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Determination of Some Yield Components of Winter Vetch Species (*Vicia* spp.) Grown in Ankara Conditions

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Abstract: Vetch is one of the most widespread annual legume cultivated in our country. This research was conducted to determine seed yields and to observe important characteristics of 3 winter vetch species (*Vicia* spp.) in Ankara conditions from 1996-1998. Common vetch (*Vicia sativa*) , Hungarian vetch (*Vicia pannonica*) and hairy vetch (*Vicia villosa*), grown for seed and hay in Central Anatolia, were sown in autumn and grown using standard agricultural practices. The study incorporated a randomized plot design with 3 replications. The following results were obtained: plant height achieved, 104.00-140.85cm; number of branch, 2.85-3.76; days to flowering, 146-153; first pod height, 58.1–71.5cm; number of pods per plant, 16.78-29.51; number of seed per pod, 4.2-5.8; pod length, 2.64-5.00cm; seed yield, 126.35–162.53 kg/da; thousand seed weight, 39.77- 44.54g; harvest index, 24.30-28.05%.

Key Words: Common vetch, Hungarian vetch, hairy vetch, yield components

Ankara Koşullarında Kışlık Yetiştirilen Fiğ Türlerinin (*Vicia* spp.) Bazı Verim Komponentlerinin Belirlenmesi

Özet: Ülkemizde tek yıllık baklagil yem bitkileri içinde tarımı en yaygın olarak yapılan fiğlerdir. Bu çalışma Ankara koşullarında kışlık olarak yetiştirilen 3 fiğ türünün tane verimi ve verim komponentlerini belirlemek amacı ile 1996-1998 yılları arasında yürütülmüştür. İç Anadolu bölgesinde tane ve yeşil yem elde etmek amacı ile kullanılan adi fiğ ((*Vicia sativa*), Macar fiği (*Vicia pannonica*), ve tüylü fiğ (*Vicia villosa*) türleri A.Ü. Ziraat Fakültesi Tarla Bitkileri Bölümü deneme tarlalarında kışlık olarak ekilmiş ve normal bakım işlemleri yapılarak yetiştirilmiştir. Tesadüf parselleri deneme desenine göre kurulan çalışmadan elde edilen sonuçlara göre bitki boyu 104.00-140.85 cm, dal sayısı 2.85-3.76 adet, çiçeklenme süreleri 146-153 gün, ilk meyve bağlama yüksekliği 58.1–71.5 cm, bitkide bakla sayısı 16.78-29.51 adet, baklada tohum sayısı 4.2-5.8 adet, bakla boyu 2.64-5.00 cm, tane verimi 126.35 –162.53 kg/da, bin tane ağırlığı 39.77- 44.54, hasat indeksi % 24.30-28.05 arasında bulunmuştur.

Anahtar Kelimeler: Adi fiğ, Macar fiği, tüylü fiğ, verim komponentleri

Introduction

Vetch is one of the forage crops commonly grown to provide seed and hay in many different farming systems in Turkey and all over the world (FAO 1997, DİE 1997). The seed, which is rich in protein content, is used especially for supplying concentrated feed, with or without barley, during the winter months. Its green and dried hay is very palatable and nutritious to livestock. In addition, its straw is an important roughage source.

Vetch is an annual legume crop. It is sown and harvested in a single year, and because of this advantage it has found a niche in growing systems practiced in many regions of the country. It can be used as a pasture plant in a mixture of grains or alone, or dried and used as silage. The Rhizobium bacteria in its root system fix nitrogen in the air to the soil. The roots that remain after harvesting enrich the physical and chemical structure of the soil (Açıkgöz 1995). This is because of the maintenance of organic matter and nitrogen status of soil, improved soil physical condition and better control of diseases and pest control as compared to continuous culture of cereals rotations.

Central Anatolia has been characterised as a semi-arid climate (Akman 1990). Annual precipitation averages around 350mm. This amount of yearly precipitation is insufficient for good plant growth. Long dry periods and harsh winter conditions prevent proper vegetation maturation (Atalay 1994). Summer droughts shorten the growing period of spring sown annual crops. This reality increases the importance of winter sown crops which start to grow early in spring using the established root system before the winter.

