nitrogen capture effects are still evident.



Unpublished data of Weil and Fisher

Some ways to establish cover crops earlier

- Plant after early harvested crops
  - corn silage
  - Potatoes
  - short season corn varieties
- July planting after wheat
- Aerial seeding into senescing crop
- Irrigation and/or “starter-N” to get quick cover crop growth
- Interseeding
  - side-dress time
  - senescence

Photo credit: Aerial seeding: http://canadabusinessinformationblogs.com/cutarmagroservices/2013/06/10/aerial-seeding/

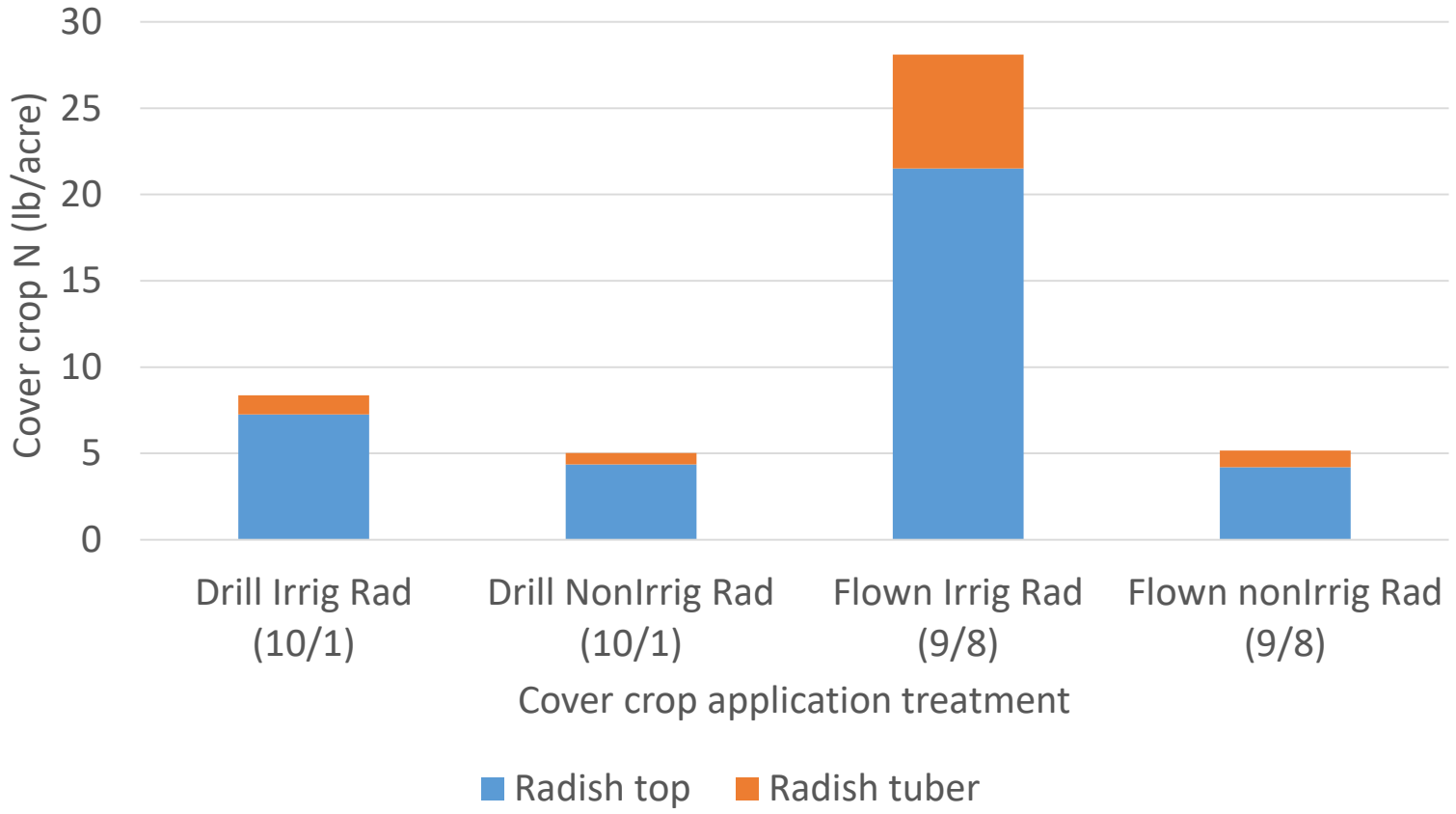
Interseeding using drop-down seeder late in summer (hi-boy with drop down nozzles)

