jotaf Journal of Tekirdag Agricultural Faculty
Tekirdağ Ziraat Fakültesi Dergisi

Ocak/January 2019, 16(1)
Başvuru/Received: 01/02/18
Kabul/Accepted: 22/02/18
DOI: 10.33462/jotaf.516865

http://dergipark.gov.tr/jotaf
http://jotaf.nku.edu.tr/

RESEARCH ARTICLE **ARAŞTIRMA MAKALESİ**

Determination of Silage Yield and Quality Characteristics of Some Maize *(Zea mays L.)* Varieties

Bazı Mısır *(Zea mays L.)* Çeşitlerinin Silajlık Verim ve Kalite Özelliklerinin Belirlenmesi

Fatih ÖNER[1*] , Adem GÜNEŞ[2]

Abstract

This research was to determine in 2015 vegetation period in Ordu. In research, 13 maize varieties was used as experimental materials. There search was done 3 times according to randomized block test pattern. In research, plant height changed between 309.93-365.20 cm, ear height changed between 99.80-150.63 cm, stem diameter changed between 23.44-27.84 mm, leaf count changed between 11.67-13.63, sowing to silking time changed between 55-65.33 days, anthesis to silking time changed between 59-67.33 days, stover yield changed between 4525.17-5984.28 kg/da, core yield changed between 2166.17-3569.57 kg/da, leaf/stem rate changed between 35.86-53.85 %, core/plant rate changed between 32.10-41.10 %, forage yield changed between 6736.33-9476.72 kg/da, dry matter yield rate changed between 1758.41-2153.43 kg/da, ADF rate changed between 25.61-30.80 %, NDF rate changed between 50.57-57.43 %, crude protein rate changed between 7.63-9.32 %. The highest green herb yield was obtained from Everest, TK 6063, OSSK 602, Sagunto, Cadız, Hido and Carella varieties.

Keywords: Quality, Silage Maize, Yield

Öz

Bu araştırma 2015 yılında Ordu'da yürütülmüştür. Araştırmada 13 mısır çeşidi materyal olarak kullanılmıştır. Araştırma tesadüf blokları deneme desenine göre 3 tekerrürlü olarak yapılmıştır. Araştırmada bitki boyu 309.93-365.20 cm, ilk koçan yüksekliği 99.80-150.63 cm, sap çapı 23.44-27.84 mm, yaprak sayısı 11.67-13.63 adet, tepe püskülü gösterme süresi 55-65 gün, koçan püskülü gösterme süresi 59-67 gün, stover verimi 4525.17-5984.28 kg/da, koçan verimi 2166.17-3569.57 kg/da, yaprak/sap oranı % 35.86-53.85, koçan/bitki oranı % 32.10-41.10, yeşil ot verimi 6736.33-9476.72 kg/da, kuru madde verimi 1758.41-2153.43 kg/da, ADF oranı % 25.61-30.80, NDF oranı % 50.57-57.43, ham protein oranı % 7.63-9.32 arasında değişmiştir. En yüksek yeşil ot verimi Everest, TK 6063, OSSK 602, Sagunto, Cadız, Hido ve Carella çeşitlerinden elde edilmiştir.

Anahtar Kelimeler: Kalite, Silajlık Mısır, Verim

[1]***Corresponding Author:** Fatih Öner, Ordu Üniversitesi, Ziraat Fakültesi, Tarla Bitkileri Bölümü, Ordu. E-mail: fatihoner38@gmail.com, OrcID: 0000-0002-6264-3752
[2]Adem Güneş, Doğu Akdeniz Geçit Kuşağı Tarımsal Araştırma Enstitüsü, Kahramanmaraş. E-mail: ademgunes27@hotmail.com.

Citation: Öner, F., Güneş, A. Bazı mısır (*Zea mays L.*) çeşitlerinin silajlık verim ve kalite özelliklerinin belirlenmesi. *Tekirdağ Ziraat Fakültesi Dergisi,* 16(1), 42-50.

Maize or corn (*Zea mays L.*) commonly grown across all continents of the world ranks second in the world, following wheat, regarding the production area and ranks first regarding production quantity due to its high yield (Anonim, 2016a). In Turkey, maize ranks third following wheat and barley regarding cultivation area and production (Anonim, 2017).

In Turkey, according to the Turkish Statistical Institute (TurkStat) data, grain maize had 6.4 million tons of production in 680,019 hectares of cultivation area and yield of 942 kg/da. Silage maize had 20.14 million tons of production in 413,826 hectares of cultivation area and yield of 4868 kg/da in 2016. In the province Ordu, according to the TurkStat data, grain maize had 6089 tons of production in 5610 hectares of area and a yield of 109 kg/da in 2016. Silage maize had 7591 tons of production in 283 hectares of area and yield of 2678 kg/da in 2016 (Anonim, 2017).

