United States Department of Agriculture

FINAL STUDY REPORT (5/2025)
Jamie L. Whitten Plant Materials Center
Coffeeville, Mississippi

Planting and Termination Date Effect on Aboveground Performance of Two Cool Season Legume Cover Crops

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ABSTRACT

Annual cool season legume cover crops may provide many benefits to production agriculture such as controlling soil erosion, reducing fertilizer costs, and improving yield. However, the success of an annual cool season legume is dependent on choosing proper planting and termination dates so that the cover crop can address the resource concern. The purpose of this study was to evaluate two cool season annual legume species based on planting and termination date combinations to identify best cropping practices. Crimson clover (*Trifolium incarnatum*) and hairy vetch (*Vicia villosa*) were evaluated at the Jamie L. Whitten Plant Materials Center near Coffeeville, MS in 2022-2023 and 2023-2024 for dry matter production, nitrogen yields, phosphorus yield, and potassium yield. Crimson clover planted from September 15 to October 15 and terminated on or after April 15 had significantly higher dry matter, nitrogen, phosphorus, and potassium yields compared to November plantings. Crimson clover planted in November failed to emerge in 2022-2023. It is recommended to plant crimson clover from September 15 to October 15 and terminate on or after April 15. Hairy vetch planted between September 15 and October 15 and terminated on or after April 15 had the highest dry matter production, nitrogen yield, phosphorus yield, and potassium yield compared to November plantings. November plantings failed to emerge until May 1 in 2022-2023. It is recommended to plant hairy vetch between September 15 and October 15 to maximize cover crop benefits.

INTRODUCTION

Cover crops can provide a host of benefits including reduced fertilizer and herbicide costs, improved yields, and reduced soil erosion (Clark, 2007). Adaptation trials of small grains, legumes, and forbs were recently conducted at PMCs nationwide to identify potential species and varieties best adapted for cover cropping (Richard and Allison, 2020). Further characterization of the best performing varieties will maximize cover crop benefits and allow NRCS planners to recommend the most appropriate species and varieties to meet the resource concern. There is great variation in cool season cover crop species and how environmental factors such as water availability, soil temperature, and length of growing period effect their growth response (Mirsky et al., 2017). Planting after recommended dates generally results in less than optimum stand vigor and dry matter yield. In fact, Mirskey et al. (2011) observed an additional 1,780 lb/acre of dry biomass when cover crop were planted earlier compared to later fall planting (August 25 to October 15) and for each 10-day incremental delay in spring termination (May 1 – June 1). Biomass production is the key for achieving many of the cover crop benefits such as erosion control, weed suppression, nutrient retention, nitrogen production and increasing soil organic matter. For instance, crimson clover has been shown to produce over 5,500 lbs of dry matter per acre and 135 lbs of N/acre when allowed to mature and produce seed by April 21 in Mississippi (Clark, 2007). Understanding which planting and termination date combinations maximize dry matter production amongst different legume species and varieties has the potential to narrow down the available options for the planner and increases the probability the cover crop will meet the conservation need.

One challenge to successfully growing cool season cover crops is timely planting. After planting, cover crops produce biomass in the fall, growth slows during the winter and following dormancy cover crops usually green up in the spring. Cover crop benefits such as reduced erosion, improved yields, weed suppression can be

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limited if cover crops are not established before frost/winter season. Mid-September through mid-October is the ideal time to sow cool season cover crops in the mid-South. Many producers still have crops in the ground in September and often perform post-harvest activities into October which makes cover crop planting difficult. Delayed sowing into November is a risk because of unfavorable weather conditions. Research conducted at the University of Tennessee-Knoxville found cool season cover crops sown in mid-September and October had greater soil cover than those planted in mid-November (Rogers et al., 2010). Similarly, Hivey et al. (2009) found earlier planted winter cover crops produced significantly more biomass in the spring than those planted in the late fall. Komatsuzaki and Wagger (2015) concluded that with each successive planting date (October, November, and December) cover crop dry matter and Nitrogen (N) accumulation decreased regardless of termination date in the spring. They also stated that earlier planted cover crops showed a greater ability to recover residual soil N before wet winter months. Saini et al. (2008) evaluated clover and rye planted 2 and 4 weeks prior to, and 2 and 4 weeks after, the 30-year average of first frost and terminated 4, 3, 2, and 1 weeks prior to cash crop planting. In general, they concluded that winter cover crop biomass increased with early planting and later termination while also decreasing weed biomass.

