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Araştırma Makalesi (Research Article)

A Study in Smooth Bromegrass (*Bromus inermis* Leyss.) in the Semi-Arid of Turkey

*Sabahaddin ÜNAL Ziya MUTLU

Central Field Crop Research Institute, Ankara, Turkey
*Corresponding author (Sorumlu yazar) e-mail: sabahaddin2015@gmail.com

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Abstract

As a cool-season grass smooth bromegrass is a versatile forage crop both for rangeland purpose and herbage production. This forage crop has the superior properties as perennial life form, bloat-freeness and drought resistance. Moreover, early growth in spring and good persistence to grazing are the other desirable aspects of this species. For those reasons, the development of smooth bromegrass varieties for planted pasture or over-sowing of native pastures for restoration is a crucial task for the semi–arid region. Smooth bromegrass isn't commonly known and grown in Turkey. Therefore, it needs to be introduced to the farmers. This breeding study was designed to aim at examining, evaluating and improving a new variety on present bromegrass (*Bromus inermis* Leyss.) local material. For this reason, at the beginning of the study, nursery plot was established and present lines were observed in it. Superior lines were selected and determined as the candidate of a new variety (local genotype, G-460). Mass selection method was implemented in this trial. Later, candidate variety determined and population were observed at two trials with 8 replications on some morphological and agronomical properties from 2007 to 2009 in Haymana and Yenimahale locations of Ankara province. The recorded morphological traits were main stem length, main stem thickness, length of internode, node numbers in main stem, length and width of flag leaf. Herbage and hay yields were determined as major agronomic properties. All data were statistically analyzed and measured properties of two genotypes were compared by t test. There found no significant differences among the studied genotypes on the following properties. Main stem length, and main stem thickness of G-460 and population had 71.06 and 70.92 cm; 4.06 and 3.99 mm for the two years, respectively. Herbage and hay yields of G-460 and population were 499.4 and 511.6 kg/da; 145.9 and 146.3 kg/da in the final two years of study, respectively. Crude protein content and relative feeding value of G-460 and population were 19.74 and 19.86%; 113.96 and 113.82 in 2009 at two locations, respectively. As a result, genotype G-460 had similar adaptation capability, yield potential and feed quality as much as population's. This can be considered a good performance for genotype G-460. So this genotype will be useful for meeting the requirement of high quality feed of farmer.

Keywords: Smooth bromegrass, morphological, and agronomical properties

Türkiye'nin Yarı-Kurak Yüksek Alanlarında Kılçıksız Bromda (*Bromus inermis* Leyss.) Bir Çalışma

Öz

Kılçıksız brom serin iklim yem bitkisi olarak mera ve ot üretimi için kullanılan çok yönlü bir yem bitkisidir. Bu yem bitkisi çok yıllık, şişkinlik yapmama ve kurağa dayanma gibi üstün özelliklere haizdir. Bu özelliklere ilaveten ilkbaharda erken gelişme ve otlatmaya dayanım bu türün istenen diğer özellikleridir. Bu bahsedilen özellikler sebebiyle meraların iyileştirilmesi için yapılacak ekim veya üstten tohumlamalarda kullanılabilen kılçıksız brom çeşitlerinin geliştirilmesi yarı kurak bölge için çok önemli bir işlevdir. Genel olarak kılçıksız brom Türkiye'de bilinmemekte ve yetiştirilmemektedir. Bu nedenle çiftçiye tanıtılmalıdır. Bu ıslah çalışması, mevcut lokal kılçıksız brom (*Bromus inermis* Leyss.) genetik materyalin incelenmesi, değerlendirilmesi ve yeni bir çeşit geliştirilmesi amaçlı olarak planlanmıştır. Bu nedenle çalışmanın başlangıcında gözlem bahçesi oluşturulmuş ve burada mevcut hatlar incelenmiştir. Üstün özellik gösteren hatlar seçilmiş ve yeni bir çeşit adayı (lokal genotip G-460 genotipi) olarak belirlenmiştir. Bu çalışmada toptan seleksiyon metodu uygulanmıştır. Daha sonra belirlenen çeşit adayı ve popülasyon 2007-2009 yılları arasında Ankara ili Haymana ve Yenimahalle lokasyonlarında kurulan 8 tekerrürlü iki denemede bazı morfolojik ve tarımsal özellikler yönünden incelenmiştir. Kayıt edilen morfolojik özellikler ana sap uzunluğu, ana sap kalınlığı, ana saptaki boğum sayısı, bayrak yaprağın uzunluğu ve genişliğidir. Yeşil ve kuru ot verimleri önemli tarımsal özellikler olarak belirlenmiştir. Tüm deneme verileri istatistiksel olarak analiz edilmiştir ve iki genotipin incelenen özellikleri t testiyle karşılaştırılmıştır. İki