Photo credit: http://www.hagie.com/product_cci.aspx

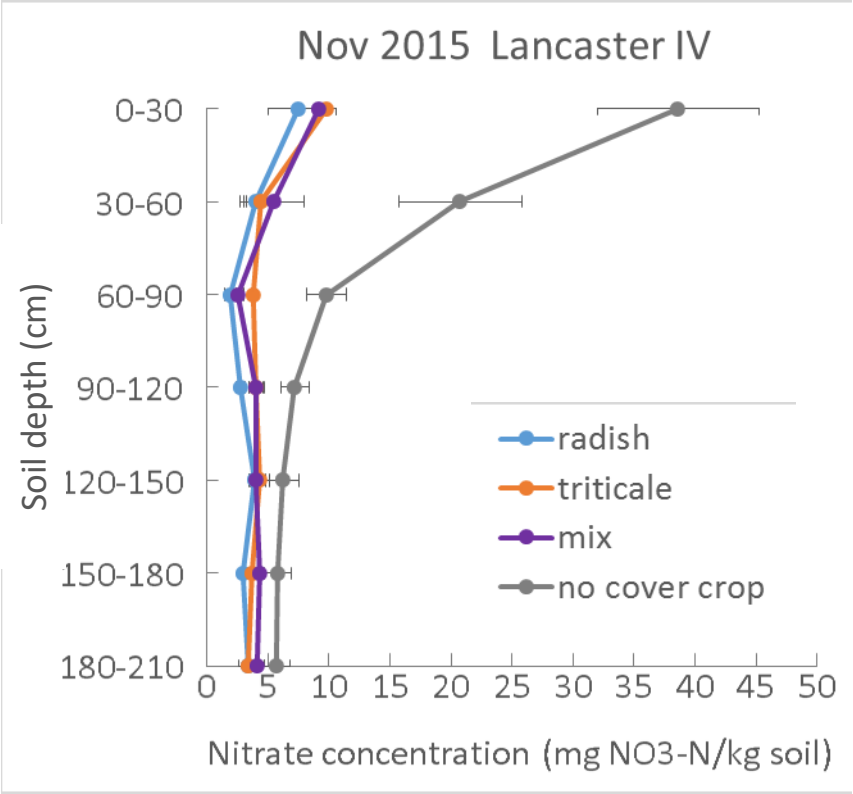
Interseeding at N side-dress time

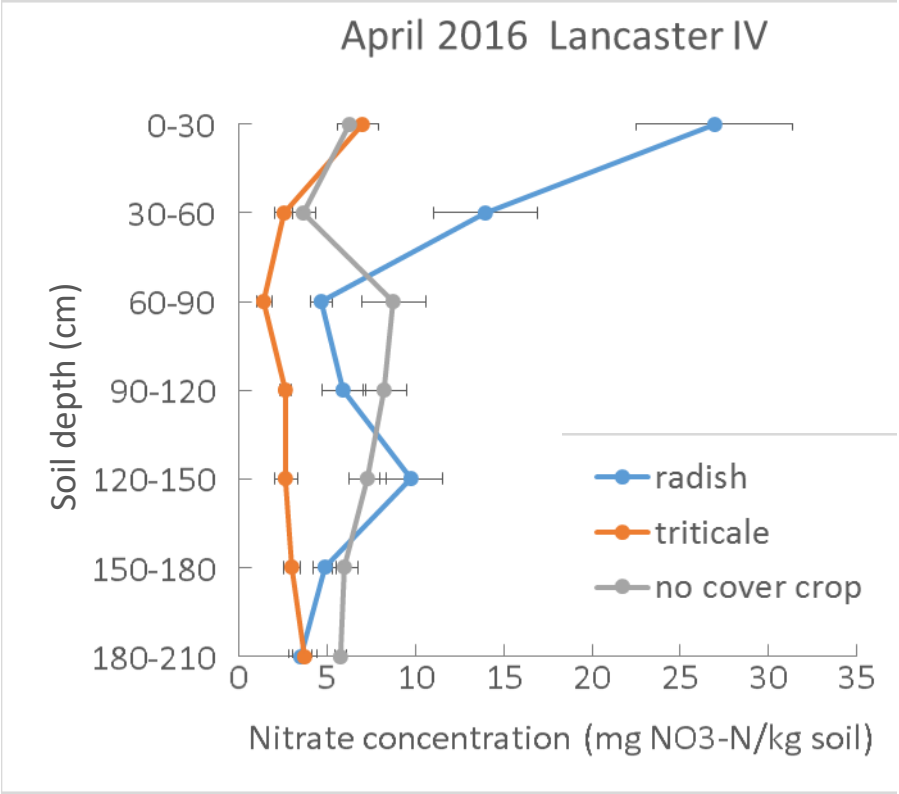
Photo credit: http://www.farmanddairy.com/news/cover-crop-interseeder-can-save-time-trips-across-field/150372.html

