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Determination of Some Yield Features of Foreign-Origin Alfalfa Cultivars (*Medicago sativa* L.) in Bingöl Conditions

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Abstract: This study was carried out to determine the some yield features of foreign origin alfalfa cultivars in Bingöl ecological conditions. In the research, a total of 15 alfalfa cultivars,12 of them are from foreign-origin (Iside, Osjecka 99, Ezzelina, Diane, Prosementi, Queen, Emiliana, Rivierea Vicentina, Banat vs, La Torre, Sabrina and Escorial) and 3 of them are standard (Elci, Bilensoy 80 and Basbag) cultivars were used as plant material. In the research; plant height, number of stems, stem thickness, green forage yield and dry matter yield were investigated. Average plant height was 97.6 cm, number of stems was 15.8, stem thickness was 2.80 mm, forage yield was 11018 kg da^{-1} and dry matter yield was 3228 kg da^{-1}. In line with these parameters examined, it has concluded that Ezzelina and Emiliana cultivars showed superior characteristics in Bingöl province.

Bingöl Koşullarında Yurtdışı Kaynaklı Yonca Çeşitlerinin (*Medicago sativa* L.) Bazı Verim Özelliklerinin Belirlenmesi

Anahtar Kelimeler
Yonca,
Sap sayısı,
Sap çapı,
Yeşil ot verimi,
Kuru ot verimi

Öz: Bu çalışma, Bingöl ekolojik koşullarında bazı yabancı orijinli yonca çeşitlerinin ot verimini belirlemek amacıyla yürütülmüştür. Araştırmada 12'si yabancı-orijinli (Iside, Osjecka 99, Ezzelina, Diane, Prosementi, Queen, Emiliana, Rivierea Vicentina, Banat vs, La Torre, Sabrina ve Escorial) ve 3'ü de standart çeşit (Elçi, Bilensoy 80 ve Başbağ) olmak üzere toplam 15 yonca çeşidi bitkisel materyal olarak kullanılmıştır. Araştırmada; bitki boyu, sap sayısı, sap çapı, yeşil ot verimi ve kuru ot verimi incelenmiştir. Ortalama bitki boyu 97,6 cm, sap sayısı 15,8, sap çapı 2,80 mm, yeşil ot verimi 11018 kg da^{-1} ve kuru ot verimi 3228 kg da^{-1} olarak tespit edilmiştir. İncelenen bu parametreler doğrultusunda Bingöl ilinde Ezzelina ve Emiliana çeşitlerinin üstün özellikler gösterdiği sonucuna varılmıştır.

1. INTRODUCTION

Fodder (forage) crops farming has great importance in developed countries, and these countries allocate a significant portion of their agricultural land to forage crop farming. For example, the ratio allocated to forage crops in the total field land are 49.8% in Australia, 36.5% in Germany, 31.4% in the Netherlands; 25.8% in France, 25.4% in England and 23.0% in the USA [1].

Alfalfa has large cultivation areas in many countries of the world and is defined as the queen of forage crops because have a high adaptability, long life, can be cut many times in a vegetation period, high yield, high nutritional value, so alfalfa is distinguished from other forage crops. Alfalfa is rich in protein, as well as vitamins such as carotene (provitamin A) and tocopherol (vitamin E). With the help of deep root, alfalfa easily benefits from water and plant nutrients found in deep areas that other plants could not use. Alfalfa leaves a nitrogen-rich soil for the next plant in its root nodosities [2].

Alfalfa naturally found in almost every region of Turkey. Cultivation of alfalfa has become increasingly common in recent years. This situation makes it necessary to research and adapt new varieties for our country besides existing alfalfa varieties. In forage

crops and especially alfalfa because mentioned reasons, it has become compulsory to develop new varieties. To increase the number of registered varieties by conducting regional adaptation studies especially after the enactment of the Pasture Law No. 4342, in Turkey important developments have taken place in terms of agriculture and forage crops [3].

In the previous studies; plant height was 59.8-76.3 cm in the first year and 90.0-121.3 cm in the second year of the Elci cultivar of alfalfa. In the first and second years of the study, the ztotal green forage yield was 6284-9159 kg da^{-1} and 7538-10715 kg da^{-1} [4].

In a three-year study examining the yield characteristics of 8 alfalfa cultivars in Ankara conditions; it has been reported that the green forage yield was determined as 7907-11140 kg da^{-1} and dry matter yield was determined as 2619-3615 kg da^{-1} [5].