Maize uses solar energy best and produces the highest yield among hot and cool climate cereals and the highest yield of dry matter per unit area (Kırtok, 1998). The use of maize in the industry has also been gradually increasing compared to other grains. The reasons include easy cultivation, harvesting, transportation, and storage as well as higher yield per unit area. In addition to being industrial raw material, maize is an important crop used in human and animal nutrition (Yalçın, 1997; Topuz, 2005).

Maize is the primary plant grown in the world for silage production. Maize (*Zea mays L.*) is among the most important forages. Maize is also among the most preferred plants for silage in Turkey and the world due to its high energy yield, suitability for mechanized agriculture from cultivation to harvesting, ease of storage and use, low loss rate, high dry matter content, high digesting rate, utilization as high-quality and delicious silage, high yield per unit area, availability of seeds, and storability in silos without any additives (Açıkgöz et al., 2002).

With the development of new varieties of silage maize, there has been a change in the understanding that high-quality and efficient grain maize varieties can also be varieties of high-quality silage maize and selection criteria and cultivation techniques have been reevaluated for silage maize (Ma et al., 2006). Therefore, in silage maize breeding, silage-specific soft-grain varieties with low NDF, high digestibility content, and slowly-declining kernel moisture are preferred rather than high-grain and strong-bodied varieties with rapidly-declining kernel moisture (Dwyer et al., 1998).

This research set out to determine silage yield and quality characteristics of some maize varieties to identify varieties that can be suggested for cultivation in the ecological conditions of Ordu. Thus, this research contributes to developing production and yield potential.

Materials and Methods

The research used 13 hybrid maize varieties obtained from seed companies as experimental material. The maize varieties were OSSK 596, OSSK 644, OSSK 602, TK 6063, Carella, Hido, SY Reserve, Everest, SY Inove, Calcio, Cadiz, Sagunto, and Tavascan.

The research was carried out in a farmer›s land in Ordu from May to August 2015 vegetation period. The trial site is located at 40°57›37.96» N latitude and 37°56›23.64» E longitude at an altitude of 9 meters.

The average temperature was 21.83 °C, the total precipitation 194.7 mm, the average sunshine hours per month 599.8 hours, and the average humidity per month 71.75%.

The soil properties are as follows: clayey, ph7.89, 2.15% of organic matter, 4.47 kg/da of phosphorus, and 77.7 kg/da of potassium.

The trial was based on a randomized block experimental design with three replications. Seeding was carried out on May 13th, 2015 on plots of 14 m² with an inter-row spacing of 70 cm, and intra-row spacing of 20 cm, and a depth of 5 to 6 cm. A mix of 20 kg nitrogen, 10 kg potassium, and 10 kg phosphorus per decare was used for fertilization (Güçdemir, 2006; Anonim, 2010).

After an edge effect of 30 cm and one row from each plot were excluded, 10 crops were randomly selected from each plot. The data were analyzed using SAS-JMP 11.0 statistical software. The Least Significant Difference (LSD) test was run to measure significant differences between means.

Results and Discussion

Plant Height (cm)

The difference in the plant height of the varieties was statistically significant ($p \leq 0.01$).

The smallest plant height was observed in the Hido variety with 309.94 cm and the greatest plant height in OSSK 644 with 365.20 cm. The mean plant height of the varieties was 326.94 cm (Table 1).

Table 1. Values of corn varieties taken for experiment were belong to plant height (PH), firs cob height (FCH), stem diameter (SD), number of leaf per plant (NLPP), sowing to silking (SS) and anthesis to silking interval (ASI).

Varieties	BB**	İKY**	SÇ	YS**	TPGS**	KPGS**
TK 6063	332.30 b	133.53 bc	25.74	13.17 a	58.00 efg	60.00 ef
Tavascan	323.57 bcd	112.57 f	25.24	13.43 a	59.00 def	61.00 def
SY Inove	337.40 b	130.27 cd	25.69	12.37 c	59.00 def	61.00 def
Sagunto	330.07 bc	118.13 ef	27.84	**13.63 a**	64.33 ab	66.33 ab
SY Reserve	330.77 bc	**99.800 g**	23.65	12.20 cd	56.00 fg	60.00 ef
OSSK 644	**365.20 a**	**150.63 a**	24.13	13.13 ab	59.00 def	61.00 def
OSSK 602	332.67 b	143.70 ab	25.96	**11.67 d**	**55.00 g**	**59.00 f**
OSSK 596	334.50 b	118.20 ef	25.83	12.53 bc	61.00 cde	63.00 cde
Hido	309.93 d	134.07 bc	23.44	13.43 a	**65.33 a**	**67.33 a**
Everest	**308.47 d**	125.47 cde	24.65	13.50 a	64.00 abc	66.00 abc
Carella	312.27 cd	113.90 ef	24.34	13.43 a	63.00 abc	65.00 abc
Calcio	322.27 bcd	120.33 def	24.97	13.13 ab	63.67 abc	65.67 abc
Cadız	310.87 d	111.50 f	26.26	13.03 ab	62.00 bcd	64.00 bcd
General Average	326.94	124.00	25.21	12.97	60.71	63.03
% VK	3.37	5.57	5.68	2.85	2.95	2.84

