



United States Department of Agriculture

FINAL STUDY REPORT (9/2026)

Jamie L. Whitten Plant Materials Center
Coffeeville, MS

Planting and Harvesting Date Effect on Forage Quality and Quantity of Two Cool Season Legume Cover Crops in the Mid-South

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ABSTRACT

Annual cool season legume cover crops can provide multiple benefits such as controlling soil erosion, fixing nitrogen, and providing winter grazing. However, the success of annual cool season cover crops for livestock forage depends on choosing the appropriate species, as well as proper planting and harvesting windows to meet the planting objectives. The objective of this study was to determine optimal planting and harvest date windows for hairy vetch (*Vicia villosa* L.) and crimson clover (*Trifolium incarnatum* L.) to maximize forage quality and quantity. The study was conducted at the Jamie L. Whitten plant materials center near Coffeeville, MS in 2022-2023 and 2023-2024 season. To maximize forage quantity and quality of crimson clover, plant between September 15 and October 15 to achieve a grazing/harvesting period from March 1 to April 1. It is recommended to provide grass hay supplementation when grazing legumes. November plantings of crimson clover are not recommended due to heightened risk of winterkill or delayed germination. Hairy vetch planted between September 15 and October 15 produced acceptable dry matter and forage quality from March 1 to April 15; however, forage quality declined if harvested on May 1 and would require significant supplementation. November plantings of hairy vetch should be avoided to maximize dry matter production.

INTRODUCTION

Cool season cover crops can provide nutritious forage and soil health benefits during the fall and winter months for producers in the southern states (Han et al, 2018). A challenge to integrating cover crops as forage in row crop production is the great variation in cool season cover crops species and how environmental factors such as water availability, soil temperature, and length of growing period affect their growth response (Mirsky et al, 2017). To address the question of cover crop adaptability, plant material centers nationwide conducted an adaptation trial of small grains, legumes, and forbs to identify potential species and varieties best adapted for cover cropping in the Mid-South (Richard and Allison, 2020). Additionally, the Jamie L. Whitten Plant Materials Center conducted a study to identify planting and termination date windows for two cool season legume species. The goal was to maximize soil cover, dry matter production, nitrogen yield, and nutrient scavenging ability for the cool season legume species (Vollmer et al, 2025). Further characterization of the forage quantity and quality of these two cool season legume cover crop species across various planting and harvest dates will maximize cover crop benefits. It will also allow NRCS planners to recommend the most appropriate species, and planting and harvesting (i.e., grazing, haying, or ensiling) windows, to meet the resource concerns of the producer.

Another challenge to integrating cover crops as a forage in row crop production is timely planting. After planting, cover crops produce biomass in the fall. Growth slows during the winter, followed by green up in the spring. Mid-September through mid-October is the ideal time to sow cool season cover crops in the Mid-South. However, many producers still have crops in the ground in September and often perform post-harvest activities in October. This makes timely cover crop planting difficult. Delayed sowing into November is a risk due to unfavorable weather conditions. Research conducted at the Jamie L. Whitten Plant Materials

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Center found two cool season legume cover crops sown between September 15 and October 15 (as compared to November 1 and November 15 plantings) produced significantly more dry matter when terminated between March 1 and April 15 (Vollmer et al, 2025). Additionally, it was also stated that November plantings tended to have a higher degree of winterkill or failed germination due to more adverse weather conditions. Understanding the proper planting windows for different winter legume species will help narrow down the available options for the planner and increase the probability that the cover crop will meet the conservation need.

Economic feasibility is another challenge to integrating cover crops as a forage in row crop production. The potential of yield loss in the subsequent cash crop and expensive forage produced from cover crops can be a major hinderance to the adoption of this practice. Rushing et al. (2023) reported that grazing stocker cattle on oats (*Avena sativa* L.) or an oat and crimson clover (*Trifolium incarnatum* L.) cover crop mix, followed by subsequent no-till soybean production, had the potential to increase net returns for livestock-row crop producers. They also reported that cover crop species did not impact the following soybean [*Glycine max* (L.) Merr.] grain yield, but they did suggest that cover crop choice impacted net revenue in east-central Mississippi. Additionally, Schomberg et al. (2014) reported that the returns from grazing had the potential to offset the establishment costs of a rye cover crop and increase profits for continuous no-till cotton (*Gossypium hirsutum* L.) in the southern Piedmont of the United States.

