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Yield and Nutritive Value of Common Vetch (*Vicia sativa* L.) Lines and Varieties

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Abstract

The aim of this study was to determine the straw yields and biochemical compounds for lines and varieties of common vetch grown under rainfed conditions in semi-arid regions of Turkey. Four common vetch lines (Pt-41, I-3, C-5 and Pt-45) and six common vetch varieties (Emir, Kubilay-82, Uludağ, Nilüfer, Adana-22 and Çubuk) were obtained from the Agricultural Faculties of Uludağ, Atatürk and Çukurova Universities. Field experiments were designed according to randomized block design with three replications during 2009. Straw yields, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), ash, dry matter (DM), dry matter digestibility (DDM), dry matter intake (DMI) and relative feed value (RFV) contents of the lines and varieties of common vetch were determined. Straw yield, DM, CP, NDF, ADF, Ash content and DDM, DMI, RFV of vetches were significantly different ($P<0.05$). Straw yields ranged from 184-300 kgda^{-1}, CP content ranged from 5.1-15.4%, ADF content ranged from 28.1-31.2%, NDF ranged from 37.4-48.1%, Ash content ranged from 4.5-10.1%, DM content ranged from 90.5-95.0%, DDM content ranged from 64.6-67.0%, DMI ranged from 2.50-3.21% and RFV ranged from 128.1-163.6 based on the lines and varieties of common vetch. The results of this study showed that CP, DDM and RFV of variety of Nilüfer were higher than in the other lines and varieties of common vetch. This is due to low amount of ADFand NDF.

Key words: *Vicia sativa*, chemical composition, straw yield, nutritive value

Yaygın Fiğ (*Vicia sativa* L.) Hat ve Çeşitlerinin Verim ve Besleme Değerleri

Özet

Bu çalışmanın amacı, Türkiye'nin yarım kurak bölgelerindeki yağış koşulları altında yetiştirilen yaygın fiğ çeşit ve hatlarının verimlerini ve biyokimyasal bileşiklerini belirlemektir. Materyal olarak kullanılan dört yaygın fiğ hattı (PT-41, I-3, C-5 ve Pt-45) ve altı yaygın fiğ çeşidi (Emir, Kubilay-82, Uludağ, Nilüfer, Adana-22 ve Çubuk) Uludağ, Atatürk ve Çukurova Üniversitelerinin Ziraat Fakültelerinden temin edilmiştir. Tarla denemeleri 2009-2010 yıllarında tesadüf blokları deneme desenine göre üç tekrarlamalı olarak düzenlenmiştir. Araştırmada; yaygın fiğ hat ve çeşitlerinin saman verimi, ham protein, asitte çözülemeyen lif (ADF), nötrde çözülemeyen lif (NDF), kül, kuru madde, kuru madde sindirilebilirliği, kuru madde tüketimi ve nispi yem değeri belirlenmiştir. Saman verimi, kuru madde, ham protein, NDF, ADF, kül, kuru madde sindirilebilirliği, kuru madde tüketimi ve nispi yem değerleri bakımından yaygın fiğler arasında istatistiki olarak önemli ($P<0.05$) farklılıklar bulunmuştur. Yaygın fiğ hat ve çeşitlerine bağlı olarak saman verimleri 184-300 kg da^{-1} arasında, ham protein içerikleri%5.1-15.4 arasında, ADF içerikleri %28.1-31.2 arasında, NDF içerikleri%37.4-48.1 arasında, kül içerikleri %4.5-10.1, kuru madde içerikleri %90.5-95.0 arasında, kuru madde sindirilebilirliği %64.6-67.0 arasında, kuru madde tüketimi %2.50-3.21 arasında ve nispi yem değeri 128.1-163.6 arasında değişim göstermiştir. Bu çalışmanın sonucunda, Nilüfer çeşidinin ham protein, kuru madde sindirilebilirliği ve nispi yem değeri diğer yaygın fiğ hat ve çeşitlerinden daha yüksek tespit edilmiştir. Bunun nedeni ADF ve NDF değerlerinin düşük olmasından kaynaklanmaktadır.

