

*Araştırma Makalesi - Research Article*

## Türkiye Florasından Toplanmış *Festuca L.* Genotiplerinde Morfolojik-Agronomik Varyasyon

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### ÖZ

Bu çalışma, Türkiye florasından toplanmış beş *Festuca* türüne ait toplam 497 genotipte morfolojik ve agronomik özelliklerin varyasyonu değerlendirilmiştir. Çalışma kapsamında toplanan tohumlar ve köklü bitkiler, serada saksılara ekilmiş ve daha sonra fidanlar Konya'da 2015 yılında 0.5m x 0.5m dikim aralıkları ile araziye aktarılmıştır. *Festuca* taksonundan 2016 yılında alınan morfo-agronomik gözlemler çim kalitesi, renk, yaprak dokusu, yoğunluk, sonbahar büyüme şekli, bitki boyu, yaprak genişliği, yaprak boyu, salkım boyu, son boğum uzunluğu, bitki başına tohum verimi ve 1000 tane ağırlığıdır. Bazı görsel özelliklerin (çim kalitesi, renk, yaprak dokusu) değerlendirilmesinde 1-9 skalası kullanılmıştır. Sonuçlara göre, *F. arundinacea* en yüksek çim kalitesine (6.90), renk (5.75), yaprak dokusu (3.03) ve yaprak genişliğine (2.79 mm) sahip olmuştur. En ince yaprak dokusu *F. ovina'* da tespit edilirken, en kısa bitki boyu *F. valesiaca'* da ve *F.* en düşük tohum verimi *pratensis'*te saptanmıştır. İncelenen özellikle göre *Festuca L.* türlerinde yüksek CV değerlerinin oluşması tür içi ve türler arası çeşitliliğin yüksek olduğunu ortaya koymaktadır. Bu durum *Festuca* cinsinde ki seleksiyon ve ıslah çalışmalarında büyük avantaj sağlayabilir.

**Anahtar Kelimeler-** *Festuca*, Varyasyon, Bitki Boyu, Çim Kalitesi, Tohum Verimi.

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## Morpho-Agronomic Variation in *Festuca* L. Genotypes from Turkey Flora

### ABSTRACT

In this study, a total of 497 taxon and five species of *Festuca* genus from Turkey flora were evaluated for morpho-agronomic variation. The collected seeds and rooted plants were sown to pots in greenhouse and then seedlings were transferred to field by 0.5m x 0.5m spaces in 2015 in Konya. In 2016, Morpho-agronomic observations of *Festuca* taxon were turf quality, color, leaf tissue, density, autumn growth type, plant height, leaf width, leaf length, cluster height, last node height, seed yield per plant and 1000 seed weight. Scales 1-9 were used to evaluate some visual characteristics (turf quality, color, leaf texture). According to the results, *F. arundinacea* had the highest turf quality (6.90), color (5.75), leaf tissue (3.03), leaf width (2.79 mm). The thinnest tissue was detected in *F. ovina* while the shortest plant height in *F. valesiaca* and the lowest seed yield in *F. pratensis*. Most of the investigated parameters showed high CV which highlighted the existence of high in-species and inter-species variation of *Festuca* L. in Turkey. This case may provide a great advantage in breeding and selection studies on *Festuca* genus.

**Keywords-** *Festuca*, Variation, Plant Height, Turf Quality, Seed Yield.

## I. INTRODUCTION

The *Festuca* is the largest genus within the *Pooideae* subtribe of the *Poaceae* family, and contains over 400 species [1,2]. Species of *Festuca* vary in morphology, with cosmopolitan distribution and it is an important component of grass ecosystems of the temperate zone. Turkey is one of the richest and interesting countries in the world in respect to *Festuca* genus, as previously noted in other resources. Turkey has floristic attraction for *Festuca* with the 52 species and, this richness is creating great genetic potential for breeding [3].