Lastly, the decision of when to terminate or harvest cover crops is another important concern. Cover crop harvest dates are normally determined based on the subsequent cash crop which can sometimes lead to early cover crop harvest. Harvesting too early can reduce dry matter; however, harvesting too late can increase forage maturity resulting in a significant decrease in forage quality. For instance, Kantar et al. (2011) observed cereal rye grazed during the early vegetative stage to boot stage provided high quality pasture in the early spring, but dry matter yields were lower. They also reported forage quality, as measured by crude protein and dry matter digestibility fiber, generally decreased with maturity while forage dry matter increased. There is limited information on the effect of planting and harvest dates on forage production of recommended varieties of cool season annual legumes commonly planted as cover crops in the Mid-South. The purpose of this study is to identify the planting and harvest or grazing windows needed for each of these cover crop species to maximize dry matter production and forage quality to address the producers' forage and 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 and five harvest dates. The planting dates were September 15, October 1, October 15, November 1, and November 15. The five harvest dates were 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 were 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 seeded with a Kincaid/Great Plains cone drill (Kincaid, Haven, KS). Plot dimensions were 5-ft x 30-ft, (5 ft x 6 ft strip plots). To mimic crop residual nutrients, 30 lbs N/acre, 60 lbs P/acre, and 30 lbs K/acre were applied prior to planting. Percent soil cover was approximated by visual observation in early February and at each harvest 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 harvest date (Equation 1). Plant growth stage was recorded at harvest. Plots were harvested using a 2.69 ft² (0.25 m²) frame. Only representative areas of the plot excluding the edge rows were selected for sampling. Samples were dried at 130°F 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 0.0035 oz (0.10 grams). Initial weight was divided by 1 pound (454 grams) to convert weight to pounds and rounded

to the nearest 0.01 lb. Dry matter yields (lb/acre) were calculated using Equation 2. Total digestible nutrients (TDN) were calculated using Equation 3 and are defined as the calculated energy value of forage expressed as a percentage of dry matter. Dry matter intake (DMI) is the amount of feed an animal will consume of the forage expressed as a percentage of the animals weight and was calculated using Equation 4. Relative feed quality (RFQ) is an index which measures the nutritional value of a forage by combining digestibility (TDN) and intake (DMI) to predict animal performance. RFQ values were calculated using Equation 5. Subsamples from replication 1 and 3 biomass harvests were used for forage analysis by Mississippi State University Chemical lab.

Experimental design was a randomized complete block design with a 5 X 5 factorial arrangement with four replications per treatment. Dry matter, crude protein, acid detergent fiber, neutral detergent fiber, total digestible nutrients, and relative feed quality 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	<i>Trifolium incarnatum</i>	Dixie	15
Hairy Vetch	<i>Vicia villosa</i>	Purple Bounty	15

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

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

$$\text{Equation 3: \% Total Digestible Nutrients (TDN)} = 73.5 + (0.62 \times \% \text{CP}) - (0.71 \times \% \text{ADF})$$

$$\text{Equation 4: \% Dry Matter Intake (DMI)} = \frac{120}{\% \text{NDF}}$$

$$\text{Equation 5: Relative Forage Quality (RFQ)} = \frac{\text{TDN} \times \text{DMI}}{1.23}$$

RESULTS AND DISCUSSION

Weather Data for the 2022-2023 and 2023-2024 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 (Figure [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 2022 (1.3 inches) and October 2023 (0.5 inches). 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 led to greater plant growth and development in the 2023-2024 season.

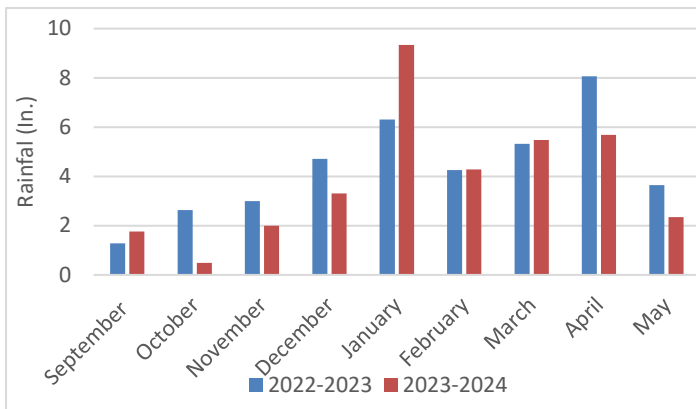


Figure 1. Monthly rainfall from September - May from RAWS for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeerville, MS, 2024.

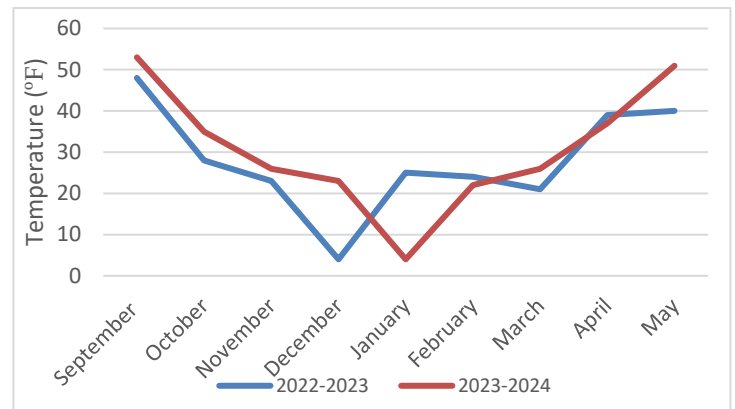


Figure 2. Monthly low temperature from September – May from RAWS for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeerville, MS, 2024.