Vetches are recognised for their potential to produce extra feed from the fallow lands. In Central Anatolia, where a fallow system is utilised, vetches, especially winter varieties, can be used in the fallow year without

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decreasing the yield of cereal sown in subsequent seasons. It is recommended to use a winter grown annual legume in the fallowing year where the soil depth is greater than 90cm (Kün et al. 1981)

The successful growth of the various vetches is largely dependent on winter hardiness and soil adaptation. Although most vetch species cannot survive in extreme temperature, vetches, usually considered as winter annuals, can be grown during the winter months in regions having mild winter temperatures. Hairy vetch can endure down to -17^0C, while common vetch (Mckee 1952) and Hungarian vetch can endure down to $-12\ ^0$C (Ahlgren, 1956).

The aim of this study is to determine the seed yield and to observe important plant traits of some vetch species that are grown as winter forage in Ankara conditions.

Material and Method

This study was conducted in the experimental fields of the Agricultural Faculty at Ankara University in the years 1996-1998. The climatic characteristics of the experimental area are given in Table 1. In both experiment years, total annual rainfall was more than long term mean.

Distribution of monthly rainfall within experiment years was balanced. The amount of rainfall in May and June, especially, was sufficient for a good plant growth. The mean monthly temperatures for the experiment years were similar to long-term monthly means. Mean relative humidity data was somewhat higher than the long-term mean due to increased rainfall during the study years.

Analysis results of the soils from the experimental area are shown in Table 2. The texture of the soil was killi-tın. Killi-tin is poor quality organic matter, slightly saline and alkaline, though it contains adequate amounts of potassium.

Seeds for each species studied was obtained from the Field crops Department of the Ankara University Agricultural Faculty. Sarıelçi (winter resistant) cultivar of common vetch (Vicia sativa), and no-name populations of Hungarian vetch (V. pannonica) and hairy vetch (V. villosa) were used.

This study was conducted over two years and utilised a randomised plot design with three replicates. Seeding was performed on October 8, 1996 the first year, and October 17, 1997 the second year. The plots, which were 2.5mx5m=12.5 m^2, were seeded manually in rows 50 cm apart with a seeding rate of 8 kg/da. After sowing, the fields were not treated, except for manual weeding after the winter when necessary.

Observations were started at full flowering and number of days to full flowering was recorded. Ten plants from each plot were chosen and labelled, then plant heights were measured. Prior to harvesting, number of branches per plant, first pod length on the plant, and number of pods were determined on the labelled plants from each plot. 10 pods taken from the chosen plants were measured using a compass, then the number of seeds in each pod were counted. When the lower pods had matured, all plants in all plots were harvested and left in the field to dry, to allow for a homogenous drying. Seed yields were calculated after threshing. Harvest indexes were determined, taking into account the seed ratio in biologic yield. Thousand seed yields were calculated for each group of seeds taken from each plot (Şehirali 1986). Results calculated for the individual and combined years of the study were subjected to variance analysis (Düzgüneş et al. 1983)

Results and Discussions

Main stem length

The main stem length means of the species, measured at full flowering stage, are given in Table 3. The vetch species studied had an average height of 121.2cm. There were significant differences among the species for main stem length when considering individual year and combined results. Hairy vetch had a higher plant height than the other two species. A two year plant height mean of 140.8 cm was found for hairy vetch. The values for main stem length were close to the upper limits reported by various researchers (Açıkgöz 1995, Sabancı 1996, Yılmaz et al. 1996) and higher than some findings (Tahtacıoğlu et al. 1996). This is mainly due to excellent growing conditions during both research years. In particular, the amount of rainfall was clearly more than long term mean, helping plant growth tremendously.

Number of branches

There were no significant differences among the species studied in regard to the number of branches produced in the analysis of separate and combined year data (Table 4). Common and Hungarian vetch species had 2.85 and 3.45 branches per plant respectively, while hairy vetch had a two year mean of 3.76. Tosun et al. (1991) found the mean number of branches to be 4.0-5.4, 4.3, 4.4-5.4 for common vetch, Hungarian vetch and hairy vetch respectively.

