

Slug working group presentation

Maggie Douglas & John Tooker

August 2011

Sustainable Dairy Cropping Systems

- Goal: Evaluate strategies to improve profitability and sustainability of Northeast dairies
 - Mostly no-till management
 - Incorporates cover crops into rotations
 - Testing manure, weed, and insect management strategies



Sustainable Dairy Cropping Systems

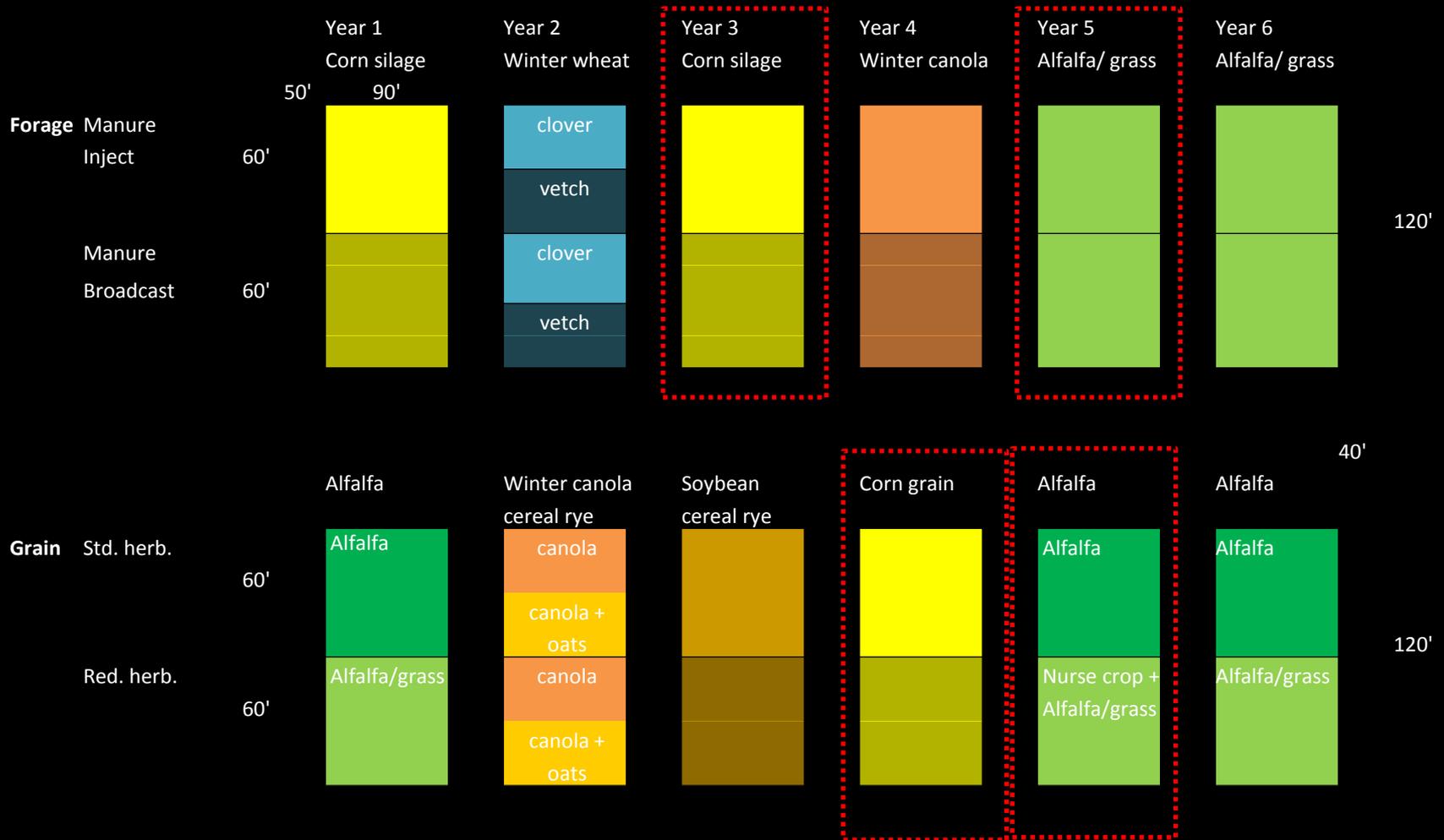
- Three crop rotations:
 - Two diverse, 6-yr rotations with cover crops
 - One corn-soy rotation without cover crops
- How do these rotations influence slugs, insect pests, and natural enemies?



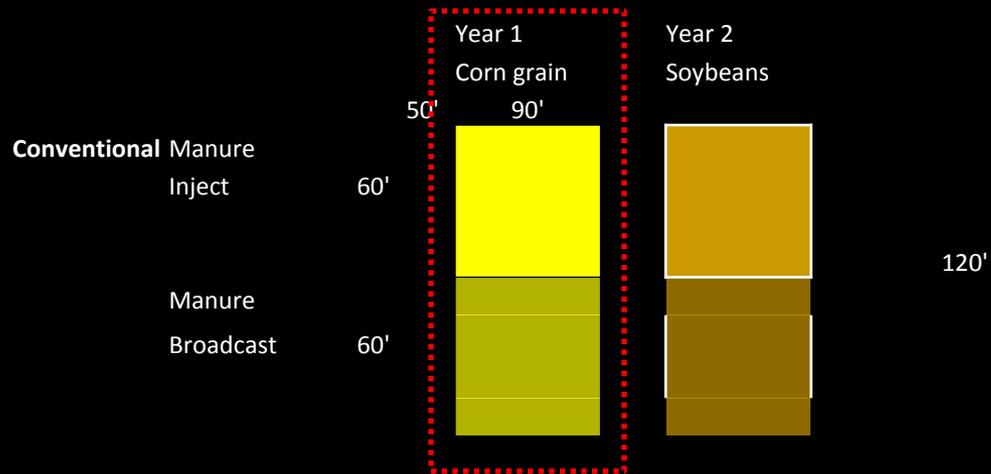
Sustainable Dairy Cropping Systems

- I will present a subset of our data
- Analysis is still in progress – this is preliminary!

Experimental design:



Experimental design:



Sustainable Dairy Cropping Systems



Large site:
~15 acres

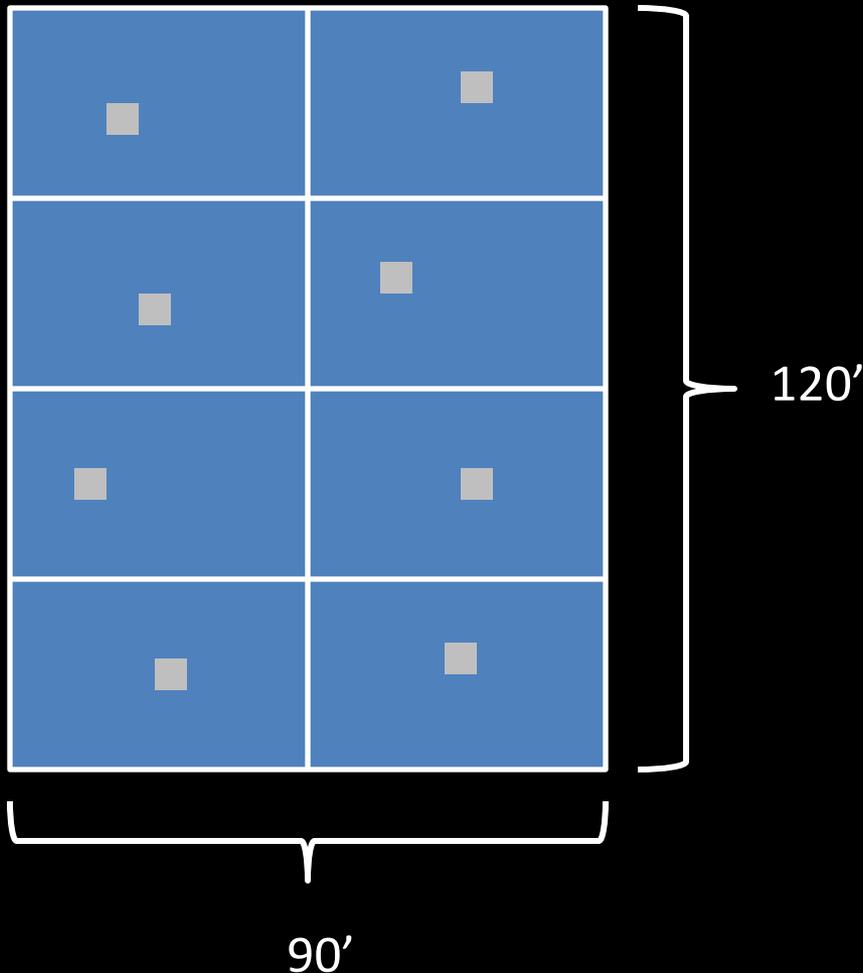
Variable soils
& history

Adventures in slug sampling...