The decision when to terminate cover crops is another important variable. Termination dates are normally determined based on the cash crop to be grown which can lead to early cover crop termination. Terminating too early can reduce biomass, N accumulation and other important soil health benefits. Komatsuzaki and Wagger (2015) saw an increase in cover crop N accumulation with delay in termination (early March, early April, and late April/early May) though it was species specific. Variation in growth habitat and phenotypical characteristics between hairy vetch and crimson clover result in different niches regarding soil N recovery based on when they were planted and terminated. This would give farmers options each year based on when they can plant and terminate cover crops. Cool season cover crop variety trials conducted in 2019 at Mississippi State University found that delaying harvest 2 weeks (from March 15 to April 1) resulted in approximately 20% increase in total N production of aboveground biomass (White and Rushing, 2019). Results indicate that delaying harvest can benefit cover crops. The purpose of this study is to identify the planting and termination windows needed for each of these cover crop species to maximize soil cover, dry matter production, and/or nitrogen scavenging ability to address cropland resource concerns.

MATERIALS AND METHODS

The study was conducted at the USDA-NRCS Jamie L. Whitten Plant Materials Center, Coffeeville, MS from 2022-2024. Treatments consisted of five planting dates: September 15, October 1, October 15, November 1, and November 15 and five termination dates: March 1, March 15, April 1, April 15, and May 1. Annual, cool season cover crops were planted on a pure live seed (PLS) basis based upon current recommendations (USDA NRCS, 2022). Varieties of each species was selected based upon cover crop varieties that performed well in the cool season adaptation trial (Richard and Allison, 2020). Prior to planting, a firm, weed-free seedbed was prepared using tillage equipment and non-selective herbicide. Study was conducted in field 35 (Oaklimeter silt loam) in 2022-2023 and field 11 (Grenada silt loam) in 2023-2024. Both fields are enclosed by an 8-foot exclusion fence to prevent deer damage to the cover crops. Plots were drill seeded with a Kincaid/Great Plains cone drill (Kincaid, Haven, KS). Plot dimensions were 5-ft x 30-ft, (5 ft x 5 ft strip plots). To mimic crop residual 30 lbs N/acre, 60 lbs P/acre, and 30 lbs K/acre were applied prior to planting. Emergence data was visually approximated using a scale (Table 1). Percent soil cover was approximated by visual observation in early February and at each termination date. No supplemental irrigation was applied. At each planting date soil moisture and air temperature was recorded. Growing Degree Days at 40°F (GDD-40) was calculated from planting to termination date (Eq. 1). Plant growth stage was recorded at termination. Plots were harvested using a 0.25 m^2 frame. Only representative areas of the plot excluding the edge rows were selected for sampling. Samples were dried at 55°C in an oven for a minimum of 72 hours or until a constant weight was obtained. The dry matter samples were removed from the oven and weighed to the nearest 0.10 grams. Initial weight was divided by 454 grams to convert weight to pounds and rounded to the nearest 0.01 lb. Dry matter yields (lb/acre) and scavenged nitrogen yield (lb/acre) were calculated using Equation 2 and Equation 3, respectively. Subsamples from replication 1 and 3 biomass harvests were used for N concentration analysis by Mississippi State University forage lab.

Experimental design was a randomized complete block design with a 5 X 5 factorial arrangement with four replications per treatment. Dry matter, Nitrogen, Phosphorus, and Potassium accumulation data were analyzed with analysis of variance (ANOVA) procedure in Statistix-10 (Analytical Software, Tallahassee, FL) and mean separation was performed by Tukey's HSD all pairwise comparison test at $P<0.05$.

Table 1. Legume species: common name, species, cultivar, and pure live seeding (PLS) rate. USDA-NRCS, Coffeeville, Mississippi, 2025.

Common name	Species	Cultivar	PLS (lb/acre)
Crimson Clover	*Trifolium incarnatum*	Dixie	15
Hairy Vetch	*Vicia villosa*	Purple Bounty	15

$$\text{Equation 1: GDD} - 40 = \frac{Min.Daily\ Temp\ (°\text{F}) + Max.Daily\ Temp\ (°\text{F})}{2} - 40°\text{F}$$

$$\text{Equation 2: Dry matter yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) = \frac{\text{Dry sample (grams)}}{454} \times 4840$$

$$\text{Equation 3: Nitrogen Yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) = \text{Dry matter yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) \times \frac{Percent\ Nitrogen\ (\%)}{100}$$

$$\text{Equation 4: Phosphorus Yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) = \text{Dry matter yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) \times \frac{Percent\ Phosphorus\ (\%)}{100}$$

$$\text{Equation 5: Potassium Yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) = \text{Dry matter yield}\ \left(\frac{\text{lb}}{\text{acre}}\right) \times \frac{Percent\ Potassium\ (\%)}{100}$$

RESULTS AND DISCUSSION

Weather Data for the 2020-2021 and 2021-2022 growing seasons.