genotip arasında takip eden özellikler açısından fark bulunmamıştır. Genotip G-460 ve popülasyonun ana sap uzunluğu ve ana sap kalınlığı sırayla 71.06 ve 70.92 cm; 4.06 ve 3.99 mm olarak bulunmuştur. Genotip G-460 ve popülasyonun yeşil ot ve kuru ot verimleri sırayla 499.4 ve 511.6 kg/da; 145.9 ve 146.3 kg/da olarak tespit edilmiştir. Genotip G-460 ve popülasyonun ham protein oranı ve nispi yem değeri iki lokasyonun 2009 yılı değerleri sırayla %19.74 ve %19.86; 113.96 ve 113.82 olmuştur. Sonuç olarak G-460 genotipi adaptasyon, verim ve kalite açısından popülasyonla aynı özellik göstermiştir. Bu G-460 genotipi için iyi bir performans olarak yorumlanabilir. Böylece bu genotip çiftçinin kaliteli kaba yem ihtiyacını giderme yönünde yararlı olacaktır.

Anahtar Kelimeler: Kılçıksız brom, morfolojik ve tarımsal özellikler

Introduction

Annual livestock feed need is considered as 63.98 million tonnes of good quality forage hay in Turkey (Anonymous 2013). The production areas of forage crops have recently increased to 1.72 million hectares in Turkey (Anonymous 2013). Current national production of the forage (vetch, alfalfa, sainfoin, and silage corn) is about 9.20 million tonnes (Anonymous 2013.) This amount accounts for only 14.39% of total requirement (Anonymous 2013). Therefore, increasing of forage production and alleviating of the feed shortages will greatly contribute to the development of livestock sector.

In the Central Anatolia, in addition to extensive growing of forage crops as vetch, alfalfa and sainfoin, the value of an alternative forage crop such as smooth bromegrass (*Bromus inermis* Leyss.) should be considered and be grown in mixtures or pure stand for both grazing and hay making (Açıkgöz 1991). It has the superior properties as a perennial life form, bloat-freeness and drought resistance. Moreover, early growth in spring and good persistence to grazing are the other desirable aspects of this species (Casler and Carlson 1995). For those reasons, the development of smooth bromegrass varieties for planted pasture or over-sowing of native pastures for restoration is a crucial task for the semi–arid region. Smooth bromegrass isn't almost known and grown in the Central Anatolia Region and Turkey.

The smooth bromegrass is indigenous to Central Asia, Afghanistan, Turkey and Iran (Nevski 1934; Bor 1970). Turkey is located in the gene centers of many plant species, and also fairly richness in diversity of smooth bromegrass. In flora of Turkey, its diversified area includes Edirne province in Thrace region, provinces of Erzurum, Kars, Ağrı, Van and Hakkari in Eastern Anatolia Region, and Konya in Central Anatolian region (Davis 1970).

The local genetic resources take a critical importance as the basic material widely utilized in breeding programs (Prosperi et al. 1996). Many studies on smooth bromegrass were conducted by numerous researchers, some of which are on its morphology (Albayrak and Ekiz 2004), its agronomy (Serin 1996a; Serin 1996b; Albayrak and Ekiz 2004; Albayrak et al. 2011; Albayrak and Türk 2013) and its quality (Serin 1996a; Serin 1996b; Albayrak et al. 2011; Albayrak and Türk 2013).

In this study, the morphological and agronomical characteristics in a local germplasm material of smooth bromegrass were tested. This material was compared with local population to improve the new variety for hay and over-seeding in degraded rangelands under the semi-arid conditions. Hence, this study was planned to improve its new variety and to release it for farmers. All those attempts hope to be contributed to enlargement of its sown area and increase in production amount in Turkey.

Material and Method

The local germplasm materials of smooth bromegrass were collected from the natural flora of the provinces of Konya (Altınova) in Central Anatolian region in 2000.

Firstly nursery plot was set up to observe these materials and selected lines having superior features for yield and yield components during 2002 and 2003. After that the local material, G-460, was selected by mass selection method for having high yield ability. Secondly regional trials in a randomized complete block design with 8 replications were founded with G-460 and local population to improve the new variety for hay and over-seeding in rangelands under the semi-arid conditions. Those trials were conducted during the years of 2007 to 2009 at the Yenimahalle and Haymana locations of The Central Research Institute for the Field Crops.