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

All planting dates were significantly different for the 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 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 November 15 planting.

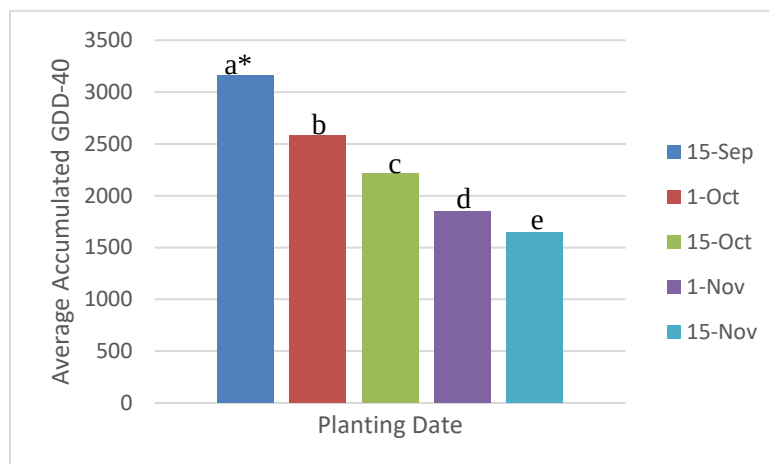


Figure 3. Average accumulated Growing Degree Day based on 40°F (GDD-40) from September 15 to November 15 for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeerville, MS, 2025. *Averages with different letters were considered significantly different according to Tukey's HSD all pairwise comparison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

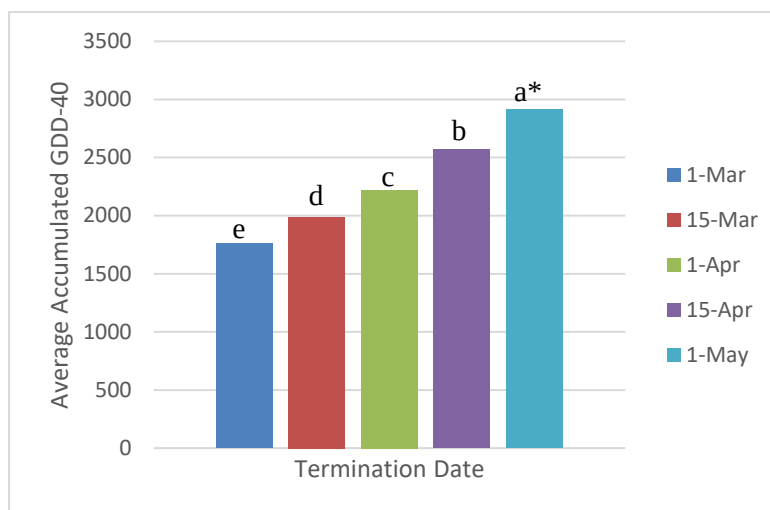


Figure 4. Termination date comparison of GDD-40 accumulation for the 2022-2023 and 2023-2024 seasons. USDA-NRCS, Coffeetown, MS, 2025. *Averages with different letters were considered significantly different according to Tukey's HSD all pairwise comparison test at $P < 0.05$.

Crimson Clover

Growth stage is critical when harvesting a winter annual legume. For instance, Albayrak et al. (2013) reported a 5.2% decline in crude protein when crimson clover harvest was delayed by four weeks. Planting and harvest 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, regardless of planting date, on April 15 in both seasons.

Table 2 Effect of planting and harvest date on growth stage of crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeetown, MS, 2026.

Planting Date	Growth Stage				
	Harvest Date (2023)				
	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	Harvest Date (2024)				
	March 1	March 15	April 1	April 15	May 1
	March 1	March 15	April 1	April 15	May 1
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) due to higher fall temperatures in 2023 (Fig. 2). Earlier planting or later harvest resulted in higher DMY. For instance, the highest DMY was achieved with an October 1 planting date and a May 1 harvest date in 2022-2023 (2,913 lbs/acre) and 2023-2024 (4,579 lbs/acre). Early fall plantings of CC 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 DMY was achieved with an October 15 planting date and a March 15 harvest date in 2022-2023 (93 lbs/acre). A

similarly low DMY was achieved with a November 15 planting date harvested on March 1 during the 2023-2024 season (182 lbs/acre). Later planting dates accumulated fewer GDD-40 in the fall, and earlier harvest dates accumulated fewer GDD-40 in the spring, resulting in reduced plant development. Additionally, crimson clover plots planted in November during the 2022-2023 season failed to emerge due to the colder temperatures (Fig. 2). Except for the March 1 harvest date, there was no significant difference in DMY in September 15 and October 1 planting regardless of spring harvest date. October 15 plantings had to delay harvesting until April 15 to have DMY like earlier plantings in both seasons. As a result, it is recommended that crimson clover be planted by October 15 and harvested between April 1 and April 15 to maximize dry matter production. November plantings are not recommended due to the risk of winterkill.

