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THE EFFECTS OF DIFFERENT HARVEST TIMES ON FORAGE YIELD AND QUALITY OF SOME VETCH (*Vicia spp.*) SPECIES

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Abstract

This research was conducted to determine the effects of four harvesting stages (beginning of flowering, 50% flowering, full flowering and beginning of seed filling stages) on forage yield and quality of some vetch (Vicia spp) species. The common vetch (Vicia sativa L.), Hungarian vetch (Vicia pannonica Crantz.) and hairy vetch (Vicia villosa L.) were used in this trial. Dry matter (DM) yield, crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF), total digestible nutrient (TDN) and relative feed value (RFV) were determined. According to results, the highest DM yield was obtained from hairy vetch. Harvesting at the late stages caused a reduction in forage quality. The CP, TDN and RFV decreased with advancing stages while DM yield, ADF and NDF contents increased in all vetch species.

Key words: *acid detergent fibre, dry matter, common vetch, Hungarian vetch, RFV.*

INTRODUCTION

Vetches can be used for the grazing of livestock, green manure, forage or silage, or the grain fed to livestock (Caballero, 1993; Chowdhury et al., 2001; Egan and Crouch, 2006). Hairy vetch, common vetch and Hungarian vetch are commonly grown to provide a seed and hay crop in many different farming systems in Turkey (Albayrak et al., 2004). Several researchers found that dry matter yield varied from 1.50 to 8.65 t ha^{-1} in common vetch grown in the different regions of Turkey (Gokkus et al., 1996; Anlarsal et al., 1999; Avcıoğlu et al., 1999; Albayrak et al., 2006). Common vetch is less winter hardy and is grown as a fall-seeded winter annual in regions with mild winters. Hairy vetch and common vetch are adapted to a wide range of soil types, but hairy vetch is better adapted to soil type extremes.

The factors influencing the nutritive value of forage are many and the degree to which they are interrelated may vary considerably from one area to another. These factors may include, alone or in combination, plant type, climate, season, weather, soil type and fertility, soil moisture, leaf to stem ratio, physiological and morphological characteristics and others, and may change depending on whether the plants are annuals perennials, grasses or legumes. Nutrient composition levels are not necessarily the only criterion in evaluating the nutritive value of plants (Stobbs, 1975; Cook and Harris, 1979).

The aim of this research was to determine the effects of harvest times on forage yield and quality of some vetch (*Vicia* spp.) species.

MATERIALS AND METHODS

The field experiment was conducted at Ipsala/Edirne located in the Marmara region of Turkey. Total precipitation was 348 mm in 2014 (March–June). The long-term average is 275,7 mm. Average temperature was 14.7^{o}C in 2014. The long- term average is 15.3^{o}C.

The experiments were established in a randomised complete block design with three replications in March in 2014. Three vetch species (‘Zemheri’ cultivar of common vetch, ‘Tarm Beyazi’ cultivar of hungarian vetch, ‘Selcuklu’ cultivar of hairy vetch) and four harvesting stages (beginning of flowering, 50% flowering, full flowering and seed filling stages) were used in this trial. Five different phosphorus rates (0, 30, 60, 90 and 120 kg P ha^{-1}) were applied in this study. Seeding rate was 100 kg ha^{-1} in common vetch, 80 kg ha^{-1} in hungarian vetch and 70 kg ha^{-1} in hairy vetch. Individual plot size was 1.5 × 8 m = 12 m^{2}. Phosphorus was applied as triple superphosphate (46% P_2O_5) during sowing in March.

Dry matter (DM) yield, CP, acid detergent fibre (ADF), neutral detergent fibre (NDF), total digestible nutrient (TDN) and relative feed value (RFV) were investigated in samples were taken from quadrats (1 m^2). Samples taken from each plot were dried at room temperature then dried in an oven at 65°C till they reached constant weight. After cooling and weighing, the samples were ground for mineral contents analyses. Nitrogen content was calculated by Kjeldahl method (Kacar, 1972). The ANKOM Fibre Analyser was used for NDF and ADF analysis. ANKOM F57 filter bags were used for ADF and NDF analysis in this study.

Total digestible nutrients (TDN), dry matter intake (DMI), digestible dry matter (DDM) and relative feed value (RFV) were estimated according to the following equations adapted from (Horrocs and Vallentine, 1999):

TDN = (-1.291 x ADF) + 101.35

DMI = 120% NDF % dry matter basis

DDM = 88.9-(0.779 x ADF % dry matter basis)

RFV = DDM% x DMI% x 0.775

The data were analysed together using the Proc GLM (SAS, 1998). Means were separated by LSD at the 5 % level of significance.

RESULTS AND DISCUSSIONS

The results of ANOVA summarized in Table 1. The results of variance analysis showed that there were statistically significant differences among vetch species for DM yields. Hairy vetch had the highest DM (3.19 t ha^{-1}) yield while the lowest DM yield (1.97 t ha^{-1}) was obtained from common vetch. The DM yield, CP, ADF, NDF, TDN contents and RFV value in vetch species were influenced significantly by harvesting times (Table 1). The lowest DM yield was obtained at the beginning of flowering, while the highest DM yield was obtained at the beginning of seed filling stages (Figure 1). In this study, the DM yield significantly increased at advanced harvest stages. As plants begin to concentrate DM in pods and seeds, an enhanced forage yield with advancing maturity is consistent with results of several researchers (Munoz et al., 1983; Hintz et al., 1992; Osborne and Riedell, 2006).