*Significant at *($P \leq 0.05$), **($P \leq 0.01$)

The results on the plant height are above those reported to be 257-291 cm in Bayram (2010), 254-293.33 cm in Küçük (2011), 193.3-230 cm in Moralar (2011), 210-260 cm in Martin et al. (2012) , 203.86-301.67 cm in Olgun et al. (2012), and 286.7-315.6 cm in Han (2016). However, they are consistent with 298-341 cm in Ergül (2008), 301-330 cm in Öner et al. (2011a), and 280-324 cm in Özata et al. (2012).

Ear Height (cm)

The difference in the ear height of the varieties was also statistically significant ($p \leq 0.01$). While the smallest ear height was obtained from SY Reserve with 99.80 cm and the greatest ear height from OSSK 644 with 150.63. The difference between OSK 644 and OSK 602 was statistically insignificant. The mean ear height of the varieties was 124.00 cm (Table 1).

The results on the ear height are above those reported to be 106.8-123.6 cm in Aydoğan (2010) and 85-126.6 cm in Moralar (2011) but below 119.7-177.7 cm in Kabakcı (2014). However, they are consistent with 100-140 cm in Martin et al. (2012), 92-135 cm in Öner et al. (2011b), and 110-153.3 cm in Han (2016).

Ear height is an important criterion for maize silage since it affects plant resistance to laying down.

Stem Diameter (mm)

The difference in the stem diameter of the varieties was statistically insignificant. The results on the stem diameter values are consistent with those reported to be 20.31-26.46 mm in Bayram (2010), 19-27 mm in Martin et al. (2012), 24.3-27.3 mm in Karaalp (2015), and 22.3-26.4 mm in Han (2016), while they are below 30.3-32.6 mm in Moralar (2011). The mean stem diameter of the varieties was 25.21 mm.

The stem diameter affects plant weight, namely forage yield in a directly proportional manner but silage quality in an inversely proportional manner.

Leaf Count (pieces)

The difference in the leaf count of the varieties was statistically significant ($p \leq 0.01$). The lowest leaf count was observed in OSSK 602 with 11.67 pieces; its difference with SY Reserve was statistically insignificant. The highest leaf count was observed in Sagunto with 13.63 pieces; its difference with the varieties Everest, Carella,

Hido, Tavascan, TK 6063, Calcio, OSSK 644, and Cadız was insignificant statistically. The mean leaf count of the varieties was 12.97 (Table 1).

The results on the leaf count are above those reported to be 8.73-10.97 pieces in Akbay (2012) and 9.8-11.6 pieces in Kabakcı (2014) but below 15.33-17.33 pieces in Moralar (2011) and 12.13-15.77 pieces in Kirendibi (2015). However, they are consistent with 12.33-14.68 pieces in Balmuk (2012) and 11.5-14.25 pieces in Aykanat (2015).

Leaves affect yield in silage maize. Leaves and stem are involved in photosynthesis. Leaves also contribute to the production of nutrients and the removal of excess water from plants through evaporation (Emeklier, 2012).

Sowing to Silking Period

There was a statistically significant ($p \leq 0.01$) difference between the varieties concerning the sowing to silking period. The shortest sowing to silking period was observed in OSSK 602 with 55.00 days; its difference with SY Reserve and TK 6063 statistically insignificant. The longest sowing to silking period was observed in Hido with 65.33 days. The mean sowing to silking period of the varieties was 60.71 days.

The results on the sowing to silking period are above those reported to be 47.2-56.5 days in Eralp (2007) but below 71-74 days in Öner et al. (2011b), 73.67-91.33 days in Akbay (2012), and 64.7-76.7 days in Kabakcı (2014). However, they are consistent with 53-63 days in Öner et al. (2011a) and 60.67-65.67 days in Kirendibi (2015).

Maize plants continue to grow height until silk emergence. When the balance of the sowing to silking period and the anthesis to silking interval is disturbed, it affects corp yield (Emeklier, 2012).

Anthesis to Silking Interval

There was a statistically significant ($p \leq 0.01$) difference between the varieties concerning the anthesis to silking interval. The shortest anthesis to silking interval was observed in OSSK 602 with 59.00 days; its difference with SY Reserve, Tavascan, SY Inove, OSSK 644, and TK 6063 was statistically insignificant. The longest anthesis to silking interval was observed in Hido with 67.33 days; its difference with Sagunto, Everest, Calcio, and Carella was statistically insignificant. The mean anthesis to silking interval was 63.03 days (Table 1).