Monthly rainfall from September through May in 2022-2023 and 2023-2024 was recorded from a Remote Automatic Weather Station (RAWS) located on the Jamie L Whitten Plant Materials Center in Coffeeville, Mississippi (Fig. 1). Total precipitation from September through May was 39.2 inches in 2022-2023 and 34.7 inches in 2023-2024. Rainfall in 2022-2023 was 4.5 inches greater than 2023-2024. However, rainfall was greater in January 2024 (9.3 inches) compared to January 2023 (6.2 inch). The driest months were September (1.3 inches) and October (0.5 inches) for 2022-2023 and 2023-2024 seasons, respectively. The coldest temperature recorded was 4°F in December 2022 and January 2024 (Fig. 2). Monthly lowest temperature was higher on average in the fall of 2023 compared to the fall of 2022. Drier conditions and higher on average low temperatures in the fall of 2023 likely led to greater plant growth and development in the 2023-2024 season.

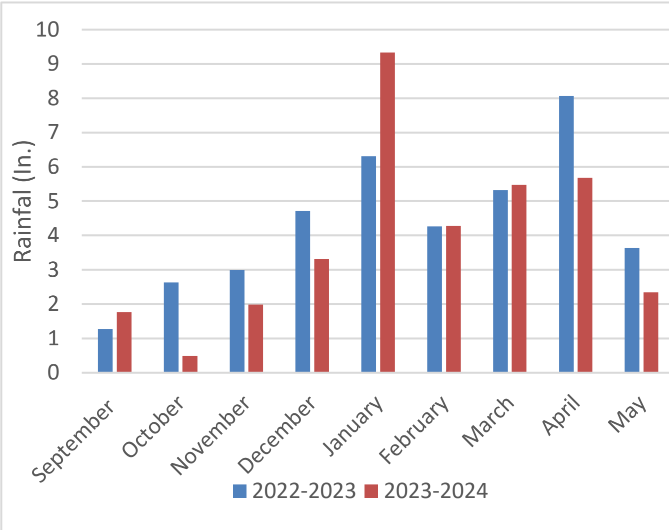

Figure 1. Monthly rainfall from September - May from RAWS for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeeville, MS, 2024.

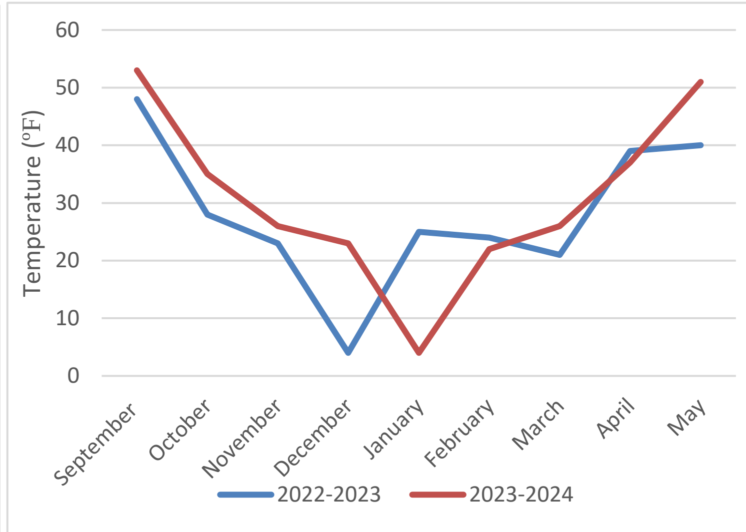

Figure 2. Monthly low temperature from September – May from RAWS for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeeville, MS, 2024.

Growing Degree Day based on 40ºF accumulation for the 2022-2023 and 2023-2024 seasons.

All planting dates were significantly different for the Growing Degree Day based on 40°F (GDD-40) accumulation (Fig. 3). Earlier planting dates accumulated more GDD-40 compared to later planting dates when averaged across termination dates. The highest GDD-40 accumulation was achieved with a September 15 (3,163) planting followed by October 1 (2,584), October 15 (2,216), November 1 (1,849), and November 15 (1,641) planting (Fig. 3). The September 15 planting date accumulated 1,522 more GDD-40 units compared to a November 15 planting.

