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Determining of some quantitative characteristics of certain tall fescue cultivars In cool season ecological conditions

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ABSTRACT

This study was conducted to determine the quantitative characteristics of newly introduced tall fescue (*Festuca arundinacea* Schreb.) cultivars in the ecological conditions of the cool climate. The experiment was carried out in Tokat Municipality between May 2009 - January 2012 for 3 years. Six cultivars of tall fescue cultivars (Firaces, Merida, Turbo, Apache, Eldorado and SR8600) were used. In this study; number of shoots (number dm^{-2}), green mass yield (g m^{-2}), dry matter content (%), dry matter yield (g m^{-2}), root mass yield (g m^{-2}) and winter endurance (1-9 points) were determined. The experimental design was a complete Randomized Block with four replications. The data were analized statisticaly and cultivar, year and cultivar × year interactions were evaluated. According to the results, the highest scores were obtained from Merida and Turbo cultivars, while other varieties had also suitable performances for ecological conditions of the region in general, and suggested that they can be used for lawn establishment in the region and in similar ecological conditions.

Keywords: Cool season turfgrasses, tall fescue, quantitative characteristics, winter endurance.

Bazı kamışsı yumak çeşitlerinin serin iklim Ekolojik koşullarında Bazı Kantitatif özelliklerinin belirlenmesi

ÖZ

Bu araştırma, yeni üretilen bazı kamışsı yumak (*Festuca arundinacea* Schreb.) çeşitlerinin serin iklim ekolojik koşullarında bazı kantitatif özelliklerinin belirlenmesi amacıyla, altı farklı kamışsı yumak çeşidi (Firaces, Merida, Turbo, Apache, Eldorado ve SR8600) ile Mart 2009 - Ocak 2012 tarihleri arasında 3 yıl süreyle Tokat'ta yürütülmüştür. Çalışmada; sürgün sayısı (adet/dm^2), yeşil kütle verimi (g/m^2), kuru madde oranı (%), kuru madde verimi (g/m^2), kök kütlesi verimi (g/m^2) ve kışa dayanıklılık (1-9 puan) özellikleri incelenmiştir. Deneme Tesadüf Blokları Deneme Deseni'ne göre dört tekrarlamalı olarak kurulmuştur. İstatistiksel analizler; çeşit, yıl ve çeşit × yıl etkileşimlere göre değerlendirilmiştir. Araştırma sonunda en yüksek rakamsal veriler Merida ve Turbo çeşitlerinden elde edilmiş ancak diğer çeşitlerin de genel anlamda bölgenin ekolojik koşullarına uygun olduğu ve çim alan tesisinde kullanılabileceği sonucuna varılmıştır.

Anahtar kelimeler: Serin iklim çim bitkileri, kamışsı yumak, kantitatif karakterler, kışa dayanıklılık.

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1. INTRODUCTION

As is the case around the world, reasons such as social life and education and notably economic reasons as well as migrations to cities have led to the construction of dense settlements in the cities of our country. As a result of dense and ad hoc settlements, many natural and artificial turf areas where people could walk about, stroll and breathe have been destroyed. Turf area plants, which constitute the most important botanical presence surrounding our living areas, are established in different grounds such as parks-gardens, airports, roadsides, cemeteries, resorts' gardens, hotels and playfields. An observation of our living environment would reveal many different plant species and varieties which create turf area texture. Among these varieties, grasses (turfgrass) plants are the most widely encountered [1,2,3].

Tall fescue (*Festuca arundinacea* Schreb.) has particular importance among plants that can be used in the establishment of green areas and is known for its coarse structure, fescue life form and adaptability to different climate and soil conditions. It is a genus which has wide leaf blades, non-frequent tillering, a dark green color, very dense, strong and deep roots and is generally unsuitable for mixing. As it shows high endurance against shade and adaptability to arid and saline soils, it is the optimal plant for use in equestrian sports' fields, road slopes, airports and particularly in problematic areas or in circumstances where a green area is to be created with little maintenance and a low budget [1,2,3,4].

Several researchers studying the tall fescue plant [1,4-19] evaluated the plant's quantitative characteristics, and offered explanatory information about quantitative characteristics performance.