In order to determine the suitable alfalfa varieties for the Eastern Anatolia region, 16 different alfalfa varieties have compared from aspect of yield and quality features in Bingöl conditions. The study has conducted in randomized block design with three replications during three years between 2014 and 2016. According to the results of the research, plant height values of alfalfa cultivars were 41.9-54.7 cm, forage yields were 2735-3591 kg da^{-1} and dry matter yields were 924-1227 kg da^{-1} [6].

The study has conducted in Bornova and Odemiş ecological conditions 2006 and 2007 years with four different alfalfa genotypes, it has found that there were significant differences from the aspect of genotypes between locations. The researchers determined that the forage yield was 9769-12235 kg da^{-1}, dry matter yield was 2078-2862 kg da^{-1}, plant height was 77.1-86.8 cm, main stem was 13.14-15.57, the main stem thickness was 3.57-3.99 mm in Odemiş condition and the forage yield was 9260-11832 kg da^{-1}, dry matter yield was 1984-2601 kg da^{-1}, plant height was 70.8-76.1 cm, main stem was 12.74-14.22 and main stem thickness was 2.84-3.12 mm in Bornova conditions [7].

The research conducted in order to determine the yield and quality characteristics of some perennial warm season legume forage crops in Adana region in the irrigated conditions the Nimet variety of alfalfa was used, the average plant height was 69.2 cm, the green forage yield was 5094.5 kg da^{-1} and dry matter yield was 1135 kg da^{-1} [8].

The aim of this study is to determine some yield features of foreign-origin alfalfa cultivars in Bingöl ecological conditions.

2. MATERIAL AND METHOD

2.1. Material

This research has conducted in Bingöl University Genc Vocational School's Application and Research Area between 2019 and 2021, under watery conditions and for two years. Genc is a town and district of Bingöl Province in the Eastern Anatolia Region of Turkey. Totally 15 alfalfa cultivars have been used in the study, 12 of which were of foreign origin (Iside, Osjecka 99, Ezzelina, Diane, Prosementi, Queen, Emiliana, Riviera vicentina, Banat vs, La Torre, Sabrina and Escorial) and the remaining 3 were used as standard (Elci, Bilensoy 80 and Basbag) and native ones.

When look at the data of climate, monthly average temperature value was 13.8-14.2 ^{0}C, total precipitation was 839.2-668 mm and relative humidity was 51.9-48.5% for 2020 and 2021. It has observed that the average temperature values for the years 2021 and 2022 are above the long-years average, while the precipitation amounts and relative humidity values are below the long-years averages.

Analysis of soil samples taken from 10 different points and 0-30 cm depth of the research location has carried out in "Bingöl University Faculty of Agriculture, Soil Science and Nutrition Department Laboratory". The soil structure of the research location was found to be sandy, clayey and loamy (clay rate 19.11%, silt rate 16.71% and sand rate 64.18%), pH level neutral (7.10), salt-free, less limy, organic matter and available phosphorus ratios low, potassium content sufficient determined.

2.2. Method

The field experiment has carried out in August 2019 following the soil preparation made in July. The research will be set up with 3 replications according to the randomized blocks trial pattern. In the experiment, parcel lengths were 5 m, the distance between rows was 20 cm and 6 rows were planted in each parcel. 3 kg of seed has be used per decare in planting. Fertilizer was given directly to the decare on the basis of pure substance before planting. Irrigation of the experiment has done by sprinkler irrigation.

The plant height (cm), the distance between the first bud until the soil surface was measured with a ruler. The stem thickness (cm) of the first plants that form flower bud has measured with a caliper between the second and third node in 10 plants. For determining the number of main stems, 10 plants have selected in each parcel. The stems emerging of the determined 10 plant roots have counted, the average number of stems was determined by taking the average per cultivar.

Green forage yield (kg da^{-1}) located 1 row further from the top of the parcel and 1 row from the bottom of the parcel, and 0.5 m from the edges has removed from the

parcel. The remaining area was harvested by cutting and the green forage yield obtained from each parcel was weighed and the values were obtained were converted to yield per decare. A sample of 0.5 kg of forage obtained from each parcel have randomly taken and dried in a drying chamber at 70 ^{0}C for 48 hours in drying chamber. Then it has been kept in drying chamber for 24 hours and then weighed so the dry herbage weight has been found then the obtained dry matter has been converted to yield per decare.