Crude protein (CP) decreased as maturation of CC progressed from vegetative to reproductive. The highest CP was achieved with an October 1 planting combined with a March 1 harvest in both 2022-2023 (26%) and 2023-2024 (24%), respectively (Table 3). Both planting and harvest date combinations correspond with the late vegetative growth stage of CC resulting in higher forage quality. Meanwhile, the lowest CP levels were achieved with September 15 planting and a May 1 harvest date in both 2022-2023 (14%) and 2023-2024 (13%). This planting and harvest date corresponds with seed formation in CC (Table 2). All planting and harvest date combinations had sufficient levels of CP to maintain dry cows (7-8%) and lactating cows (10-12%) according to Ball et al. (1991). Delaying harvest until April 15 or later resulted in significantly lower CP levels compared to earlier harvest dates. To maximize DMY and CP, crimson clover should be planted between September 15 and October 15 with harvest occurring on or before April 1.

Table 3. Effect of planting and harvest date on dry matter yields (DMY) and crude protein of crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeetown, MS, 2026.

Planting Date	Harvest Dates (2023)									
	DMY (lbs/acre)					%CP				
	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	25 aA	22 bA	17 cB	16 cB	14 dA
October 1	368 bB	403 bA	710 abA	974 abA	2913 aA*	26 aA*	22 bA	17 cB	16 cB	15 cA
October 15	.	93 cB	892 abA	913 abA	2336 aA	.	24 bA	27 aA	25 abA	18 cA
November 1	.	.	.	.	.	.	.	.	.	.
November 15	.	.	.	.	.	.	.	.	.	.
Planting Date	Harvest Dates (2024)									
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	239 cA	1045 bcA	1972 bA	3912 aA	4104 aA	22 aA	23 aA	22 aA	17 bA	13 cA
October 1	499 cA	1591 bcA	2261 bA	4397 aA	4579 aA*	24 aA*	22 abA	22 abA	16 abA	13 bA
October 15	450 bA	1124 bA	1876 bA	3994 aA	3812 aA	20 bcB	23 aA	22 abA	18 cdA	15 dA
November 1	296 cA	981 caA	2311 bA	2724 abA	3716 aA	23 aA	21 abA	20 abA	17 abA	15 bA
November 15	182 cA	838 bcA	1341 bA	2532 aA	3223 aA	23 aA	23 aA	23 aA	19 abA	15 bA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at $P < 0.05$ according to Tukey's HSD all pairwise comparisons test.

Acid detergent fiber (ADF) increased with earlier planting and/or delayed harvest (Table 4). For instance, the lowest ADF was achieved with October 1 and September 15 planting harvested on March 1 in 2022-2023 (19%) and 2023-2024 (20%), respectively. These two planting and harvest date combinations correspond with late vegetative growth. On the other hand, the highest ADF was achieved when planting CC on September 15 and harvesting on May 1 in both 2022-2023 (37%) and 2023-2024 (42%)(Table 4). This combination corresponds with seed set in CC (Table 2). There was a significant increase in ADF from vegetative growth stage to reproductive growth stage. Albayrak et al. (2013) reported similar findings and determined that harvesting crimson clover at later growth stages significantly reduced forage quality. To decrease ADF and preserve forage quality, graze or harvest prior to full bloom (April 1).

Neutral detergent fiber (NDF) declined with earlier harvests. The lowest NDF was achieved with

October 1 (24%) and November 15 (24%) planting, harvested on March 1 in 2022-2023 and 2023-2024 (Table 4). Both planting and harvest date combinations correspond with late vegetative growth stage when fiber content is lowest in the plants. On the other hand the highest NDF occurred when CC was planted on September 15 and harvested on May 1 in both 2022-2023 (49%) season and 2023-2024 season (53%) (Table 4). This planting and harvest date corresponds with seed set in both seasons when fiber content is highest in the plants. Within the same planting date, NDF increased significantly when harvested after April 1. It is recommended that CC be planted between September 15 and October 15 with harvest occurring prior to April 15 to decrease the fiber content within the plants and improve intake.

