Legume winter survival and spring biomass production in the Northeast: effect of planting date and nurse crops.

July 28, 2023 Arthur Siller, UMass Amherst

Objective

Investigate the relationship between fall planting time and cereal nurse crops on legume cover crop winter survival and spring growth nitrogen contribution across the Northeast through two research trials: 1) on-farm strip trials and 2) randomized trials at research stations. Research station trials will be implemented in the late summer of 2023 and 2024 and strip trials will be done in the fall of 2024.

Rationale

Crimson clover and winter peas do not consistently overwinter in cooler areas of the Northeast while balansa clover is relatively untested. While hairy vetch has a reputation for good winter survival, it has not shown consistent growth habit in mixtures. Winter survival and spring growth in each year are affected by several factors including fall growth and development and protection/competition from nurse crops. The warming climate may allow crimson and balansa clovers and winter peas to be used in place of hairy vetch as a winter annual legume but a better understanding of the factors affecting winter survival are needed.

Hypotheses

Early establishment of legumes will promote winter survival. Both cereal nurse crops will support winter survival. Planting with winter rye will increase winter survival compared to oats but will reduce spring legume biomass production due to competition.

Draft Experimental Design

Randomized Research Station Trial

3 factor RCB (2 years, 2023-2024 and 2024-2025)
4 Reps
Factors:
1) Planting Date (**6 weeks** before last frost, **3 weeks** before last frost)
2) Legume Crop - **crimson clover** (Dixie), **balansa clover** (Viper), **winter pea** (Keystone), **hairy vetch** (Patagonia)
3) Cereal Nurse Crop - **rye** (Danko), **oats** (Reeves), **none**
Treatment Layout: Split plot design
Main Plot: planting date
Sub Plots: legume x cereal
Experimental Units: 96
Plot Size: at least 100 ft^2 but dimensions depend on seed drill width. I will send enough seed to do at least 180 ft^2 per plot.

Randomized trial treatments								
seeding	legume	planting date	nurse crop	legume seeding rate	cereal seeding rate	plot size	legume seeding rate	cereal seeding rate
treatment				#/A	#/A	sq ft	g/plot	g/plot
1	crimson clover	6 weeks before typical frost	oats	20	30	100	20.8	31.3
2	crimson clover	6 weeks before typical frost	rye	20	30	100	20.8	31.3
3	crimson clover	6 weeks before typical frost	none	20	0	100	20.8	0.0
4	balansa clover	6 weeks before typical frost	oats	8	30	100	8.3	31.3
5	balansa clover	6 weeks before typical frost	rye	8	30	100	8.3	31.3
6	balansa clover	6 weeks before typical frost	none	8	0	100	8.3	0.0
7	hairy vetch	6 weeks before typical frost	oats	20	30	100	20.8	31.3
8	hairy vetch	6 weeks before typical frost	rye	20	30	100	20.8	31.3
9	hairy vetch	6 weeks before typical frost	none	20	0	100	20.8	0.0
10	winter pea	6 weeks before typical frost	oats	40	30	100	41.7	31.3
11	winter pea	6 weeks before typical frost	rye	40	30	100	41.7	31.3
12	winter pea	6 weeks before typical frost	none	40	0	100	41.7	0.0
13	crimson clover	3 weeks before typical frost	oats	20	30	100	20.8	31.3
14	crimson clover	3 weeks before typical frost	rye	20	30	100	20.8	31.3
15	crimson clover	3 weeks before typical frost	none	20	0	100	20.8	0.0
16	balansa clover	3 weeks before typical frost	oats	8	30	100	8.3	31.3
17	balansa clover	3 weeks before typical frost	rye	8	30	100	8.3	31.3
18	balansa clover	3 weeks before typical frost	none	8	0	100	8.3	0.0
19	hairy vetch	3 weeks before typical frost	oats	20	30	100	20.8	31.3
20	hairy vetch	3 weeks before typical frost	rye	20	30	100	20.8	31.3
21	hairy vetch	3 weeks before typical frost	none	20	0	100	20.8	0.0
22	winter pea	3 weeks before typical frost	oats	40	30	100	41.7	31.3
23	winter pea	3 weeks before typical frost	rye	40	30	100	41.7	31.3
24	winter pea	3 weeks before typical frost	none	40	0	100	41.7	0.0

Data Collection Summary

Fall soil sample at each planting date
Field history
Fall stand count 3 weeks after planting
Biomass sampling in spring at rye boot stage (in seeding date 1)
Legume and rye growth stage at spring sampling
Separate, dry, and weigh biomass into legume, rye, and weeds
Note common weed species at biomass sampling
Send biomass sample subset to UMass for nitrogen analysis

Draft Operations Timeline

Late July 2023
Finalize experimental design
Source seed to UMass

Early August
Mail seed to participating researchers

Randomized Research Station Trial

6 weeks before typical frost
Plant seeding date 1 with grain drill
Collect soil sample for seeding date 1
Record field history (preceding crops, herbicide burndown, tillage, other notes)
Send 2023-2024 plot layout to *asiller@umass.edu*

3 weeks before typical frost
Plant seeding date 2 with grain drill
Collect soil sample for seeding date 2
Make 1/4 m^2 permanent quadrat and count seedlings in seeding date 1

0 week before typical frost
Make 1/4 m^2 permanent quadrat and count seedlings in seeding date 2
Mail soil samples to *Arthur Siller, 201 Natural Resources Rd Amherst MA 01003*

Winter 2023-2024
Upload stand count data
Finalize spring sampling protocol

Rye boot stage in seeding date 1
Permanent quadrat harvest in seeding dates 1 and 2
Separate biomass into legume, rye, and weed portions

Rye boot stage in seeding date 1 cont.
Dry and weigh legume, rye, and weed biomass
Evaluate legume and rye growth stage
Note common weed species

June 2024
Send biomass sample subset for nitrogen analysis to *Arthur Siller, 201 Natural Resources Rd Amherst MA 01003*
Upload biomass data