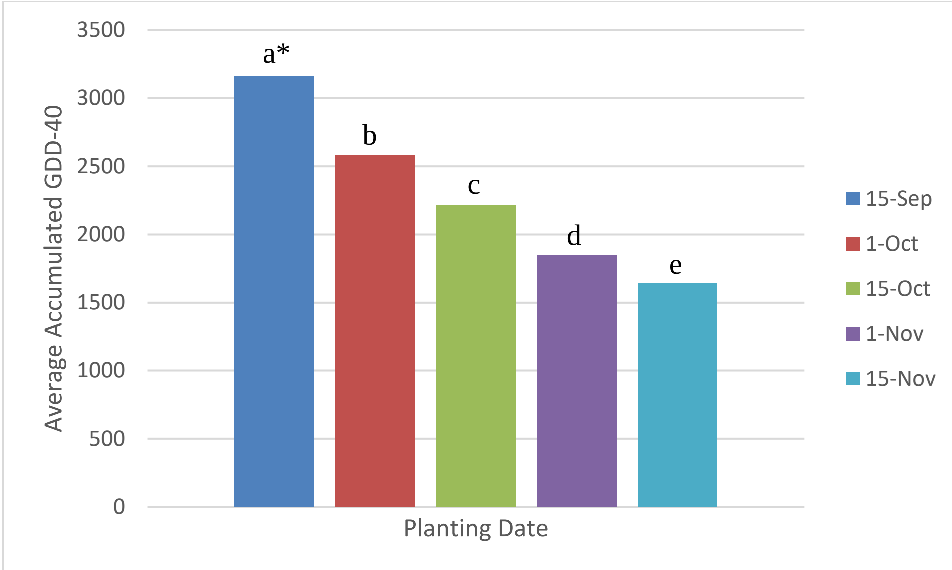

Figure 3. Average accumulated Growing Degree Day based on 40°F (GDD-40) from September 15 to November 15 for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeeville, MS, 2025. *Averages with different letters were considered significantly different according to Tukey's HSD all pairwise comparison test at $P<0.05$.

There were significant differences in average GDD-40 accumulation among termination dates (Fig. 4). Later termination dates accumulated more GDD-40 units compared to earlier termination dates. The highest GDD-40 accumulation was a May 1 (2,917) termination followed by April 15 (2,568), April 1 (2,220), March 15 (1,990), and March 1 (1,760) termination. On average, May 1 termination dates had 1,157 more GDD-40 units than March 1.

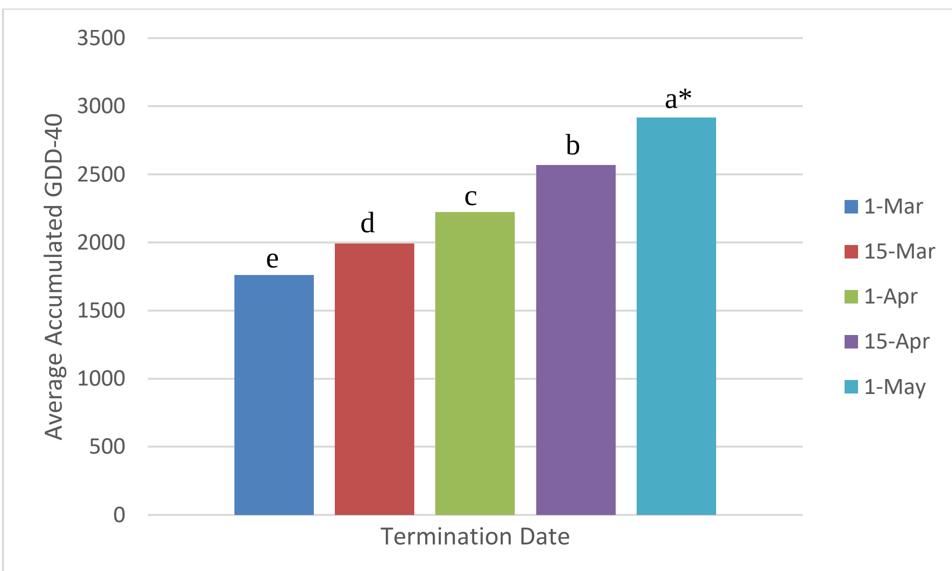

Figure 4. Termination date comparison of GDD-40 accumulation for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeeville, MS, 2025. *Averages with different letters were considered significantly different according to Tukey's HSD all pairwise comparison test at $P<0.05$.

Crimson Clover

Growth stage is critical when terminating a winter annual legume cover crop. For instance, cool season cover crop variety trials conducted by Mississippi State University found that delaying the harvest of cover crops by 2 weeks resulted in a 20% increase in total N production of aboveground biomass (White and Rushing, 2019). Planting and termination date combinations were at similar growth stages in both the 2022-2023 and 2023-2024 seasons (Table 2). November plantings of crimson clover failed to germinate in the fall of 2022 resulting in a crop failure. It is important to note that 'Dixie' crimson clover reached the full bloom stage on April 15 in both seasons.