Farm trial investigating aerial seeding and irrigation



Lancaster Co PA farm (history of heavy manure application)
Fall and spring deep soil core nitrate

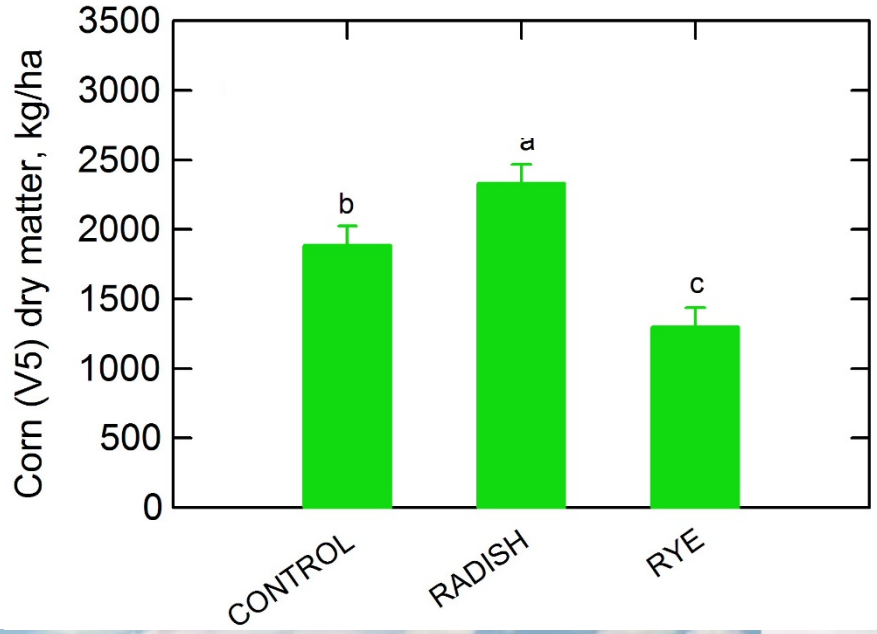