Table 4. Effect of planting and harvest date on acid detergent fiber (ADF) and neutral detergent fiber (NDF) of crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2026.

Planting Date	Harvest Dates (2023)									
	%ADF					%NDF				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	20 dA	19 dA	27 cA	32 bA	37 aA*	27 dA	25 eA	37 cA	42 bA	49 aA*
October 1	19 cA	19 cA	28 abcA	33 abA	35 aA	24 bA	24 bA	39 aA	43 aA	46 aA
October 15	.	21 bA	19 bA	17 bB	31 aA	.	29 bA	24 bcA	20 cB	39 aA
November 1	.	.	.	.	.	.	.	.	.	.
November 15	.	.	.	.	.	.	.	.	.	.
Planting Date	Harvest Dates (2024)									
	%ADF					%NDF				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	20 cB	23 cA	27 bcA	34 bA	42 aA*	25 bB	28 bA	33 bA	44 aA	53 aA*
October 1	22 cB	26 bcA	27 bcA	35 abA	42 aA	26 cAB	31 bcA	34 bcA	44 abA	53 aA
October 15	26 bA	26 bA	25 bA	36 aA	41 aA	31 bA	31 bA	32 bA	45 abA	50 aA
November 1	23 cAB	25 cA	28 bcA	32 bA	41 aA	27 dAB	30 cdA	34 bcA	41 bA	51 aA
November 15	21 cB	28 bcA	28 bcA	29 bA	40 aA	24 cB	36 bA	34 bcA	37 bA	50 aA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at $P < 0.05$ according to Tukey's HSD all pairwise comparisons test.

Total digestible nutrients (TDN) declined with earlier planting and delayed harvest dates. The lowest TDN was achieved with September 15 planting and a May 1 harvest in 2022-2023 (56%) and 2023-2024 (51%). In both seasons, CC was in the seed set stage of maturation at these planting and harvest date combinations. Lloveras and Iglesias (2001) reported nutritive value decline when crimson clover matured, coinciding with lower leaf to stem ratio. Meanwhile the highest TDN was achieved with an October 15 planting and April 1 harvest in 2022-2023 (76%), and a November 15 planting and March 1 harvest in 2023-2024 (74%). Both planting and harvest date combinations correspond with late vegetative growth, resulting in less fiber content and higher leaf to stem ratio for CC. As a result of these findings, CC can be grazed between March 1 and April 15 to maintain sufficient TDN for dry pregnant cattle ($\geq 50\%$) and lactating cattle (≥ 60) with supplementation (Ball et al., 1991).

Relative forage quality (RFQ) decreased with earlier planting and/or later harvest (Table 5) resulting from the increase in maturity. Relative forage quality ranged from 372 to 113 in 2022-2023, and from 303 to 95 in 2023-2024. The highest RFQ was achieved with an October 15 planting and March 15 harvest in 2022-2023 (372), and a November 15 planting and March 1 harvest in 2023-2024 (303). Both planting and harvest date combinations correspond to a vegetative growth stage (Table 2). The lowest RFQ value was achieved with a September 15 planting and a May 1 harvest in 2022-2023 (113) and 2023-2024 (95) which corresponds with seed setting. Crimson clover planted from September 15 to October 15 had premium to good RFQ (Appendix 1) when harvested between March 1 and April 15 in 2022-2023 and 2023-2024. Relative forage quality of CC planted between September 15 to October 15 still maintained fair quality when harvest occurred on May 1 in both seasons (Appendix 1). Relative forage quality was within the range of dry cows (Appendix 2) regardless of planting or harvest date. The RFQ needed for lactating beef cows (Appendix 2) were

achieved with CC planted between September 15 to October 15 and harvested prior to May 1. However, RFQ were unsuitable for lactating/dry cows when harvested May 1 without sufficient supplementation. To provide sufficient RFQ for lactating cows, plant CC between September 15 and October 15 to obtain a grazing/harvest period from March 1 to April 15 (Appendix 2).

Table 5. Effect of planting and harvest date on total digestible nutrients (TDN) and relative forage quality (RFQ) of crimson clover in 2022-2023 and 2023-2024, USDA-NRCS Coffeerville, MS, 2026.

