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# Investigations on Forage Yield, Yield Parameters of Oats Varieties and Lines Grown Under Irrigated Conditions in Konya

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**ABSTRACT :** *Oat is an important cereal as human food and animal feed. In this research, it was aimed to evaluate some oat (Avena sativa L.) genotypes (lines and cultivars) sown at the end of March for forage yield and forage quality parameters. Research was carried out in Konya irrigated conditions, in 2018 seasons with 12 oat genotypes [nine lines (BDY-1, BDY-2, BDY-3, BDY-4, BDY-5, BDY-6, BDY-7, BDY-8, BDY-9) and three were registered cultivars (Diriliş, Cheocota, Seydişehir)]. The trial was established according to the Randomized Blocks Experimental Design with three replications. Oats genotypes were harvested at milk to dough period. In research, the traits such as; days to heading, green forage yield, dry forage yield, plant height, the number of stems per square meter, the number of fertil stems per square meter, fertile cluster ratio, the number of node per stems, stem thickness, 10 stem weight, leaves weight, leaf stem ratio, cluster length, flag leaf length and the number of leaves per stems.*

**KEYWORDS:** oats, varieties, line, forage, yield,yield components

## INTRODUCTION

Oat is an important cereal plant grown as a cultivated plant and used in both human and animal nutrition. In recent years, the increasing importance of oats in human nutrition in the world and its use in industry has led to an increase in production areas. Besides being animal feed and human food; It has gained importance especially in recent years due to the increase in usage areas in the pharmaceutical and cosmetic industry (Çeri and Acar, 2019a). Our country, in Turkey, has a potential that cannot be underestimated in the world in terms of the number of animals. However, in terms of animal food production and consumption, this issue is known to be at a lower level compared to developed countries. In order to increase all kinds of animal production, inexpensive, always easily available and available feed sources are required. While the area of oat planted for green green forage in our country was 825.512, 803.644, 826.282, 825 890, 867.895, 1.063.555 and 2.142.574 decares in 2012, 2013, 2014, 2015, 2016, 2017 and 2018, respectively, the green forage production in the same years was respectively. 934.157, 1.088.168, 1.156.553, 1.180.294, 1.549.846, 1.755.323 and 2.843.686 tons (Çeri and Acar, 2019b)

Quality roughage production plays a key role in the development of the forage crops and livestock industry. In addition, feed and feeding costs, which cover a large part of 60-70%

during the production stage in the livestock industry, significantly affect the profitability of the enterprise. One of the quality roughage sources is forage plants found in field agriculture (Özkan and Şahin Demirbağ, 2016). In order to increase all kinds of animal production, inexpensive, always easily available and available feed sources are required for the producer. Of these sources, oats are an important alternative herb. Oat is a priority product as animal food in the world, and it is inevitable to increase its production in our country, considering the importance of oats in animal nutrition (Sayar, 2017).

In this research article; It was aimed to investigate the forage yield and some forage yield components of some oat varieties and lines in Konya ırrigated conditions.

## MATERIALS AND METHODS

The field study was conducted at the Bahri Dağdaş International Agricultural Research Institute (BDIARI) in Konya in irrigated conditions during the early spring growing season of 2018. The experimental design of this research was a randomized complete block design (RCBD) with factorial arrangement three replications of the selected 12 oat genotypes, which are nine lines and three cultivars (Table 1).

**Table 1.** Oat genotypes used in the experiment

| G.N. | Pedigree |
|---|---|
| BDY 1 | ND040492(ND970216/Souris)/FL0917F1(OA 1178-2 /FL03184-K9) |
| BDY 2 | FL0105-H3 TX97C1168/IA91462-45-6 |
| BDY 3 | BW 803/FL99078-H1 |
| BDY 4 | UFRGS 046054-2/MN06120 |
| BDY 5 | UFRGS 028153-2 (UFRGS 881971//PC68*5/STARTER F4)/FL0109 - H3 (P94327A2-2-2-3-3/LA989IBI-42 F4) |
| BDY 6 | UFRGS 046054-2/MN06120 |
| BDY 7 | FL0567-L1(UFRGS028152-1/FL0123-H2)/FL0905F1(UPF98H1600-2-1/FL03129- Ab3) |
| BDY 8 | NC03-2421 / LA09094,F1(UFRGS087212-1 / LA04004SBSB-61-B-S1) |
| BDY 9 | UPF97H300-2-12 / ND030349 |
| BDY 10 | DİRİLİŞ |
| BDY 11 | CHEOCOTA |
| BDY 12 | SEYDİŞEHİR |

BDY-1, BDY-2, BDY-3, BDY-4, BDY-5, BDY-6, BDY-7, BDY-8, BDY-9 lines are provided by Bahri Dagdas International Agricultural Research Institute (BDIARI). Diriliş, Cheocota, and Seydişehir varieties were also used as research materials.