- Attempted soil cores + flooding
 - Recovered only 15 slugs from 160 soil cores (each 11 cm diameter)
- Also attempted counting slugs on plants at night
 - Was very time consuming on a large scale
- Finally settled on the homely shingle



Methods for slug monitoring

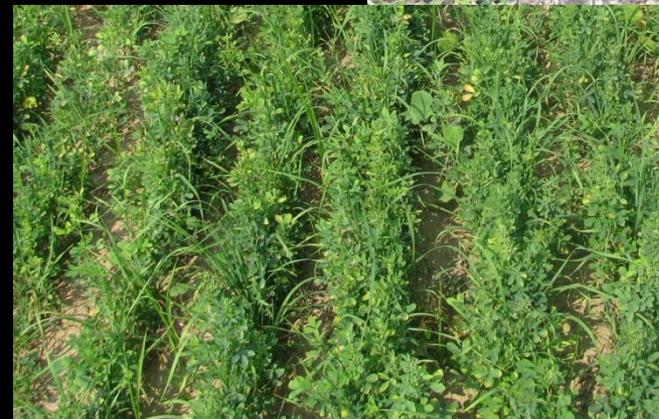


- 8 shingles/plot
 - 1 sq ft – white
 - Brush residue aside
- 20 plots total
 - 12 corn; 8 alfalfa
- Count slugs about once/week during active periods



Methods for assessing plant damage

- Alfalfa + forage mixes
 - Stand counts + damage measurements ~40 days after planting
 - 20 samples (40cm long) per plot
 - Record presence/absence of slug damage

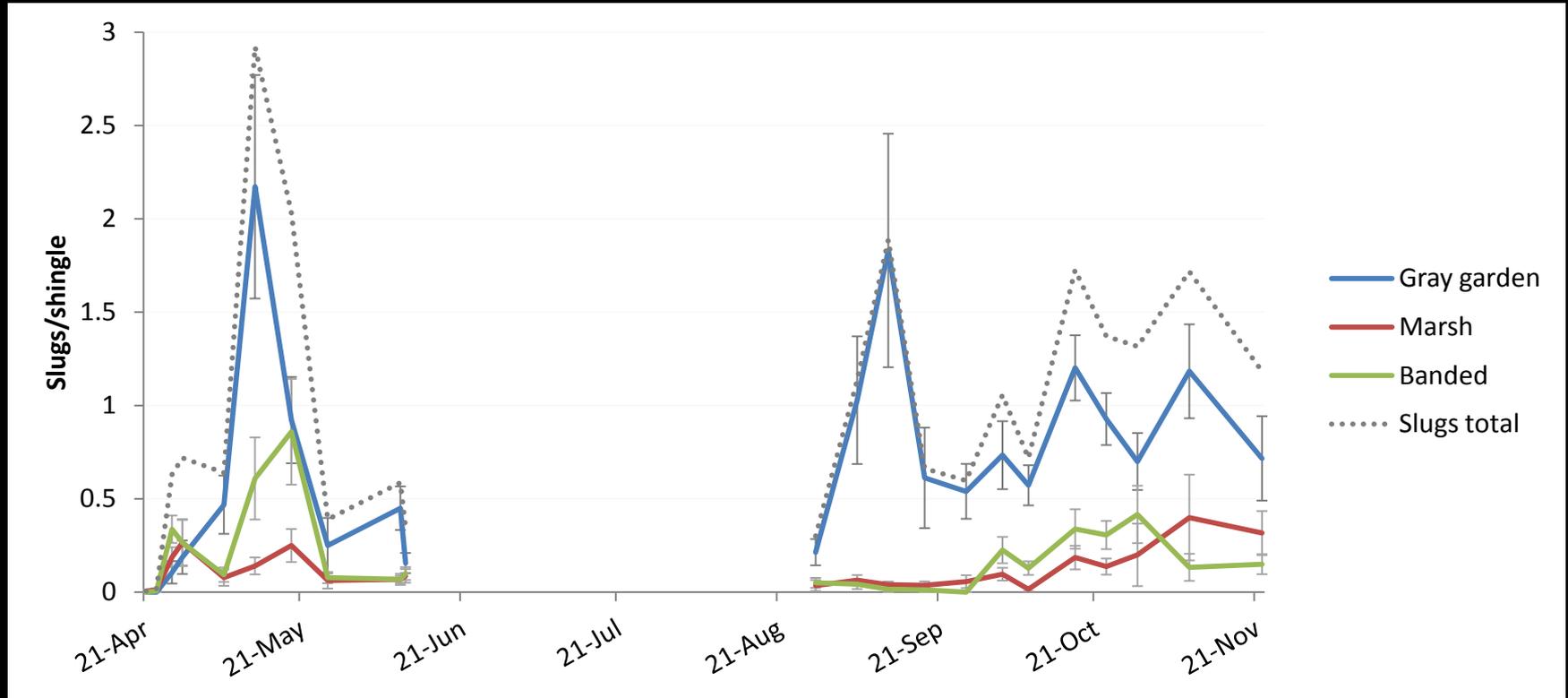


Methods for assessing plant damage

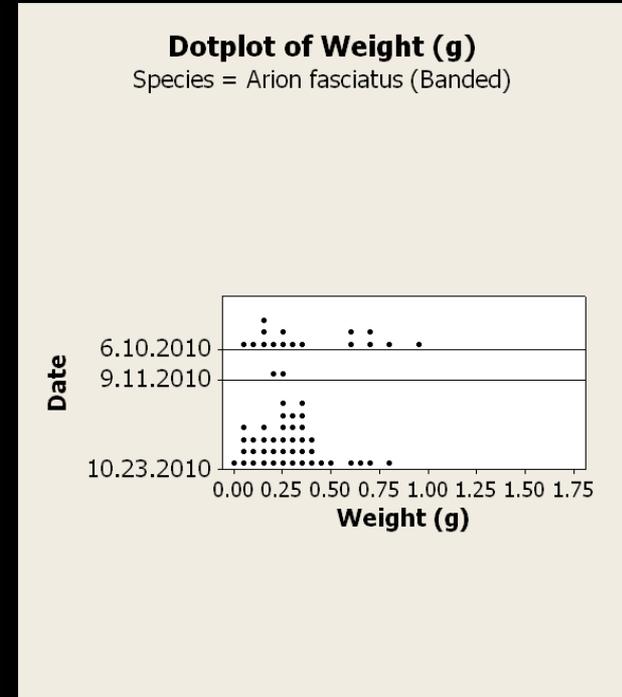
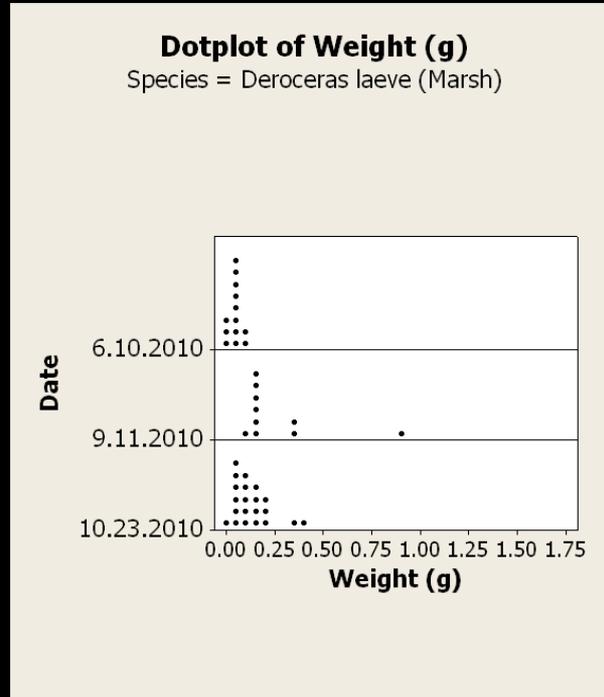
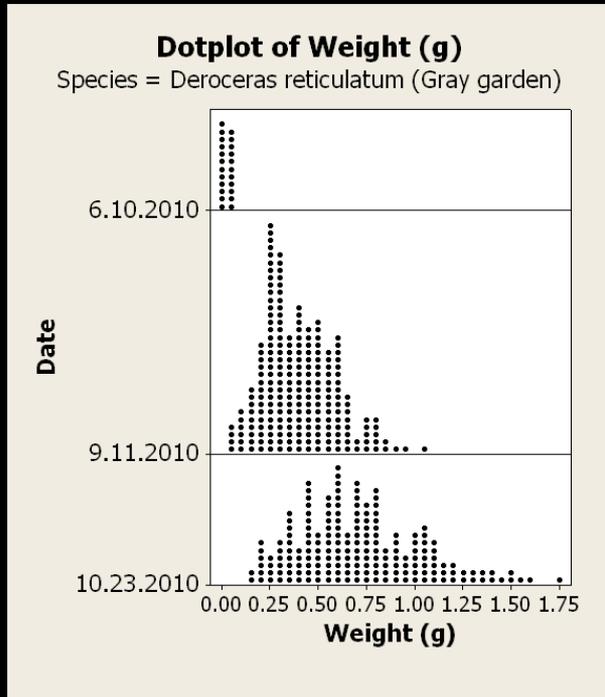
- Corn
 - Stand counts + damage measurements at V2 + V5
 - 8 samples (each 10ft of row) per plot
 - Record slug damage on a scale from 0 – 4
 - Also record insect damage (cutworm, billbug, etc.)