Seeds were sown by hand. The plot size was 3.2 m x 5.0 m = 16.0 m^2, consisting of 8 rows spaced at 40 cm for green herbage. The

harvested plot size was 9.6 m^2. The experiments at the both locations were established in a fallow field.

After seeding (16 April 2007 in Yenimahalle and, 12 April 2007 in Haymana), 18 kg N, and 46 kg P_2O_5 ha^{-1} were applied, mixed into the soil and the upper layer of soil was compacted with plowing roller. Weed control was performed by hand hoeing when necessary. Cutting dates for green herbage at Yenimahalle and Haymana were at the dates of 23 May 2008 - 12 May 2009 and 23 May 2008 -18 May 2009.

At the blooming stage of each accession, 10 plants were sampled and measured from each plot for the plant characters. After that, a 9.6 m^2 of 16.0 m^2 of each plots was harvested for green herbage and samples (each 500g) were dried at 70 ^{0}C for 48 h. All data measured were performed in excel software program of Microsoft office 2003. Averages were compared by the t test.

The soil of the experimental site in Yenimahalle had a clay texture, neutral, poor in organic matter, but moderate in lime content. The soil of Haymana site was clay textured, slightly alkaline, poor in organic matter, but high in lime content. Soil features of two sites were found to be different in pH and lime content (Anonymous 2007).

During the experimental seasons of 2006-2007, 2007-2008, and 2008-2009 total precipitation, average temperatures and average relative humidity were 315.7 mm, 295.8 mm, and 370.8 mm; 220.5 mm, 316.6 mm, and 393.0 mm; 12.9 ^{0}C, 12.8 ^{0}C , and 9.8 ^{0}C; 10.8 ^{0}C , 10.0 ^{0}C and 7.9 ^{0}C; 55.6% , 54.8%, and 64.6%; 65.20% , 58.90%, and 70.44% at Yenimahalle and Haymana, respectively (Table 1) (Anonymous 2009). Yenimahalle location received higher precipitation than Haymana location at the first season but it took lower precipitation than those at second and third seasons. Yenimahalle location was higher temperature than Haymana location during the trial period. Yenimahalle location received lower humidity than Haymana location at the three seasons. Long term average precipitation and temperatures are 396.1 mm and 11.8 ^{0}C at Yenimahalle (1975-2006), and 395.5 mm and 10.1 ^{0}C and Haymana (1990-2006). Yenimahalle location is more warmer than Haymana location. Overall precipitation is almost the same for two locations.

Morphological properties

The main stem length (MSL) (cm): The longest one was selected as main stem, and from ground to tip of this stem was measured as the main stem length for each plant.

The main stem diameter (MSD) (mm): On each plant stem thickness between the second and third nodes of main stem was measured with a setting-stick, scaling to 0.1 mm.

The length of internode (LI) (mm): The length of internode of the second node and the third node was measured.

Node numbers in main stem (NNMS) (number): All nodes in main stem were counted.

Flag leaf length (FLL) (cm): It was measured from flag leaf blade connected to leaf sheath towards leaf tip.

Flag leaf width (FLW) (mm): Flag leaf width was measured.

Agronomical properties

Herbage yield: Each plot was mowed from just above ground and then it was weighed.

Hay yield: A 500 g of herbage was dried at 70 ^{0}C in 48 hours in oven, after that oven dry weight was weighted latter that value was converted into hay yield.

Quality properties

Quality properties were analyzed for study hay materials at the two locations in 2009 as follows: dry matter content (%), crude protein content (%), ADF (%) and NDF (%) detected by NIR (Kutlu 2008), DDM (%) by formula 88.9-(0.779x%ADF (Starkey et al. 1993), RFV by formula SKMx(120) / %NDF (Starkey et al. 1993).

All data were analyzed in excel program and averages were tested by t test.

Results and Discussion

Morphological properties

No statistically differences observed between two genotypes, G-460 genotype and population, on morphological properties at two locations (Table 1). Some morphological properties were measured as follows: main stem length (MSL), main stem diameter (MSD), the length of internode (LI), node numbers in main stem (NNMS), flag leaf length (FLL), and flag leaf width (FLW).

Agronomical properties

Main stem length (MSL)

The G-460 and population were 80.98 and 87.86 cm; 79.03 and 87.40 cm in MSL during 2008 and 2009 years, respectively in Haymana location (Table 1). The G-460 genotype and population averaged 84.45 and 83.23 cm, respectively.