Seydişehir oat variety, which released in 2004 by BDIARI, is a local variety and has favorable forage yield and quality traits. Diriliş oat variety, which released in 2017 by BDIARI, is a desirable oat variety for its grain and forage yield. Cheocota oat variety was released by Eskisehir Transitional Zone Agricultural Research Institute (ETRI) and selected for its high-quality traits.

In 2018, when the study was carried out, the average temperature was higher than the average for many years (Table 2). Although a total of 14.4 mm rainfall in April, there was a drought in early spring (Table 2). Table 2 below also shows the relative humidity rate, which averages 60,4% in the spring period in 2018.

During the research process, rainfall, which usually falls in April, is spread over May and the following months due to climate change. Thus, the total amount of precipitation in the spring period (March-June 2018) was 161.4 mm, while it has been a total of 126.8 mm for many years (Table 2).

**Table 2.**Temperature and rainfall averages of Konya for a long term (1950-2018) and spring (March, April, May, June) cultivation period

| Months | Temperature ($^0$C) | | Rainfall (mm) | | Relative Humidity (%) |
|---|---|---|---|---|---|
| | Long Term Average (1950-2018) | 2018 | Long Term Average (1950-2018) | 2018 | 2018 |
| **March** | 5,5 | 9,8 | 26,2 | 36 | 67,6 |
| **April** | 11,1 | 13,9 | 38,8 | 14,4 | 52,9 |
| **May** | 15,7 | 17,2 | 41,7 | 72,2 | 66,9 |
| **June** | 19,9 | 21,2 | 20,1 | 38,8 | 54,2 |
| **Average** | 13,05 | 15,53 | 31,7 | 40,35 | 60,4 |
| **Total** | 52,2 | 62,1 | 126,8 | 161,4 | 241,6 |

Soil samples of this experiment were collected from topsoil (0-30 cm depth) and analyzed for defining the physical and chemical properties of the field where the research was run. The results of the soil analysis illustrated that the area, where the experiment was set up, has a clay-loamy structure, and it contains medium (1.83%) organic matter rate. The soil in this area has high lime content (31.32%) and shows alkaline (pH: 8.30) reaction. The soil has a sufficient amount of phosphorus (9 kg/da), and it is rich in potassium (75.53 kg/da). Also, the soil analysis results highlight no salinity problem.

Oat seeds were sowed on 450 parcels/m2 in irrigated conditions on the 27th of March in 2018. The parcel dimensions of the experiment were 8.4 m2 (1.2x7 m) with six rows and 20 cm spaced apart from each row. The field experiment was irrigated in 3 stages; 1) during the plantation, 2) when having 2-5 siblings, 3) the beginning of stalk growth in 2-3 cm from the ground (Zadoks growth scale 30-31). Irrigation applications were applied after fertilization for six hours. In the experiment, 9 kg/da $P_2O_5$, 12 kg/da N fertilizer was applied. Weed was controlled by using a chemical (2.4-D Ester, 130 g/da).The period between milk and pulp death was highly recommended for the shaping of oats and other cereal grains by Staples (1989). For this reason, trial parcels were cut with a reaping-hook during the milk to dough the growing stage.Correlation coefficients among forage, grain yield, and other traits were analyzed by the statistics program JMP 11.

**Investigated Features**

**Number of days of clustering:** The date when 50% of the plants in the plot were clustered (Fowler, 2009).

**Green forage yield (kg / da):** In the study, the study of (Albayrak, 2003) was modified and used to determine the green forage yields. Oat genotypes were harvested during the milk and dough death period. The oat forage harvested from 1 m2 area was weighed and converted to decare and green forage yield was calculated.

**Dry Forage yield (kg / da):** After weighing the green forage harvested (harvested) from each parcel, 0.5 kg of green forage samples taken randomly will be placed on paper bags and dried in a drying cabinet at 70 $^oC$ for 48 hours (Ünal, 2011). The samples taken out of the drying cabinet were kept at room temperature for 24 hours and then weighed in an electronic scale with 0.05 g precision in order to determine the dry forage weight. Dry forage yields per decare were calculated as kg / da from the values obtained.