The data that have been obtained have been evaluated by variance analysis with the help of the JMP statistical package program (a software belonging to the SAS program), and the differences of the groups have been compared with the Tukey test.

3. RESULTS AND DISCUSSION

3.1. Plant Height (cm)

Two-year averages of plant heights of foreign origin alfalfa cultivars and groupings of these averages have given in Table 1. As seen in Table 1, the difference between the plant heights of alfalfa cultivars was significant in terms of years and cultivars (P≤0.01), in terms of year x cultivar interaction was determined to be insignificant. In terms of cultivars, the highest plant height cultivar is Emiliana (106.2 cm), it has seen that other cultivars except Basbag and Sabrina cultivars are in the same group statistically. The lowest plant height was determined in Basbag (87.6 cm) and Sabrina (90.8 cm) cultivars. In terms of years, the average plant height (100.9 cm) determined in 2021 higher than the average plant height determined in 2020 (94.4 cm).

Table 1. Plant heights of alfalfa cultivars (cm)

Cultivars Name	2020	2021	Mean
Banat vs	98.7^{ns}	99.3	99.0 abc**
Basbag	86.6	88.7	87.6 c
Bilensoy 80	96.7	103.3	100.0 abc
Diane	92.1	101.9	97.0 abc
Elci	93.8	106.2	100.0 abc
Emiliana	108.8	103.5	106.2 a
Escorial	87.4	98.6	93.0 abc
Ezzelina	97.4	109.8	103.6 ab
Iside	87.4	105.7	96.6 abc
La Torre	91.2	97.4	94.3 abc
Osjecka 99	90.8	97.4	94.1 abc
Prosementi	99.9	103.9	101.9 abc
Queen	93.5	102.3	97.9 abc
Riviera vicentina	104.7	100.7	102.7 ab
Sabrina	86.2	95.3	90.8 bc
Mean	94.4 B**	100.9 A	97.6

CV(%): 7.50%, **(P≤0.01), ns: none significant

When look at the previous studies on the plant height in alfalfa; it has been reported that it is detected between 79-100 cm in Bornova conditions [9], 57.70-79.40 cm in Northern Cyprus conditions [10], 74.8-86.8 cm in Izmir conditions [11], 85.10-93.20 cm in Tokat-Kazova conditions [12], 66.61-101.28 cm in Antalya conditions [13], 80.33-103.22 cm in Goller Region [14], 76.3-90 cm in Yozgat ecological conditions [15] and 59.3-109.3 cm in Bingöl conditions [16]. It is seen that the 87.6-106.2 cm alfalfa height obtained in this study is close and similar to the plant heights obtained in these studies.

3.2. Stem Number

Two-year averages of plant heights of foreign origin alfalfa cultivars and groupings of these averages have given in Table 2. As seen in Table 2, the difference between the stem number of alfalfa cultivars was determined to be insignificant in terms of year, cultivar and year x cultivar interaction. The average number of stems of the cultivars is between 14.9-18.3 and the average is 16.1 in the first year, between 12.3-17.9 and the average is 15.4 in the second year. As the average of two years, it changed between 13.8-18.1 and the average two years were obtained as 15.8.

Table 2. The stem number of alfalfa cultivar (number)

Cultivars	2020	2021	Mean
Banat vs	15.3^{ns}	16.4	15.8^{ns}
Basbag	17.2	16.0	16.6
Bilensoy 80	16.3	14.1	15.2
Diane	16.2	16.2	16.2
Elci	15.1	15.0	15.1
Emiliana	14.9	14.5	14.7
Escorial	16.7	17.7	17.2
Ezzelina	15.2	14.7	14.9
Isıde	16.8	14.2	15.5
La Torre	16.7	15.1	15.9
Osjecka 99	18.3	17.9	18.1
Prosementi	16.6	16.1	16.4
Queen	16.2	16.1	16.1
Riviera vicentina	15.2	12.3	13.8
Sabrina	15.2	15.3	15.3
Mean	**16.1^{ns}**	**15.4**	**15.8**

CV(%): 19.4%, ns: none significant

Regarding to previous studies in alfalfas stem number, Soya and Kavut [17] have determined between 12.1-12.4 in Bornova conditions, Kir ve Soya [11] have presented the between 11.3-18.5 in Izmir conditions, Mohammed [18] has found 10.6-25.8 in Ankara and Konya conditions, Demiroglu et al. [19] have found 11.3-11.9 in Bornova and Odemis conditions and Kavut et al. [7] have determined between 12.9-14.9 in Izmir conditions. In this study the average number of stems has obtained between 13.8-18.1 is similar to results that mentioned in above researches.