Table 1. Results of Analysis of Variance Traits Determined

	df	DMY	CP	ADF	NDF	TDN	RFV
Block	2	0.32**	0.33	0.06	0.08	0.10	2.58
Vetch species (V)	2	560.83**	0.09	1.26	0.47	2.09	19.11
Harvesting Times (HT)	3	272.42**	41.67**	70.24**	86.83**	117.07**	4007.2**
V x HT intr.	6	7.35**	0.23	0.55	0.63	0.92	7.71
Error	22	0.05	0.11	0.37	0.19	0.61	6.04

DF, degrees of freedom; ns, not significant. * : P < 0.05, ** : P < 0.01.

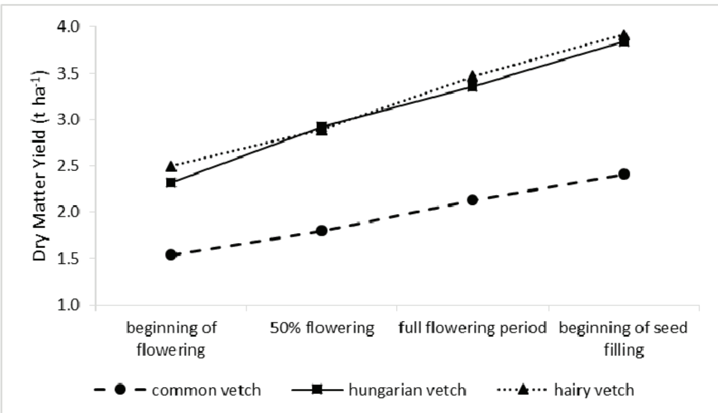

Figure 1. The DM yields of vetch species at different harvesting stages

There were no statistically significant differences in CP contents among vetch species. Crude protein contents of vetch species decreased with advancing stages. The highest CP content was obtained at the beginning of flowering, while the lowest CP content was obtained at the beginning of seed filling stages in all vetch species (Figure 2). There is a rapid uptake of minerals during early growth and a gradual dilution as the plant matures (Lanyasunya et al., 2007). The changes in element content with maturity are related to the increasing stem to leaf ratio. Our results confirm those of Turk et al. (2007, 2009), Tan et al. (2003).

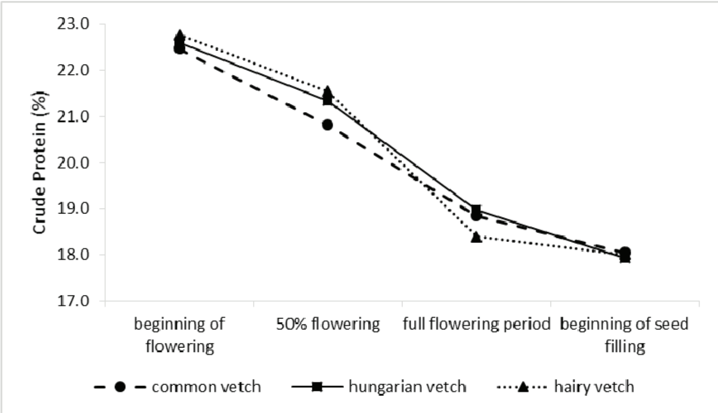

Figure 2. The CP ratios of vetch species at different harvesting stages

The effects of harvesting times on ADF and NDF contents of vetch species were found statistically significant. The ADF and NDF contents of vetches increased with advancing maturity. The lowest ADF and NDF contents were obtained at the beginning of flowering, while the highest ADF and NDF contents were obtained at the beginning of seed filling stages (Figure 3 and 4). Our results confirm the finding of Albayrak et al. (2009), Sürmen et al. (2011) and Türk et al. (2007). The trends in ADF and NDF contents with increasing maturity are normally the reverse of protein (Oelberg, 1956; Rebole et al., 2004). Young plant cells has the primary cell wall, but also the secondary cell wall occurs with maturing. This causes being the more fibrous of mature plants (Arzani et al., 2004).