**Plant height(cm):** The average value obtained by measuring the distance between the soil level and the top of the main cluster in centimeter division meters without removing 10 plants randomly selected before harvest (shape) in each plot by modifying the study of the plant height (Balabanlı and Ekiz, 1996) in the study which is taken as the natural plant height.

**Number of stems per square meter (pieces):** The studies of (Tosun and Yurtman, 1973) were modified and used in our study to determine the number of stems per square meter. During the form period, stems in 1 m in 1 row were counted in each plot and the number of stems per square meter was found by multiplying by 5.

**The number of stems with clusters per square meter (pieces):** The study of Sobayoğlu (2017) was modified and used in our study to determine the number of clustered stems per square meter. In the form period, stems in 1 m in 1 row were counted and multiplied by 5 in each plot, and the number of clustered stems per $m^2$ was found.

**Cluster length (cm):** In the cluster of 10 plants determined randomly in each plot, the length from the lower node of the cluster to the top of the cluster, excluding the awns, was measured in cm (Yağbasanlar 1987).

**Cluster or Fertile stem ratio (%):** In determining the cluster stem ratio (the number of clusters per m2 x 100), the formula for stem number in / $m^2$ was used.

**The number of nodes in the stem (number):** In each parcel, the number of internodes of the plants above the ground level were counted.

**Stem thickness (mm):** 10 plants randomly selected before harvesting in each parcel were removed as rooted and the thickness of the main stem between the 2nd and 3rd node was measured with a 0.1 mm compartment caliper and the value obtained was taken as the average main stem thickness (Sayar, 2011).

**Stem thickness (mm):** 10 plants randomly selected before harvesting in each parcel were removed as rooted and the thickness of the main stem between the 2nd and 3rd node was measured with a 0.1 mm compartment caliper and the value obtained was taken as the average main stem thickness (Sayar, 2011).

**10 Leaf weight on the stem (g):** The leaves on the main stem of 10 plants taken from each plot were cut and separated from the bottom of the leaf sheath and weighed in grams (Yürür et al., 1981).

**Leaf / stem ratio (%):** 10 plants were randomly selected from each plot, leaves and stems were separated, weighed and determined (Bares et al., 1985).

**Flag leaf length (cm):** In the study, the study of (Bares et al., 1985) was modified and used to determine the flag leaf length. 10 plants were selected from each parcel, the length of the flag leaf was measured in cm and averaged.

**The number of leaves on the stem (pieces):** The leaves on the main stem of 10 plants taken from each plot were counted and expressed as averaged pieces (Yürür et al., 1981).
The findings obtained as a result of the study were subjected to variance analysis with the help of the JMP (11) statistical package program in accordance with the Trial Pattern of Random Blocks with three repetitions. According to the results of variance analysis, statistically significant factor averages were compared with the LSD test (Kalaycı, 2005).

## FİNDİNGS AND DİSCUSSİON

In our study, the number of days of clustering of oat genotypes used in our research, Green forage yield, Dry forage yield, Plant height, Stem number per square meter, Number of cluster stems per square meter, Cluster length, Number of cluster or fertile stems, Number of cluster or fertile stems, Number of nodes in the stem, Stem Thickness 10 Stem weight, 10 Stem leaf weight, Leaf / stem ratio, Flag leaf length and the average number of leaves on the stem are given in Table 1.

**Number of days of clustering:**

In the oat genotypes used in our study, the number of days of clustering was obtained between 68-85 days. According to this, the earliest lines among the lines were BDY-1 and BDY-3 (68 days); Cheocota has been 70 days. The latest lines among the lines were BDY-5 (78 days) and BDY-6 (78 days); The latest variety among the varieties was Seydişehir (85 days). In the oat genotypes used in our study, the number of days of clustering was obtained between 68-85 days. In studies on a similar feature, Gül et al. (1999) 116.2-129.5 days; Yağbasanlar et al. (1990) have determined values for 116-122 days. It was determined that the values we obtained in our study were lower. The fact that the number of days of clustering obtained by other researchers is different; It may have resulted from the genotypes they use, environmental conditions, applied cultural processes and planting time.

**Green forage yield (kg / da):**

The green forage yield of the oat genotypes used in the study was statistically significant at the level of 5% ($p < 0.05$).There were statistically different groups in the oat genotypes used in the study in terms of green forage yield. Accordingly, the first group (a) from the lines BDY-7 (3109 kg / da), while Seydişehir (3025 kg / da), one of the varieties in the same group, was formed and the last group was Diriliş (2342 kg / da). The lines and varieties considered in the experiment were listed between these two groups. Significant differences were determined in terms of green forage yield in oat genotypes used in the study; While the green forage yield of the oat genotypes used in the study varied between 2342-3109 kg / da, the average green forage yield was 2651 kg / da.