The results on the anthesis to silking interval are above those reported to be 51.3-61.2 days in Eralp (2007) but below 73-77 days in Öner et al. (2011b) and 65.7-75.7 days in Kabakcı (2014). However, they are consistent with 65.67-71.67 days in Kirendibi (2015).

Stover Yield (Leaf+Stem)

The difference in the stover yield of the varieties was statistically significant ($p \leq 0.01$). The lowest stover yield was obtained from OSSK 644 with 4525.17 kg/da, while the highest stover yield was from TK 6063 with 598.428 kg/da. The mean stover yield of the varieties was 5189.21 kg/da (Table 2).

Table 2. Values of corn varieties taken for experiment were belong to stover yield (SY), corncob yield(CY), leaf / stem ratio (L/S), cob/plant ratio (C/P) and forage yield (FY).

Varieties	SV**	KV**	Y/S**	K/B**	YOV**
TK 6063	**5984,28 a**	3051,06 bcd	40,84 de	34,05 de	9035,34 ab
Tavascan	4930,12 bc	2868,94 cde	46,95 bc	36,69 bcd	7799,06 bcde
SY Inove	4643,01 c	2500,41 ef	41,36 cde	35,06 cde	7143,43 de
Sagunto	5896,44 a	3027,49 bcd	46,06 bcd	33,95 de	8923,93 ab
SY Reserve	4583,02 c	3198,90 abc	46,83 bc	**41,10 a**	7781,92 bcde
OSSK 644	**4525,17 c**	2603,26 def	40,91 de	36,52 bcd	7128,43 de
OSSK 602	5860,01 ab	3066,06 bcd	**35,86 e**	34,42 de	8926,07 ab
OSSK 596	4632,30 c	2802,52 cde	39,61 e	37,83 bc	7434,82 cde
Hido	5159,38 abc	3353,17 ab	51,58 ab	39,39 ab	8512,55 abc
Everest	5907,15 a	**3569,57 a**	**53,85 a**	37,66 bc	**9476,72 a**
Carella	5075,82 abc	3138,91 abc	48,81 ab	38,24 abc	8214,73 abcd
Calcio	4570,17 c	**2166,17 f**	48,88 ab	**32,1 e**	**6736,33 e**
Cadız	5692,89 ab	2963,22 bcde	39,59 e	34,18 de	8656,10 abc
General Average	5189.21	2946.90	44.70	36.24	8136.11

% VK	10.84	9.36	7.44	5.29	9.55

*Significant at *(P≤ 0.05), **(P≤ 0.01)

The results on the stover yield are above those reported to be 916.66-1601.19 kg/da in Balmuk (2012), 358.67-1017.87 kg/da in Akbay (2012), and 992.78-1352.78 kg/da in Kirendibi (2015).

Core Yield (kg/da)

The difference in the core yield of the varieties was statistically significant (p≤ 0.01).

The lowest core yield was obtained from Calcio with 2166.17 kg/da and the highest core yield from Everest with 3569.57 kg/da. The mean core yield of the varieties was 2946,90 kg/da.

The results on the core yield are above those reported to be 916.70-2452.38 kg/da in Balmuk (2012) and 1507.78-2000 kg/da in Kirendibi (2015) but 1595.23-6107.13 kg/da in Akbay (2012).

Core yield is of great importance for silage quality. 50% of green ear yield and 70% of nutrients are obtained from cores (Açıkgöz, 1991).

Leaf:Stem Ratio (%)

The difference between varieties was statistically significant concerning the leaf:stem ratio (p≤ 0.01). The variation in the leaf:stem ratio was within the range of 35.86 to 53.85%. The mean leaf:stem ratio of the varieties was 44.70%.

The results on the leaf:stem ratio are above those reported to be 26-43% in Öner et al. (2011a) but consistent with 41.3-52.3% in Erdal et al. (2009).

The quality of forage depends on the high volume of the leaf:stem ratio, protein concentration, and digestible nutrients but on the low volume of lignin and fiber (Heath et al., 1985). What is desired in silage maize varieties is high yield, high leaf count, and high core rate but low stem rate.

Core:Plant Ratio (%)

The difference between varieties was statistically significant (p≤ 0.01) concerning the core:plant ratio. The lowest core:plant ratio was obtained from Calcio with 32.10%. The highest core:plant ratio was from SY reserve with 41.10%. The mean core:plant ratio of the varieties was 36.24%.

