Mississippi Corn Promotion Board

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

PI: Brian Baldwin, Jesse Morrison, and Brien Henry

Department: Plant and Soil Sciences

Project Summary (Issue/Response)

Cover crops hold the soil, provide organic matter, suppress weeds, improve soil heath 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, along with all cole seed (including tillage turnip), fail to germinate while the soil temperature is above 70°F (20°C). Baldwin and Morrison have made preliminary selections for seed of hairy vetch, crimson, arrowleaf and berseem clover that germinate and grow at temperatures greater than 104°F (40°C). 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 rains (not possible with an October seeding as evidenced by our drought this year). Late summer planted cover crops will scavenge residual corn nitrogen in the soil, while converting 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 legume species listed in the proposal are reported to capture 100 – 200 lbs of N/acre/season without altering soil pH (like application of ammonium nitrate does). Given the cost of nitrogen fertilizer, the cost savings of a leguminous cover crop could be $130-150/acre plus a significant portion liming costs (less legume seed cost and initial liming cost).

Project Results/Outcomes

Laboratory Germination Testing:

We have made initial selections for heat germinating legumes (hairy vetch, crimson and berseem clover). They have been tested under Association of Official Seed Analysts (AOSA) standard testing temperature (70°F/20°C) and also at 104°F/40°C to determine if differences due to selection have manifested in the population. Balansa clover was screened and selected this year for the first time. High temperature germination performance results are presented in Figures 1-3 and AOSA testing in Figures 4-6.

Data to determine selection success indicates that selection for heat-tolerance is not clearly evident; however, selection for velocity of germination is apparent in hairy vetch (days 2-8; Fig. 1) and crimson clover (days 2-6; Fig. 2). This is significant because in event of rain, you want your seed to germinate rapidly, while soil moisture is available. Heat-selected hairy vetch reached maximum high temperature germination in 10 days and the unselected hairy vetch lagged behind, catching up at the 10th day (Fig. 1). Heat-selected crimson clover shows a small increase in velocity of germination (Fig. 2) to the 6th day, but then the unselected population surpasses the germination of the heat-selected material during the 40°C (Fig. 2). This was unexpected. Examining the germination of the crimson clover seed lots germinated at 20°C (Fig. 5) indicates the unselected seedlot is of superior quality to it heat-selected counterpart; so the results at 40°C are not completely unexpected. The 20°C germination of hairy vetch (Fig. 4) and berseem clover (Fig. 6) indicate no difference in velocity of germination (no differences in the two lines from days 2-4); further confirming differences in the early germination

Project Results

at 40°C of the heat-selected material are due to selection. It is common for the first cycles of selection to show limited progress. However, we do show a response to selection in terms of the velocity of germination in crimson clover and hairy vetch.

Field Plantings:

Collaborative field plantings with Dr. Henry have been established using these clover species in larger plots (7' x 30') on reworked corn beds for field evaluation. Lack of rain has prevented germination and therefore unable to provide an early field assessment. Field studies at the North Farm (impact on subsequent corn crop) and South Farms (sequential planting of heat tolerant & non-heat tolerant lines) were confounded by the extreme drought of the summer of 2016. South Farm sequential plantings were made 23 September, 19 October, and 23 November 2015 to determine if material screened for heat tolerance would germinate in the field earlier than their commercial counterparts. The objective was to count at two-week intervals after planting. Lack of rain until 29 November, delayed a majority of the germination from the September and October plantings. However, there was some germination of the September-planted material that was recorded on 1 December (2 days after the first rain in the fall).

The data shown in Table 1 indicate more than sufficient plant densities to cover plots. However, because of very late rains, individual plant size is limited.

North Farm field planting was less affected by limited rain. The entire test was planted on 7 October. Effective planting date was 29 November. There was no plating effect due to weather; however, seedling counts declined in mid-January. It should be noted, 3-4 seedlings per foot are sufficient for complete coverage.

Nineteen crimson clover germinated at 40°C on day 3 out of 48,000 screened.