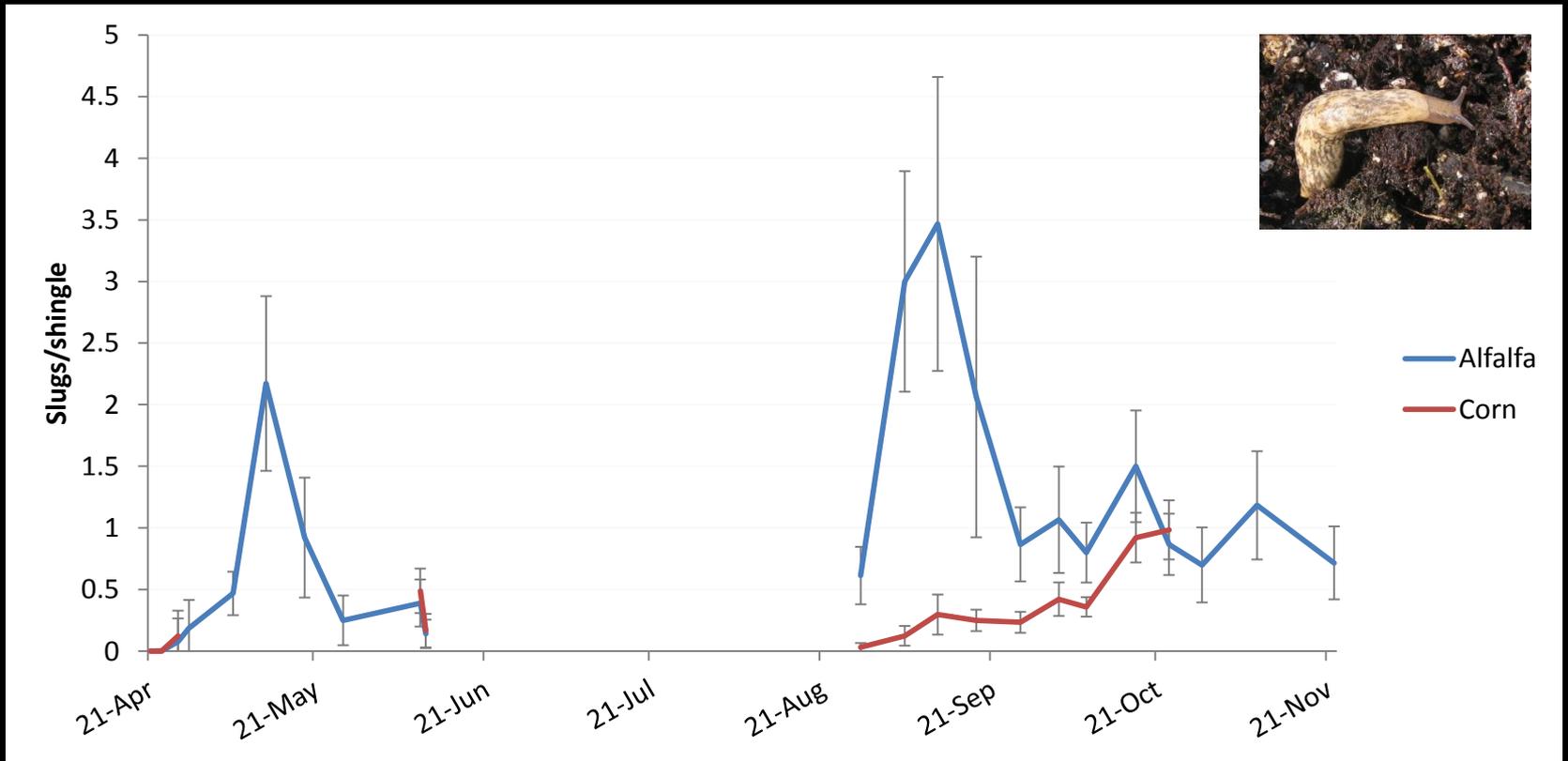
Slug activity 2010



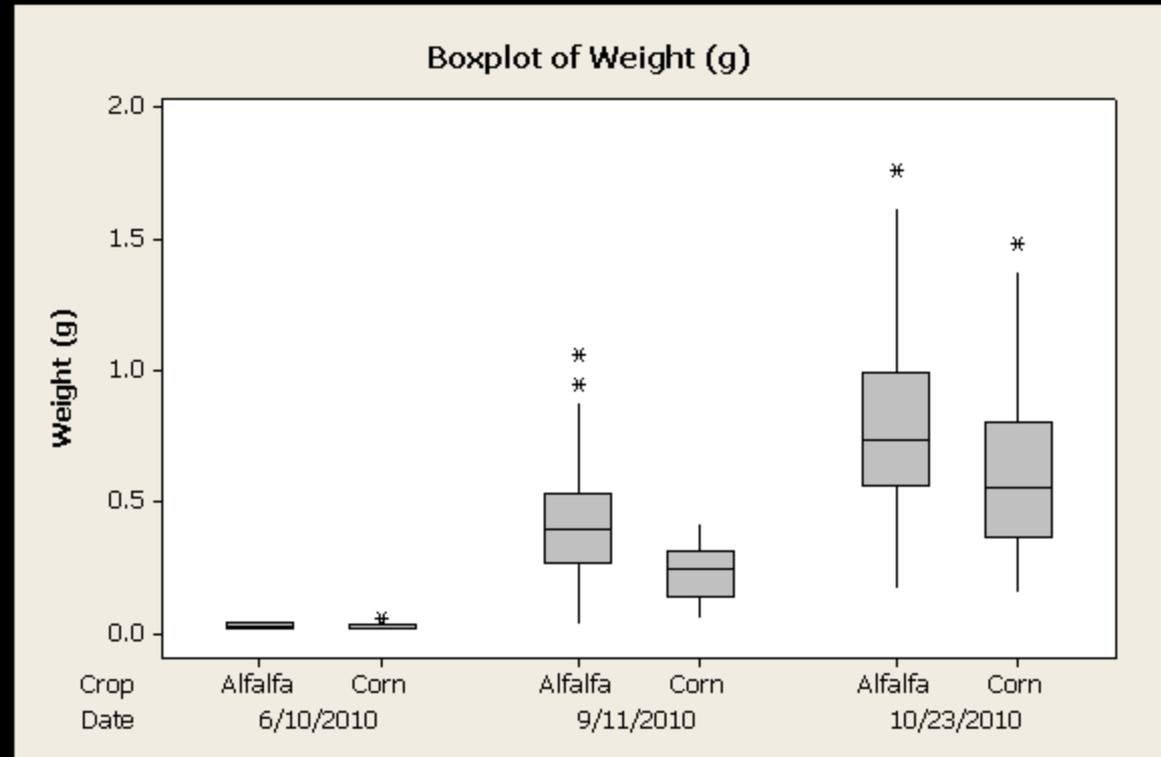
Slug growth & development 2010



Gray garden slug X crop 2010



Gray garden slug growth X crop plant

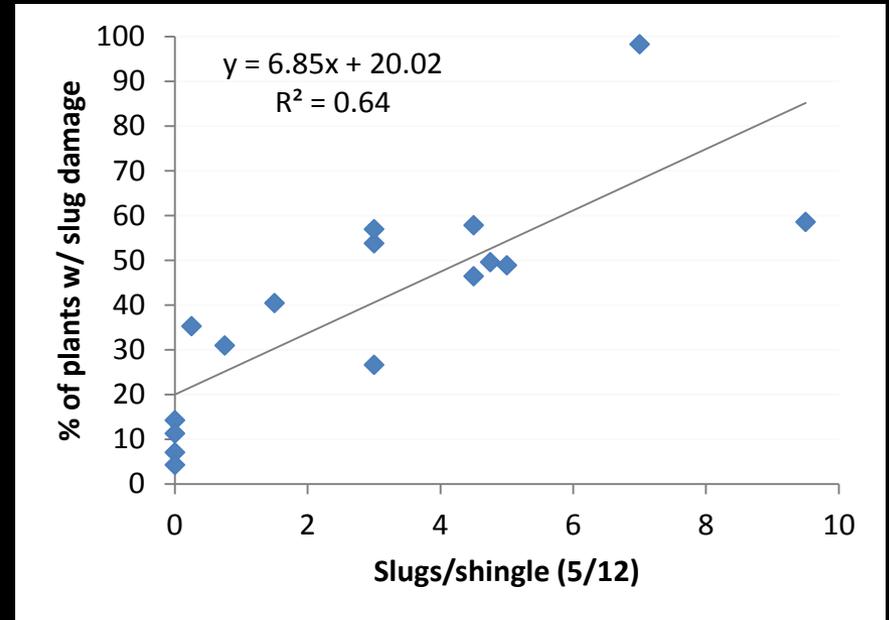
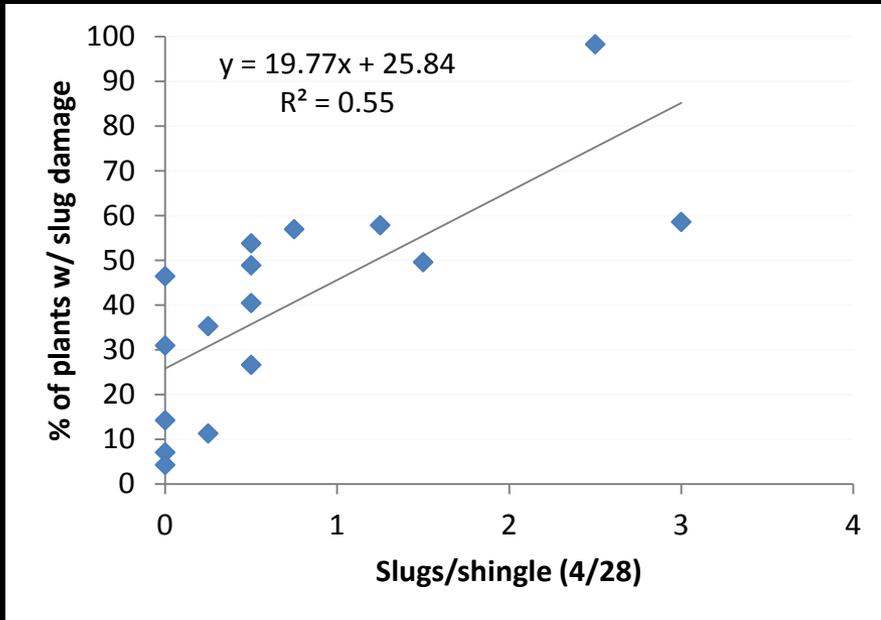


Shingle traps & slug damage

- Can slug counts under shingle traps in spring help predict crop damage?