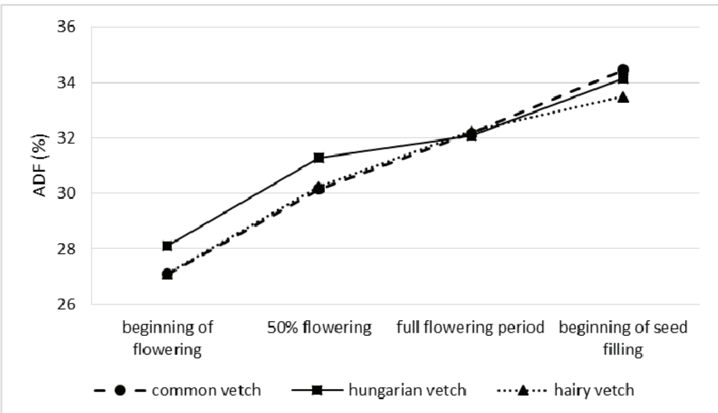

Figure 3. The ADF ratios of vetch species at different harvesting stages

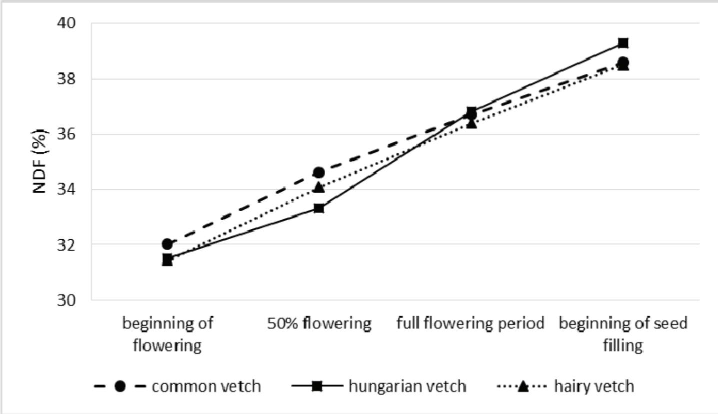

Figure 4. The NDF ratios of vetch species at different harvesting stages

The highest TDN values were obtained at the beginning of flowering, while the lowest TDN values were obtained at beginning of seed filling stages (Figure 5). The TDN refers to the nutrients that are available for livestock and are related to the ADF concentration of the forage (Sürmen et al., 2011). As ADF increases there is a decline in TDN which means that animals are not able to utilize the nutrients that are present in the forage (Aydın et al., 2010). Turk and Albayrak (2012) reported that the contents TDN values decreased as plant growth advanced. These results are in agreement with our results.

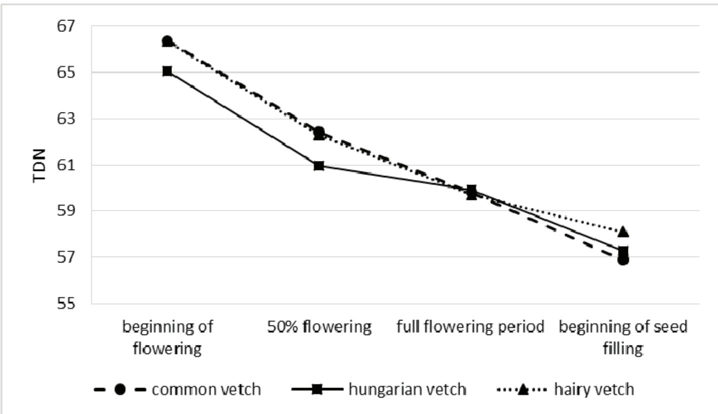

Figure 5. The TDN values of vetch species at different harvesting stages.

The RFV is an index that is used to predict the intake and energy value of the forages and it is derived from the DDM and dry matter intake (DMI). Forages with an RFV value over 151, between 150-125, 124-103, 102-87 and 86-75, and less than 75 are considered as prime, premium, good, fair, poor and reject, respectively (Lithourgidis et al., 2006). The highest RFV values were obtained at the beginning of flowering, while the lowest RFV values were obtained at beginning of seed filling stages in all vetch species (Figure 6). Similar results were reported by Sürmen et al. (2011), Turk and Albayrak (2012).

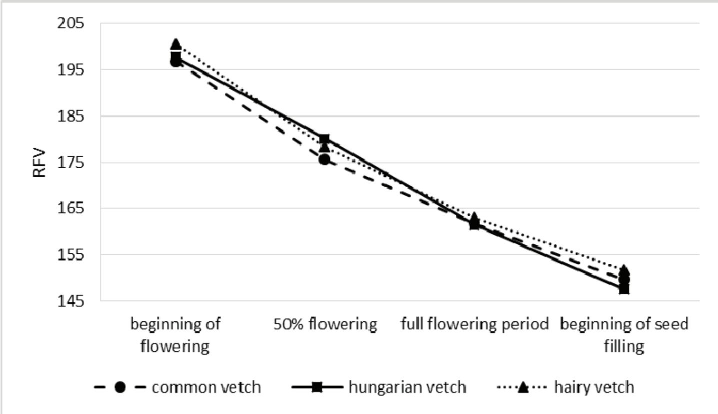

Figure 6. The RFV values of vetch species at different harvesting stages

CONCLUSIONS

Results further showed that vetches have mineral content well above the suggested requirement limits for dairy cattle. The results of this study showed that hairy vetch had the highest DM yield. The lowest DM yield was obtained from common vetch. There were no statistically significant differences in CP ratio, ADF, NDF, TDN and RFV among vetches. Harvesting at the late stages caused a reduction in forage quality. Contents of CP, TDN and RFV decreased with advancing growth while DM yield, ADF and NDF contents increased.

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