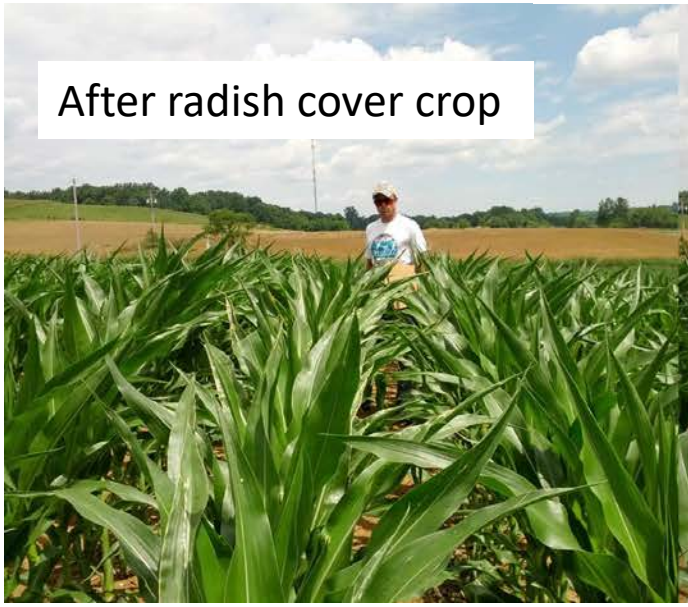


Error bars show standard error of mean

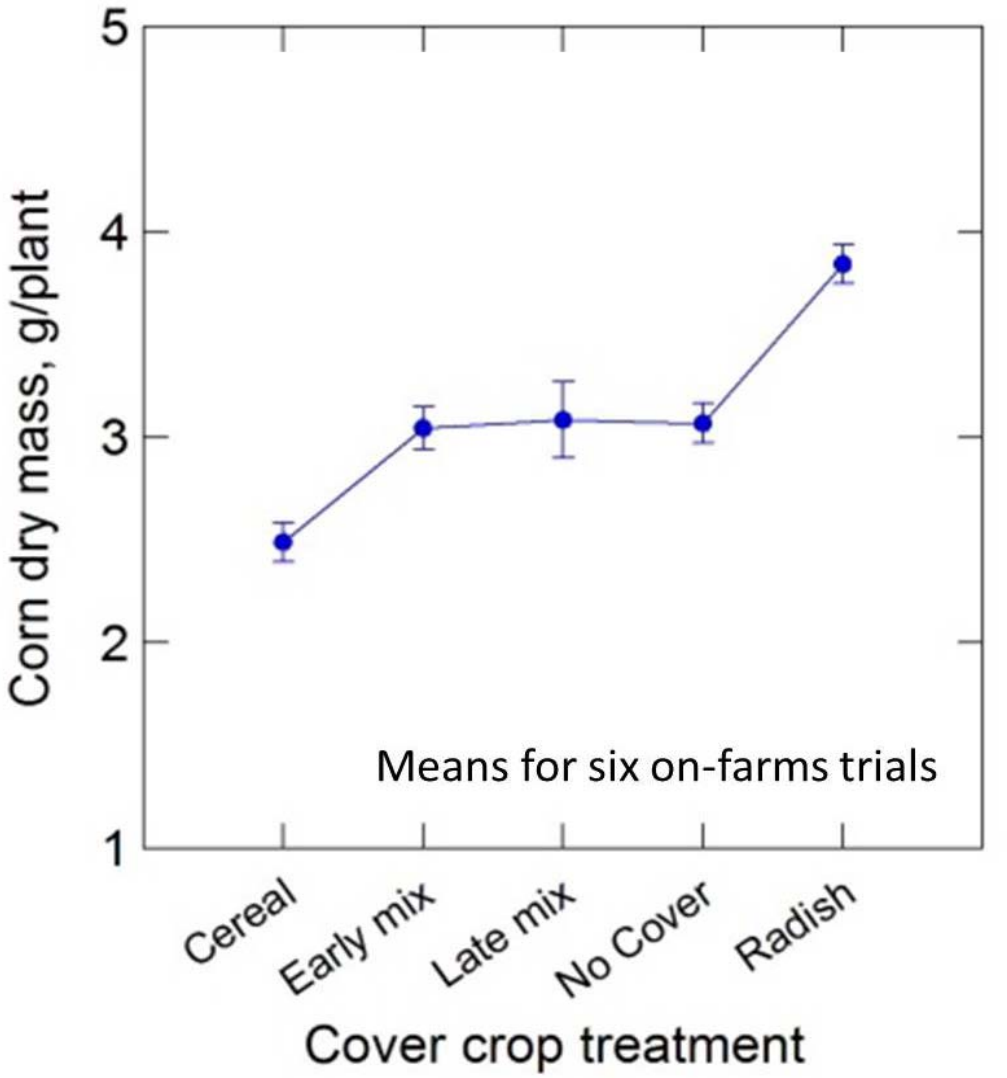
Early season (V5 stage) corn biomass following cover crop treatments