Furthermore, among researchers who studied the topics of shoot height, green herbage and dry herbage content and yields, and root yield; the best indicators of whether plants adapted well to their cultivation area, 1.200 [20], 429-523 [21], 1.400-1.700 [22], 100-4.500 (mean: 800) [23], 128 [24], 688 [10], reported a root yield of 315-1.200 [12] g m^{-2}. On the other hand, it is stated that root dry matter amounts were approximately 80% of dry herbage yield [25].

This study was carried out with the aim of assessing the performance of certain tall fescue (*Festuca arundinacea* Schreb.) cultivars, introduced in recent years, in the ecological conditions of the cool climate province of Tokat.

2. MATERIALS AND METHODS

The study was conducted in the province of Tokat (40° 19'34.80" N, 36°33'18.26" E and 640 m above sea level), located in a transition zone between the Central Black Sea and Central Anatolia Regions. The experiment was established in the Plant Cultivation garden of the Parks and Gardens Directorate of Tokat Municipality. Mean climate data values pertaining to years of this research and long-term average have been listed in Table 1.

Table 1. The climate dates of Tokat Province for 2009-2012 years and Long Term Average (LTA*)

Years	Climatic factors		
	Total precipitaion (mm)	Average temperature (°C)	Moisture (%)
2009	481.4	13.1	62.8
2010	476.8	12.8	63.1
2011	480.5	13.0	61.9
2012	475.6	12.5	61.0
LTA*	445.5	12.4	62.2

(*): The Official Directoryship of Meteorological Bulletion for Tokat.

Analyses of soil samples taken from 0-20 cm depths of the research area were conducted in the Middle Black Sea Transitional Zone Agricultural Research Institute's Laboratory, and were classified. The soils indicated national-loamy structure, were very slightly alkaline (pH: 7.3), non-saline (0.022%), medium alkaline (9.1%), insufficient in terms of available phosphorus (11.24 kg ha^{-1}), sufficient in terms of potassium (279 kg ha^{-1}) and at a medium level in terms of organic substances (1.55%) [26].

Six different newly introduced tall fescue cultivars (Firaces, Merida, Turbo, from Semillas Fito Co-, Apache, Eldorado - from DLF Trifolium Co.- and SR8600 -from SRO Co.) were used as vegetational materials in the study, and sowing was carried out by use of 20 g m^{-2} sowing norm, with consideration to germination percentages [2,3].

The study was carried out for 3 years from 30 March, 2009 to 15 January, 2012. Plot sizes were 2×1 m (2 m^2) and 50 cm spaces were left in between plots.

For an annual NPK fertilization dosage of 25-15-15 g m^{-2}, recommended by Acikgoz [2] and Avcioglu [3] and supported by certain research

[12,19] results as the appropriate amount in the ecological conditions of Tokat, 15-15-15 compound and a 26% ammonium nitrate was used, the fertilizer was divided into 14 equal shares and was applied every 15 days from April to September. Irrigation was applied using automatic rotary sprinklers. Upon reaching heights of 6-10 cm, plants were mown at a height of 4 cm with a gas lawn mower, 20 times per year (spring 7, summer 6, autumn 7, winter 0).

In the study; shoot number (number dm^{-2}) was determined using the total yield obtained from cuttings performed in June 15 every year, green mass yield (g m^{-2}) from a total of 20 cuttings performed every year; 7 in spring (April 3, May 4), 6 in summer (June 2, July 2, August 2), and 7 in autumn (September 3, October 3, November 1); dry matter content (%) was calculated by weighing the dry weights of samples taken after each cutting, which were then waited in the drying oven at a temperature of 105 °C for 48 hours [27], dry matter yield (g m^{-2}) was calculated as green herbage yield × dry matter content; to measure root mass yield (g m^{-2}) 20×20×20 cm soil samples taken after the last cutting of both years of the experiment were leached, filtered, root masses within were dried, weighed and proportioned, and winter endurance (1: very bad, 9: very good) was calculated from yields taken on the 15th of January each year.

A Two-Way Randomized Block Experimental Design with four replications was established, statistical analyses of the results obtained at the end of the study were performed using the TOTEMSTAT Statistical Program [28] and LSD values (5%) were stated underneath the Tables. The data were analized statisticaly and cultivar, season, year and season × year interactions were evaluated.