Planting Date	Harvest Dates (2023)									
	%TDN					%RFQ				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	74 aA	74 bA	65 cAB	64 dB	56 eA	274 aA	288 aA	169 bB	142 cB	113 dA
October 1	76 aA	74 aA	64 bB	60 bB	58 bA	314 aA	304 aA	159 bB	136 bB	125 bA
October 15	.	73 aA	77 aA*	77 aA	63 bA	.	250 bcA	316 abA	372 aA*	157 cA
November 1	.	.	.	.	.	.	.	.	.	.
November 15	.	.	.	.	.	.	.	.	.	.
Planting Date	Harvest Dates (2024)									
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	73 aA	72 aA	68 abAB	60 bcA	51 cA	289 aAB	251 aA	207 abA	137 bcAB	95 cA
October 1	73 aA	69 abA	68 abAB	59 bcA	52 cA	284 aAB	219 abA	196 bA	136 bcAB	96 cA
October 15	68 bB	70 aA	70 aA	59 bA	54 bA	218 abB	220 aA	214 abA	130 bcB	106 cA
November 1	73 aA	69 aA	67 abAB	62 bA	54 cA	268 aAB	227 abA	192 bcA	148 cdAB	102 dA
November 15	74 aA*	68 abA	68 abAB	65 bA	55 cA	303 aA*	188 bA	196 bA	175 bcA	108 cA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at $P < 0.05$ according to Tukey's HSD all pairwise comparisons test.

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. Hairy vetch tended to transition into the reproductive stages from April 15 to May 1. Çetin and Turk (2016) reported that harvesting hairy vetch at later stages (full flowering and seed filling) caused a significant reduction in CP and TDN. Growth stage at harvest is critical for preserving forage quality.

Table. 6 Effect of planting date and harvest date on growth stage of hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeerville, MS, 2026.

Planting Date	Growth Stage				
	Harvest Dates (2023)				
	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
Planting Date	Harvest dates (2024)				
	March 1	March 15	April 1	April 15	May 1
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

DMY was higher for earlier planting dates or later harvest dates (Table 7). The highest DMY was achieved with a September 15 planting date and a May 1 harvest date in 2022-2023 (4603 lbs/acre), and an October 1 harvest date and May 1 harvest date in 2023-2024 (4860 lbs/acre) (Table 7). Earlier planting dates were able to take advantage of greater GDD-40 accumulation prior to winter quiescence compared to later

plantings (Fig. 3). Hairy vetch harvested on March 1 accumulated significantly more DMY when planted between September 15 to October 15 compared to the November plantings (Table 3). In fact, November plantings experienced delayed emergence due to late fall planting in the 2022-2023 season. On the other hand, later planting dates could accumulate GDD-40s by delaying harvest in the spring (Fig.4). The lowest DMY was achieved with October 15 planting and March 1 harvest dates in 2022-2023 (275 lbs/acre), and November 1 planting and March 1 harvest dates in 2023-2024 (374 lbs/acre) (Table 7). To maximize DMY and promote earlier harvest dates, it is recommended to plant HV between September 15 and October 15, delaying harvest until April 1.

Percent CP declined as maturity increased (Table 7). The highest CP was achieved with September 15 planting and March 1 harvest in 2022-2023 (30%), and an April 1 harvest in 2023-2024 (25%). Both dates correspond with HV being in the early vegetative or budding stage of growth. Earlier harvests produced small plants which had higher nitrogen content due to less GDD-40 accumulation, resulting in plants with higher CP (Fig. 3 and Fig. 4). The lowest CP was achieved with an October 15 planting and a May 1 harvest in 2022-2023 (17%), and a November 1 planting and May 1 harvest in 2023-2024 (20%) when HV was in the 10% bloom growth stage. All planting date and harvest date combinations produced sufficient CP for dry cattle (7-8%) and lactating cattle (10-12%) (Ball et al., 1991). Cattle fed on legume hay should be supplemented with sufficient grass hay and kept under observation to prevent bloat. It is recommended to plant HV between September 15 and October 15 with a harvest date of April 1 to maximize CP and DMY.

Table 7. Effect of planting and harvest date on dry matter yields (DMY) and crude protein of hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2026.

Planting Date	Harvest Dates (2023)									
	DMY (lbs/acre)					%CP				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	692 bA	1184 bA	2639 abA	4454 aA	4603 aA*	30 aA*	29 aA	29 aA	25 aA	24 aA
October 1	781 cA	824 cB	1769 bA	3880 aA	3320 aA	30 aA	28 abA	28 abA	24 bcA	22 cA
October 15	275 bB	418 bC	738 bA	2910 aA	2913 aA	30 aA	27 aA	28 abA	23 bA	17 cA
November 1	.	.	.	721 a B	1187 aB	.	.	.	25 aA	19 aA
November 15	.	.	.	653 aB	885 aB	.	.	.	26 aA	21 aA
Planting Date	Harvest Dates (2024)									
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	2400 aA	2122 aA	2881 aA	3890 aA	3668 aA	24 aA	23 aA	25 aA*	25 aA	24 aA
October 1	1009 bA	1904 abA	1188 bA	3598 abA	4860 aA*	23 aA	24 aA	20 aA	22 aA	23 aA
October 15	389 bA	796 abA	1951 abA	2582 abA	3505 aA	22 aA	24 aA	22 aA	21 aA	22 aA
November 1	374 cA	1034 bcA	1512 abcA	3655 aA	2967 abA	20 aA	21 aA	22 aA	23 aA	20 aA
November 15	.	803 aA	1398 aA	1284 aA	4054 aA	.	22 aA	21 aA	21 aA	20 aA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at P<0.05 according to Tukey's HSD all pairwise comparisons test.