Table. 2 Effect of planting and terminate date on growth stage of 'Dixie' crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Growth Stage				
	Termination Date (2023)				
Planting Date	March 1	March 15	April 1	April 15	May 1
September 15	Late Vegetative	Late Vegetative	Late Vegetative	Full Bloom	Seed Set
October 1	Late Vegetative	Late Vegetative	Late Vegetative	Full Bloom	Seed Set
October 15	.	Late Vegetative	Late Vegetative	Full Bloom	Seed Set
November 1	.	.	.	.	.
November 15	.	.	.	.	.
Planting Date	Termination Date (2024)				
September 15	Late Vegetative	Late Vegetative	Budding	Full Bloom	Seed Set
October 1	Late Vegetative	Late Vegetative	Budding	Full Bloom	Seed Set
October 15	Late Vegetative	Late Vegetative	Budding	Full Bloom	Seed Set
November 1	Early Vegetative	Early Vegetative	Late Vegetative	Full Bloom	Seed Set
November 15	Early Vegetative	Early Vegetative	Late Vegetative	Full Bloom	Seed Set

Dry matter yields (DMY) were higher in 2023-2024 compared to 2022-2023 (Table 3) likely due to higher fall temperatures in 2023 (Figure 2). Earlier planting and/or later termination resulted in higher DMY. For instance, the highest DMY was achieved with an October 1 planting date and a May 1 termination date in 2022-2023 (2,914 lbs/acre) and 2023-2024 (4,579 lbs/acre). Early fall plantings of crimson clover were able to take advantage of the greater GDD-40 accumulation prior to winter quiescence compared to later fall plantings. However, later plantings had to accumulate GDD-40 in the spring resulting in delayed vegetative growth. The lowest dry matter yields were achieved with an October 15 planting date and a March 15 termination date in 2022-2023 (93 lbs/acre) and a November 15 planting date terminated on March 1 during the 2023-2024 season (182 lbs/acre). Later planting dates accumulate fewer GDD-40 in the fall and earlier termination dates accumulated fewer GDD-40 in the spring, resulting in reduced plant development. Additionally, crimson clover plots planted in the November during the 2022-2023 season failed to emerge due to the colder temperatures (Figure 2). Except for the March 1 termination date, there were no significant differences in DMY in a September 15 and October 1 planting regardless of spring termination date. November 1 and November 15 plantings did not produce dry matter samples during the 2022-2023 season due to winter kill.

Nitrogen yields were higher in 2023-2024 compared to 2022-2023 (Table 3) due to more favorable growing conditions in the fall of 2023 (Figures 1 and 2). Nitrogen yields increased with earlier planting date and/or later termination dates. The highest nitrogen yield was achieved with an October 1 planting and a May 1 termination in 2022-2023 (69 lbs of N/acre) and an April 15 termination in 2023-2024 (113 lbs of N/acre). These termination dates coincide with full bloom or seed set. Early fall plantings (September 15 to October 1) of crimson clover had greater GDD-40 accumulation compared to later fall plantings resulting in greater vegetative growth and greater nitrogen yields. Later fall plantings had very little growth in the fall due to less GDD-40 accumulation and less favorable growing conditions resulting in significantly less nitrogen yields. The lowest nitrogen yields were achieved with an October 15 planting and March 15 termination (3 lbs of N/acre) in 2022-2023 and a November 15 planting and March 1 termination (32 lbs of N/acre) in 2023-2024. November plantings in 2022-2023 failed to germinate due to colder fall weather conditions.

Table. 3 Effect of planting and termination date on dry matter yields (DMY) and nitrogen yields of 'Dixie' crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Termination Date (2023)									
	DMY (lbs/acre)					Nitrogen Yield (lbs of N/acre)				
Planting Date	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	642 bA	606 bA	913 abA	1204 abA	2407 aA	20 bA	22 bA	30 abA	31 abA	57 aA
October 1	368 bB	403 bA	710 abA	974 abA	2913 aA*	12 bA	16 bA	24 bA	24 bA	69 aA*
October 15	.	93 cB	892 abA	913 abA	2336 aA	.	3 cB	37 bA	35 bA	62 aA
November 1	.	.	.	.	.	.	.	.	.	.
November 15	.	.	.	.	.	.	.	.	.	.
Planting Date	Termination Date (2024)									
September 15	239 cA	1045 bcA	1972 bA	3912 aA	4104 aA	8 dA	38 cdA	68 bcA	107 aA	84 abA
October 1	499 cA	1591 bcA	2261 bA	4397 aA	4579 aA*	19 cA	57 bcA	80 abA	113 aA*	90 abA
October 15	450 bA	1124 bA	1876 bA	3994 aA	3812 aA	15 dA	41 cdA	65 bcA	111 aA	92 abA
November 1	296 cA	981 caA	2311 bA	2724 abA	3716 aA	11 cA	33 bcA	79 abA	75 abA	87 aA
November 15	182 cA	838 bcA	1341 bA	2532 aA	3223 aA	7 cA	31 bcA	49 abA	88 aA	77 aA