The green grass yield of 2651 kg / da obtained from our research was determined by Acar and Özkaynak (2000) at 149.18 kg / da and Nawaz et al. (2004) has been higher than the values of 1416 kg / da. On the other hand, the value of 2651 kg / da, which is our finding, is Lithourgidis et al. (2006) 's average yield is 3323 kg / da; For Avcı (2017), 5565 kg / da in winter works and 3739 kg / da in summer works; Kara (2017) was lower than the values of 3488.6 kg / da.

**Dry forage yield (kg/da):**

The dry forage yields of the oat genotypes used in the study were statistically significant at the level of 1% ($p < 0.01$).In the oat genotypes used in the study, statistically different groups were formed in terms of dry forage yield. Accordingly, BDY-4 (994 kg / da) from genotypes formed the first group (a) alone. In the genotypes, the last group (f) formed BDY-2 (614 kg / da). The lines and varieties considered in the experiment were listed between these two groups. While the hay yield of the oat genotypes used in the study varied between 614-994 kg / da, the average dry forage yield was 774 kg / da.

Acar and Özkaynak (2000), 122.31 kg / da from oats; Kara (2017), 576.14 kg / da; Caballero et al. (1995), the dry matter yield of oats 657 kg / ha; Carr et al. (2004), 291 kg / da of oats; Nawaz et al. (2004), 190 kg / da; Avcı (2017) determined that they obtained an average dry forage yield of 688.40 kg / da from summer cultivation. According to our research results, the hay yields we obtained were higher than the results of these researchers. On the other hand, the hay yield of 774 kg / da was found by Lithourgidis et al. (2006), (1162 kg / da) and Avcı (2017) were lower than the hay yield they obtained in winter planting (1262.93 kg / da).

The different hay yield values obtained by other researchers with the data we have obtained; may have resulted from the different genotypes they used, environmental conditions, applied cultural processes and planting time.

**Plant height (cm):**
The difference between varieties in terms of plant height of oat genotypes used in the study ($p < 0.01$) was found to be statistically significant. In the oat genotypes used in the study, statistically different groups were formed in terms of plant height. Accordingly, the first group (a) was formed from lines BDY-1 (108 cm) and BD-7 (108.7 cm.), While Cheocota (107.9 cm) entered the same group, and the last group was Diriliş (79.6 cm.). The lines and varieties considered in the experiment were listed between these two groups. Nawaz et al. (2004) also reported that they found that the plant height was significantly different for all varieties in their study. While the plant height of the oat genotypes used in our study varied between 79.6 cm.-108.7 cm., Average plant height was 97.6 cm. Acar (1995), the average plant height determined in their work 67.11 cm; Avcı (2017) determined the plant height in oat genotypes as 54.09 cm in summer planting in his study, and the plant height value (97.6 cm) we measured in our study was considerably higher than that of the study.

Gül et al. (1999), in his work between 79.98-103.60 cm; Erbaş (2012), in his study, found that the plant height between 66.0-109.2 cm in oat genotypes was compatible with the 70.9 cm-108.7 cm intervals we obtained in our study. In terms of plant height in the oat genotypes in his study, Avcı (2017) determined average values of 139.52 cm in winter cultivation and 108.78 cm measured by Kara (2017), which is higher than 97.6 cm that we found in our study.

Different plant height values obtained by other researchers; may have resulted from the different genotypes they used, environmental conditions, applied cultural processes and planting time.

**Number of stems per square meter (pieces):**

The difference between the varieties in terms of stem number per square meter was found to be statistically significant 1% ($p < 0.01$).In the oat genotypes used in the study, statistically different groups were formed in terms of the number of sap per square meter. Accordingly, lines BDY-2 (604.17 pieces / $m^2$), BDY-3 (586.67 pieces / $m^2$) and BDY-3 (605 pieces / $m^2$) lines were included in the second group (ab), while the lines were not included in the first group (a). Only Seydişehir variety (677.33 pcs / $m^2$) entered the first group (a) among the varieties. Among the varieties, the lowest value (465.83 pieces / $m^2$) was Diriliş. The average number of stems of the oat genotypes in the study was 533.46 per square meter and varied between 453.33-677.33.