- Can shingle traps be a useful sampling technique for large studies?
- Challenges: variability & timing



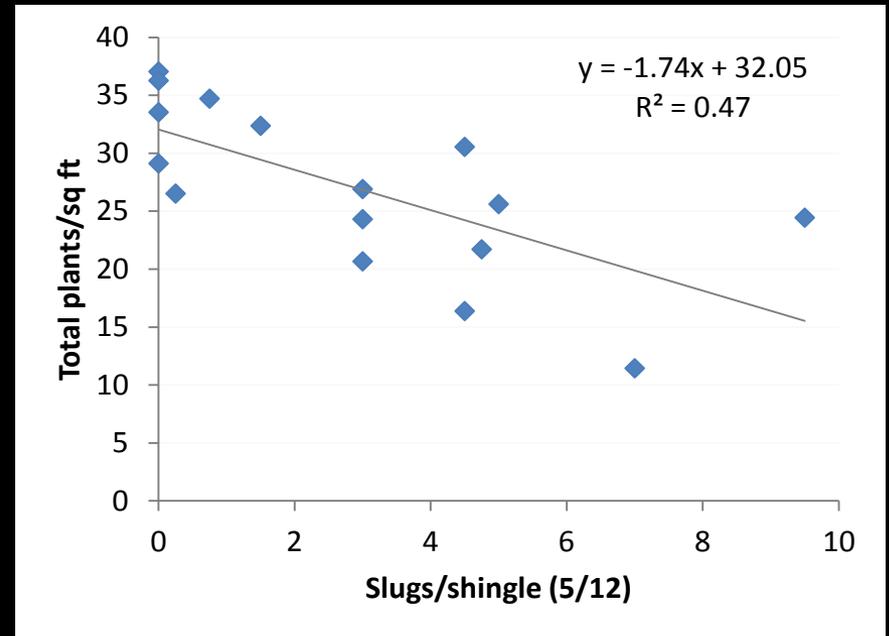
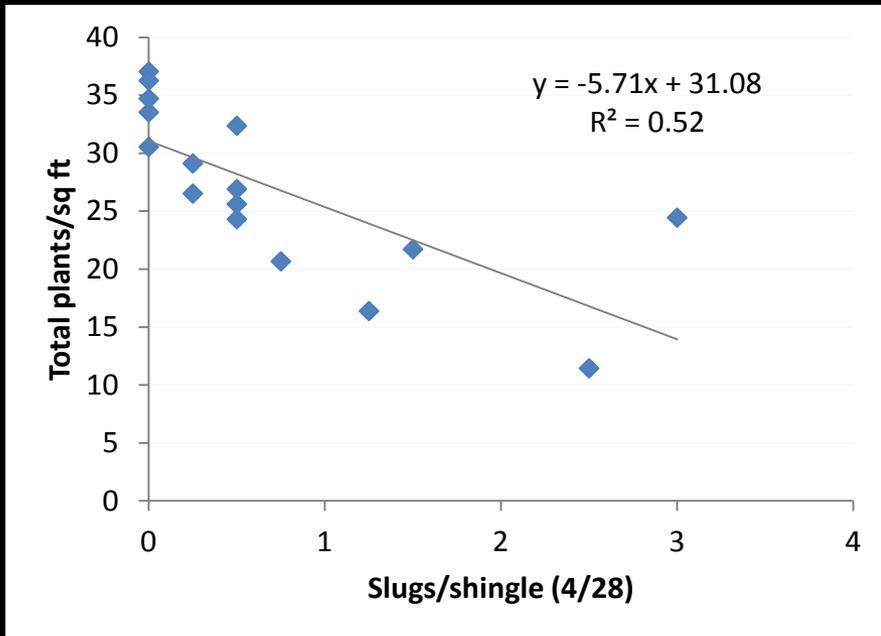
Forages: Shingle traps & crop damage



- Slugs under shingles were positively related to crop damage
- Stands were planted 4/15 and assessed 5/26



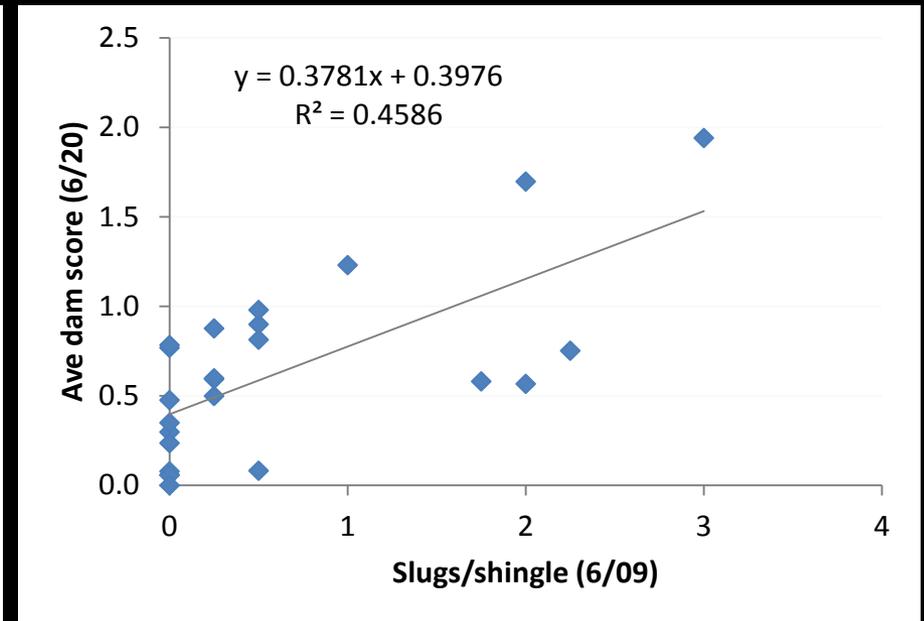
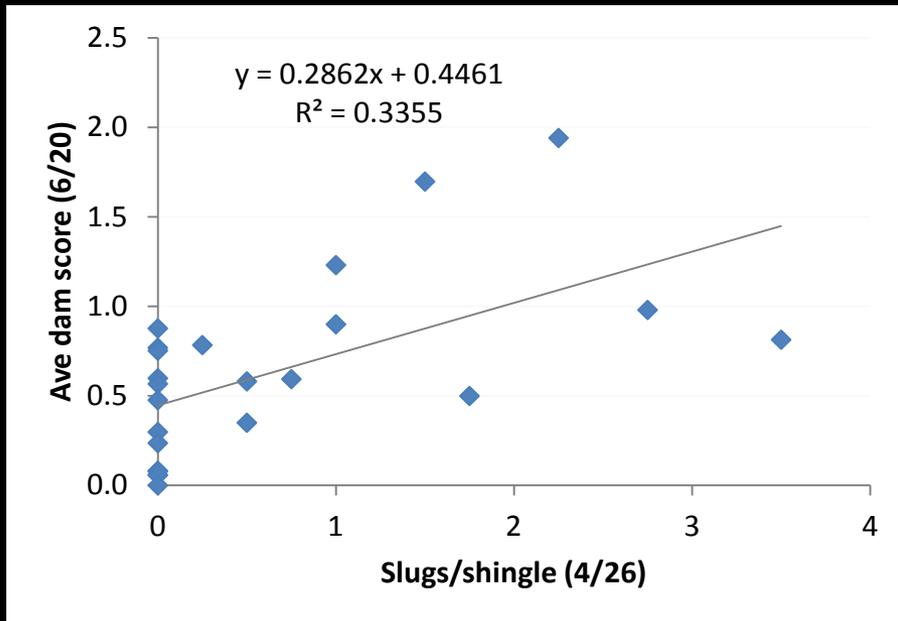
Forages: Shingle traps & crop damage