*Means within rows for a planting date followed by the same lower-case letters and within columns for a termination date followed by the same upper-case letters are not significantly different at $P<0.05$ using Tukey's LSD pairwise comparison.

Phosphorus yields were higher in 2023-2024 compared to 2022-2023 (Table 4) which likely resulted from higher fall temperatures in 2023 compared to 2022 (Figure 1 and Figure 2). More favorable conditions led to increased plant growth resulting in greater dry matter production (Table 3) and nutrient scavenging. Phosphorus yields increased with earlier planting and/or delayed termination. Crimson clover planted on October 1 had the highest phosphorus yield when terminated on May 1 (9 lbs of P/acre) in 2022-2023 and April 15 (13 lbs of P/acre) in 2023-2024. The lowest phosphorus yields were achieved with an October 15 planting and a March 15 harvest (0 lbs of P/acre) in 2022-2023 and a November 1 and a March 1 harvest (1 lbs of P/acre) in 2023-2024. Crimson clover failed to germinate and emerge when planted in November in 2022. There were no significant differences in phosphorus yield between planting dates at the same harvest date. Phosphorus yields were significantly higher regardless of planting date when crimson clover was harvested on April 15 or May 1.

Potassium yields increased with earlier planting and/or later termination dates. Higher fall temperatures in 2023-2024 resulted in higher DMY and potassium yields compared to 2022-2023 (Table 4). The highest potassium yields were achieved with an October 1 planting and May 1 termination (60 lbs of K/acre) in 2022-2023 and an October 15 planting and April 15 termination (108 lbs of K/acre) in 2023-2024. These termination dates correspond to the full bloom or seed set growth stage of Dixie crimson clover. The lowest potassium yields were seen with an October 15 planting and March 15 termination (1 lbs of K/acre) in 2022-2023 and a November 15 planting and a March 1 termination (5 lbs of K/acre) in 2023-2024. These termination dates aligned with the crimson clover vegetative growth stage.

Table. 4 Effect of planting and termination date on phosphorus and potassium yields of 'Dixie' crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Termination Date (2023)									
	Phosphorus Yield (lbs of P/acre)					Potassium Yield (lbs of K/acre)				
Planting Date	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1

September 15	2 bA	2 bA	3 bA	4 abA	7 aA	14 bA	17 bA	20 bA	27 bA	46 aA
October 1	1 bA	1 bA	2 bA	3 bA	9 aA	8 cA	12 bcA	16 bA	18 bA	60 aA*
October 15	.	0 cA	3 bA	3 bA	7 aA	.	1 cB	27 bA	22 bA	52 aA
November 1	.	.	.	.	.	.	.	.	.	.
November 15	.	.	.	.	.	.	.	.	.	.
Planting Date	Termination Date (2024)									
September 15	1 dA	4 cdA	7 bcA	13 aA	10 abA	5 cA	27 bcAB	60 abA	81 aA	68 abA
October 1	2 dA	6 cdA	8 bcA	13 aA*	11 abA	14 bA	48 abA	64 aA	89 aA	71 aA
October 15	2 dA	4 cdA	7 bcA	13 aA	11 abA	12 cA	31 bcA	51 bAB	108 aA*	92 aA
November 1	1 cA	4 bcA	8 abA	9 aA	11 aA	8 cA	26 bcAB	65 abA	67 aA	93 aA
November 15	1 cA	4 bcA	5 bA	9 aA	11 aA	5 dA	21 cdB	41 bcB	63 abA	79 aA

Means within rows for a planting date followed by the same lower-case letters and within columns for a termination date followed by the same upper-case letters are not significantly different at $P<0.05$ using Tukey's LSD pairwise comparison.

Hairy Vetch

'Purple Bounty' hairy vetch began to bloom May 1 and April 15 in 2024-2023 and 2023-2024, respectively. It is important to note that in both seasons hairy vetch remained vegetative from March 1 to April 1. Growth stage at termination is critical for nitrogen production. Cover crop variety trials conducted by Mississippi State University found that delaying the harvest of cool season cover crops by 2 weeks resulted in a 20% increase in total N production of above ground biomass (White and Rushing, 2019).