The G-460 and population had 69.64 and 45.66 cm; 45.55 and 58.61 cm in MSL during 2008 and 2009 years, in Yenimahalle location, respectively. The G-460 genotype and population averages were 57.66 and 58.61 cm, respectively.

Two location averages were similar for two genotypes.

May et al. (1998) measured as 116-135 cm of a plant height. These values were taller than data above. Ünal et al. (2003) found 56.56 cm (34.00-76.00 cm), 94.79 cm (64.25-119.50 cm) in MSL of G-457 and G-460 genotypes, respectively. The G-457 were similar to this trial data,G-460 had higher than that. Albayrak and Ekiz (2004) measured main stem length which was 48.35 cm. This data was the same as those values in Yenimahalle but lower than others in this trial. Plant height ranges between 61.0 and 119.4 cm (Jensen et al. 2006). These values correspond to MSL in these trials. This character is very important which is closely related to hay yield. Serin et al. (2001) claimed that three traits as plant height, hay yield and total stem numbers are significant for high herbage yield performance of smooth brome genotypes.

Those characters should be considered as determining high yield genotypes of genetic resources and breeding materials.

Main stem diameter (MSD)

The G-460 and population were 3.58 and 5.13 mm; 3.38 and 5.10 mm in MSD during the years of 2008 and 2009, respectively in Haymana location (Table 1). The G-460 genotype and population averaged 4.35 and 4.24 mm, respectively.

The G-460 and population were 3.49 and 4.05 mm; 3.59 and 3.90 mm in MSD in 2008 and 2009, respectively in Yenimahalle location. Two genotypes had similar averages. Their two location averages also measured almost the same.

Ünal et al. (2003) measured 2.26 mm (1.75-2.60 mm), 4.20 mm (2.75-5.85 mm) in MSD of G-457 and G-460 genotypes, respectively. The G-457 were lower than this trial data, G-460 became almost the same this trial value. Albayrak and Ekiz (2004) detected that MSD was 3.55 mm. This study results complied that their value. It is apparently seemed that this trait shows broad variation.

The length of internode (LI)

No differences observed in LI over years in Haymana (Table 1). Their averages were also similar. The G-460 and population were 7.11 and 7.08 cm; 7.26 and 8.44 mm in the consequent years, respectively in Yenimahalle location. The G-460 genotype and population averaged 7.11 and 7.86 mm, respectively. Their two location averages were closely similar.

Node numbers in main stem (NNMS)

The G-460 and population were 3.98 and 4.16; 3.93 and 4.04 in NNMS in the following years in Haymana location, respectively (Table 1). Their averages were almost the same.

In Yenimahalle location, they had 4.38 and 4.50; 4.28 and 4.34 in the consequent years, respectively. Two genotypes averaged similar. The G-460 and population location averages were 4.18, 4.33 and 4.28; 4.10, 4.19 and 4.17 at two locations over years, respectively.

Flag leaf length (FLL)

The G-460 and population were 14.16 and 21.14 cm; 13.84 and 21.81 cm in FLL in 2008 and 2009, respectively in Haymana location (Table 1). Significant difference observed on two genotypes in the second year results. The G-460 genotype and population averaged 17.68 and 17.84 cm, respectively.

In Yenimahalle location, they were 13.65 and 14.56 cm; 14.13 and 14.86 cm in in FLL over years, respectively. Their averages had similar values. Their two location averages were 13.91, 17.85 and 15.88; 13.98, 18.34 and 16.16 cm in 2008, 2009, and overall, respectively.

Flag leaf width (FLW)

The G-460 and population were 8.38 and 8.01 mm; 7.72 and 8.52 mm in FLW during the study years in Haymana, respectively (Table 1). They had averages as 8.05 and 8.28 mm, respectively. Two genotypes were 8.00 and 8.25 mm; 7.81 and 7.54 mm over years in the second location, respectively. They averaged almost the

Table 1. Some morphological properties data as MSL (mm), MSD (mm), LI (mm), NNMS, FLL (cm) and FLW (mm) at two locations in 2008, 2009 and two year averages
Çizelge 1. : İki lokasyondaki 2008, 2009 ve iki yıllık ortalamadaki ana sap uzunluğu (cm), ana sap kalınlığı (mm), boğum arası uzunluk (mm), ana saptaki boğum sayısı, bayrak yaprağının uzunluğu (cm) ve genişliği (mm) gibi bazı morfolojik özellik değerleri