Anahtar Kelimeler: *Vicia sativa*, kimyasal kompozisyon, saman verimi, besleme değeri

Introduction

The genus *Vicia* L. comprises approximately 190 species in the world and 64 species in Turkey (Erik and Tarikahya, 2004; Ildis, 1999). This genus is primarily located in the Mediterranean regions (Kupicha, 1981). Common vetch (*Vicia sativa* L.) is an annual legume which is cultivated under rainfed conditions in the semi-arid regions of Turkey and other Mediterranean regions (Icarda, 1998). Vetches (*Vicia* spp.) are legumes well adapted to winter growth in the Mediterranean environments throughout the world on a variety of soil types and are used in west Asia, North Africa, Australia, and Turkey for varied purposes such as dry matter, silage and green manure (Abd El Moneim *et al.*, 1988; Açıkgöz, 2001). In the extensive Mediterranean production systems, fibrous feeds, particularly cereal straws and stubbles, are the most important diet ingredients for ruminants. Although quantitatively less important, legume straws can represent a valuable feed resource during summer for those animals having access to the site of grains threshing (Bruno-Soares*et et al.*, 2000). Since cell-wall carbohydrates are the most important components of the straws, an efficient microbial digestion in the rumen is crucial for their utilization in ruminant feeding. In recent years, a number of studies have suggested that degradation characteristics of this type of feeds in the rumen will provide a useful basis for the evaluation of their nutritive value (Qrskov *et al.*, 1988; Shem *et al.*, 1995). However, the available information on the nutritive value of legume straws is scarcer in case of cereal straws or grass hays. Chemical compounds of common vetch lines can be affected by adverse agricultural conditions (Milczak *et al.*, 2001). Increased neutral detergent fiber (NDF) and acid detergent fiber (ADF) affect lowering intake and digestions of the animals (Van Soest *et al.*, 1991; Van Soest, 1994). Higher crude protein (CP) content is important for feeding ruminants, while essential amino acid content is more important than CP values for themonogastric animals (Roy, 1981). Firincioglu *et al.*, (2007) reported that some variations between the common vetch lines are in terms of toxicity levels.

The objective of this study was to determine the straw yield and nutritive values of *V. sativa* lines and varieties from Bingöl of Turkey.

Materials and Methods

The studies were conducted at the Agricultural Faculty, Bingöl University, (38°53´55.86´´ N, 40°29´15.07´´ E, altitude 1166 m) in Bingöl, during the growing season of 2009. Soil sample was collected at a depth of 0 – 20 cm. The soils texture is clay loam, available P_2O_5 327.5 kg ha^{-1} and available K_2O 1150 kg ha^{-1}, medium in organic matter content (2.57%), pH 6.85. Average temperatures of 12.2 and 12.2°C were recorded between April and July during growing season of 2009 and long-term averages in Bingöl, respectively. Total precipitations of 1212.4 and 923.8 mm were recorded between April and July during the 2009 and long-term periods in Bingöl, respectively. Four common vetch lines (Pt-41, I-3, C-5 and Pt-45) and six common vetch varieties (Emir, Kubilay-82, Uludag, Nilüfer, Adana-22 and Çubuk) were obtained from the Agricultural Faculties of Uludag, Atatürk and Çukurova Universities. Field experiments were designed according to randomized block design with three replications during 2009. Seeds were sown on the first of April, 2009 in Bingöl conditions. Plot size was 5 x 1.8 m. Sowing rate was 120 kg ha^{-1}. 30 kg N ha^{-1} and 80 kg P_2O_5 ha^{-1} were uniformly applied to soil before sowing. Straw yield was harvested at maturity, acid detergent fiber and neutral detergent fibers in straw yield were analyzed according to Van Soest *et al.*, (1991). Ash content was determined by incinerating the samples in a muffle furnace at 550°C for 4 h. Nitrogen contenting seeds was determined by the Kjeldahl procedure described by Nelson and Sommers (1980), and crude protein content was calculated by multiplying the nitrogen content values by 6.25.DDM (Oba and Allen, 1999), DMI (Mertens, 1987) and RFV of samples were calculated based on Moore and Undersander (2002) as follows: DDM = 88.9 - (0.779 ×ADF %), DMI =120 / NDF%, RFV = (DMI×DDM)/1.29.