The results on the core:plant ratio are above those reported to be 28.6-38.2% in Ergül (2008) and 23.84-32.48% in Küçük (2011) but below 44.26-58.05% in Aydoğan (2010), 39.51-59.69% in Olgun et al. (2012), and 41.23-47.66% in Kabakcı (2014). However, they are consistent with 33-41% in Öner et al. (2011a), 30-48% in Özata et al. (2012), and 28.1-43% in Aşar (2014).

The highest quality silage is obtained from materials with 25-30% or even more dry matter. For this reason, the grain content of silage is very important and it is desired that grain produces at least 25% of the harvested material (Heath et al., 1985).

Forage Yield (kg/da)

The difference in the forage yield of the varieties was statistically significant (p≤ 0.01). The lowest forage yield was obtained from Calcio with 6736.33 kg/da and the highest forage yield from Everest with 9476.72 kg/da. The mean forage yield of the varieties was 8136.11kg/da.

The results on the forage yield are above those reported to be 3190-7050 kg/da in Martin et al. (2012), 4673.7-8753.7 kg/da in Kabakcı (2014), 2020-2330 kg/da in Safdarian et al. (2014), and 4693-6029 kg/da in Anonim (2015) but below 9290-11356 kg/da in Aydoğan (2010) and 6698.81-13487.14 kg/da in Olgun et al. (2012). However, they are consistent with 6795-10348 kg/da in Ergül (2008) and 7270-8441 kg/da in Han (2016).

Dry Matter Yield (kg/da)

The difference in the dry matter yield of the varieties was statistically insignificant (Table 3).

Table 3. Valuesof corn varieties taken for experiment were belong to dry matter production (DMP), ADF (%), NDF (%) and crude protein yield (CPY).

Varieties	KMV	ADF*	NDF*	HPO*
TK 6063	2098.53	**30,8 a**	57,14 a	8,1 cd
Tavascan	1989.07	28,43 abcd	52,25 bcd	**7,63 d**
SY Inove	1928.92	30,75 ab	55,73 ab	7,74 d
Sagunto	2055.95	28,12 abcd	54,21 abcd	9,23 ab
SY Reserve	2098.65	**25,61 d**	**50,57 d**	8,48 abcd
OSSK 644	1867.12	27,14 cd	51,95 bcd	8,38 abcd
OSSK 602	2120.28	27,87 bcd	52,87 bcd	8,44 abcd
OSSK 596	2004.52	26,52 cd	51,11 cd	8,34 bcd
Hido	1968.94	28,78 abc	54,81 abc	8,96 abc
Everest	**2153.43**	26,91 cd	52,41 bcd	**9,32 a**
Carella	2008.83	27,07 cd	52,42 bcd	9,03 abc
Calcio	**1758.41**	30,49 ab	**57,43 a**	7,91 d
Cadız	1932.76	29,28 abc	55,58 ab	9,09 ab
General Average	1998.87	28.29	53.73	8.51
% VK	7.99	6.13	4.28	6.69

*Significant at *(P≤ 0.05), **(P≤ 0.01)

The results on the dry matter yield are above those reported to be 1243.72-1725.88 kg/da in Balmuk (2012), 1867.7-1105 kg/da in Özata et al. (2012), 733.94-1697.70 kg/da in Akbay (2012), and 469.5-2001.5 kg/da in Ferreira, (2015) but below 2402-3242 kg/da in Aydoğan (2010) and 1826.67-4100.33 kg/da in Olgun et al. (2012). However, they are consistent with 1374.71-2152.67 kg/da in Küçük (2011), 1606.6-1895.8 kg/da in Aşar (2014), and 1527-2320 kg/da in Ferreira et al. (2014).

ADF (%)

The difference between varieties was statistically significant concerning ADF rate (p≤ 0.05). ADF rate varied from 25.61 to 30.80%. The mean ADF rate of the varieties was 28.29%.

The results on the ADF rate are consistent with those reported to be 27.3-30.8% in Ferreira et al. (2014) but below 28.67-40.92% in Bayram (2010), 31-41% in Öner et al. (2011a), 24.1-40.9% in Özata et al. (2012), 22.7-44.0% in Martin et al.(2012), 27-33% in Safdarian et al .(2014), and 32.9%-34.8% in Karaalp (2015).

ADF is composed of cellulose and lignin and indicative of the digestibility of nutrients. The digestibility of cellulose varies; however, a high amount of lignin has a negative effect on the digestibility of cellulose. The lower ADF rate is, the greater digestibility is. ADF rate is expected to be low in forages (Anonim, 2016b).

Considering that the ADF rates were lower than 31%, all maize varieties are classified as top quality.

NDF (%)

The difference between varieties was statistically significant (p≤ 0.05) concerning NDF rate. The lowest NDF rate was observed in SY Reserve with 50.57% and the highest NDF rate in Calcio with 57.43%. The mean NDF rate of the varieties was 53.73%.