	MSL									**MSD**								
	Haymana			Yenimahalle			**Two location averages**			Haymana			Yenimahalle			**Two location averages**		
	2008	**2009**	**Ave.**	**2008**	**2009**	**Ave.**	**2008**	**2009**	**Overall**	**2008**	**2009**	**Ave.**	**2008**	**2009**	**Ave.**	**2008**	**2009**	**Overall**
G-460	80,98	87,86	84,45	69,64	45,66	57,66	75,31	66,76	71,06	3,58	5,13	4,35	3,49	4,05	3,76	3,53	4,59	4,06
Population	79,03	87,40	83,23	71,61	45,55	58,61	75,32	66,48	70,92	3,38	5,10	4,24	3,59	3,90	3,75	3,48	4,50	3,99
DF	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
t Stat	0,99	0,17	0,67	-0,72	0,02	-0,30	-0,01	0,08	0,06	1,33	0,16	0,79	-0,59	0,87	0,11	0,46	1,03	0,79
	LI									**NNMS**								
G-460	9,99	9,83	9,90	7,11	7,08	7,11	8,55	8,45	8,51	3,98	4,16	4,09	4,38	4,50	4,46	4,18	4,33	4,28
Population	9,11	8,96	9,05	7,26	8,44	7,86	8,19	8,70	8,46	3,93	4,04	4,00	4,28	4,34	4,34	4,10	4,19	4,17
DF	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
t Stat	0,75	1,66	1,60	-0,13	-2,36	-0,99	0,40	-0,79	0,12	0,20	1,26	0,77	0,66	1,14	1,11	0,46	1,47	1,10
	FLL									**FLW**								
G-460	14,16	21,14	17,68	13,65	14,56	14,09	13,91	17,85	15,88	8,38	7,72	8,05	8,00	7,81	7,90	8,19	7,77	7,98
Population	13,84	21,81	17,84	14,13	14,86	14,48	13,98	18,34	16,16	8,01	8,52	8,28	8,25	7,54	7,89	8,13	8,03	8,08
DF	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
t Stat	0,48	-1,99*	-0,55	-1,58	-0,40	-0,96	-0,21	-0,99	-1,34	0,75	-1,20	-0,57	-0,51	0,93	0,05	0,17	-0,64	-0,36

Table 4. Quality data as crude protein content (%), ADF (%), NDF (%) dry matter content (%), digestible dry matter and relative feeding value at the two locations and their averages
Çizelge 4. İki lokayondaki ham protein oranı (%), ADF (%), NDF (%), kuru madde içeriği (%), sindirilebilir kuru madde (%), nispi nem değeri gibi kalite özellikleri

	Dry matter (%)			DDM			Crude protein (%)		
	Yenimahalle	Haymana	Averages	Yenimahalle	Haymana	Averages	Yenimahalle	Haymana	Averages
G-460	89,75	89,89	89,82	61,92	59,58	60,75	21,62	17,85	19,74
Population	89,81	89,87	89,84	62,09	59,54	60,82	21,93	17,79	19,86
Average	89,78	89,88	89,83	62,01	59,56	60,78	21,78	17,82	19,80
Df	7	7	7	7	7	7	7	7	7
t Stat	-0,64	0,244	-0,423	-0,345	0,064	-0,175	-0,429	0,149	-0,299
t Stat (location)	-2,50			22,43 **			21,38 **		
	ADF (%)			NDF (%)			RFV		
	Yenimahalle	Haymana	Averages	Yenimahalle	Haymana	Averages	Yenimahalle	Haymana	Averages
G-460	34,64	37,64	36,14	61,79	66,43	64,11	120,24	107,64	113,96
Population	34,41	37,69	36,05	62,20	66,34	64,27	119,80	107,81	113,82
Average	34,53	37,67	36,10	62,00	66,39	64,19	120,02	107,72	113,89
Df	7	7	7	7	7	7	7	7	7
t Stat	0,345	-0,064	0,175	-0,714	0,086	-0,251	0,457	-0,134	0,159
t Stat (location)	-22,43 **			-17,56 **			47,31 **		

same values. Two location averages of G-460 and population were 8.19, 7.77 and 7.98 mm; 8.13, 8.03, and 8.08 mm in 2008, 2009, and overall, respectively.

Green herbage yields (GHYs)

The G-460 genotype and population had similar results in years at the two locations (Table 2). The G-460 and population GHYs were 556,5 and 492,9 kg/da; 869,1 and 942,1 kg/da in 2008 and 2009, respectively in Haymana location. The G-460 genotype and population averaged 712.84 and 717.51 kg/da, respectively.