*Festuca* L. is a widely used in temperate regions both turf and forage grass, with many known species [4]. Also, *Festuca* species are important for erosion control in mountainous areas as well as forage grasses for animals [5]. In this respect, *F. arundinacea* (tall fescue), is one of the most agriculturally important species of *Festuca* genus was used in land reclamation projects during the “Dust Bowl” period of the 1930s in the United States [6]. Tall fescue with broad-leaved is used widely for green forage as well as conservation purposes and turf [7]. It has high yield stability and adaptation to different environments [8]. Meadow fescue (*F. pratensis*) has many positive traits such as tolerance to abiotic and biotic stresses, good persistence and adaptation to grazing and frequent cutting and high nutritive quality. Sheep fescue (*F. ovina*), another important species of *Festuca* L., its early grow and vigorous root system make it competitiveness with other grasses and, it is fairly resistant to drought and trampling by animals [9,10]. Sheep fescue is also tolerant to frequent grazing because of their growth characteristics and broad temporal adaptation on rangelands. There have been many studies on the morphological variation in the diverse species of the *Festuca*, especially on the leaves due to high variation from fine to broad [11]. Same authors studied on *F. pratensis*, *F. arundinacea*, *F. rubra* and *F. ovina* collected from various locations of Turkey found that thousand seed weight were 2, 2, 1.2 and 0.7 g, and plant height between 40-100, 120-150, 40-90 and 10-60 cm respectively in the studied species. [12] Previously, 100-160 cm plant height, 18-24 cm cluster height, 2.2-2.49 g thousand seed weight were measured on the *F. arundinacea* [13] In *F. ovina* subspecies, 20 – 50 cm plant height, 0.8-1.0 g thousand seed weight were noted, [14] It was reported that turf grass traits of *F. arundinacea* were 4.11 to 6.97 for leaf tissue, 6.47 to 6.90 for color, 6.94 to 8.36 for turf quality and 7.93 to 8.98 for thinning (1-9 scale).

This natural species or genotypes are inherently diverse because of adaptation to many climates and locations over many years. Many of new varieties were developed by the selection of promising genotypes from natural fields. In this case, understanding morphologic diversity of certain species is not only useful in addressing the evolutionary process, but also a prerequisite for efficient use of genetic resources in breeding programs. Also, interest in the genetic structure of natural populations of grass species has been increased in the last few years due to the necessity of broadening the knowledge of genetic variations in Turkey.

Present study was performed to identify some morpho-agronomic characteristics in 5 *Festuca* species collected from Turkey, especially uses in the evaluation of turf grass.

## I. MATERIAL AND METHOD

In the present research, 5 *Festuca* species consisted from the project of coded with “TUBITAK 113O919” in 2014 were used. A total of 497 *Festuca* L. genotype were formed by 130 of *F. arundinacea* Schreb., 217 of *F. ovina* L., 27 of *F. pinifolia* (Hack. ex Boiss) Bornm., 46 of *F. pratensis* Huds., and 77 of *F. valesiaca* Schleich. ex Gaudin. Their rooted plants and seeds were collected from 13 Cities (Ankara, Cankiri, Corum, Yozgat, Eskisehir, Afyon, Konya, Aksaray, Nigde, Karaman, Kirsehir, Kayseri, Kirikkale, Sivas, Mersin and Antalya) of Turkey.

The collected seeds and the rooted plants were sown to pots in greenhouse and then they were transferred to field by 0.5m x 0.5m spaces in 2015 in Konya. The soil at the experimental site taken 30 cm depth is classified as clay-loam with pH: 7.34, low organic matter (1.82%), medium P<sub>2</sub>O<sub>5</sub> (6.07 kg da<sup>-1</sup>) and high K<sub>2</sub>O (201.77 kg da<sup>-1</sup>) content. Annual rainfall, average temperature and moisture are 330 mm, 11.8 °C and 54.8 %, respectively in the experimental site in 2016. In the trial regular turf maintenance techniques were carried out such as irrigation, fertilization, weed control and cutting. The data for investigated characteristics was collected in 2016 during the period from flowering to seed maturity. These characteristics are turf quality (1-9 scale), color, leaf tissue (1-9 scale), density (1-9 scale), autumn growth type (1-9 scale), plan height (cm), leaf width (mm), leaf length (cm), cluster height (cm), last node height (cm), seed yield per plant and 1000 seed weight. In

scale 1-9, 1 refers to lowest or bad while 9 to the best or the highest value [15,16]. The data was evaluated separately for each species and statistically analyzed in SPSS version 20.0.

## II. RESULTS AND DISCUSSION

Mean values and some statistical data of detected morpho-agronomic characteristics in the genotypes of *F. arundinacea* Schreb., *F. ovina* L., *F. pinifolia* (Hack. ex Boiss) Bornm., *F. pratensis* Huds. and *F. valesiaca* Schleich. ex Gaudin were given in Table 1,2,3,4 and 5. Average of the turf quality was similar as 6-7 (well) almost in all species. But, the highest turf quality was determined in *F. arundinacea* (6.90) genotypes and the lowest turf quality was appointed in *F. pratensis* (6.76) genotypes. Although the coefficient of variation was similar all species, the highest CV content was examined in *F. ovina* L. (12.66%) genotypes. The color property determined by 1-9 scale, *F. arundinacea* genotypes have been darker color than the other species. The color property is fairly importance in breeding trials because the color may vary depending on the turf grass (Table 1).