The results on the NDF rate are above those reported to be 46.3-47% in Karaalp (2015), 43.7-47.5% in Row et al. (2015), and 33.89-43.94% in Anonim (2015) but below those reported be 48.0-65.8% in Martin et al. (2012), 57.50-73.85% in Balmuk (2012), and 52.1-59% in Safdarian et al.(2014). However, they are consistent with 49-60% in Öner et al. (2011a), 47.5-58.9% in Özata et al. (2012), and 41.8-58.8% in Ferreira (2015).

NDF represents all nutrients that form the digestible and indigestible cell wall (structural carbohydrates). A low NDF rate is desired (Anonim, 2016b).

The NDF rate of OSSK 602, Carella, Everest, Tavascan, OSSK 644, OSSK 596, and SY Reserve varied from 47 to 53%, indicating a good quality; the remaining varieties demonstrated a medium quality.

Crude Protein Ratio (%)

The difference between varieties was statistically significant ($p \leq 0.05$) concerning crude protein content. The lowest crude protein content was observed in Tavascan with 7.63% and the highest crude protein content in Everest with 9.32%. The mean crude protein value of the varieties was 8.51%.

The results on the crude protein content are above those reported to be 5.13-5.93% in Aydoğan (2010), 5.2-6.5% in Aşar (2014), 4.2-7.2% in Safdarian et al. (2014), 6.94-7.93% in Anonim (2015), and 6.5-8.1% in Han (2016) but below 6.72-11.26% in Kirendibi (2015), 6.7-11.5% in Ferreira (2015), and 10.4-10.9% in Row et al. (2015). However, they are consistent with 5.11-11.16% in Balmuk (2012), 5.2-9.06% in Özata et al. (2012), 6.3-10.7% in Martin et al. (2012), 7.7-8.8% in Ferreira et al. (2014), and 7.7-8.8% in Karaalp (2015).

Protein ratio is an important quality criterion in silage maize; thus, high protein content is desired.

The crude protein ratio of Calcio, SY Inove, and Tavascan was lower than 8%, indicating a poor quality while the remaining varieties demonstrated a low quality.

Conclusion

The plant height varied from 308.47 to 365.20 cm. While the smallest plant height was observed in Everest with 308.47 cm, the greatest plant height was in OSSK 644 with 365.20 cm. The greatest ear height was observed in OSSK 644 with 150.63 cm and the smallest ear height in SY Reserve with 99.80 cm. The Sagunto variety had the largest stem diameter with 27.84 mm, while Hido had the smallest stem diameter with 23.44 mm.

The leaf count varied from 11.67 to 13.63. Sagunto had the highest leaf count with 13.63 pieces. Considering the sowing to silking period, the earliest variety was OSSK 602 with 55 days, while the latest was Hido with 65 days. Everest produced the highest core yield with 3569.57 kg/da. Similar to the sowing to silking period, OSSK 602 demonstrated the shortest anthesis to silking interval with 59 days and Hido the longest with 67 days. TK 6063 produced the highest stover yield with 598.428 kg/da. The lowest Stover yield was obtained from OSSK 644 cultivars with 4525.17 kg/da. Everest had the highest leaf:stem ratio with 53.85% and OSSK 602 had the lowest with 35.86%. SF Reserve had the highest core:plant ratio with 41.10%.

The highest forage yield was obtained from Everest with 9476.72 kg/da, while the lowest forage yield was from Calcio with 6736.33 kg/da. Similar to the forage yield, Everest produced the highest dry matter yield with 2153.43 kg/da and Calcio produced the lowest with 1758.41 kg/da. The highest ADF rate was obtained from TK 6063 with 30.80% and the lowest from SF Reserve with 25.61%. The highest NDF rate was obtained from Calcio with 57.43% and the lowest from SF Reserve with 50.57%. Everest had the highest crude protein content with 9.32% and Tavascan had the lowest with 7.63%.

This study found that the ecological conditions in Ordu are suitable for silage maize cultivation and the silage maize forage yield is higher than in most places in Turkey. The silage maize varieties, which stand out in terms of forage yield in the ecological conditions in Ordu are Everest, TK6063, OSSK 602, Sagunto, and Hido.

References

Açıkgöz, E., Turgut, İ., Filya, İ. (2002). *Silaj bitkileri yetiştirme ve silaj yapımı.*Hasad Yayıncılık Limited Şirketi, ISBN 975-8377-19-1.

Açıkgöz, E., (1991). *Yem bitkileri.* Uludağ Üniversitesi Ziraat Fakültesi. Bursa.

Akbay, S. (2012). *Tokat ekolojik koşullarında ikinci ürün olarak yetiştirilebilecek bazı silajlık mısır (ZeamaysL.) çeşitlerinin verim ve verim özelliklerinin belirlenmesi.* (Yüksek Lisans Tezi), Gaziosmanpaşa Üniversitesi, Fen Bilimleri Enstitüsü, Tokat.