Table. 5 Effect of planting date and termination date on growth stage of hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Growth Stage				
	Termination Dates (2023)				
Planting Date	March 1	March 15	April 1	April 15	May 1
September 15	Early Vegetative	Late Vegetative	Late Vegetative	Late Vegetative	10% Bloom
October 1	Early Vegetative	Late Vegetative	Late Vegetative	Late Vegetative	10% Bloom
October 15	Early Vegetative	Late Vegetative	Late Vegetative	Late Vegetative	10% Bloom
November 1	.	Early Vegetative	Early Vegetative	Early Vegetative	Budding
November 15	.	Early Vegetative	Early Vegetative	Early Vegetative	Budding
	Termination dates (2024)				
September 15	Early Vegetative	Late Vegetative	Budding	10% Bloom	20% Bloom
October 1	Early Vegetative	Late Vegetative	Budding	10% Bloom	20% Bloom
October 15	Early Vegetative	Late Vegetative	Budding	10% Bloom	20% Bloom
November 1	Early Vegetative	Early Vegetative	Late Vegetative	Budding	10% Bloom
November 15	Early Vegetative	Early Vegetative	Late Vegetative	Budding	10% Bloom

Dry matter yields were higher in 2023-2024 compared to the 2022-2023 season. Higher rainfall combined with higher temperatures in the fall of 2023 likely resulted in greater plant growth in 2023-2024 compared to the 2022-2023 season (Fig 1 and Fig 2). Earlier planting and/or delayed termination dates resulted in increased dry matter production (Table 6). The highest DMY was achieved with a September 15 planting and a May 1 termination (4,553 lbs/acre) in 2022-2023 and an October 1 and a May termination (4,860 lbs/acre) in 2023-2024. In the 2022-2023 season, November 1 and November 15 planted treatments failed to emerge until March 1? resulting in DMY of less than 1,000 lbs. During the 2023-2024 season, only the November 15 planting failed to emerge by March 1. Hairy vetch planted between September 15 and

October 15 accumulated GDD-40s prior to winter senesce resulting in greater winter survivability and spring growth. However, hairy vetch planted in November failed to accumulate adequate GDD-40s in the fall and relied on spring growing conditions to achieve dry matter yields.

Nitrogen yields tended to be higher in the 2023-2024 season compared to the 2022-2023 season. Plant growth was higher in 2023-2024 compared to 2022-2023 likely due to the higher air temperatures (Fig 2). Earlier plantings and/or later termination dates resulted in increased nitrogen production (Table 6). Hairy vetch planting on September 15 and terminated on May 1 had the highest nitrogen yield in 2022-2023 (181 lbs of N/acre). In the 2023-2024 season, the highest nitrogen yield was achieved with an October 1 planting and a May 1 termination (176 lbs of N/acre). The lowest nitrogen yield was achieved with an October 15 planting and a March 1 termination (6 lbs of N/acre) in 2022-2023 and a November 1 planting and March 1 termination in 2023-2024 (12 lbs of N/acre). Hairy vetch planted on November 15 failed to emerge in both seasons by March 1, but did produce significant dry matter after March 1 in the 2023-2024 season.

Table. 6 Effect of planting and termination date on dry matter yields (DMY) and nitrogen yields of ‘Purple Bounty’ hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Termination Date (2023)									
	DMY (lbs/acre)					Nitrogen (lbs/acre)				
Planting Date	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	510 bB	692 bA	1184 abA	2639 abA	4553 aA*	23 bB	33 bA	54 bA	123 aA	181 aA*
October 1	1102 bA	781 bA	824 bB	1769 abA	3879 aA	50 bA	37 bA	37 bB	78 abA	148 aA
October 15	150 bB	275 bB	417 bC	738 bB	2910 aAB	6 bB	12 bB	18 bC	32 bB	102 aAB
November 1	.	.	.	.	724 aB	.	.	.	.	28 aB
November 15	.	.	.	.	653 aB	.	.	.	.	27 aB
Planting Date	Termination Date (2024)									
September 15	2400 aA	2122 aA	2881 aA	3890 aA	3668 aA	89 aA	79 aA	112 aA	137 aA	150 aA
October 1	1009 cAB	1904 bcAB	1188 cB	3598 abA	4860 aA*	37 bB	72 bAB	39 bB	129 abA	176 aA*
October 15	389 bB	796 bC	1951 abAB	2582 aA	3505 aA	14 cB	31 bcBC	69 abAB	87 aA	119 aA
November 1	374 cB	1034 cBC	1512 bcAB	3655 aA	2967 abA	12 cB	35 bcBC	55 bcAB	135 aA	96 abA
November 15	.	803 bC	1398 bAB	1284 bB	4054 aA	.	28 bC	48 bB	44 bB	130 aA

Means within rows for a planting date followed by the same lower-case letters and within columns for a termination date followed by the same upper-case letters are not significantly different at $P<0.05$ using Tukey’s LSD pairwise comparison.