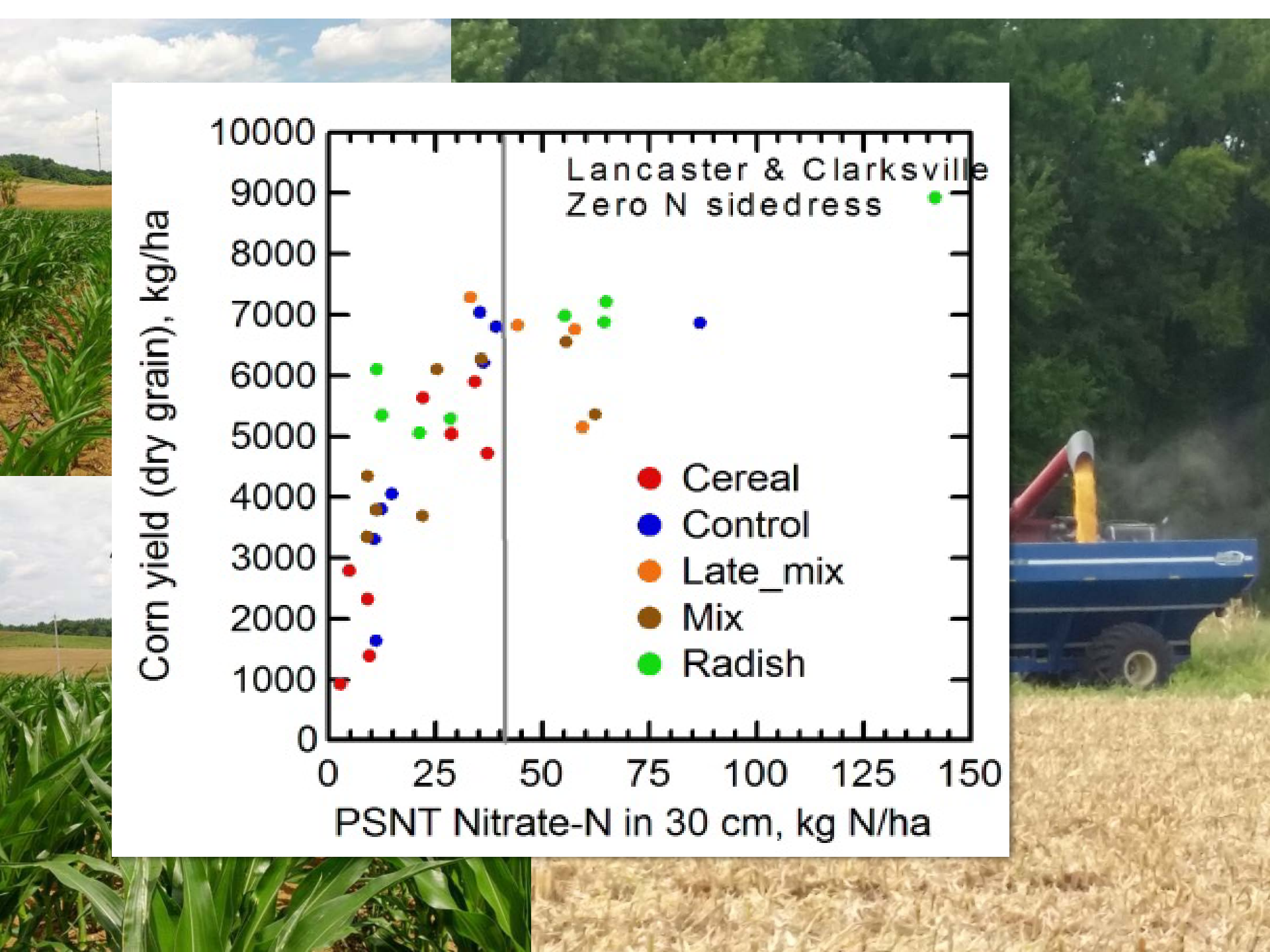
Howard MD, 2015



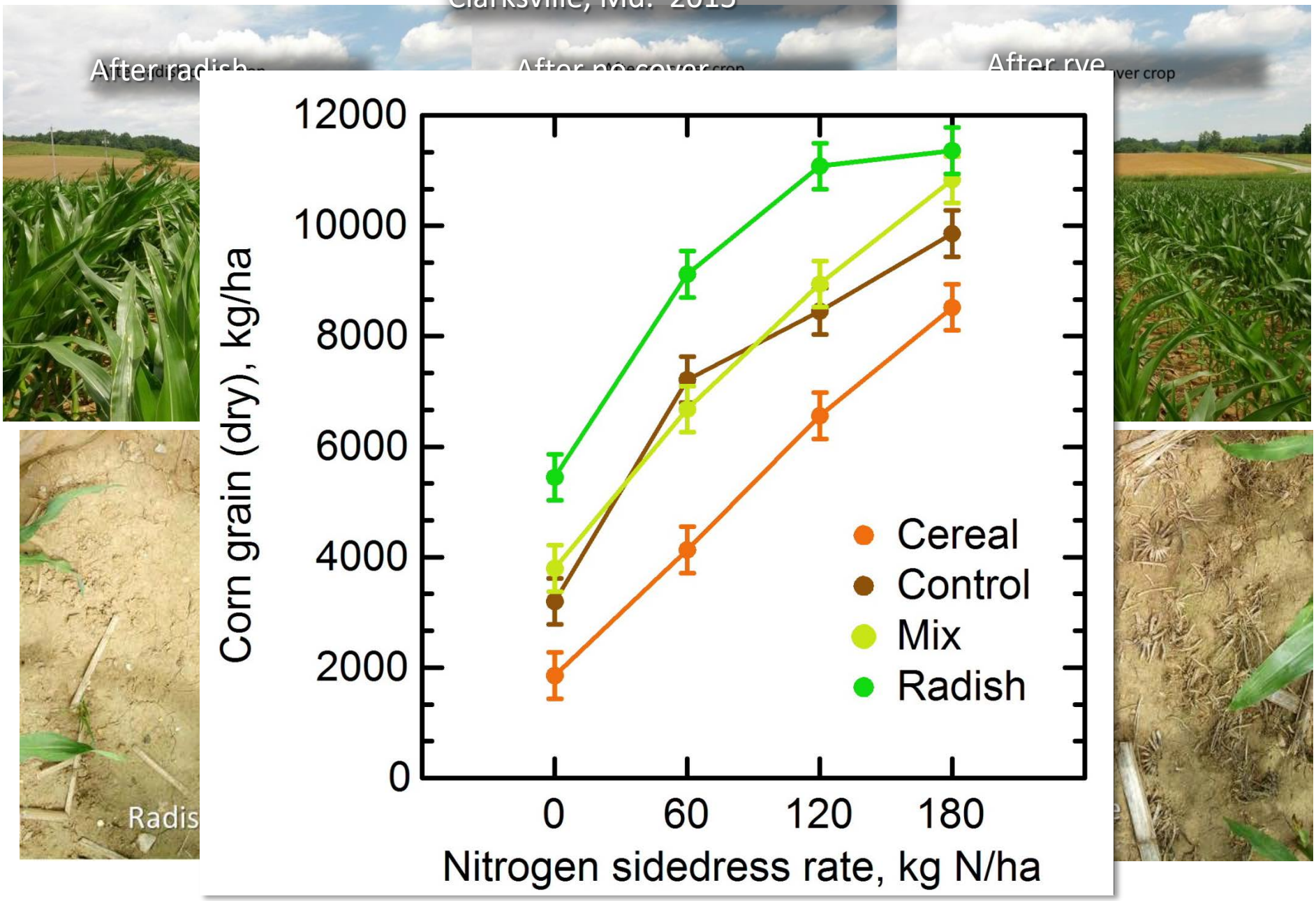


Early season (V5 stage) corn biomass

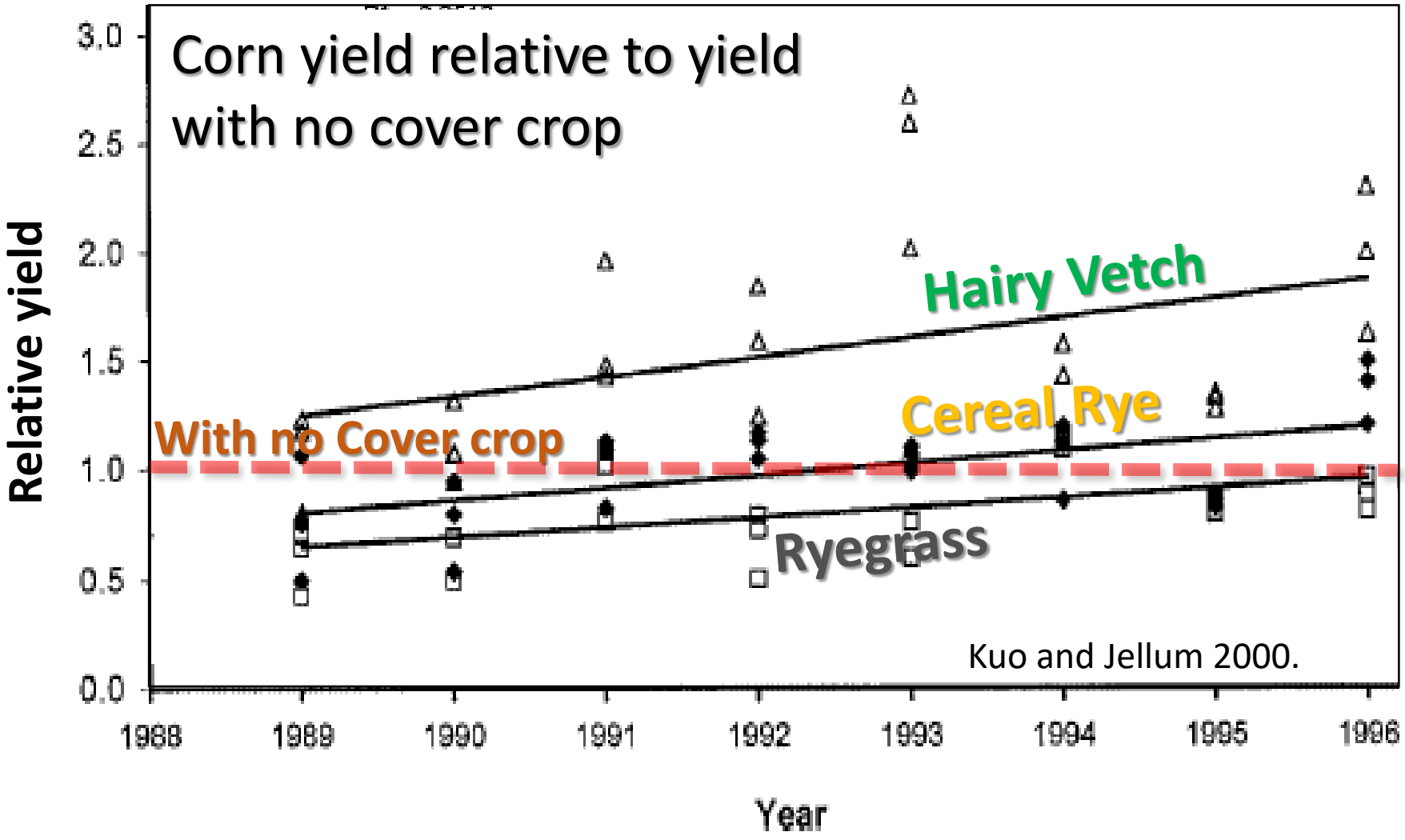



Lancaster & Clarksville
Zero N sidedress
Corn yield (dry grain), kg/ha
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
25
50
75
100
125
150
PSNT Nitrate-N in 30 cm, kg N/ha
Cereal
Control
Late_mix
Mix
Radish

Clarksville, Md. 2015



Long term N immobilization effect by grass cover crops (Tilled system with cover crop incorporation)



Grass covers enhanced soil organic N and gradually improved corn biomass over the long term.

Keys to effective cover cropping:

- Plant early—let it get deep in Fall
- Kill late—let it work for you in Spring

https://www.no-tillfarmer.com/articles/4664-reasons-to-no-till-plant-into-green-cover-crops


Thank you for your attention and happy cover cropping
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