- Slugs under shingles were negatively related to stand count
- 25 – 30 plants/ft² is the target



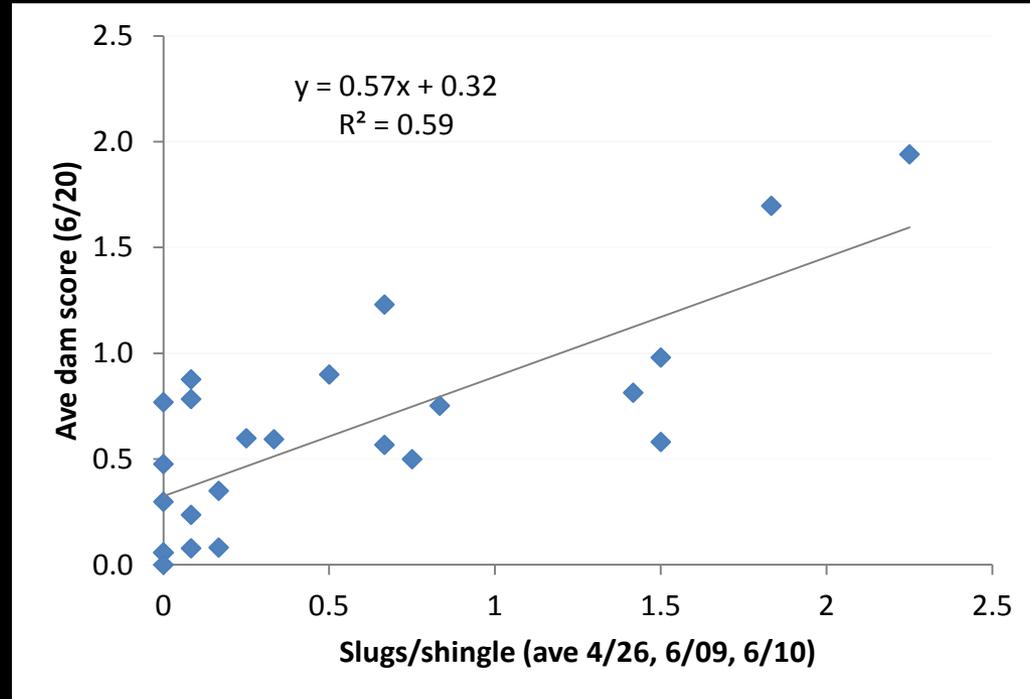
Corn: Shingle traps & crop damage



- Sampling before manure application + planting was not very predictive (prob. too early)
- Sampling later was a little bit more predictive



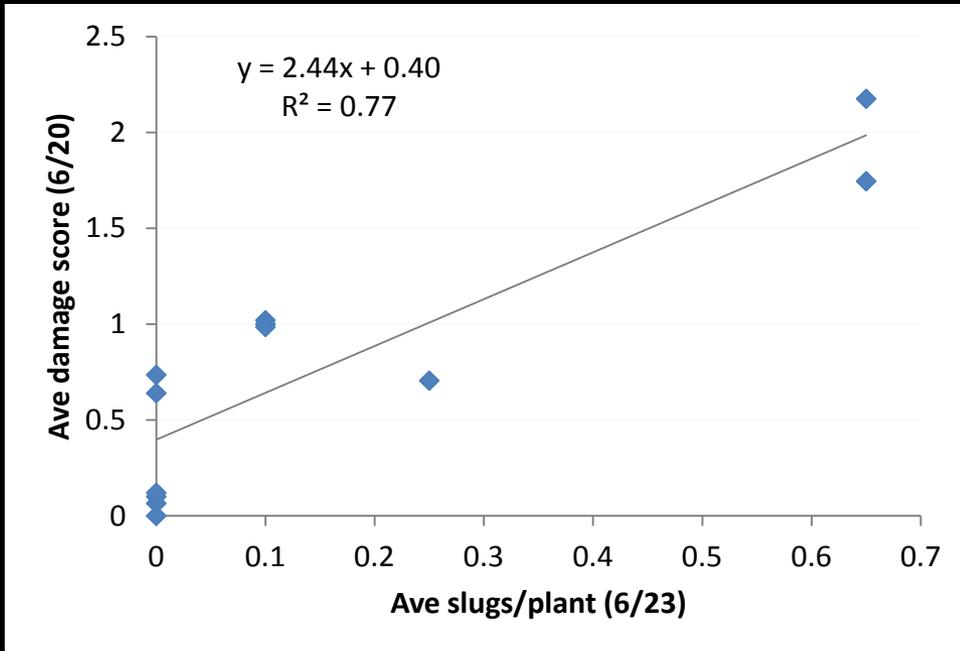
Corn: Shingle traps & crop damage



- Averaging slug counts from 3 sample dates (one pre-plant and two post-plant) improved the fit