The G-460 and population were 226,6 and 202,5 kg/da; 345,5 and 408,9 kg/da in GHYs during 2008 and 2009, respectively in Yenimahalle location. The G-460 genotype and population produced 286.02, and 305.66 kg/da, respectively.

There was high significant difference ($P<0.01$) between the two location yields (Table 2). Haymana location (715.16 kg/da) produced more GHY than Yenimahalle location (295.84 kg/da). This high difference can result from high rainfall amount and low temperature degree during the growing season. The cool-season grasses as smooth brome grass were described by Casler and Carlson (1995) that are adapted to cool climates or to region in which cool seasons prevail and produce vegetative growth during the early part of the season.

Hay yields (HYs)

HYs were evaluated for two location-years (Table 3). The G-460 genotype and population had similar HYs.

The G-460 and population produced 139.1 and 123.2 kg/da; 253.6 and 269.6 kg/da in HYs during 2008 and 2009 years, respectively in Haymana location. They averaged 196.39 and 196.41 kg/da in HYs, respectively.

The G-460 and population were 88.3 and 77.1 kg/da; 102.3 and 115.2 kg/da in HYs during 2008 and 2009 years, respectively in Yenimahalle location. The G-460 genotype and population averaged 95.30 and 96.12 kg/da, respectively.

There found statistically significant difference ($P<0.01$) between the two location

Table 2. Green herbage yields (kg/da) at the two locations in 2008, 2009 and two year averages

Çizelge 2. İki lokasyondaki 2008, 2009 ve iki yıllık ortalama yeşil ot verimleri (kg/da)

Materials	Haymana location			Yenimahalle location			Two year averages		
Numbers of replication 8	2008	2009	Averages	2008	2009	Averages	2008	2009	Averages
G-460	556.5	869.1	712.8	226.6	345.5	286.0	391,6	607,3	499,4
Population	492.9	942.1	717.5	202.5	408.9	305.7	347,7	675,5	511,6
DF	7	7	**7**	7	7	**7**	7	7	7
t Stat $_{(0.05)}$	0.64	-0.69	**-0.06**	0.46	-0.72	**-0.32**	0,617	-0,903	-0,196
Yields			715,16			295,84			505,5
t Stat location)				8,11**					

Table 3. Hay yields (kg/da) at the two locations in 2008, 2009 and two year averages

Çizelge 3. İki lokasyondaki 2008, 2009 ve iki yıllık ortalama kuru ot verimleri (kg/da)

Materials	Haymana location			Yenimahalle location			Two year averages		
Numbers of replication 8	2008	2009	Averages	2008	2009	Averages	2008	2009	Averages
G-460	139.1	253.6	196.4	88.3	102.3	95.3	113,7	178,0	145,9
Population	123.2	269.6	196.4	77.1	115.2	96.1	100,2	192,4	146,3
DF	7	7	7	7	7	7	7	7	7
t Stat $_{(0.05)}$	0.64	-0.56	0.00	0.54	-0.57	-0.04	0,638	-0,717	-0,025
Averages			196,41			95,72			146,1
t Stat (location)				7,22**					

yields (Table 3). The HYs in Haymana and Yenimahalle locations became as 196.41 and 95.72 kg/da, respectively. Haymana location had higher HYs than Yenimahalle location.

Some research results reported highest yields of hay as 335.3 kg/da and 432,7 kg/da at the various applications under the rainfed conditions (Serin 1996a); but these values ranged from 615.7 kg/da to 770.8 kg/da under the irrigated conditions (Serin 1996b). Albayrak and Ekiz (2004) obtained the hay yield as 137.23 kg/da in their study.

Significant difference were observed on dry matter yields in the following different trials as 719-1039 kg/da (May et al. 1998); 129.14 kg/da (Albayrak and Ekiz 2004); 316.0 kg /da (Albayrak et al. 2011); 575.0 kg/da (2009), 635.0 kg/da (2010) (Albayrak and Türk 2013). These variation can result from climatic conditions, soil properties, and growing conditions.

Moreover, the apparently narrow genetic variability within the local species in GHYs and HYs may also reflected the limited geographic area from which collections were made (May et al. 1998). They recommended that this problem may be overcome by collections from more diverse areas with having a greater variation.

Hay quality properties

There weren't statistically differences between G-460 genotype and population on hay quality properties (Table 4). Their analysis results were given in order.

Dry matter content

Genotypes and locations averages became almost the same. The G-460 genotype, population and overall averages were 89.82%, 89.84%, and 89.83%, respectively.