ADF increased with earlier planting or delayed harvest dates (Table 8). Hairy vetch planted on October 15, 2022, and harvested on March 15, 2023 (14%), and HV planted on November 1, 2023, and harvested on March 1, 2024 (25%) produced the lowest ADF in their prospective seasons. These two dates correspond with the vegetative growth stages. Conversely, the highest ADF was achieved with a May 1 harvest date of plantings on October 15, 2022 (36%) and September 15, 2023 (41%), which correspond with the blooming stage. Hairy vetch experienced an increase in maturity when harvest was delayed from April 1 (vegetative) to May 1 (10% bloom to 20% bloom). This resulted in an increase in fiber content and subsequently higher ADF. It is recommended that HV be planted between September 15 and October 15 and harvested by April 1 in order maintain low ADF and high DMY.

Hairy vetch experienced a significant increase in NDF when harvest was delayed until April 15. For

example, the highest NDF was achieved when harvest was delayed until May 1 in combination with an October 15, 2022 (48%) and a September 15, 2023 (54%) planting date (Table 8). These planting and harvest date combinations correspond with the 10% bloom and 20% growth stages which caused a decline in nutritive value (Table 6). The lowest NDF occurred when HV was in the vegetative growth stage at the October 15 planting and March 15 harvest (21%) in 2022-2023, and the November 1 planting and March 1 harvest (29%) in 2023-2024 season. As a result, it is recommended that HV be planted between September 15 and October 15 with harvest occurring by April 1 to maintain a low NDF.

Table 8. Effect of planting and harvest date on acid detergent fiber (ADF) and neutral detergent fiber (NDF) of hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2026.

Planting Date	Harvest Dates (2023)									
	%ADF					%NDF				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	20 cdAB	17 dA	25 bcA	29 abA	32 aA	25 cA	23 cA	35 bA	40 abA	43 aA
October 1	22 bA	16 cA	22 bA	30 aA	29 aA	26 bcA	22 cA	31 bA	41 aA	41 aA
October 15	19 cB	14 cA	18 cB	28 bA	36 aA*	23 cA	21 cA	26 cB	39 bA	48 aA*
November 1	.	.	.	23 aB	28 aA	.	.	.	31 aB	38 aA
November 15	.	.	.	21 aB	24 aA	.	.	.	31 aB	33 aA
Planting Date	Harvest Dates (2024)									
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	25 bA	31 abA	34 abA	34 abA	41 aA*	29 b A	40 abA	46 aA	45 aA	54 aA*
October 1	27 cA	28 cA	29 bcA	35 abA	39 aA	31 cA	36 bcA	40 abcA	46 abA	52 aA
October 15	26 cA	26 cA	32 bA	34 bA	39 aA	30 cA	34 bcA	43 abA	47 aA	50 aA
November 1	25 dA	28 cdA	30 cA	35 bA	40 aA	29 cA	33 cA	38 bcA	48 abA	52 aA
November 15	.	28 aA	29 aA	36 aA	39 aA	.	34 bA	41 abA	48 abA	52 aA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at $P < 0.05$ according to Tukey's HSD all pairwise comparisons test.

TDN decreased as harvest was delayed (Table 9). The highest TDN was achieved with October 15 planting combined with a March 1 harvest in both 2022-2023 (81%) and 2023-2024 (70%). On the other hand, the lowest TDN occurred with a May 1 harvest when combined with an October 15 planting in 2022-2023 (59%) and 2023-2024 (58%). During the 2022-2023 season, TDN decreased significantly harvest was delayed until April 15 for HV planted between September 15 and October 15. Total digestible nutrients were within the acceptable range for dry cattle ($\geq 50\%$) and lactating cattle (≥ 60) regardless of planting or harvest date (Ball et al., 1991). However, it is recommended that HV be planted between September 15 and October 15 with harvest occurring by April 1 to promote higher DMV and TDN values.