Phosphorus yields were higher in 2023-2024 compared to 2022-2023 due to higher fall temperatures in the fall of 2023 (Figure 2). More favorable conditions led to increased plant growth, resulting in greater dry matter production and subsequent phosphorus scavenging. Phosphorus yields increased with earlier planting and/or delayed termination. Hairy vetch planted on September 15 and October 1 had the highest phosphorus yields when terminated on May 1 in both 2022-2023 (17 lbs of P/acre) and 2023-2024 (19 lbs of P/acre), respectively (Table 7). In both seasons, the lowest phosphorus yields were seen with an October 15 planting and a March 1 termination (1 lbs of P/acre). Hairy vetch did not emerge until May 1 when planted in November 2022. There is no significant difference between September 15 and October 1 planting dates after termination occurs on April 15.

Higher fall temperatures in 2023-2024 resulted in higher dry matter yields and potassium yields compared to 2022-2023 (Table 7). Potassium yields increased with earlier planting and/or later termination dates. The highest potassium yields were achieved with a September 15 planting and an April 15 termination (47 lbs of K/acre) in 2022-2023 and an October 1 planting and a May 1 termination (125 lbs of K/acre) in 2023-2024 (Table 7). Meanwhile, the lowest potassium yields were achieved with an October 15 planting and a March 1 termination in both 2022-2023 and 2023-2024. These planting and termination dates correspond to the early and late vegetative growth stage (Table 5). While the highest potassium yields correspond with the blooming growth stages.

Table. 7 Effect of planting and termination date on phosphorus and potassium yields (lb/acre) of 'Purple Bounty' hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2025.

	Termination Date (2023)									
	Phosphorus (lbs/acre)					Potassium (lbs/acre)				
Planting Date	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	2 bB	3 abA	4 abA	11 abA	17 aA*	5 bB	11 abA	16 abA	47 abA*	64 aA
October 1	4 bA	3 bA	3 bB	6 abA	14 aA	7 bA	12 bA	10 bAB	27 abA	46 aAB
October 15	1 bB	1 bB	2 bC	3 bB	10 aAB	2 bB	5 bB	5 bB	12 bB	26 aBC
November 1	.	.	.	.	2 aB	.	.	.	.	9 aC
November 15	.	.	.	.	2 aB	.	.	.	.	11 aC
Planting Date	Termination Date (2024)									
September 15	5 aA	8 aA	11 aA	14 aA	16 aA	27 aA	57 aA	64 aA	92 aA	91 aA
October 1	3 bA	7 bAB	4 bA	14 abA	19 aA*	20 bA	45 bAB	27 bB	86 abA	125 aA*
October 15	1 bA	3 bB	7 abA	10 aA	12 aA	8 cA	21 bcB	47 abcAB	55 abA	85 aA
November 1	2 cA	4 bcAB	5 bcA	14 aA	10 abA	11 bA	34 bAB	38 bAB	91 aA	78 aA
November 15	.	3 bB	5 bA	5 bB	15 aA	.	28 bAB	41 bAB	32 b B	100 aA

Means within rows for a planting date followed by the same lower-case letters and within columns for a termination date followed by the same upper-case letters are not significantly different at P<0.05 using Tukey's LSD pairwise comparison.

CONCLUSION

Dixie crimson clover produced the highest dry matter yields when planted from September 15 to October 15 and when termination was delayed until April 15 during the full bloom stage. Nitrogen, phosphorus, and potassium yields also increased with earlier planting and/or later termination dates. As a result, crimson clover should be planted prior to October 15 to optimize dry matter production and nutrient scavenging abilities with an April 15 termination date. However, if crimson clover is planted on November 1 – November 15, then there is a greater risk of failed germination and termination should be delayed until May 1 to optimize cover crop performance by accumulating GDD-40's in the spring.

Purple Bounty hairy vetch has the highest dry matter yields when planted between September 15 to October 15 and when termination was delayed until April 15 during the 10% bloom stage. Nitrogen, phosphorus, and potassium yields also increased with these early planting and later termination dates combinations. Hairy vetch planted in November experienced greater variability in germination and emergence resulting in severely delayed dry matter production. To maximize dry matter production and nutrient yields, it is recommended that hairy vetch is planted by October 15 followed by an April 15 termination.

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