Days to flowering

The vetches species studied needed 150.3 days until full flowering (Table 5). Common vetch had the longest period until full flowering among the species when the years were analysed separately. Yılmaz et al. (1996) are of the opinion that the number of days to flowering for common vetch ranges from 124-148. Orak and Elçi (1990) report that the number of days to 50% flowering for common vetch ranges from 67-72. Moneim and Saxena (1995) point out that common vetch requires 134-160 days before flowering.

Table 1. Climatic data for Ankara (long term and during years experiment conducted)

Months	Long Term (1920-1999)			1996/1997			1997/1998		
	Tem. (°C)	Humid. (%)	Precip. (mm)	Tem. (°C)	Humid. (%)	Precip. (mm)	Tem. (°C)	Humid. (%)	Precip. (mm)
October	12.8	58	24.4	12.6	71.0	44.5	12.9	66.6	50.0
November	7.3	70	30.9	8.1	70.2	8.7	7.3	73.5	36.9
December	2.3	78	45.6	6.6	81.1	65.1	3.7	76.9	65.5
January	-0.1	78	40.5	2.3	76.4	37.1	2.2	72.9	10.9
February	1.3	74	34.9	0.7	68.4	17.2	3.2	68.6	52.8
March	5.4	65	35.6	3.4	58.6	15.2	4.0	67.6	45.8
April	11.2	59	40.3	7.5	67.0	91.3	13.6	66.6	71.1
May	15.9	57	51.6	17.4	57.5	71.4	16.0	70.3	64.3
June	19.8	51	32.6	20.3	55.4	122.4	20.2	65.0	47.6
July	23.1	44	13.5	22.8	50.4	1.4	24.6	52.8	18.0
August	23.0	42	10.3	20.9	58.2	29.5	25.2	45.7	0.0
September	18.4	47	17.4	16.8	55.6	0.2	19.4	53.5	8.4
Total			377.6			504.0			471
Means	11.7	60.2		11.5	64.1		12.6	65.2	

Table 2. Soil properties of the experimental area

Texture	Total salt (%)	pH	Lime (%)	Available plant nutrients (kg/da)		Organic matter (%)
				P_2O_5	K_2O	
Clay-loam	0.02	7.85	0.85			1.96
				6.00	78.3	

Table 3. Main stem length of the winter grown vetch species (cm)*

Species	1997	1998	Means of years
Common vetch	93.3 b	114.7 c	104.00 b
Hungarian vetch	101.3 b	136.0 b	118.67 b
Hairy vetch	125.7 a	156.0 a	140.85 a
Means of species	106.8	135.6	121.2

* Mean bearing the same letter does not differ at 5% probability level

Table 4. Number of branches of the winter grown vetch species*

Species	1997	1998	Means of years
Common vetch	3.0 a	2.7 a	2.85 a
Hungarian vetch	3.6 a	3.3 a	3.45 a
Hairy vetch	4.3 a	3.2 a	3.76 a
Mean of species	3.66	3.04	3.35

* Mean bearing the same letter does not differ at 5% probability level

Table 5. Number of days to flowering of winter grown vetch species*

Species	1997	1998	Means of years
Common vetch	156 a	150 a	153
Hungarian vetch	148 c	144 b	146
Hairy vetch	154 b	150 a	152
Means of species	152.7	148	150.3

* Mean bearing the same letter does not differ at 5% probability level

First pod height on stem

The three species studied had a two-year mean height from the ground of 62.9cm for first pod (Table 6). Significant differences were found among the species for first pod height. When the years were evaluated together and separately, Hungarian vetch had the highest first pod height; it had a first pod height mean of 71.5cm. Atsan (1998) found that the first pod height in common vetch ranged from 17.8-25.6cm.

Pod number

Mean pod number of the species were 23.08 (Table 7). There were statisticaliy significant differences among the species for pod number in both of years. Hairy vetch had the biggest pod number of the species. It produced 29.51 pods as a mean of two years. Hungarian vetch had the lowest pod number having 16.78 pods. The pod number of the vetch species varies in different papers. Sabancı (1996) reported that pod number of common vetch was 37.8 while Açıkgöz et al (1989) and Atsan (1998) found it as 18.2 and 9.1-15.3 respectively. Tosun et al. (1991) reports the pod numbers of common vetch, Hungarian vetch and hairy vetch as 19.7-22.4, 5.8 and 13.7-33.7 respectively.