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While it was observed that the number of 362 stems per square meter stated by Narlıoğlu (2016) is lower than our research (533.46 pieces / $m^2$); With the 430-532.5 pieces / $m^2$ range and the average 475 pieces / $m^2$ values obtained as a result of the studies of Sobayoğlu (2017) and Hışır, (2009) the values of the number of clusters of 502.00 - 665.25 pieces / $m^2$ in his study show a similarity with our research results.

As a result of their study, Peltonen-Sainio and Järvinen (1995) stated that the number of stems per square meter should be evaluated together with other characteristics, not alone.
Different researchers obtained the values of the number of stems per square meter; may have resulted from the different genotypes they used, environmental conditions, applied cultural processes and planting time.

**Panicle length (cm):**
The difference between the genotypes in terms of cluster length was found to be statistically significant 1% ($p < 0.01$).In the oat genotypes used in the study, statistically different groups were formed in terms of cluster length. Accordingly, the first group (a) from lines BDY-7 (22.70 cm) was formed, while Cheocota (22.72 cm), which was included in the same group from the varieties and got the highest value, formed the last group from the cultivars Diriliş (17.48 cm). The lines and varieties considered in the experiment were listed between these two groups. In the oat genotypes used in the study, while the cluster length varied between 17.48-22.72 cm, the average cluster length was 19.67 cm.

Hışır, (2009), in his study, the average cluster length of oat genotypes (30.60 cm): Yellow (2012), in YVD-1, the average cluster size in the 2009-2010 production period is 22.80 cm, and the average cluster size in the period is 24.21 ( cm), these values were found to be higher than the 19.67 cm value we determined in our study.Erbaş (2012) determined the cluster length (14.7-25.8 cm) in his study; Özgen (1993) in 23.3 cm; Nırmalakumarı et al. (2013) determined the cluster height as 15.01-33.23 cm. The values obtained by these researchers are closer and compatible with the values we obtained in our research.

Different cluster length values obtained by the researchers; may have resulted from the different genotypes they used, environmental conditions, applied cultural processes and planting time.



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**Number of fertile (cluster) stems (pieces / m$^2$):**

The difference between genotypes in terms of the number of fertile stalks per square meter was found to be statistically significant 1% (p <0.01).In our research, the lines included in the first group (a) BDY-3 line with 450 pieces / m$^2$ and the second group (ab) BDY-4 400,83 and BDY-1 line 385 lines / m$^2$. The BDY-5 line has a value of 133.33 pieces / m$^2$ to the last group.Among the varieties in our study, Diriliş got the highest value with 307.50 pieces / m$^2$, while the lowest value was found in Seydişehir variety with 190.83.

In our study, the number of fertile stalks varied between 133.33-450.83 pieces / m2; The average number of fertile stalks was 296.74 units / m$^2$.Naneli and Sakin (2017) found that the average number of fertile clusters per square meter was between 567.6 and 646.8 in their study; In his study, Maral (2009) determined that the average number of clusters per square meter of varieties varied between 334 clusters / m² and 506 clusters / m² in terms of the number of clusters per square meter.It was found that the values we detected were lower than the values of other researchers. Different fertile stem count values per square meter they obtain; The difference from the genotypes they use may be due to environmental conditions, applied cultural processes and planting time.

**Fertile (cluster) stem rate (%):**

The difference between genotypes in terms of fertile stem ratio was found to be statistically significant 1% (p <0.01).In our study, the fertile stem ratio varied between 28.22-80.57%; the average fertile stem rate was 56.10%. Among the lines included in our study, (a) BDY-1 and BDY-3 lines in the first group took place with the rates of 80.57 and 77.40%, respectively, while the second group (ab) BDY-4 line took place with 66.31%.

Öztürk (1999) determined the fertile stem rate of 75.7% in his study in wheat under irrigated conditions. Although this value is close to the upper value in our study, when we consider the average value, it is higher than 56.10%.

The values we determined are different from the values of the other researcher; The different purpose of the plant they used in the study may be due to environmental conditions, applied cultural processes and planting time.