**Table 1.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the turf quality and color in examined *Festuca* L. species

Species	n	Turf quality (1-9)					Color (1-9)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	6.90	5.00	8.00	0.83	12.09	5.75	1.00	9.00	1.29	22.50
<i>F. ovina</i>	217	6.82	4.00	9.00	0.86	12.66	5.44	2.00	8.00	1.34	24.69
<i>F. pinifolia</i>	27	6.78	6.00	8.00	0.75	11.08	5.07	3.00	8.00	1.44	28.36
<i>F. pratensis</i>	46	6.76	5.00	8.00	0.85	12.54	5.39	3.00	8.00	1.29	23.94
<i>F. valesiaca</i>	77	6.81	5.00	9.00	0.83	12.16	5.22	3.00	8.00	1.22	23.30

**Table 2.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the leaf tissue and density in examined *Festuca* L. species

Species	n	Leaf tissue (1-9)					Density (1-9)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	3.03	1.00	8.00	1.13	37.41	5.89	1.00	8.00	1.53	25.90
<i>F. ovina</i>	217	2.46	1.00	6.00	1.17	47.72	5.62	1.00	8.00	1.54	27.33
<i>F. pinifolia</i>	27	2.48	1.00	5.00	1.28	51.67	5.44	2.00	8.00	1.72	31.54
<i>F. pratensis</i>	46	2.93	1.00	6.00	1.22	41.52	6.02	3.00	8.00	1.44	23.87
<i>F. valesiaca</i>	77	2.85	1.00	6.00	1.25	44.03	5.41	3.00	8.00	1.42	26.29

Leaf tissue and density are the characters related to the general appearance of plant and leaves. Leaf tissue of the species were ranged between 2.46 (*F. ovina*) and 3.03 (*F. arundinacea*) with a medium coefficient of variation. Average leaf tissue of *F. arundinacea* was thicker than other species while *F. ovina* was the thinnest. Average density of *F. pratensis* and *F. arundinacea* were determined by 6.02 and 5.89, respectively. It is also noteworthy to mention that these species may use as forage or in pastures. The lowest density was determined in *F. valesiaca* genotypes as a mean of 5.41. However, regarding to leaf tissue and density, the highest variation was determined in *F. pinifolia* (51.67, 31.54%) and *F. ovina* (47.72, 27.33 %) genotypes.

**Table 3.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the plant height and leaf width in examined *Festuca* L. species

Species	n	Plant height (cm)					Leaf width (mm)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	38.81	15.00	95.00	13.10	36.59	2.79	0.50	10.00	1.57	56.42
<i>F. ovina</i>	217	32.82	5.00	79.00	14.29	43.54	1.80	0.50	3.00	1.07	29.49
<i>F. pinifolia</i>	27	35.00	8.00	94.00	19.03	54.38	2.25	0.50	4.00	1.02	45.36
<i>F. pratensis</i>	46	38.78	11.00	90.00	12.57	32.42	2.48	0.50	6.00	1.11	44.91
<i>F. valesiaca</i>	77	32.79	7.00	73.00	12.69	38.70	2.24	0.50	5.00	1.12	50.21

In the green areas, the thin-leaved and the short plants are preferred to reduce maintenance costs. In this context, mean plant height varied from 32.79 (*F. valesiaca*) to 38.81 cm (*F. arundinacea*) in fescue species. Furthermore, plant height up to 95 cm was recorded in *F. arundinacea* while it was as low as 5.00 cm in *F. ovina* genotypes. In terms of averages of leaf width, the lowest value was in *F. ovina* (1.80 mm) with minimum CV (29.49%), and the highest value was in *F. arundinacea* (2.79 mm) with maximum CV (56.42%).

**Table 4.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the leaf length and cluster height in examined *Festuca* L. species

Species	n	Leaf length (cm)					Cluster height (cm)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	8.52	5.00	27.00	4.09	48.00	5.99	2.00	15.00	1.98	33.08
<i>F. ovina</i>	217	7.22	2.00	21.00	3.31	45.85	6.40	2.00	18.00	2.56	39.96
<i>F. pinifolia</i>	27	6.77	2.00	14.00	2.67	39.44	6.00	2.00	17.00	3.71	61.91
<i>F. pratensis</i>	46	7.33	3.00	18.00	2.53	34.52	5.94	3.00	13.00	2.34	39.39
<i>F. valesiaca</i>	77	6.92	2.00	15.00	3.43	49.59	6.42	3.00	14.00	2.77	43.14

Among these five fescue species, mean leaf length was varied between 6.77 (*F. pinifolia*) and 8.52 cm (*F. arundinacea*) and cluster height varied from 5.94 (*F. pratensis*) to 6.42 cm (*F. valesiaca*) (Table 4). All species had high coefficient variation for these characters, especially *F. valesiaca* (49.59%) and *F. pinifolia* (61.91%).