Number of seed per pod

There were significant differences among the species for seed number per pod (Table 8). Common vetch and Hungarian vetch had 5.8 and 5.5 seed per pod. Sabancı (1996) declares pod number per plant in common vetch as 7.5 while Açıkgöz et al. (1989) and Bucak and Anlarsal (1996) found 6.10, 2.8-6.3 for the same species, respectively.

Manga et al. (1995) describe Hungarian vetch having 2-8 seed per pod. Tosun (1974) declares that the numbers of seed per pod in hairy vetch and Hungarian vetch varied between 2-8. In the research of Tosun et al. (1991) the number of seed fer plant was 5.3-6.2 in common vetch, 5.6 in Hungarian vetch and 3.4 in hairy vetch. Elçi and Açıkgöz (1989) found 2-8 seed per pod in hairy vetch.

Pod length

Pod length of the species was 3.54cm as a mean of two years (Table 9). According to analysis results of the years separately and combined, species were grouped separately for pod length. Common vetch had a longer pod length than the other 2 species. Hairy vetch had the shortest pod length among the species with 2.64cm.

Pod length for common vetch is given by Tosun (1974) as 5-7cm, Sabancı (1996), as 4.9 cm, Elçi and Açıkgöz (1989) as 3-7 cm, Orak and Elçi (1990) as 4.3-4.4 cm, Atsan (1998) as 3.8-4.5cm. Tosun reports pod length in Hungarian vetch as 3 cm, while Elçi and Açıkgöz and Balabanlı (1992) 1.5-3cm,1.9-2.8cm, respectively. Manga et al. (1995) and Elçi and Açıkgöz decribe hairy vetch with a 2-4 cm pod length.

Seed yield

Seed yield of the species was 140.46 kg/da as a mean of two years (Table 10). In the analysis of years separately and combined, it was found that common vetch had the highest seed yield. As a mean of two years it produced 162.53kg/da seed yield. Hungarian vetch and hairy vetch had no differences for seed yield in both years and evaluated in the same group. Hungarian vetch had the lowest seed yield with 126.35 kg/da as a mean of 2 years.

Though vetches have a seed yield of 80-100 kg/da in Central Anatolia, their yield increases 50% in rainy years (Manga et al. 1995). Orak and Elçi (1990) had a seed yield of 113.6-134.0 kg/da in common vetch. Açıkgöz et al (1989) and Atsan (1998) report seed yield of common vertch cultivars as 169.3 kg da and 107.0-141.7 respectively. Tosun et al. (1991) found the seed yield of common vetch, Hungarian vetch, and hairy vetch as 142-234 kg/da, 39 kg/da and 67-139 kg/da respectively.

Moneim et al. (1990) point out that seed yield of common vetch varies between 93-237 kg/da.Seed yield of common vetch lines in Tel-Hadya, Syria were found between 110-150 kg/da (ICARDA, 1996). Balabanlı (1992), had a seed yield of 154 kg/da in Hungarian vetch. Fırıncıoğlu et al. (1995) point out that winter sown Hungarian vetch had a 40.9-167.3 kg/da seed yield.

Thousand seed weight

Table 11 shows thousand seed yields of species used in the experiment. As a mean of years, vetch species had a 41.69 g of thousand seed weight. With the evaluating yearly means separately and together, hairy vetch had the higher thousand seed weight than two other species. It had 44.54 g of thousand seed weight.

Thousand seed weight of common vetch varies between 30.5 and 63.4 g (Açıkgöz et al (1989) Keleş (1994), Sabancı (1996) , Atsan (1998). Manga et al. (1995), gives the thousand seed weights of common vetch, Hungarian vetch and hairy vetch as 40 g, 40-60 g and 20-40 g respectively. Tosun et al (1991) reports that thousand seed weight of common vetch, Hungarian vetch and hairy vetch as 57.8-61.7 g, 32.2 g and 30.4-43.5 g respectively. Thousand seed vetch of Hungarian vetch varies between 40-50g (Elçi and Açıkgöz, 1989).