**The number of nodes in the stems (pieces):**

The variation between genotypes in terms of the number of nodes in the stem was found statistically significant at the level of 1% (p <0.01).In our study, the number of k nodes in the stem varied between 3.73 and 4.77; It was determined that the average number of nodes was 4.15.Among the lines in our study, the highest node number values were obtained for BDY-7 (4.5 pieces) and BDY-6 4.33 (pieces). It was determined that BDY-3 line received the lowest number of nodes with 3.73. Among the varieties we used as standard in our study, the highest number of nodes was found in Cheocota variety with 4.77. This value is also the highest value of the genotypes used in the study in terms of the number of nodes. Erbaş (2012), in his study, the number of nodes in the main stem (2.0-4.8); Çalışkan and Koç (2019), in their study on local varieties, have 14 genotypes with 5 to 6 nodes on the main stem, 61 genotypes with 6 to 7 nodes, 46 genotypes with 7 to 8 nodes, 40 genotypes with 8 to 9 nodes. Reported that they identified 3 genotypes with more than 9 nodes. They found that the number of knuckles in the main stem of the standard varieties they used varied between 4.0 and 8.1, and their average was 5.8.

While the values obtained in Erbaş (2012) and the values we obtained in our research coincide; It was determined that the values obtained by Çalışkan and Koç (2012) are higher than the values we obtained in our study.
The values we determined are different from the values of the other researcher; It may have resulted from environmental conditions, applied cultural processes and planting time.

**Stem thickness (mm):**

The variation between genotypes in terms of stem thickness was found statistically significant at 1% (p <0.01) level.
In the oat genotypes used in the study, statistically different groups were formed in terms of stem thickness. Accordingly, the first group (ab) formed the lines BDY-5 (5.62 mm) and BDY-7 (5.33 mm). The last group (e) formed the BDY-3 line (3.68 mm) from the genotypes, and the lines and varieties considered in the experiment were listed between these two groups. In the oat genotypes used in the study, stem thickness varied between 3.68-5.62 mm, while the average stem thickness was 4.48 mm.

Erbaş (2012), one of the other researchers, determined the stem thicknesses in the range of 2.11-4.89 mm. Our study result was consistent with the data of this study. Similarly, our results coincide with the values between 4.3-6.1 mm, which is the average stem thickness of Narlıoğlu (2016) in his study on 16 oat genotypes.Ahmad et al. (2008) stated in their study that the stem thickness is important for the oat plant with the problem of lodging, as well as a very important feature in increasing the forage in oats to be used as forage plants.

**10 Stem weight (g):**
The genotypes used in the study were found to be statistically significant at the level of 1% (p <0.01) in terms of ten stem weight.In the oat genotypes used in the study, statistically different groups of ten stem weights were formed. Accordingly, only BDY-7 (133.46 g) line formed the first group (a) among the genotypes. The last group (e) formed BDY-3 line with other genotypes (68.527 g). The lines and varieties considered in the experiment were listed between these two groups. While ten stem weights in the oat genotypes used in the study varied between 68.52-133.46 g, the average ten stem weights were 94.28 g.

Çeri et al. (2018a) reported that they obtained the highest single stem weight 6.06 g (60.6 g for ten sttems) and the lowest single stem weight 5.25 g (52.5 g for ten stems) in their study on 31 oat lines in 2015. Values of ten stems in our study were found between 68.52-133.46 g, and higher values were obtained from the mentioned study.The difference between the ten stem weight values obtained by the other researcher with the data we have obtained; It may have resulted from different genotypes used, environmental conditions, applied cultural processes and planting time.

**Leaf weight in 10 stem (g):**
The genotypes used in the study were found to be statistically significant at the level of 1% (p <0.01) in terms of leaf weight in ten stems.In the oat genotypes used in the study, statistically different groups were formed in terms of leaf weights in ten stems. Accordingly, the first group (a) formed the lines BDY-7 (35.06 g) and BDY-5 (30.56 g).

The last group (d) formed the lines Diriliş (13.74 g) and BDY-1 (13.02 g). In the oat genotypes used in the study, leaf weights in ten stems varied between 13.02 g-35.06 g, while the average leaf weights in ten stems were 21.51 g.

**Leaf / stem ratio (%):**
The genotypes used in the study were found to be statistically significant at the level of 1% (p <0.01) in terms of leaf / stem ratio.In the oat genotypes used in the study, statistically different groups were formed in terms of leaf / stem ratios. Accordingly, the first group (a) was composed of Seydişehir variety alone. The last group (g) formed the BDY-1 line (0.14) from the genotypes. The lines and varieties considered in the experiment were listed between these two groups. While the leaf / stem ratio of the oat genotypes used in the study varied between 0.14-0.27, the average leaf / stem ratio was 0.23.