Digestible dry matter

The G-460 genotype and population had the values of 61.92, and 62.09; 59.58 and 59.54 in Yenimahalle and Haymana, respectively. Locations averaged 62.01 and 59.56 in DDM in Yenimahalle and Haymana, respectively. The G-460 genotype, population and overall averages were 60.75, 60.82, and 60.78, respectively. No significant differences were observed among those values.

Crude protein content

The G-460 genotype and population had the values of 21.62%, and 21.93%; 17.85%, and 17.79% on crude protein content in Yenimahalle and Haymana, respectively.

Locations averages were 21.78% and 17.82% in Yenimahalle and Haymana, respectively.

The G-460 genotype, population and overall averages were 19.74%, 19.86% and 19.80%, respectively. No significant differences between two genotypes, but high differences existed between locations.

May et al. (1998) detected crude protein amounts as 113, 154 g/kg; 99, 174 g/kg in first harvest and regrowth in year 1 and year 2, respectively.

Crude protein contents were found as 10.79 % (Albayrak et al. 2011); 111 g/kg and 108 g/kg in 2009 and 2010, respectively (Albayrak and Türk 2013). Serin (1996a; 1996b) found the highest of crude protein values as 12.76% - 14.19% and 13.13% - 15.02% under the rainfed and under the irrigated conditions, respectively. Data mentioned above were lower values than this study. These differences may be caused from diverse ecological conditions, various implementations, and variety differences.

Acid detergent fiber (ADF)

The G-460 genotype and population had the values of 34.64%, and 34.41%;37.64% and 37.69% on ADF in Yenimahalle and Haymana, respectively. Locations averages were 34.53% and 37.67% in Yenimahalle and Haymana, respectively. The G-460 genotype, population and overall averages were similar. May et al. (1998) had ADF as 433, 362 g/kg; 421, 306 g/kg in first harvest and regrowth in year 1 and year 2, respectively. ADF was detected as 42.64% (Albayrak et al. 2011), 410 g/kg, and 425 g/kg in 2009 and 2010, respectively (Albayrak and Türk 2013). These data were higher than this trial but the values in regrowth of May et al. (1998) were similar to and lower than this trial.

Neutral detergent fiber (NDF)

The G-460 genotype and population had 61.79%, and 62.20%; 66.43%, and 66.34% in values for NDF in Yenimahalle and Haymana, respectively. Locations averaged highly different as 62.00% and 66.39% in Yenimahalle and Haymana, respectively. The G-460 genotype, population and overall averages were 64.11%, 64.27%, and 64.19%, respectively.

May et al. (1998) measured NDF as 692, 576 g/kg; 695, 542 g/kg in first harvest and regrowth in year 1 and year 2, respectively. It was reported as 58.82% (Albayrak et al. 2011), 557 g/kg, 551 g/kg in 2009 and 2010, respectively (Albayrak and Türk 2013). These data were lower than values in this study but the values in first harvest of May et al. (1998) were higher than this trial.

Relative feeding values

The G-460 genotype and population had the values of 120.24 and 119.80; 107.64 and 107.81 on relative feeding values in Yenimahalle and Haymana, respectively. There was no observed significant differences between two genotypes. The G-460 genotype, population and overall averages were measured almost the same. But two locations showed significant differences.

As a result, Yenimahalle location had better hay quality properties than Haymana location.

This difference may be due to the difference in temperature. Plant grows fast, from April 1 to June 30, in the spring and early summer months. Mean temperature of Yenimahalle (15.5 ^{0}C) was higher than that of Haymana (13.6 ^{0}C) during this period.

Consequently, crude protein contents and NDF in this study were higher than mentioned trial results above but ADF were lower than their values. It seemed the change on quality factors in relation to locations and varieties differences.

Conclusions

The local genotypes may be considered as genetic resources for developing the new cultivars in breeding programs.

The local grass species (G-460) was promising with the results of the trials. Its green herbage and hay yields were satisfied on two-year at two locations. This G-460 performance can be interpreted as acceptable at the first phase of its breeding program. This program should be sustained with the extended new approaches.

No significant differences between the local grass species and population on quality properties, but high differences existed between locations.

The G-460 could be also used in making mixtures of artificial grasslands and over-seeding disturbed areas under the semi- arid conditions in the Central Anatolia Region. It has got a high potential for wide distribution in similar areas of Turkey. Similar studies should be organized having release cultivars in the near future. Moreover, material collections from more diverse areas with having a greater variation will be placed in breeding program for fast improving of new cultivars.

Literature

Açıkgöz E., 1991. Forage crops, Uludağ University publication, number: 7-025-0210, Bursa.