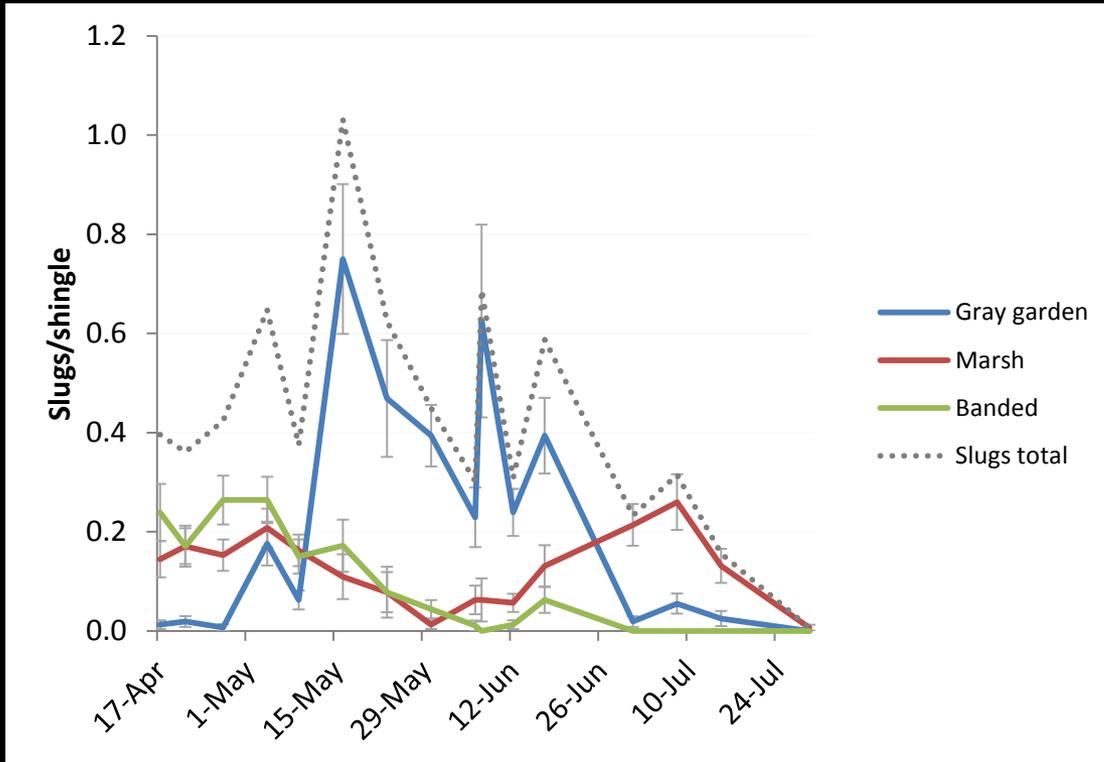


Corn: Counting slugs at night



- Slugs/plant were positively related to crop damage in June

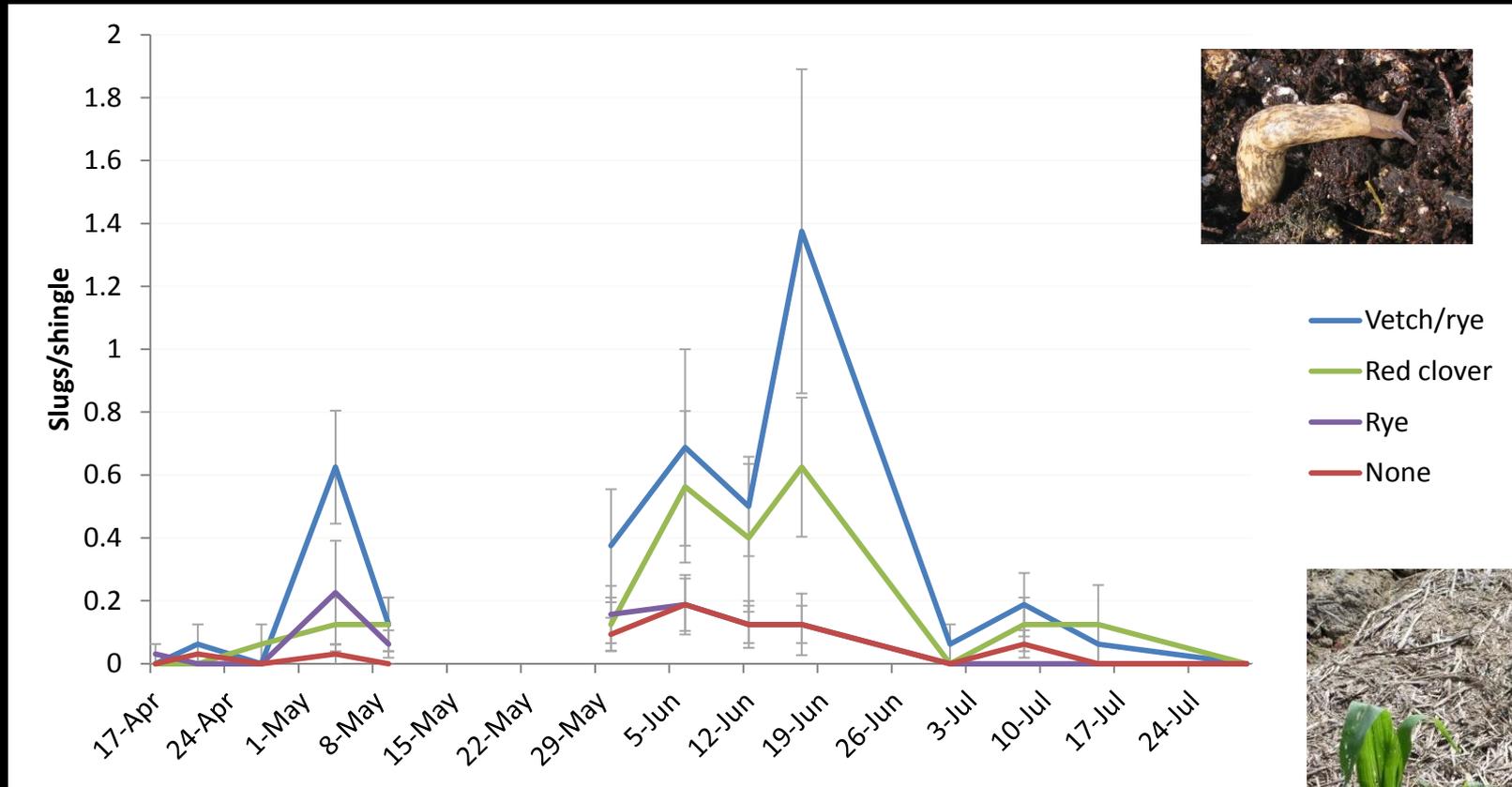
Slug activity 2011



Slugs have been far less abundant this year

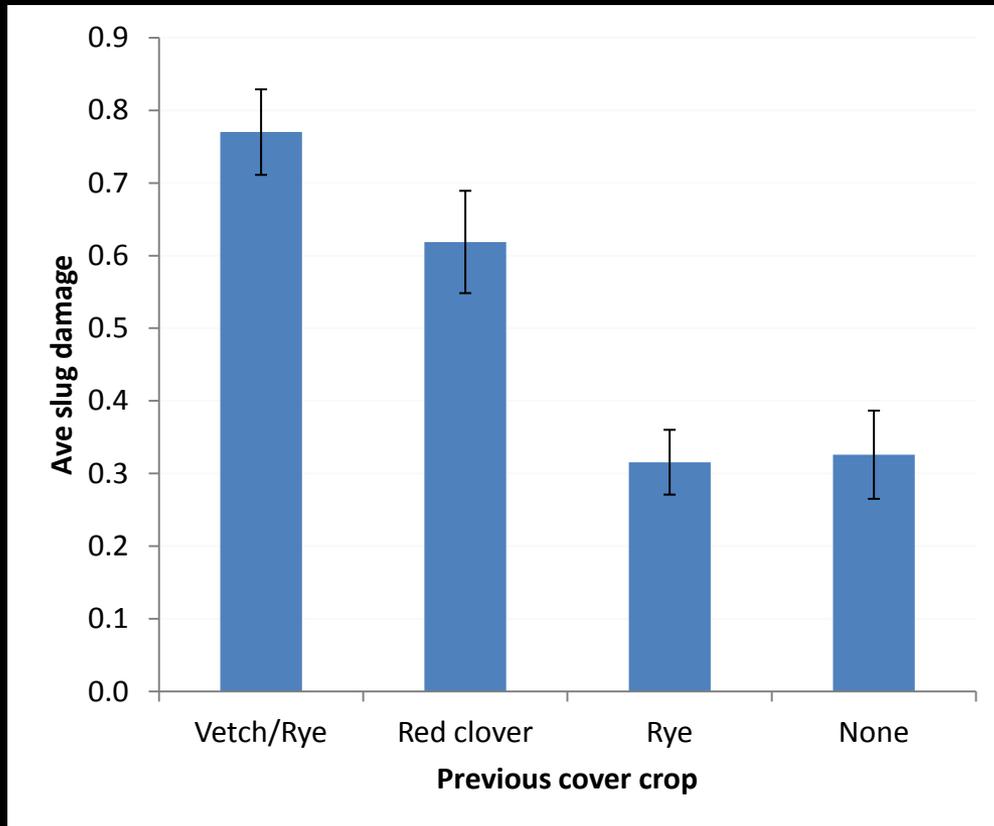


Gray garden slugs X cover crop 2011



Slug activity in corn was higher after certain cover crops

Slug damage to corn – V5



Slug damage was low, but did follow a pattern similar to activity under shingles

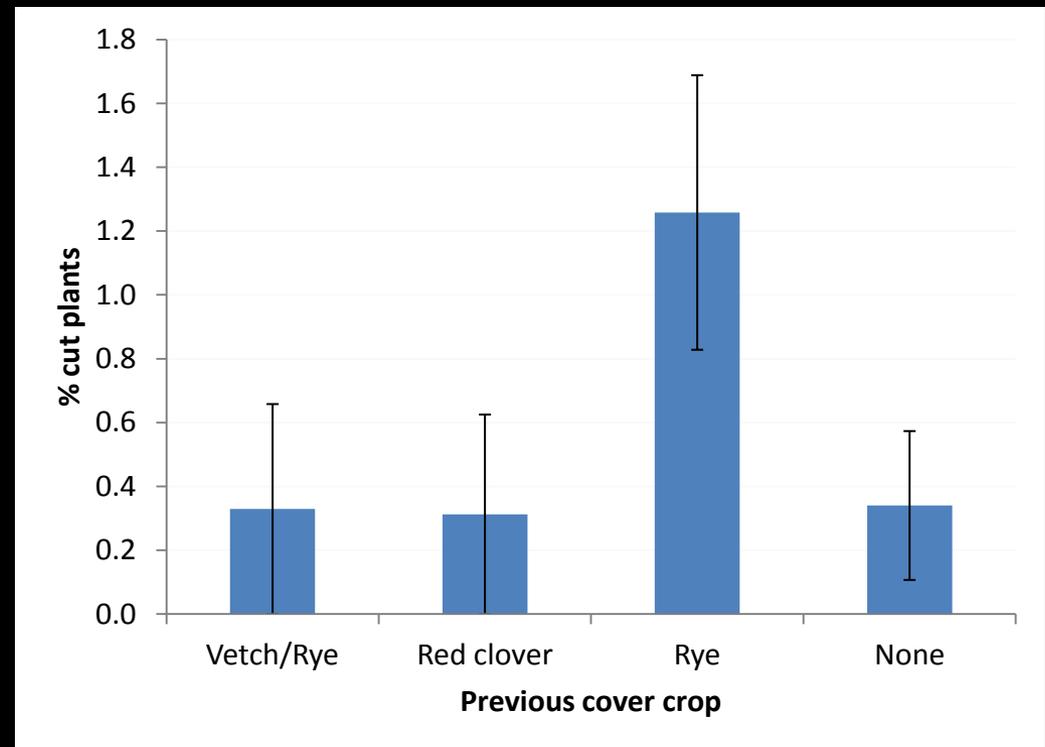
Damage scale:

