



Mississippi Corn Promotion Board 2018 Progress Report

Project Title: Use of Winter Legumes as Late Summer through Spring Cover Crops

PI: Dr. Brian Baldwin

Department: Plant & Soil Sciences

Project Summary (Issue/Response)



Cover crops hold the soil, provide organic matter, suppress weeds, improve soil health and aggregate stability, and provide refuge for pollinators and beneficial/predatory insects. The Southeast has a distinct advantage over the rest of the U.S. in that cool-season legumes proliferate during our winter months. However, while these species are well adapted to all areas of Mississippi, all winter legume seed, fail to germinate while the soil temperature is above 70°F (20°C). Baldwin, Morrison and McLemore have made 3 cycles of selection for seed of hairy vetch, crimson, berseem and balansa clover that germinate and grow at temperatures greater than 104°F (40°C). Significant positive results have been obtained with crimson clover and hairy vetch. With germination at these higher temperatures it is possible to target overseeding immediately after corn harvest (late August/early September). Planting at this time of year will facilitate stand establishment from late summer. Late summer planted cover crops will scavenge residual corn nitrogen in the soil, and convert to nitrogen fixation once soil nitrogen is exhausted. Early establishment will suppress germination of other winter weeds, including those resistant to herbicides (RR ryegrass).

The laboratory germination results show a positive gain in reduced secondary dormancy in hairy vetch, and inconsistent progress for the two clover species (berseem and crimson). We believe poor quality seed limited plant performance during the 2017-2018 growing season and have reselected and increased these seed lots. Germination results indicate clear gain in reduced secondary dormancy in hairy vetch. In the high temperature selection process individuals that germinate within the first 2-6 days should be used to contribute to the next generation of heat selected (HS) individuals. This rapid germination at high temperatures indicates a high metabolism under heat stress conditions, i.e. the ability to grow under strongly unfavorable environmental conditions.

Sweep net insect counts in the cover crop species indicated hairy vetch housed the greatest number of harmful insects (33), but also carried the greatest number of beneficial insects (7; lady beetle and spined soldier bug), probably due to its dense canopy. Adult southern corn rootworm was the greatest concern, but can be controlled with cry3a corn germplasm.

The 2017-2018 field trial concluded the most advanced HS cycle 2 of each species optimal planting date was 1st week of September (the earliest tried). Crimson clover and hairy vetch provided the greatest weed control. Early coverage of hairy vetch completely suppressed weeds in the plot.

Based on the results of this two year study, berseem clover or hairy vetch provided the corn grain yield of 100 lb/A of nitrogen.

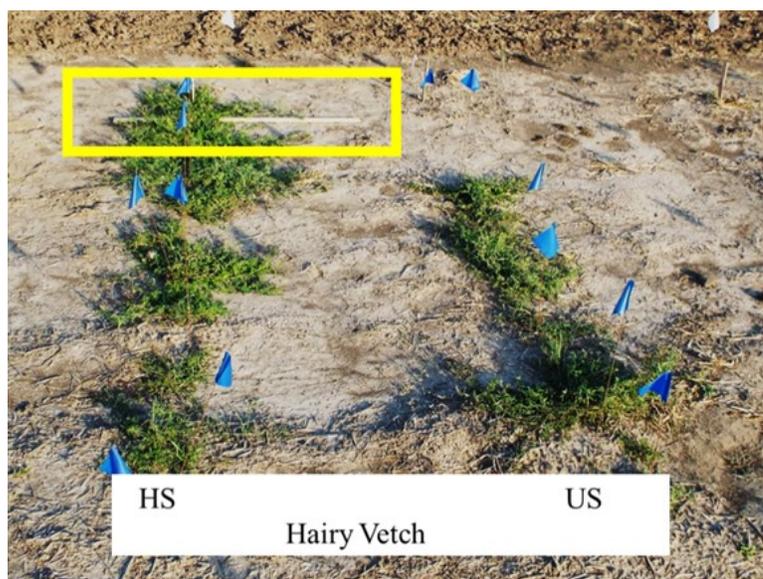


Project Results/Outcomes

- Laboratory assessment indicated selection for reduced secondary dormancy in the three tested legume species tested (berseem, crimson clover and hairy vetch) had mixed results. It was unsuccessful for the two clover species. Clear germination performance was muddled with the effects of seed production environment and limited seed produced to select from. The quantitative alleles conferring heat tolerance to hairy vetch ultimately showed gains. However, the final screening of hairy vetch under 104°F showed advanced cycles (HS2 and HS3) germinated at higher levels than HS1 and the unselected populations.
- In the field assessment of paired rows (HS vs US), we were successful in establishing a clear difference between selected and unselected populations of each species based on emergence over the three field planting months.
- The results of this two year corn-following-cover-crop study indicated crimson clover and hairy vetch were quickest to cover and establish canopy. This provided the greatest weed suppression of the four legumes tested.
- Sweep net insect counts in the cover crop species indicated hairy vetch housed the greatest number of harmful insects (33), but also carried the greatest number of beneficial insects (7).
- Corn grain yields from the legume treatments were similar to the yields of the 100 lbs N/A treatment.