3. RESULTS

3.1. Shoot number

Mean shoot number values and values for all three years of the study were listed in Table 2. Among the studied cultivars, the highest mean shoot number was obtained from the Merida cultivar with 228.8, while the lowest number was identified in the Apache cultivar with 181.1. Comparison between years showed that shoot number was considerably higher in the third year with 242.7 when compared to the second (235.0) and especially the first year (152.7). Assessment of the results in terms of cultivar × year interactions revealed that once again the highest shoot number (261.0) was observed in Merida in the third year and the lowest number (125.3) was seen in the Apache cultivar in the first year.

Table 2. Shoot number (number dm^{-2})

Turf Cultivars	Shooth number			
	1. year	2. year	3. year	Mean
Apache	125.3	205.5	212.4	181.1
Eldorado	145.2	224.5	233.2	201.0
Firaces	151.5	241.3	249.3	214.0
Merida	171.1	254.3	261.0	228.8
SR8600	157.4	235.6	242.4	211.8
Turbo	165.7	248.6	258.0	224.1
Means	152.7	235.0	242.7	-----
LSD 5%	*C: 6.4*	*Y: 4.2*	*C×Y: 11.3*	

C. Cultivar, Y: Year, C×Y: Cutivar × Year

If shoot number in 1 dm^2 is less than 100 it is considered "*poor*", if it is between 100-200 "*moderate*" and if it is more than 200 "*dense*" [1,2,3]. According to this assessment, all cultivars were classified as "*moderate*" in the first year in which the experiment had only been established and as "*dense*" the second and third year, when they were able to show their true performance.

3.2. Green mass yield

Green mass yield values pertaining to the years of the study and mean value evaluations were presented in Table 3.

Table 3. Green mass yield (g m^{-2})

Turf Cultivars	Green mass yield			
	1. year	2. year	3. year	Mean
Apache	4562.5	5386.8	5477.1	5142.1
Eldorado	4896.2	5637.9	5722.5	5418.9
Firaces	4951.6	5741.1	5828.5	5507.1
Merida	5364.5	6112.4	6216.1	5897.7
SR8600	4993.2	5761.6	5851.6	5535.5
Turbo	5325.4	6061.6	6161.0	5849.3
Means	5015.6	5783.6	5876.1	-----
LSD 5%	*C: 35.3*	*Y: 23.2*	*C×Y: 59.6*	

High green herbage yield indicates that cultivars have strong development capacities and adapted nicely to the ecology.

3.3. Dry matter content

Dry matter content values from all three years of the study and mean value evaluations were given in Table 4. Among all the cultivars, the highest dry matter content values were obtained by Merida and Turbo with 27.3% while the lowest dry matter content value was taken from the Apache cultivar with 26.3%.

Table 4. Dry matter content (%)

Turf Cultivars	Dry matter content			
	1. year	2. year	3. year	Mean
Apache	25.5	26.2	27.1	26.3
Eldorado	25.8	26.9	27.8	26.8
Firaces	25.5	26.6	27.4	26.5
Merida	26.5	27.2	28.2	27.3
SR8600	26.1	26.6	27.5	26.7
Turbo	26.6	27.2	28.2	27.3
Means	26.0	26.8	27.7	-----
LSD 5%	*C: 0.49*	*Y: 0.34*	*C×Y: 0.85*	

As for years, the third year attained considerably higher results in comparison to the other years with 27.7%. In cultivar × year interactions, Merida and Turbo obtained the highest value (28.2%) in the third year, and the Apache cultivar had the lowest value (25.5%) in the first year.

3.4. Dry matter yield (g m^{-2})

Dry matter yield values from first, second and third year of the study and the three years' mean were listed in Table 5.

Table 5. Dry matter yield (g m^{-2})

Turf Cultivars	Dry matter yield			
	1. year	2. year	3. year	Mean
Apache	1163.4	1411.3	1484.3	1350.7
Eldorado	1263.2	1516.6	1590.9	1454.1
Firaces	1262.7	1527.1	1597.0	1459.4
Merida	1421.6	1662.6	1746.7	1608.1
SR8600	1303.2	1532.6	1609.2	1479.8
Turbo	1416.6	1648.8	1737.4	1598.8
Means	1304.0	1549.0	1626.7	-----
LSD 5%	*C: 12.6*	*Y: 8.2*	*C×Y: 21.4*	

In terms of dry matter yield, the highest yield was obtained from the Merida cultivar with 1608.1 g m^{-2} and the lowest yield from the Apache cultivar with 1350.7 g m^{-2}. From study years, the third year achieved the highest yield with 1626.7 g m^{-2}. Assessment of the data in terms of cultivar × year interactions revealed that the highest yield was taken in the third year from Merida with 1746.7 g m^{-2}, while the lowest value was seen in the first year in the Apache cultivar with 1163.4 g m^{-2}.