Anonim, (2010). *Tarımsal değerleri ölçme denemeleri teknik talimatı,* http://www.tarim.gov.tr/BUGEM/TTSM/Belgeler/Tescil/Teknik%20Talimatlar/S%C4%B1cak%20%C4%B0klim%20Tah%C4%B1llar%C4%B1/m%C4%B1s%C4%B1r.pdf (Erişim tarihi: 27.09.2017)

Anonim, (2015). 2015 Results: PA Commerical grain and silage hybrid corntests report, *PennState*, http://extension.psu.edu/plants/crops/grains/corn/hybrid-tests/2015-reports (Erişim Tarihi: 25.10.2016).

Anonim, (2016a). *Food and Agriculture Organization of the United Nations (FAO),* http://www.fao.org/faostat/en/#home, (Erişim tarihi: 01.10.2016)

Anonim, (2016b). *Deciphering hay quality, kentucky equinee search,* http://www.morganequine.com/uploads/5/6/7/9/5679571/_testing_hay_quality.pdf, (Erişim tarihi: 25.10.2016).

Anonim, (2017). *Türkiye İstatistik Kurumu (TÜİK)*, http://www.tuik.gov.tr, (Erişim Tarihi: 27.05.2017).

Aydoğan, V. (2010). *Ordu İlinde yetiştirilen bazı yerel ve melez mısır çeşitlerinin silaj kalitelerinin belirlenmesi.* (Yüksek Lisans Tezi), Ordu Üniversitesi Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilin Dalı, Ordu.

Aykanat S., Korkmaz Y., Barut H. (2015). Adana ekolojisi II. ürün koşullarında farklı mısır çeşitlerinin silajlık özelliklerinin belirlenmesi. *GAP VII. Tarım Kongresi,* 28 Nisan-1 Mayıs 2015, Şanlıurfa.

Balmuk, Y. (2012). *Konya Yunak koşullarında ikinci ürün olarak yetiştirilebilecek silajlık mısır çeşitlerinin verim ve verim özelliklerinin belirlenmesi.* (Yüksek lisans Tezi), Gaziosmanpaşa Üniversitesi, Fen Bilimleri Enstitüsü Tokat.

Bayram, M. (2010). *İkinci ürün silajlık mısır tarımında farklı toprak işleme yöntemlerinin mısır çeşitlerinin verim ve kalitelerine etkileri.* (Yüksek Lisans Tezi), Gaziosmanpaşa Üniversitesi, Fen Bilimleri Enstitüsü Tarım Makinaları Anabilim Dalı, Tokat.

Dwyer, L.M., Stewart D.W & Glenn, F. (1998). *Silage yields of leafy and normal hybrids.* Com and Sorghum Conf. Am. Seed Trade.Assoc. Washington D.C.

Emeklier, Y. (2012). *Sıcak iklim tahılları*. Ankara Üniversitesi Yayınları, ISBN: 978-605-136-006-5, Ankara, 118.

Eralp, Ö. (2007). *Menemen koşullarında ikinci ürün tarımına uygun silajlık mısır çeşitlerinin belirlenmesi.* Adnan Menderes Üniversitesi, Fen Bilimleri Enstitüsü, Aydın.

Erdal, Ş., Pamukçu, M., Ekiz, H., Soysal, M., Savur, O., Toros, A. (2009). Bazı silajlık mısır çeşit adaylarının silajlık verim ve kalite özelliklerinin belirlenmesi. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi,* 22 (1) 75-81, Antalya.

Ergül, Y. (2008). *Silajlık mısır çeşitlerinin önemli tarımsal ve kalite özelliklerinin belirlenmesi.* (Yüksek Lisans Tezi), Selçuk Üniversitesi, Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı, Konya.

Ferreira G.,Alfonso M., Depino, S., Alessandri, E. (2014). Effect of plantingdensity on nutritionalquality of green-choppedcornforsilage. *J. DairySci*. 97: 5918 –5921.

Ferreira, G. (2015). Understanding the effects of drought stress on corn silage yield and quality. *Tri-State Dairy Nutrition Conference,* April 20-22, 2015, Virginia, ABD.

Güçdemir, İ.H. (2006). *Türkiye gübre ve gübreleme rehberi.* Tarımsal Araştırmalar Genel Müdürlüğü Toprak ve Gübre Araştırma Enstitüsü Müdürlüğü Yayınları, Genel Yayın No: 231, Teknik Yayınlar No. T. 69, Ankara.

Han, E. (2016). *Bazı mısır çeşitlerinin dane verimleri ile silaj ve kalite özelliklerinin belirlenmesi.* (Yüksek Lisans Tezi), Ordu Üniversitesi, Fen Bilimleri Enstitüsü, Ordu.