Table 6. First pod heights of winter grown vetch species (cm)*

Species	1997	1998	Means of years
Common vetch	60.2 b	56.0 b	58.1 c
Hungarian vetch	72.0 a	71.0 a	71.5 a
Hairy vetch	61.7 b	56.8 b	59.3 b
Means of species	64.6	61.3	62.9

* Mean bearing the same letter does not differ at 5% probability level

Table 7. Pod numbers of winter grown vetch species*

Species	1997	1998	Means of years
Common vetch	23.87 b	22.00 b	22.94 b
Hungarian vetch	16.56 c	17.00 c	16.78 c
Hairy vetch	30.36 a	28.66 a	29.51 a
Mean of species	23.60	22.55	23.08

* Mean bearing the same letter does not differ at 5% probability level

Table 8. Number of seed per pod of winter grown vetch species*

Species	1997	1998	Means of years
Common vetch	6.0 a	5.6 a	5.8 a
Hungarian vetch	5.6 a	5.4 a	5.5 a
Hairy vetch	4.3 b	4.2 b	4.2 b
Means of species	5.3	5.1	5.2

* Mean bearing the same letter does not differ at 5% probability level

Table 9. Pod length of winter grown vetch species (cm)*

Species	1997	1998	Means of years
Common vetch	5.06 a	4.94 a	5.00 a
Hungarian vetch	2.99 b	2.97 b	2.98 b
Airy vetch	2.63 c	2.65 c	2.64 c
Means of species	3.56	3.52	3.54

* Mean bearing the same letter does not differ at 5% probability level

Table 10. Seed yield of winter grown vetch species (kg/da)*

Species	1997	1998	Means of years
Common vetch	165.27 a	159.80 a	162.53 a
Hungarian vetch	124.27 b	128.40 b	126.35 b
Hairy vetch	131.03 b	133.93 b	132.48 b
Means of species	140.19	140.72	140.46

* Mean bearing the same letter does not differ at 5% probability level

Table 11. Thousand seed weight of winter grown vetch species (g)*

Species	1997	1998	Means of years
Common vetch	39.31 b	40.23 b	39.77 b
Hungarian vetch	40.28 b	41.23 b	40.75 b
Hairy vetch	44.72 a	44.36 a	44.54 a
Means of species	41.44	41.94	41.69

* Mean bearing the same letter does not differ at 5% probability level

Harvest index

There were no significant differences for harvest indexes among the species, when the years evaluated separately (Table 12). When the years evaluated together, common vetch and Hungarian vetch had a higher harvest index than hairy vetch. As a mean, common vetch and Hungarian vetch had an harvest index of 28.05%, 25.02% respectively. Tosun et al. (1991) found harvest indexes in common vetch, Hungarian vetch and hairy vetch as 29-38%, 19% and 15-26% respectively. Moneim et al. (1990) is of the opinion that harvest index in common vetch varies between %17 and 33%. Fırıncıoğlu et al (1995) point out that Hungarian vetch has an harvest index of %25-27.

Table 12. Harvest indexes of winter grown vetch species (%)*

Species	1997	1998	Means of years
Common vetch	28.46 a	27.6 a	28.05 a
Hungarian vetch	24.93 a	25.1 a	25.02 ab
Hairy vetch	24.66 a	23.9 a	24.30 b
Means of species	26.01	25.56	25.79

* Mean bearing the same letter does not differ at 5% probability level

Conclusions

Vetches, which have great potential as a forage and soil improving crop, have not been grown in areas where harsh winter conditions prevail except hairy vetch. Common vetch, which has a winter type cultivar, produced higher yields than Hungarian and hairy vetches in both experiment years. When considering seed yield, which is the primary aim of vetch cultivation, common vetch was found to be superior to the two other species. Overall, all the species studied showed their potential, producing good growth and yield under the sufficient and regular rainfall and mild winter conditions of the study years. Common vetch has a greater yield potential than the other vetch species (Gençkan 1983, Açıkgöz 1995). Under proper conditions, common vetch produces good growth. However, it does not produce high yield in harsh winter conditions. Hairy vetch, which is a winter-hardy species, grows abundantly in rainy years, producing sufficient yield (Gençkan 1983). Furthermore, this species has high drought resistance, which increases its use possibilities in Central Anatolia. Although Hungarian vetch has a lower yield under proper conditions than common vetch, its higher resistance to cold, earliness, resistance to lodging and convenience for harvesting equipment because of its higher first pod length makes it a suitable vetch species for the Anatolian region.

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