Choudhary (2016) carried out different fertilizer and irrigation practices in 2 forage oat varieties in their study during 2011-12 growing period. As a result of this study, they reported that they found the leaf / stem ratio, which is one of the characteristics, between 0.51-0.55. The fact that the value of 0.14-0.27 we obtained is different from the data obtained by this researcher may be due to the different genotypes used, environmental conditions, applied cultural processes, and the time of planting and forming.

**Flag leaf length (cm):**
The genotypes used in the study were found to be statistically significant at the level of 1% (p <0.01) in terms of flag leaf length.In the oat genotypes used in the study, different groups were formed in the statistical sense of the mean flag leaf length (cm). Accordingly, the first group (a) from genotypes formed BDY-7 (23.90 cm) line. The last group (e) formed the genotypes Diriliş (14.63 cm). The lines and varieties considered in the experiment were listed between these two groups. While flag leaf length varied between 14.63 cm.-23.90 cm in oat genotypes used in the study, the average flag leaf length was 18.87 cm.

Narlıoğlu (2016) found in his study that he found the flag leaf length between 18.5-25.3 cm. It was observed that the values we obtained in our study were consistent with these results.

Çalışkan, Koç (2019) reported that the flag leaf lengths varied between 18.4 and 45.8 cm and their average was 28.5 cm in their study on local varieties. Although the values we obtained in our study were not included in this range, it was determined that the range and averages they obtained in Çalışkan and Koç (2019) studies were higher than the average we obtained in our study.

Some researchers reported that the length of the flag leaves varies according to the cultivars (Semchenko and Zobel 2005) and some researchers according to the environmental conditions (Gautam et al., 2006; Dumlupınar et al., 2012).The difference in the values of flag leaf lengths obtained by the other researcher with the data we obtained; It may have resulted from different genotypes used, environmental conditions, applied cultural processes and planting time.

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**The number of leaves on the stem (pieces):**
The genotypes used in the study were found to be statistically significant at the level of 1% (p <0.01) in terms of the number of leaves on the stem.In the oat genotypes used in the study, statistically different groups were formed for the number of leaves on the stem. Accordingly, only Cheocota (4.87) varieties formed the first group (a) among the genotypes. The last group (e) formed BDY-3 line with the genotypes (4.07 pieces). In the oat genotypes used in the study, the number of leaves on the stem varied between 4.07-4.87, while the number of leaves on the average stem was 4.49.

Molla et al. (2018), in their study on mixing and harvesting periods with 2 oat lines at different rates, stated that the highest number of leaves was 5.03 and the least 4.38. While CI-8237 produced 5.21 leaves, CI-8251 reported that it produced 4.38 leaves. Alemu et al. (2007) reported the highest and lowest values of the number of leaves on the stem as 5.15 and 4.58, respectively. It has been observed that the number of leaves obtained as a result of our study is compatible with the values obtained from other studies.

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***Table 3.*** *Some of oat lines and varieties days to heading, green forage yield, dry forage yield, plant height, the number of stems per square meter, the number of fertil stems per square meter, fertile cluster ratio, the number of node per stems, stem thickness, 10 stem weight, leaves weight, leaf stem ratio, cluster length, flag leaf length and the number of leaves per stem average values*