Project Impacts/Benefits

Late summer planted cover crops will scavenge residual corn nitrogen in the soil, while converting 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 legume species listed in the proposal are reported to capture 100 – 200 lbs of N/acre/season without altering soil pH (like application of ammonium nitrate does). Given the cost of nitrogen fertilizer, the cost savings of a leguminous cover crop could be $130-150/acre plus a significant portion liming costs (less legume seed cost and initial liming cost).

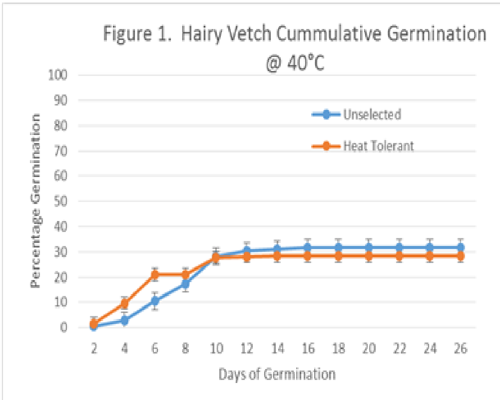
Project Deliverables

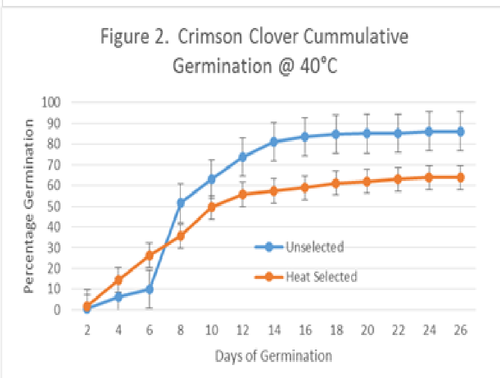
Deliverables include the development of four improved legume varieties and their associated intellectual property and associated royalty flow.

MISSISSIPPI STATE UNIVERSITY
MS AGRICULTURAL AND FORESTRY EXPERIMENT STATION

MISSISSIPPI STATE UNIVERSITY
EXTENSION

Figure 1-3. Germination of legumes at high temperature (40°C = 104°F).





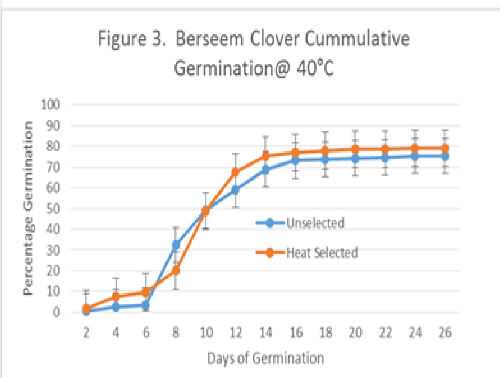
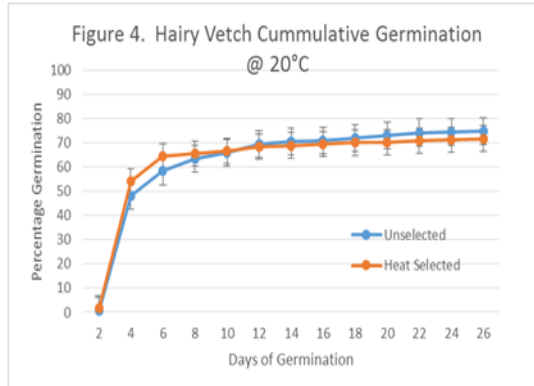
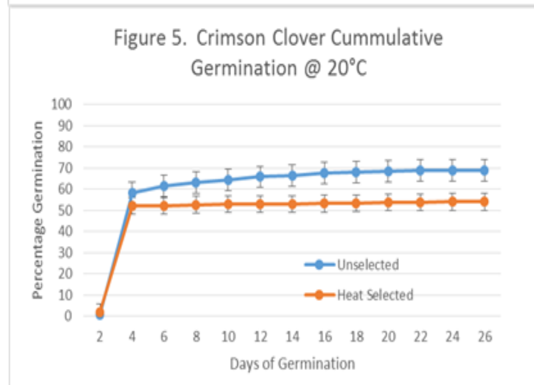


Figure 4-6. Germination of legumes at normal temperature (20°C = 71°F).





