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EFFECTS OF HARVESTING STAGES ON FORAGE YIELD AND QUALITY OF CRIMSON CLOVER

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Abstract

The effects of three different harvesting stages (beginning of flowering, full flowering, and seed filling) on forage yield and quality of crimson clover (Trifolium incarnatum L.) were evaluated under the Mediterranean conditions of Turkey in 2011 and 2012 growing seasons. Dry matter (DM) yield, crude protein (CP), ADF, NDF, total digestible nutrients (TDN) and relative feed values (RFV) were determined in this research. Harvesting stages significantly affected most of the quality components determined in crimson clover. Harvesting at the late stages causes a reduction in forage quality. CP, TDN and RFV contents decreased with advancing stages while ADF and NDF contents increased.

Key words: *ADF, Crimson Clover, Crude Protein, Dry Matter, TDN.*

INTRODUCTION

Crimson clover (*Trifolium incarnatum* L.) is an erect annual legume. Its foliage is light-green and covered with soft hairs. It may be used as a cover crop, green manure, pasture or hay. It often is used as a winter annual cover crop in annual rotations (Sattell et al. 1998). The dry matter yields of 2.1 to 5.0 t ha^{-1} have been reported for crimson clover (Ross et al. 2001; Smith et al. 1992; Knight and Hollowell, 1973). One of the most important factor affecting the chemical composition and digestibility of forage is stage of grown. In general all forages are highly succulent and palatable in early growth. Most of the plants show a similarity in declining nutrient composition with advancing development towards maturation (Stubbendieck and Foster 1978; Rebole et al. 2004). The aim of this research was to determine the effects of harvesting stages on dry matter yield forage quality and nutritional value of crimson clover.

MATERIALS AND METHODS

This study was conducted at Isparta (37°45'N, 30°33'E, elevation 1035 m) located in the Mediterranean region of Turkey during 2011 and 2012. The monthly rainfall for March through June was 30.4, 52.3, 38.8 and 19.1 mm in 2011 (140.6 mm total) and 81.3, 48.7, 40.5 and 22.3 mm in 2012 (192.8 mm total), respectively. The 30-year mean for the same months is 219.9 mm.

The experiment was established in a randomized complete block design with three replicates. Three different harvesting stages (beginning of flowering at the end of April, full flowering at the end of the May and seed filling at the middle of the June) were used in this study.

Seeding rates were 20 kg ha^{-1}. Individual plot size was 2.1 × 10 m. Samples were taken from quadrats (1 m^2). The experiment was repeated on an adjacent site in the second year.

After the harvest, samples were collected, dried at 70°C for 48 h, and weighed. The dried samples were reassembled and ground to pass through a 1-mm screen. The crude protein (CP) content was calculated by multiplying the Kjeldahl nitrogen concentration by 6.25 (Kacar and Inal 2008). The acid detergent fiber (ADF) and neutral detergent fiber (NDF) concentrations were measured according to methods from Ankom Technology. The total digestible nutrient (TDN) content and the relative feed value (RFV) were estimated according to the following equations adapted from Albayrak et al. (2011) :

TDN content= (-1.291 x ADF) + 101.35

RFV = [120 / NDF] × [88.9 – (0.779 × ADF)] × [0.775].

The statistical analysis of the yield and quality data was performed using the General Linear Model procedure of SAS (SAS Inst., 1998). The means were compared using the LSD test at the 0.05 probability level.

RESULTS AND DISCUSSIONS

Second and third harvest stage (3388 and 3921 kg ha^{-1}, respectively) had higher DM yields than the first harvest stage (2340 kg ha^{-1}). The DM yield increased after the first harvest stage. The third harvest stage exhibited lower CP values than the all other harvest stage. CP values decreased thought the vegetation period. The highest CP values obtained from the first harvest stage (221 g kg^{-1}). Sattell et al. (1998) reported that dry matter yield varied from 2200 to 11000 kg ha^{-1} in crimson clover. Ross et al. (2001) found that dry matter yield in crimson clover was varied from 2050 to 3950 kg ha^{-1}. Smith et al. (1992) found that dry matter yield in crimson clover was 4300 kg ha^{-1}. Knight and Hollowell (1973) obtained 2500-5000 kg ha^{-1} dry matter yield and 120-140 g kg^{-1} crude protein content in crimson clover. Albayrak et al. (2006) obtained 3200-4200 kg ha^{-1} dry matter yield and 171-174 g kg^{-1} crude protein content in crimson clover. Similar findings were found in present study.

Differences in NDF and ADF concentrations occurred between the harvest stage. The third harvest stage had higher NDF and ADF values than the first harvest stage. The NDF and ADF concentrations of forage are also important quality parameters (Caballero et al., 1995). At the early vegetative period legumes had lower NDF and ADF concentrations than at later vegetative period legumes. This situation can be explained by the fact that the amounts of cell wall constituents (NDF and ADF) in young legumes are not as large as those of old legumes (Buxton et al., 1991). The TDN refers to the nutrients that are available for livestock and are related to the ADF concentration of the forage. As ADF increases there is a decline in TDN which means that animal are not able to utilize the nutrients that are present in the forage (Aydin et al., 2010). In present study, the highest TDN value was obtained from the first and second harvest stage (723 and 695 gkg^{-1}), the third harvest stage had the least (664 g kg^{-1}). RFV was affected by harvest stage. The highest RFV determined on the first harvest stage (196). The first harvest stage displayed higher RFV, which may have been due to the decrease in the NDF and ADF concentrations in the crimson clover. Albayrak and Türk (2013) stated that forages with an RFV of over 151, 150–125, 124–103, 102–87, 86–75, and less than 75 are categorized as prime, premium, good, fair, poor, and rejected, respectively. Van Soest (1996) reported that the RFV is not a direct measure of the nutritional content of forage, but that it is important for estimating the value of the forage. Based on the average of the 2 years, at the different harvest stage crimson clover had relative feed values ranging from 162 to 196 and, thus, may be categorized as prime quality.

Table 1. Forage yield and quality parameters of crimson clover at different harvest stages (average of 2 years)

Harvest stage	DMY (kg ha^{-1})	CP (g kg^{-1})	ADF (g kg^{-1})	NDF (g kg^{-1})	TDN (g kg^{-1})	RFV
I	2340 b	221 a	225 b	338 b	723 a	196 a
II	3388 ab	192 ab	246 ab	365 ab	695 ab	177 ab
III	3921 a	169 b	270 a	389 a	664 b	162 b
CV (%)	15.49	9.85	10.36	5.78	4.75	5.07

Means in the same column were not significantly different at the 0.05 level in the Least Significant Difference (LSD) test.

CONCLUSIONS

Forage yield and quality changed by harvesting stages. Delaying harvest stage resulted in increased DM yield and decreased forage quality. At the end of the 2 year-research, full flowering harvesting stage could be recommended for high herbage quality growing crimson clover at similar soils and environments in Mediterranean conditions of Turkey.

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