- 0 = no leaf are gone
- 1 = < 25% leaf area gone
- 2 = 25-50% leaf area gone
- 3 = 50-75% leaf area gone
- 4 = 75-100% leaf area gone

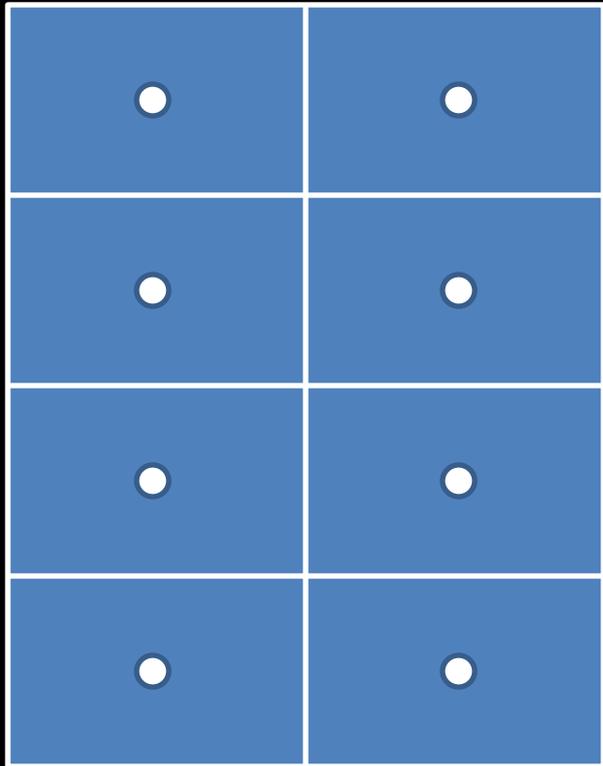
* bars = 1 SE

Other early season pests – V5

- Most other early season pests were rare
- Cutworm damage was highest after a rye cover crop



Natural enemy sampling



- 8 pitfall traps per plot
- Open for 48 hours every 2 to 3 weeks
- 20 plots total
 - 12 corn
 - 8 alfalfa
- Same plots as slug sampling
- Results are still to come...



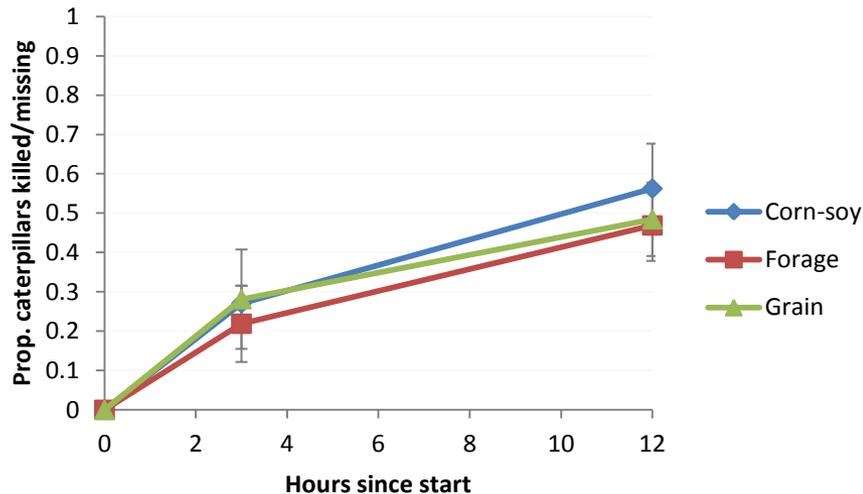
Measuring predation in the field



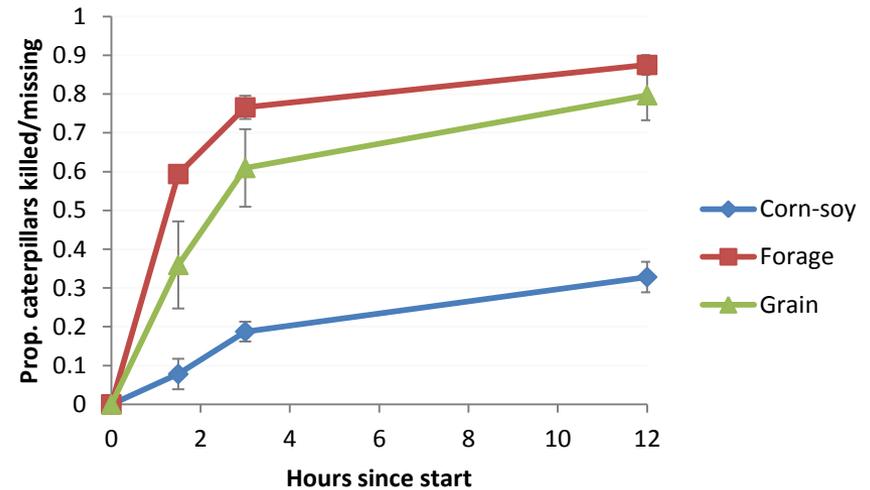
- Waxworm caterpillars (*Galleria mellonella*) are used as sentinel prey items
- 32 deployed per plot, half in vertebrate exclusion cages
- AM: 8:30 am – 8pm
- PM: 8:30pm – 8am
- Early (June) and mid-season (July) sample dates

Insect predation in corn (7/20/11)

AM predation



PM predation



- At night, caterpillars were attacked more quickly in the diverse rotations with cover crops
- Major night-time predators were ground beetles, ants, wolf spiders, and harvestmen

Lab studies on slug predation

- Does central PA host potential natural enemies of slugs?
- Do these predators discriminate between slug species?
- Do predators influence slug behavior?

Laboratory predation assays

- Microcosms with slugs, predators, + soybean seedlings
- Field-collected predators are starved for one day
- Soybeans are planted one day before trial begins
- Trial is run for 4 days in a growth chamber (21° C, 12L:12D)