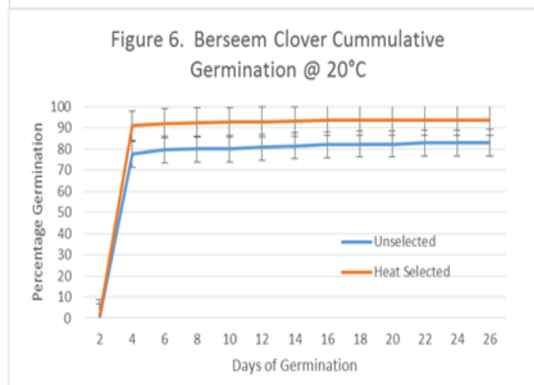
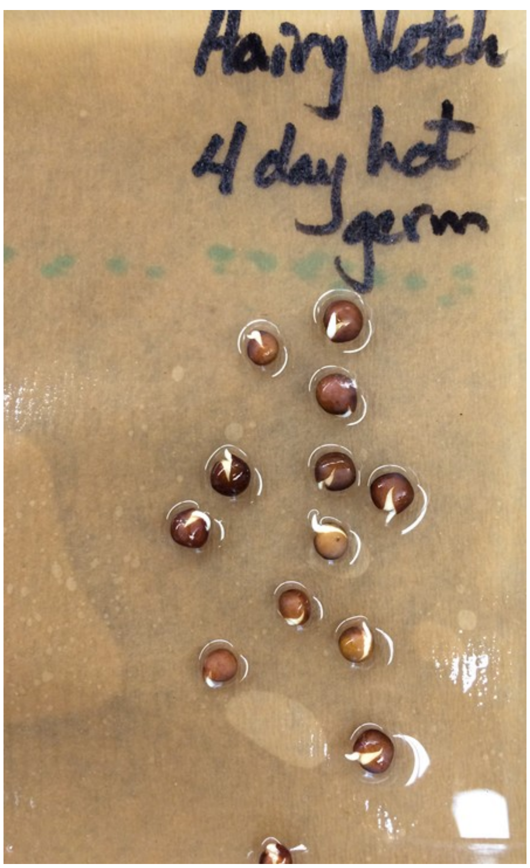


Table 1. Seedling count for the September field plantings of three legume species.

September Planted						
		- - - - - - - - - - - - Counting Date - - - - - - - - - - - -				
Species	Selected	1 December	15 December	4 January	16 January	Mean
		(Seedlings per square foot)				
Crimson clover	Heat tolerant	11.7	10.8	11.3	9.2	10.75
	Non-tolerant	14.5	17.4	12.3	13.3	14.38
Hairy vetch	Heat tolerant	2.8	4.6	4.4	6.6	4.6
	Non-tolerant	3.8	4.1	4.3	4.6	4.2
Berseem clover	Heat tolerant	2.0	6.7	3.0	2.3	3.5
	Non-tolerant	3.8	5.1	3.8	2.0	3.68
Mean		6.43	8.12	6.52	6.33	ns / ns

Table 2. Seedling counts of four cover crop legumes planted 7 October 2016.

	- - - - - - - - - - - - Counting Date - - - - - - - - - - - -			
Species	15 December	4 January	16 January	Mean
	(Seedlings per square foot)			
Crimson clover	5	4	2	3.67
Hairy vetch	3	4	5	4.00
Berseem clover	6	4	1	3.67
Balansa	7	4	1	4.00
Mean	5.25a	4.00a	2.25b	ns



Thirteen hairy vetch germinated at 40°C on day 4 out of 21,000 screened.