Albayrak S. and Ekiz H., 2004. The determination of features related to hay yield with correlation coefficient and path analysis on some perennial forage crops. Agricultural Science Journal 10 (3): 250-257.

Albayrak S., Türk M., Yüksel O. and Yılmaz M., 2011. Forage Yield and the Quality of Perennial Legume – Grass Mixtures under Rainfed Conditions. Not Bot Hort Agrobot Cluj, 2011, 39(1):114-118.

Albayrak S. and Türk M., 2013. Changes in the forage yield and quality of legume–grass mixtures throughout a vegetation period Turk J Agric For 37: 139-147.

Anonymous 2007. Soil analysis results of trails in Haymana. Central Soil, Fertilizer and Water Resources Research Institute, Ankara .

Anonymous 2009. The climatic data of Sivas province. The General Director of State Meteorological Service, Ankara, Turkey.

Anonymous 2013. The summary agricultural statistics. Turkish Statistical Institute, Prime Ministry Republic of Turkey.

Bor N.L., 1970. Gramineae. Tribus VII. Triticeae Dumort, pp. 147-244. In K. H. Rechinger (ed.) Flora Iranica, Vol. 70, Akademische Druck-u. Verlagsanstal, Graz, Austria.

Casler M.D. and Carlson I.T., 1995. Smooth Bromegrass. Edi: Barnes R.F., D. A. Miller and C. J. Nelson Forages pp. 313-324.

Davis P.H., 1970. Flora of Turkey, Vol. 9. University of Edinburgh, Edinburgh University Press, 22 George Square, Edinburg. Pg., 300-301.

Jensen K.B., Waldron B.L., Robins J.G., 2006. Cool season perennial grasses for hay. Research Geneticists, USDA-ARS Forage and Range Research Lab, Logan, UT 84322-6300. pp.8.

Kutlu R. H. 2008. The techniques of feed evaluation and analysis (lecture note) Cukurova University Agr. Fac. Animal Husbandary Department pp. 10, Adana.

May K.W., Stout D. G., Willms W. D., Mir Z., Coulman B., Fairey N. A., and Hall, J.W. 1998. Growth and forage quality of three Bromus species native to western Canada. Can. J. Plant Sci. 78: 597–603.

Nevski S.A., 1934. Tribe Hordeae. pg. 369-579. In V.L. marov (ed.) Flora of the USSR. Vol. II. Israel Program Scientific Translations, Jerusalem, Israel.

Prosperi J.M., Angevain M., Bonnin I., Chaulet E., Genier G., Jenczewski E., Olivieri I. and Ronfort J., 1996. Genetic diversity, preservation and use of genetic resources of Mediterranean legumes: Alfalfa and Medics. The Genus *Medicago* in the Mediterranean Region : Current Situation and Prospects in Research, Vol: 18. Cahiers Options Mediterranean, CIHEAM, pp.,189.

Serin Y., 1996a. A study on effect of various row distances and fertilization rates on hay yield and crude protein yield of smooth brome (*Bromus inermis* Leyss) under the rainfed condition of Erzurum province. Turkey 3. Meadow – Rangeland and Forage Crops Congress, 17-19 June 1996, p.384-392. Atatürk University Agricultural Faculty, Erzurum.

Serin Y., 1996b. A study on effect of various row distances and fertilization rates on hay yield and crude protein yield of smooth brome (*Bromus inermis* Leyss) under the irrigated condition of Erzurum province. Turkey 3. Meadow - Rangeland and Forage Crops Congress, 17-19 June 1996, p.564-570. Atatürk University Agricultural Faculty, Erzurum.

Serin Y., Şeker H., Tan M., Gökkuş A., Koç A., Erkovan H.İ. and Bulut S., 2001. Determination on biometric features of yield and some yield components of Smooth Brome (*Bromus inermis* Leyss) clones. Turkey 4. Field Crops Congress, 17-21 September 2001 vol.(3) p. 193-198. Trakya University Agricultural Faculty, Tekirdağ, Turkey.

Starkey D. L., Shroyer J.P., Fick, W. H. and Harbers, L.H., 1993. Effects of Early-Cutting Management on Forage Yield and Qualıty of Alfalfa in Northeast Kansas. Experiment Station and Cooperative Extension Service, pp., 1-6.

Ünal, S., Doğruyol, L. and H.K. Fırıncıoğlu, 2003. The annual report of the project of Germplasm enhancement of some plant species for use in the rehabilitation of the Central Anatolia Rangelands. Field Crops Central Research Institute (Unpublished report).