3.3. Stem Thickness (mm)

Two-year averages of stem thickness of foreign origin alfalfa cultivars and groupings of these averages have given in Table 3. As seen in Table 3, the difference between the stem thicknesses of alfalfa cultivars is significant in terms of year and cultivar (P≤0.01), in terms of year x cultivar interaction was determined to be insignificant.

Table 3. The stem thickness of alfalfa cultivars (mm)

Cultivars	2020	2021	Mean
Banat vs	2.76^{ns}	3.28	3.02 ab**
Basbag	1.98	2.52	2.25 c
Bilensoy 80	2.15	3.10	2.63 bc
Diane	2.55	3.08	2.82 abc
Elci	2.36	3.11	2.73 abc
Emiliana	3.34	3.28	3.31 a
Escorial	2.46	2.64	2.55 bc
Ezzelina	2.78	2.96	2.87 abc
Isıde	2.56	3.05	2.81 abc
La Torre	2.33	2.78	2.56 bc
Osjecka 99	2.60	3.53	3.06 ab
Prosementi	2.87	2.74	2.81 abc
Queen	2.67	2.74	2.70 abc
Riviera vicentina	3.13	3.14	3.13 ab
Sabrina	2.44	3.07	2.76 abc
Mean	2.60 B**	3.00 A	2.80

CV (%): 11.6%, **: P≤0.01, ns: none significant

In terms of cultivars, it has determined that the highest stem thickness was in Emiliana (3.31 mm), the lowest stem thickness was in Basbag (2.25 mm). Banat vs, Diane, Elci, Ezzelina, Iside, Osjecka 99, Queen, Riviera vicentina and Sabrina cultivars are also in the group with the highest value. In terms of years, it was determined that the 2.60 mm average stem thickness obtained in 2020 was statistically lower than the 3.00 mm average stem thickness obtained in 2021.

Regarding to previous studies on stem thickness in alfalfa; Seker [20] have found 2.78-2.89 mm in Erzurum ecological conditions, Soya and Kavut [17] have reported 2.78-2.90 mm in Bornova ecological conditions, Tongel and Ayan [21] reported that stem thickness varied between 2.93-3.27 mm on 19 alfalfa cultivars in Samsun ecological conditions, Dumlu et al. [22] reported that the stem thickness varies between 2.81-3.04 mm in Erzurum conditions. We found the stem thickness between 2.25-3.31 mm in this study that is similar to results that mentioned in above researches.

3.4. Green Forage Yield (kg da^{-1})

Two-year averages of forage yield of foreign origin alfalfa cultivars and groupings of these averages have given in Table 4. As seen in Table 4, the difference between the forage yields of alfalfa cultivars is significant in terms of year and cultivar (P≤0.05), in terms of year x cultivar interaction was determined to be insignificant. In terms of cultivars, it has seen that the highest forage yield cultivars was in Ezzelina cultivar (14069 kg). Banat vs, Bilensoy 80, Emiliana, Diane, Elci, Osjecka 99, Prosementi, Riviera vicentina, Iside and Queen cultivars are also in the highest value group. The lowest forage yield was determined in Basbag, Sabrina, La Torre and Escorial cultivars. In terms of years, it has seen that the average forage yield (11471 kg) in 2021 is higher than the forage yield (10565 kg) in 2020.

Table 4. The forage yield of alfalfa cultivars (kg da^{-1})

Cultivars Name	2020	2021	Mean
Banat vs	10150^{ns}	10337	10243 ab*
Basbag	10664	8748	9706 b
Bilensoy 80	10782	12014	11398 ab
Diane	11811	11673	11742 ab
Elci	10246	11977	11111 ab
Emiliana	10742	12052	11397 ab
Escorial	8761	10697	9729 b
Ezzelina	11878	16261	14069 a
Isıde	9033	11453	10243 ab
La Torre	9673	9574	9624 b
Osjecka 99	10373	11588	10981 ab
Prosementi	13187	11662	12424 ab
Queen	9972	12173	11072 ab
Riviera vicentina	11836	11563	11700 ab
Sabrina	9372	10298	9835 b
Mean	10565 B*	11471 A	11018