| **Line / Varieties** | **HD (day)** | **GFY (kg da$^{-1}$)** | **DFY (kg da$^{-1}$)** | **PH (cm)** | **$M^2$ NS (number $m^{-2}$)** | **$M^2$ NFS (number $m^{-2}$)** | **FCR (%)** | **S NN (number)** | **ST (mm)** | **10S LW (gr)** | **10S LW (gr)** | **L $S^{-1}$ (%)** | **CL (cm)** | **FLL (cm)** | **S NL (number)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BDY-1** | 68 | 2746 abc | 707 cdef | 108 a | 477.50 c | 385.00 ab | 80.57 a | 3.83 fg | 4.31 cde | 95.7 cd | 13.02 d | 0.14 g | 20.65 b | 17.55 de | 4.17 de |
| **BDY-2** | 73 | 2419 bc | 614 f | 100 abcd | 604.17 ab | 357.50 abc | 59.19 bc | 4 ef | 3.89 de | 84.4 de | 21.86 bc | 0.26 ab | 18.10 de | 17.72 cde | 4.47 bcd |
| **BDY-3** | 68 | 2407 bc | 754 bde | 98 bde | 586.67 ab | 450.83 a | 77.40 a | 3.73 g | 3.68 e | 68.52 e | 13.36 d | 0.20 ef | 18.40 de | 17.43 de | 4.07 e |
| **BDY-4** | 72 | 2783 abc | 994 a | 100 abc | 605 ab | 400.83 ab | 66.31 ab | 4.2 cde | 4.26 cde | 77.63 de | 19.88 bc | 0.26 ab | 19.33 bcd | 19.27 bcd | 4.43 bcd |
| **BDY-5** | 78 | 2377 bc | 694 def | 91 de | 453.33 c | 133.33 f | 29.77 e | 4 ef | 5.62 ab | 124.15 ab | 30.56 a | 0.25 bc | 19.37 bcd | 22.68 ab | 4.23 de |
| **BDY-6** | 78 | 2421 bc | 683 def | 91 cde | 468.33 c | 286.67 cde | 60.90 bc | 4.33 bc | 4.54 bcd | 79.32 de | 19.08 c | 0.24 bc | 19.43 bcd | 19.73 bcd | 4.43 bcd |
| **BDY-7** | 76 | 3109 a | 846 bc | 109 a | 475 c | 287.50 cde | 59.79 bc | 4.5 b | 5.33 ab | 133.46 a | 35.06 a | 0.26 ab | 22.70 a | 23.90 a | 4.7 abc |
| **BDY-8** | 74 | 2900 ab | 881 ab | 95 bde | 541.67 bc | 217.50 def | 40.22 de | 4.27 bcd | 5.1 abc | 107.55 bc | 24.56 b | 0.23 cd | 18.80 cde | 19.22 bcd | 4.63 abc |
| **BDY-9** | 70 | 2438 bc | 788 bd | 102 ab | 509.17 bc | 277.50 cde | 54.81 bcd | 4.2 cde | 4.21 de | 89.31 cd | 21.5 bc | 0.24 bc | 18.63 cde | 16.45 de | 4.77 ab |
| **Diriliş** | 72 | 2342 c | 810 bd | 80 f | 465.83 c | 307.50 bcd | 65.59 abc | 3.93 fg | 4.35 cde | 78.44 de | 13.74 d | 0.18 f | 17.48 e | 14.63 e | 4.37 cd |
| **Cheocota** | 70 | 2846 abc | 887 ab | 108 a | 537.50 bc | 270.83 cde | 50.46 cd | 4.77 a | 4.55 bcd | 108.49 bc | 22.32 bc | 0.21 de | 22.72 a | 21.47 abc | 4.87 a |
| **Seydişehir** | 85 | 3025 a | 627ef | 90 e | 677.33 a | 190.83 ef | 28.22 e | 4.07 def | 3.94 de | 84.45 de | 23.23 bc | 0.27 a | 20.28 bc | 16.38 de | 4.73 b |
| **Ortalama** | 74 | 2651 | 774 | 97.6 | 533.46 | 296.74 | 56.10 | 4.15 | 4.48 | 94.28 | 21.51 | 0.23 | 19.67 | 18.87 | 4.49 |
| **DK $_{(\%)}$** | | 12 | 139 | 5.82 | 10.7 | 19.50 | 15.96 | 3.8 | 11.26 | 12 | 13.20 | 6.77 | 5.03 | 12.08 | 4.62 |
| **AÖF$_{(0.05)}$** | | 544 | 11 | 9.63 | 92.29 | 98.02 | 15.16 | 0.27 | 0.85 | 19.53 | 4.81 | 0.03 | 1.67 | 3.86 | 0.35 |
| | - | * | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |

**(*);** P< 0.05 ; (**); P< 0.01

**HD:** days to heading; **GFY:** green forage yield; **DFY**: dry forage yield; **PH:** plant height; **$M^2$ NS:** the number of stems per square meter; **$M^2$ NFS:** the number of fertil stems per square meter; **FCR:** fertile cluster ratio; **S NN:** the number of node per stems; **ST:** stem thickness; **10 SW:** 10 stem weight; **10S LW:** leaves weight; , **10S L/S:** leaf stem ratio; **CL:** cluster length; **FLL:** flag leaf length; **S NL:** the number of leaves per stems

## RESULTS

In this study, which was carried out in order to determine the oat genotypes that can help to close our early spring feed deficit and reduce the pressure on pastures due to the feed deficit, the lines BDY-7, BDY-8 lines were considered promising as weed-purpose oats. Among the varieties, it has been determined that the Seydişehir oat variety stands out in terms of grass yield.

In order to close the quality roughage deficit for our country, it is necessary to increase the field and yield of fodder crops in field agriculture, and it is one of the ways that one-year crops should be alternated as the second crop for the production of roughage in irrigated areas (Acar, 1995a).

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