Hairy vetch experienced a significant decrease in RFQ with earlier planting dates or later harvest dates (Table 9) resulting from the increased maturity (Table 6). Relative feed quality ranged from 385 to 118 in 2022-2023, and 237 to 108 in 2023-2024. The highest RFQ was obtained with an October 15 planting and a March 15 harvest in 2022-2023, and a September 15 planting with a March 1 harvest date in 2023-2024. Hairy vetch planted on October 15, 2022 and harvested on March 15, 2023, and planted on September 15 and harvested on March 1 correspond with the vegetative growth stages (Table 6). The lowest RFQ was achieved with an October 15 planting and May 1 harvest in 2022-2023 (118), and September 15 planting and May 1 harvest in 2023-2024 (108) (Table 9), which corresponds with the blooming stage. Hairy vetch planted between September 15 and October 15 had premium to good RFQ (Appendix 1) regardless of harvest dates in both seasons. Relative feed quality for HV when planted in November was premium to good when DMV were large enough to sample (Appendix 1). Only HV planted on September 15 and harvested on May 1, 2024, had an RFQ category of Fair. The relative feed quality needed for feeding dairy cattle for the 1st 120 days was achieved when HV was planted between September 15 and October 15, with harvest occurring between March 1 and April 1 in both seasons (Appendix 2). With supplementation, RFQ values were sufficient for

lactating cattle and dry cattle regardless of planting or harvest dates. To maximize DMY and RFQ values for lactating and dry cattle, it is recommended to plant HV between September 15 and October 15 with harvest occurring between March 1 and April 15, with forage being supplemented to deal with bloat (Appendix 2).

Table 9. Effect of planting and harvest date on total digestible nutrients (TDN) and relative forage quality (RFQ) of hairy vetch in 2022-2023 and 2023-2024, USDA-NRCS Coffeeville, MS, 2026.

Planting Date	Harvest Dates (2023)									
	%TDN					%RFQ				
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	78 aAB	79 aA	74 abA	68 bcBC	66 cA	304 aA	342 aA	208 bB	166 bcB	151 cA
October 1	77 abB	80 aA	75 bA	68 cC	66 cA	291 abA	356 aA	237 bB	161 cB	161 cA
October 15	80 aA	81 aA*	78 aA	68 bBC	59 cA	339 abA	385 aA*	298 bA	172 cB	118 cA
November 1	.	.	.	73 aAB	66 aA	.	.	.	233 aA	167 aA
November 15	.	.	.	75 aA	70 aA	.	.	.	235 aA	215 aA
Planting Date	Harvest Dates (2024)									
	March 1	March 15	April 1	April 15	May 1	March 1	March 15	April 1	April 15	May 1
September 15	70 aA	66 aA	65 aA	65 aA	59 aA	237 aA*	164 abA	140 bA	143 bA	108 bA
October 1	69 aA	69 aA	66 abA	63 bcA	60 cA	219 aA	188 abA	161 bcA	132 bcA	112 cA
October 15	69 aA	70 aA*	65 aA	63 aA	60 aA	227 aA	199 aA	149 bA	131 bA	118 bA
November 1	68 aA	68 aA	67 abA	63 bA	58 cA	229 aA	200 abA	171 bcA	127 cdA	110 dA
November 15	.	67 aA	66 aA	62 aA	59 aA	.	196 aA	159 abA	126 bcA	112 cA

*Means within row for a planting date followed by the same lower-case letters and within columns for a harvest date followed by the same upper-case letters are not significantly different at $P < 0.05$ according to Tukey's HSD all pairwise comparisons test.

CONCLUSION

Crimson clover had higher dry matter yields when planted between September 15 and October 15 and harvest was delayed until April 1. Crude protein and total digestible nutrients decreased with earlier planting date and/or later harvest date. Acid detergent fiber and neutral detergent fiber increased with earlier planting date and/or later harvest date. Relative forage quality was premium to fair regardless of planting or harvest date. To maximize dry matter yields and forage quality, it is recommended to plant crimson clover between September 15 and October 15 with harvest occurring between March 1 and April 15. Planting crimson clover in November is not recommended due to the risk of establishment failure and delayed vegetative growth.

Dry matter yields were higher for hairy vetch when planting between September 15 and October 15 and harvest was delayed until April 1. Crude protein and total digestible nutrients decreased with earlier planting and/or later harvest dates. Acid detergent fiber and neutral detergent fiber increased with earlier planting date and/or later harvest date. It is recommended to plant hairy vetch between September 15 and October 15 with harvest occurring between March 1 and April 15 to balance high dry matter yields with forage quality. November planting hairy vetch is not recommended due to the risk of establishment failure.

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APPENDIX

Appendix 1. The categories and Relative forage quality (RFQ) ranges in the Southeastern Forage Quality categorization system.

Forage Quality Category	RFQ
Premium	≥140
Good	110-139
Fair	90-109
Utility	<90

(adapted from Hancock, 2011)

Appendix 2. The Relative Forage Quality (RFQ) ranges that are suitable to various livestock classes.

Livestock Classes	RFQ range
Dairy cow 1 st 120 days	≥140
Dairy (last 200 days)/Stocker cattle	125-140
Lactating beef cow	115-130
Dry cow	100-115

(adapted from Hancock, 2011)

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