CV: 17.8%, *: P≤0.05, ns: none significant

The forage yield was obtained in the study is similar with forage yields of Kusvuran et al. [10] research that has obtained 10828 kg da^{-1} in Northern Cyprus ecological conditions. In addition, Gokalp et al. [23] have determined 11150-13905 kg da^{-1} in Tokat-Kazova conditions. However, the forage yield was obtained in the study higher than the Basbag et al. [24] results that is between 3672,13-6153,38 kg da^{-1} in irrigated conditions in Diyarbakir. Also Yılmaz et al. [25] have reported 1297-1771 kg da^{-1} in Kahramanmaras conditions. The yield obtained in alfalfa cultivation is largely related to the number of harvests. The number of harvests is higher in warm regions and less in cold regions. The difference in the number of harvests causes the forage yield obtained in alfalfa cultivation to be different. Therefore, different forage yields can obtained in different ecological regions.

3.5. Dry Matter Yield (kg da^{-1})

Two-year averages of dry matter yield of foreign origin alfalfa cultivars and groupings of these averages have given in Table 5. As seen in Table 5, the difference between the dry matter yields of alfalfa cultivars is significant only for cultivars (P≤0.05), in terms of year and year x cultivar interaction was determined to be insignificant. In terms of cultivars, it has seen that the highest dry matter yield has obtained from Ezzelina cultivar. Banat vs, Bilensoy 80, Emiliana, Diane, Elci, Osjecka 99, Prosementi, Riviera vicentina, Sabrina, Iside and Queen are also among the highest value

groups. The lowest dry matter yield was determined in Basbag, La Torre and Escorial cultivars.

Table 5. The dry matter yield of alfalfa cultivars (kg da^{-1})

Cultivars	2020	2021	Mean
Banat vs	3012^{ns}	3074	3043 ab *
Basbag	3076	2633	2855 b
Bilensoy 80	3180	3283	3232 ab
Diane	3327	3171	3249 ab
Elci	3143	3398	3270 ab
Emiliana	3194	3450	3322 ab
Escorial	2709	2974	2841 b
Ezzelina	3535	4376	3955 a
Iside	2954	3085	3020 ab
La Torre	3038	2854	2946 b
Osjecka 99	3260	3310	3285 ab
Prosementi	3857	3510	3684 ab
Queen	2913	3495	3204 ab
Riviera vicentina	3446	3501	3474 ab
Sabrina	3031	3063	3047 ab
Mean	**3178^{ns}**	**3279**	**3228**

CV: 15.1%, *: P≤0.05, ns: none significant

The dry matter yields have obtained in current study is similar to the dry matter yields in previous researches of alfalfa that have presented below. Altınok et al. [5] obtained 3.214 kg da^{-1} in Ankara conditions, Avci et al. [26] obtained 2094.0-2230.0 kg da^{-1} in Konya and Ankara conditions and Yüksel et al. [27] obtained 2845-3339 kg da^{-1} and 2032-2617 kg da^{-1} in Ankara and Isparta locations, respectively. However, the dry matter yields in the study have found to be higher than the dry matter yields of 1104.7-1333.5 kg da^{-1} in Erzurum ecological conditions [20], 2031-2710 kg da^{-1} in Odemis and Bornova conditions [7], 1143-2183 kg da^{-1} in the Goller [28] and 1122.7-1396.9 kg da^{-1} in Erzurum ecological conditions [22]. The dry matter yield has directly related to the forage yield obtained. In areas where forage yield is high, dry matter yield has generally also obtained higher.

4. CONCLUSIONS

The plant heights of alfalfa cultivars varied between 87.6-106.2 cm and the average was 97.6 cm, the number of stems varied between 13.8-18.1 and the average was 15.8, stem thickness varied between 2.25-3.31 mm and the average was 2.80 mm, the forage yield varied between 9706-14069 kg da^{-1} and the average was 11018 kg da^{-1}, the dry matter yield varied between 2841-3955 kg da^{-1} and the average was obtained as 3228 kg da^{-1}. Statistically, the highest plant height and stem thickness have obtained from Emiliana, while the highest forage yield and dry matter yield have obtained from Ezzelina. Emiliana and Ezzelina cultivars gave higher values than both standard and foreign cultivars. The number of stems of the cultivars did not differ statistically. In line with these parameters examined, it has concluded that Ezzelina and Emiliana cultivars showed superior characteristics in Bingöl province.

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