3.5. Root mass yield

Root mass values were presented in Table 6. In terms of root mass yield, the highest yield was observed in Merida with 1499.4 g m^{-2} and the lowest yield was seen in the Apache cultivar with 1266.6 g m^{-2}. Among study years, third year yield (1609.3 g m^{-2}) was higher than the other years. Assessment of the data in terms of cultivar × year interactions showed that the highest yield was

Table 6. Root mass yield (g m^{-2})

Turf Cultivars	Root mass yield			
	1. year	2. year	3. year	Mean
Apache	1018.5	1320.2	1461.0	1266.6
Eldorado	1121.3	1447.5	1594.2	1387.7
Firaces	1135.6	1451.4	1601.5	1396.2
Merida	1245.3	1551.4	1701.6	1499.4
SR8600	1149.5	1461.2	1611.1	1407.3
Turbo	1218.6	1534.3	1686.1	1479.7
Means	1148.1	1461.0	1609.3	-----
LSD 5%	*C: 49.1*	*Y: 34.2*	*C×Y: 86.7*	

obtained in the second year by Merida with 1701.6g m^{-2}, whereas the lowest value was seen in the first year in the Apache cultivar with 1018.5 g m^{-2}.

High root yield is an important indicator that cultivars developed greatly and had a good adaptation capability [1,2,3,4].

3.6. Winter endurance

Winter endurance values were given in Table 7.

Table 7. Winter endurance (1-9 point)

Turf Cultivars	Winter endurance			
	1. year	2. year	3. year	Mean
Apache	7.5	7.8	8.1	7.8
Eldorado	7.8	8.0	8.2	8.0
Firaces	7.9	8.1	8.4	8.1
Merida	8.3	8.7	8.9	8.6
SR8600	8.0	8.3	8.5	8.3
Turbo	8.3	8.7	8.9	8.6
Means	8.0	8.3	8.5	-----
LSD 5%	*C: 0.03*	*Y: 0.02*	*C×Y: 0.05*	

The Merida and Turbo cultivars attained the highest winter endurance values with a score of 8.6 and the Apache cultivar had the lowest value with a score of 7.8. From study years, the third year surpassed the 8.0 score of the first year and the 8.3 score of the second year by obtaining a score of 8.5. Assessment of the data in terms of cultivar × year interactions revealed that the highest value was achieved in the third year by the Merida and Turbo cultivars with a score of 8.9, while the lowest score was seen in the first year in the Apache cultivar with a score of 7.5.

Collected data showed that the cultivars included in this experiment were not affected negatively by the winter conditions of the area.

4. DISCUSSION

The results obtained in this study regarding shoot number, green herbage yield, dry matter content and yield, and winter endurance were in agreement

with the results of Yilmaz [10], Yilmaz and Avcioglu [12,13], who studied the Finelawn cultivar of the tall fescue in the conditions of Tokat and with those of Oral [8], who carried out research in similar ecological conditions in Bursa and with some other studies [5,9,10,12,20-23]. However, the results of this study were higher than certain studies carried out in the conditions of Izmir [6,7,14-17,24,]. This may be because the ecological conditions of Tokat have a longer period of cool and rainy days in comparison to the ecology of Izmir.

Root mass yield values observed between 1018.5-1701.6 g m^{-2} were in line with root yield values reported between 315-1.700 g m^{-2} by certain researchers [10,12,20-23,]. However, they were higher than values obtained by Birant [24], who worked with cool season turf grass plants which couldn't show their true performance in the conditions of Izmir and who achieved a yield value of 128 g m^{-2}. As was explained above, the reason for this are ecological conditions.

Furthermore, data acquired in this study validate Tarman [25], who reported that root dry matter is around 80% of dry herbage yield.

When data obtained in the study is assessed as a whole, it is possible to say that the Merida and Turbo cultivars stand out in all the evaluated features, whereas the Apache cultivar had lowest results; nevertheless, all cultivars achieved positive results.

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