*F. arundinacea* has shown maximum value of plant height, leaf width and length as 38.81 cm, 2.79 mm and 8.52 cm, respectively. These results show that *F. pratensis* and *F. arundinacea* can be suitable as forage, while *F. valesiaca*, *F. ovina* and *F. pinifolia* as turf grass. Previously, this conclusion supported by [10]. However, each species should be evaluated separately due to high intra-species variation. In other words, each species can include genotypes suitable for use as both forage and turf grass.

**Table 5.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the last node height and seed yield per plant in examined *Festuca* L. species

Species	n	Last node height (cm)					Seed yield per plant (g)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	19.54	6.00	39.00	6.32	34.11	1.85	0.95	3.40	0.67	36.47
<i>F. ovina</i>	217	19.44	7.00	63.00	9.02	46.39	1.45	0.25	6.83	1.36	93.79
<i>F. pinifolia</i>	27	18.10	7.00	45.00	8.73	48.24	1.22	0.29	2.60	0.89	72.61
<i>F. pratensis</i>	46	19.53	9.00	33.00	5.94	30.44	1.00	0.25	2.35	0.68	67.87
<i>F. valesiaca</i>	77	17.55	8.00	37.00	6.06	34.51	1.74	0.35	4.20	0.96	54.97

Last node height averaged between 17.55 (*F. valesiaca*) and 19.54 cm (*F. arundinacea*) and seed yield per plant varied from 1.00 (*F. pratensis*) to 1.85g (*F. arundinacea*) (Table 5). Mean 1000 seed weight ranged between 0.76 (*F. pinifolia*) and 1.64g (*F. arundinacea*) in *Festuca* L. Similarly the range of autumn growth type was between 4.87 (*F. pratensis*) and 5.60 (*F. arundinacea*) (Table 6). And, the maximum value of seed yield per plant was detected in *F. ovina* while the maximum 1000 seed weight was in *F. arundinacea*. However, mean seed yield per plant and 1000 seed weight were the highest in *F. arundinacea* with low CV (36.47 and 35.52%, respectively). The highest variation among the investigated characters was observed in seed yield per plant, especially in *F. ovina* with 93.79% CV (Table 5).

**Table 6.** Mean, minimum, maximum values, standard deviation (Sd) and coefficient of variation (CV) for the 1000 seed weight and autumn growth type in examined *Festuca* L. species

Species	n	1000 seed weight (g)					Autumn growth type (1-9)				
		Mean	Min.	Max.	Sd.	CV(%)	Mean	Min.	Max.	Sd.	CV(%)
<i>F. arundinacea</i>	130	1.64	0.82	3.24	0.58	35.52	5.60	3.00	9.00	1.72	30.69
<i>F. ovina</i>	217	1.02	0.05	2.50	0.46	44.91	5.03	1.00	9.00	1.85	36.74
<i>F. pinifolia</i>	27	0.76	0.34	1.35	0.28	36.48	5.46	1.00	9.00	2.18	39.99
<i>F. pratensis</i>	46	0.82	0.38	1.38	0.39	48.12	4.87	3.00	7.00	1.77	36.32
<i>F. valesiaca</i>	77	0.94	0.49	2.18	0.39	41.35	5.21	3.00	9.00	1.76	33.83

The fescue species exhibited high variation for most of the studied traits, which all had a coefficient variation of higher than 10%. This variation can be attributed to the ecological and genetic factors. Also, due to outcrossing in all the species this results are expected as reported many authors [7,9,11,12,13,14] who are study with grass species collected from natural land. The high variation may give an alternative to select better samples and a contribution to success in breeding.

### III. CONCLUSION

This research, a total of 497 *Festuca* L. genotypes that are consisted from five different species presented quite more variations for the investigated characteristics. As a result of this study, it was highlighted the existence of variability in-species and inter-species and once again reveals the genetic diversity of Turkey in terms of *Festuca* L.. According to the results of the parameters examined, totally 34 *Festuca* L. genotypes which are 4 *F. arundinacea*, 20 *F. ovina*, 1 *F. pratensis*, 1 *F. pinifolia* and 8 *F. valesiaca* were determined to be superior to use turf grass. However, owing to dominant effects of environment factors on perennial plants, it is fair that the investigated characteristics in the study should be collected again in the following years to stability and reliability.

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