Heath, M.E., Bomes, R.F., Metcalfe, D.S., (1985). *Forages.* ıowastateuniversitypress. FortEducators , Ames, Iowa, USA.

Kabakçı, S. (2014). *Iğdır ekolojik şartlarına uygun silajlık mısır (ZeamaysL.) çeşitlerinin belirlenmesi.* (Yüksek Lisans Tezi), Iğdır Üniversitesi, Fen Bilimleri Enstitüsü Tarla Bitkileri Bölümü Anabilim Dalı, Iğdır.

Karaalp, S. (2015). *İkinci ürün şartlarında yetiştirilen silajlık mısır çeşitlerinin sıra üzeri mesafeye tepkilerinin Boğazlıyan şartlarında belirlenmesi.* (Yüksek Lisans Tezi), Erciyes Üniversitesi, Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı, Kayseri.

Kırtok, Y. (1998). *Mısır üretimi ve kullanımı.* Çukurova Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü, Adana.

Kirendibi, E. (2015). Çankırı ekolojik koşullarında ana ürün olarak yetiştirilebilecek silajlık çeşitlerinin verim ve verim özelliklerinin belirlenmesi. Yüksek Lisans Tezi, Gaziosmanpaşa Üniversitesi, Fen Bilimleri Enstitüsü, Tarla Bitkileri, Tokat.

Küçük, B. (2011). *Bazı silajlık mısır çeşitlerinde morfolojik özelliklerin ve yem verimlerinin belirlenmesi.* (Yüksek Lisans Tezi), Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Ankara.

Ma, B.L., Subedi, K.D., Stewart, D.W., Dwyer, L.M. (2006). Dry matter accumulation and silage moisture changes after silking in leafy and dual-purpose com hybrids. *Agronomy Journal,* 98(4): 922-929.

Martin, T.N.,Vieira V.C., Menezes L. F. G., Ortiz S., Bertoncelli P., Storck L. (2012). Bromatological characterization of maize genotypes for silage. Acta Scientiarum. *AnimalSciences,* 34(4): 363-370.

Moralar, E. (2011). *Tekirdağ ilinde yetiştirilen bazı silajlık mısır çeşitlerinde gelişme sürecinin belirlenmesi ve verimliliklerinin tespiti.* (Yüksek Lisans Tezi), Namık Kemal Üniversitesi, Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı, Tekirdağ.

Olgun, M., Kutlu İ., Ayter N. G., Başçiftçi Z., Kayan N. (2012). Farklı silajlık mısır genotiplerinineskişehir koşullarında adaptasyon yeteneklerinin belirlenmesi. *Biyoloji Bilimleri Araştırma Dergisi,* 5(1): 93-97.

Öner, F., Aydın, İ., Sezer, İ., Gülümser, A., Mut, Z. (2011b). Samsun koşullarında bazı hibrit mısır çeşitlerinin verim ve kalite özelliklerinin belirlenmesi. *Türkiye 9. Tarla Bitkileri Kongresi,* Bursa.

Öner, F., Aydın, İ., Sezer, İ., Gülümser, A., Özata, E., Algan, D. (2011a). Bazı silajlık mısır çeşitlerinde verim ve kalite özelliklerinin belirlenmesi. *Türkiye 9. Tarla Bitkileri Kongresi,* Bursa.

Özata, E., Öz, A., Kapar, H. (2012). Silajlık hibrit mısır çeşit adaylarının verim ve kalite özelliklerinin belirlenmesi. *Tarım Bilimleri Araştırma Dergisi,* 5(1): 37-41

Row, C.A. (2015). *Cornplant maturity effect on yield and nutritional quality; corn silage in oculation on performance of cattle fed silage with or without live yeast added.* (Forthe Degree of Master of Science), University of Nebraska, AnimalScience, Lincoln, Nebraska

Safdarian, M., Razmjoo, J., Dehnavi, M. M. (2014). Effect of nitrogen sources and rates on yield and quality of silage corn. *Journal of Plant Nutrition,* 37: 611–617.

Topuz, N. (2005). *Ege bölgesi bazı illerinde, süt sığırcılığı işletmelerinde silaj mekanizasyonu örneğinde ortak makine kullanım olanakları.* (Doktora Tezi), Ege Üniversitesi, Fen Bilimleri Enstitüsü Tarım makinaları, ABD, İzmir.

Yalçın, H. (1997). *Silajlık ikinci ürün mısır üretiminde uygun toprak işleme yöntemlerinin belirlenmesi üzerinde bir araştırma*. (Doktora Tezi), Ege Üniversitesi, Fen Bilimleri Enstitüsü, Tarım Makineleri, ABD, İzmir.