Master's student John McLemore evaluating hairy vetch coverage in his research plots.



Difference in early season ground coverage of heat selected (HS) hairy vetch versus its unselected (US) parent.

Project Impacts/Benefits

This germplasm was generated with a reduction of secondary dormancy in mind. Removal of secondary dormancy would allow seed to germinate earlier, enhancing establishment of these species when used as a fall/winter cover crop. Early planted corn in Mississippi senesces in August. Harvest in August or early September leaves ground fallow (uncovered) until the following March. Naturalized and domestic cultivars of cool-season legumes germinate in late October. Breeding to remove or reduce the effects of secondary dormancy would allow improved cultivars to germinate upon planting. Planting these cultivars would allow early soil coverage with associated benefits, such as; sequestering residual N, reducing erosion, and weed suppression. Hairy vetch and crimson clover provided corn grain yields equal to 100 lbs/A of nitrogen. Burn-down leguminous cover crops are able to provide plant available N early in the corn season (VE-V6 corn growth stage) while holding the soil in place. Corn N uptake peaks between the V8 and VT growth stage. If senesced cover crops are available to provide N between the VE and V6 growth stage then a single chemical fertilizer application can be delayed until V5 or V6 growth stage. Future planting schemes might incorporate cover crop species coupled with inorganic N fertilizer to take advantage of both options; providing early N fertility from mineralizing legume biomass and later N fertility with an application of inorganic N when corn roots are established and can intercept more N fertilizer.

Project Deliverables

- One master's student graduated and holding a job: John McLemore, Jr. Agriculture and Natural Resource Extension Agent, Douglas (Coffee County) Georgia.
- Three improved varieties, one of each of three species selected for early germination and heat tolerance.

Presentations:

McLemore, J.Q., J.I. Morrison, and B.S. Baldwin. 2018. Utilizing Hairy Vetch (*Vicia villosa* Roth.) as winter leguminous cover crop in an early-planted Mississippi corn production system. 72nd Proc. Southern Pasture and Forages Improvement Conf. Fayetteville, AR 14-16 May.

McLemore, J.Q., J.I. Morrison and B.S. Baldwin. 2018. Utilizing crimson clover (*Trifolium incarnatum* L.) as winter cover crop in an early-planted Mississippi corn production system. Plant & Soil Sciences Second Ann. Poster Contest. Wise Center, Mississippi State, MS. 19 Apr.

McLemore, J.Q., J.I. Morrison and B.S. Baldwin. 2018. The use of recurrent phenotypic selection to reduce secondary dormancy in *T. alexandrinum* L., *T. incarnatum* L., *Vicia villosa* Roth. for use as a leguminous cover crop in Mississippi. Miss. State University Graduate Student Research Symposium. Starkville, MS. 17 Feb.

McLemore, J.Q., J.I. Morrison, B.S. Baldwin, and W.B. Henry. 2018. Breeding for rapid germination in crimson clover (*Trifolium incarnatum* L.) to implement as a winter leguminous cover crop. 6th Annual Future of Agriculture competition. Starkville, MS. 8 Feb.

McLemore, J.Q., J.I. Morrison, B.S. Baldwin, and W.B. Henry. 2018. Ameliorate secondary dormancy of leguminous cover crop species for use in commodity production systems through recurrent phenotypic selection. Southern Assoc. of Agric. Scientists. Jacksonville, FL. 4-6 Feb.

McLemore, J.Q., J.I. Morrison, and B.S. Baldwin. 2017. Developing heat-tolerant leguminous cover crops for use in an early-planted Mississippi corn production system. 71st Proc. Southern Pasture and Forages Improvement Conf. Knoxville, TN 5-7 June.

McLemore, J.Q., J.I. Morrison and B.S. Baldwin. 2017. Reducing Secondary Dormancy in Cool-season Legumes Species through Recurrent Selection. Miss. State Uni. Graduate Student Research Symposium. Starkville, MS. 25 Mar.

McLemore, J.Q., J.I. Morrison and B.S. Baldwin. 2017. Use of winter legumes as late summer through spring cover crops. Southern Assoc. of Agric. Scientists. Mobile, AL. 5-7 Feb.

McLemore, J.Q., J.I. Morrison and B.S. Baldwin. 2016. Use of winter legumes as late summer through spring cover crops. Plant & Soil Sciences Second Ann. Poster Contest. Wise Center, Mississippi State, MS 3 Nov.



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