The experimental design was completely randomized design with 3 replications. Data were analyzed by using the SAS packet program. The differences between means were separated by multiple range test of LSD (p = 0.05) (Gomez and Gomez, 1984).

Result and Discussion

Straw yield and chemical compositions of the lines and varieties of common vetch are given in Table 1; dry Matter, digestibility dry matter, dry matter intake and relative food value of the lines and varieties of common vetch are seen in Table 2.

Table 1. Straw yield and chemical compositions of the lines and varieties of common vetch.

Common vetches	*Straw yield (kg ha^{-1})	CP	ADF	NDF	Ash
			(%)		
Line No: Pt-41	2503 abcd	6.3 e	28.1 h	42.6 e	7.3 b
Emir	1997 cd	5.4 f	29.4 d	44.2 d	8.5 ab
Line No: I-3	2950 a	9.1 b	28.7 f	38.8 g	4.5 c
Kubilay-82	2180 bcd	8.8 b	30.5 b	42.2 f	6.7 b
Line No: C-5	3000 a	7.6 c	29.2 de	47.2 b	7.6 b
Uludağ	2590 abc	8.9 b	31.2 a	45.3 c	7.4 b
Nilüfer	2330 abcd	15.4 a	29.8 c	37.4 h	4.6 c
Line No: Pt-45	2757 ab	5.1 f	29.1 e	42.8 e	4.8 c
Adana-22	2127 bcd	7.0 d	29.2 de	48.1 a	10.1 a
Çubuk	1840 d	8.8 b	28.4 g	47.5 b	7.3 b
Avarage	2427	8.2	29.4	43.6	6.9

*Different letters between genotypes denote significant differences (LSD test, $p < 0.05$); CP: crude protein; ADF: acid detergent fiber; NDF: neutral detergent fiber.

Table 2. Dry Matter, Digestibility Dry Matter, Dry Matter Intake and Relative Food Value of the lines and varieties of common vetch.

Common vetches	*DM	*DDM	*DMI	*RFV
		%		
Hat No:Pt-41	94.9 a	67.0 a	2.82 cd	146.5 c
Emir	94.7 ab	66.0 e	2.71 e	138.8 e
Hat No:I-3	95.0 a	66.5 c	3.09 b	159.5 b
Kubilay-82	90.5 c	65.1 g	2.85 c	143.6 d
Hat No:C-5	94.6 ab	66.2 de	2.54 g	130.6 g
Uludağ	94.4 b	64.6 h	2.65 f	132.8 f
Nilüfer	94.9 a	65.7 f	3.21 a	163.6 a
Hat No:Pt-45	94.7 ab	66.3 d	2.81 d	144.2 d
Adana-22	94.7 ab	66.2 de	2.50 h	128.1 h
Çubuk	94.4 b	66.8 b	2.53 g	130.9 g
Average	94.3	66.0	2.77	141.9

*Different letters between genotypes denote significant differences (LSD test, $p < 0.05$).

There were significant differences among common vetches in the straw yield and chemical composition. Straw yield ranged from 1840.0 to 3000.0 kg ha^{-1}, depending on the lines and varieties of common vetch. The highest straw yield was obtained from line of C-5, while the lowest straw yield was obtained from variety of Çubuk. Lithourgidis *et al.*, (2006) reported similar straw yield, however, our straw yield was lower than the findings of Thompson *et al.,* (1992), Bingol *et al.*, (2007), Yücel & Avcı (2009) and Yavuz *et al.*, (2011). Ecological conditions and genotypes tested might cause such a difference. Abd El-Moneim (1993) stated that seed yields of *Vicia* species were linearly related to total rainfall in similar ecological conditions. Critical period of forage legumes in terms of water is from the beginning of flowering to seed formation (Barnes *et al.*, 2003).