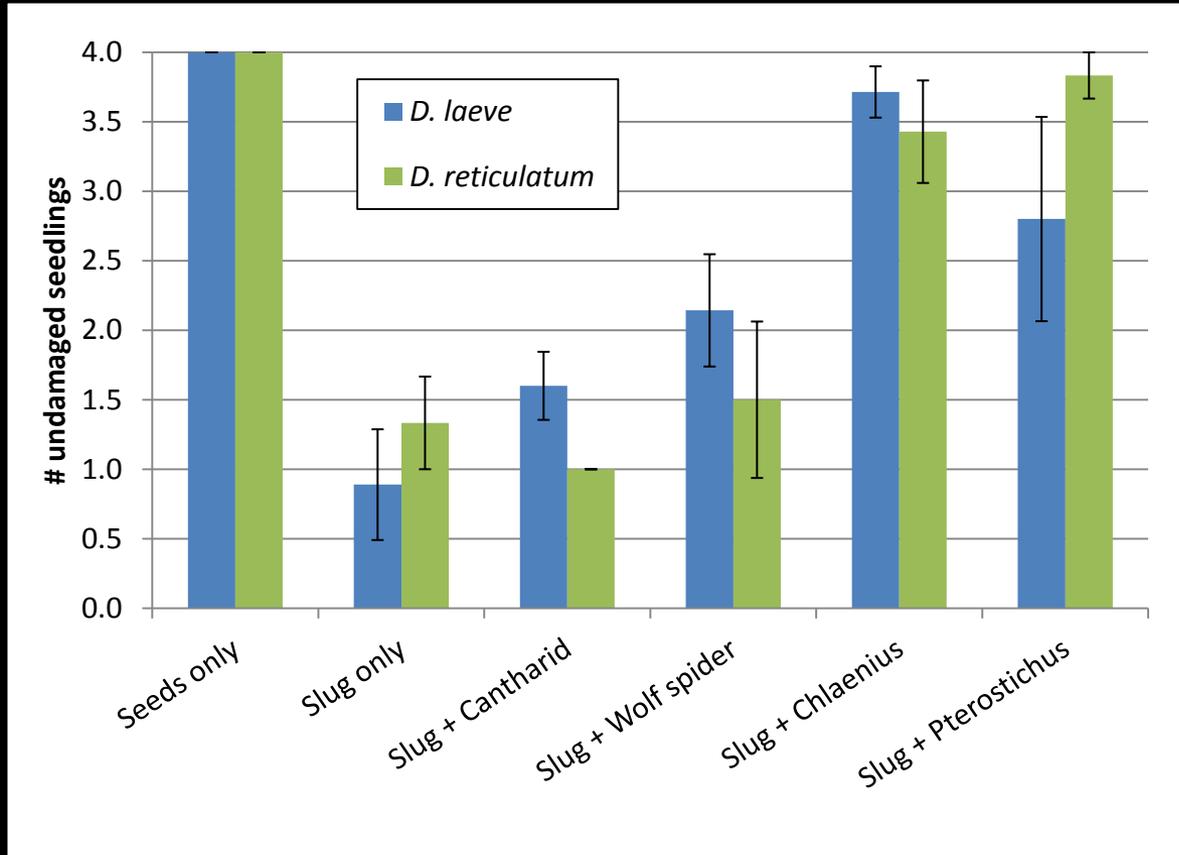
Before



After



Laboratory predation assays

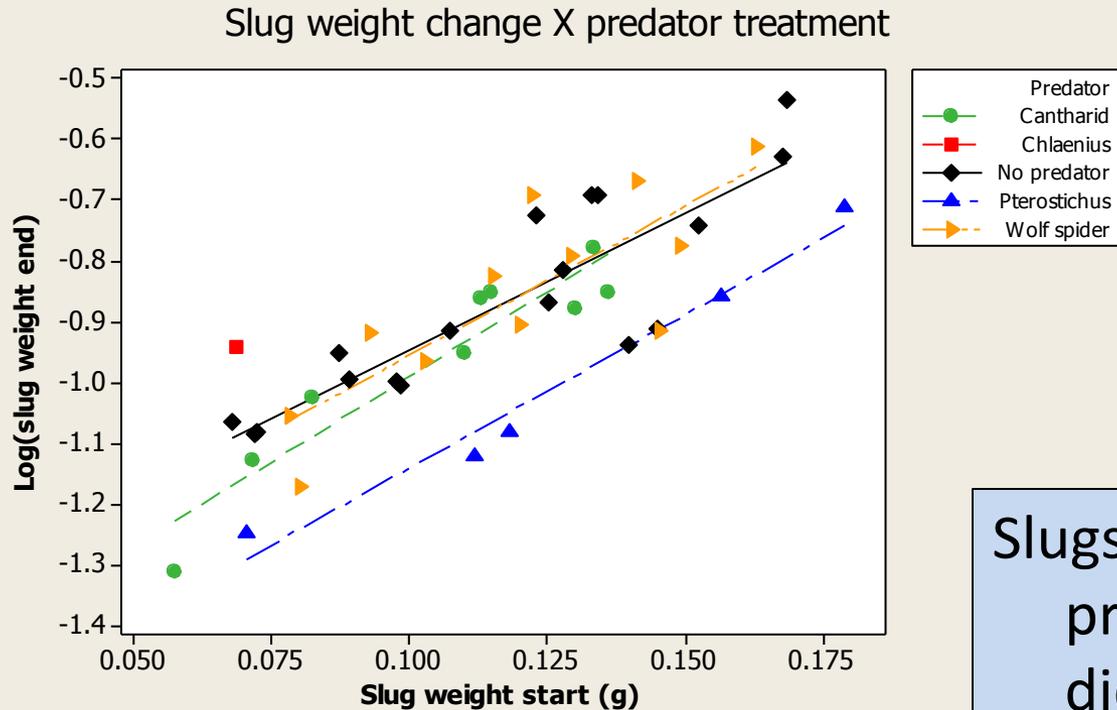


Pterostichus melanarius



Chlaenius tricolor

Laboratory predation assays

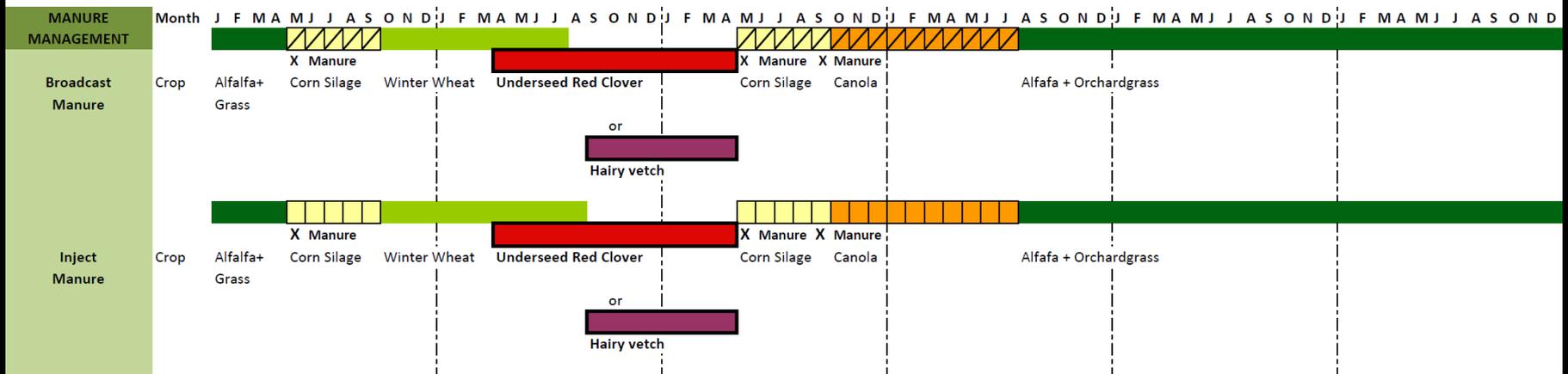


Slugs that survived in the presence of *P. melanarius* did not gain as much weight as control slugs or slugs in the presence of other predators

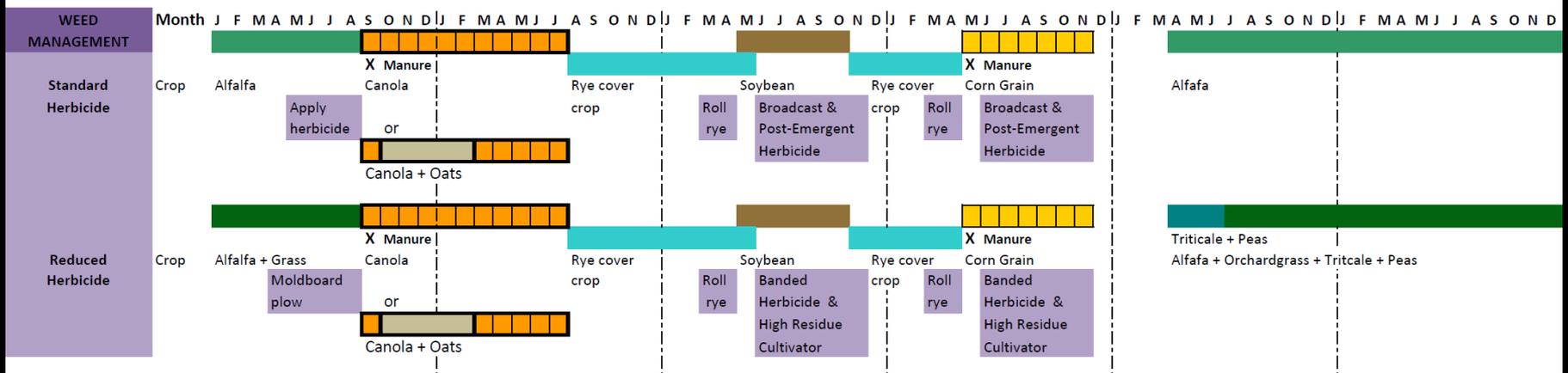
Questions?

PENN STATE SUSTAINABLE DAIRY CROPPING SYSTEMS (All systems are no-till, except in one year in the 'Reduced Herbicide Grain Rotation')

FORAGE ROTATION: manure management, green manure species comparison, & standard herbicide regime



GRAIN ROTATION: weed management, canola mycorrhizae management comparison, & inject manure regime



CORN GRAIN CONVENTIONAL ROTATION: manure, standard herbicides, and GM-crops