CP percentages ranged from 5.1 to 15.4%, depending on the lines and varieties of common vetch. The highest CP content was obtained from variety of Nilüfer, while the lowest CP content was obtained from line of Pt-45. These results were higher than those reported by Bruno-Sorares *et al.* (2000), while our CP content was lower than the findings of Thompson *et al.*, (1992), Al-Masrı (1998), Tuna et al., (2004), Lithourgiedis *et al.* (2006), Bingol *et al.* (2007), Yücel and Avcı (2009) and Yavuz *et al.*, (2011). Differences among common vetches in precipitation and temperature as well as the different lines in the field experiments may have contributed to the differences in protein content. ADF content ranged from 28.1 to 31.2%, depending on the lines and varieties of common vetch. The highest ADF content was obtained from variety of Uludag, while the lowest ADF was obtained from line of Pt-41. Al-Masri (1998), Tuna *et al.*, (2004), Bingol*et al.*,(2007), Yavuz *et al.*, (2011) and Yolcu (2011) reported similar ADF contents, however, our ADF contents were lower than the findings of Thompson *et al.*, (1992), Bruno-Sorares *et al.*,

(2000), Lithourgiedis *et al.*, (2006) and Yücel & Avcı (2009). Since, ADF values have negative correlation with ruminant digestion (Van Soest, 1994), lower values of ADF are preferable for the animal production.

NDF content ranged from 37.4 to 48.1%, depending on the lines and varieties of common vetch. The highest NDF content was obtained from variety of Adana-22, while the lowest NDF was obtained from variety of Nilüfer. Lithourgidis *et al.* (2006), Al-Masri (1998), Tuna *et al.*, (2004) and Yücel & Avcı (2009) reported similar NDF contents, however, while our NDF contents were higher than the findings of Badrzadeh *et al.*, (2008), Yavuz *et al.*, (2011) and Yolcu (2011), these results were lower than those reported by Thompson *et al.* (1992), Bruno-Sorares *et al.*, (2000) and Bingöl *et al.*, (2007). Since, NDF values negatively associated with animal intake, NDF values of seeds should be lower for monogastric and ruminant animals (Van Soest, 1994).

Ash content ranged from 4.5 to 10.1%, depending on the lines and varieties of common vetch. The highest Ash content was obtained from variety of Adana-22, while the lowest Ash was obtained from line of I-3. Turhan *et al.*, (1997), Tuna *et al.*, (2004) and Bingöl *et al.*, (2007) reported similar Ash contents, however, these results were lower than those reported by Bruno-Sorares *et al.*, (2000), Tan & Celen (2001) and Badrzadeh *et al.*, (2008).

Dry matter (DM) contents and estimated parameters of the lines and varieties of common vetches are given in Table 2. The highest DM content was obtained from the line of I-3 with 95.0%, while the lowest DM was obtained from the variety ofKubilay-82 with 90.5%. This result is in agreement with the findings of Tuna *et al.*, (2004) and Bingöl *et al.*, (2007), but contrast with those of Al-Masri (1998) who found that the DM content was lowest in common vetch (*Vicia sativa*).

Conclusions

Straw yield ranged from 1840.0 to 3000.0 kg ha^{-1}, depending on the lines and varieties of common vetch. The highest CP content was obtained from variety of Nilüfer, while the lowest CP content was obtained from line of Pt-45. The highest ADF content was obtained from variety of Uludag, while the lowest ADF was obtained from line of Pt-41. The highest NDF content was obtained from variety of Adana-22, while the lowest NDF was obtained from variety of Nilüfer Estimated parameters (DDM, DMI and RFV) of common vetches were statistically significantly influenced by lines and varieties. DDM, DMI and RFV of the common vetches ranged from 64.6 to 67.0%, from 2.50 to 3.21% and from 128.1 to 163.6, respectively. The highest DDM was obtained from the line of Pt-41, while the lowest DDM was obtained from the variety of Uludağ. The highest DMI and RFV were obtained from the variety of Nilüfer, while the lowest DMI and RFV were obtained from the variety of Adana-22. The highest Ash content was obtained from variety of Adana-22.

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