Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi
Journal of Agricultural Faculty of Gaziosmanpasa University
http://ziraatdergi.gop.edu.tr/

Araştırma Makalesi/*Research Article*

JAFAG
ISSN: 1300-2910
E-ISSN: 2147-8848
(2021) 38(3) 123-131
doi:**10.13002/jafag4781**

Effects of Plant Density on Silage Yield and Quality Parameters of Maize (*Zea mays* L.) Cultivars Grown as the Second Crop

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Alındığı tarih (Received): 15.06.2021 Kabul tarihi (Accepted): 15.10.2021
Online Baskı tarihi (Printed Online): 28.10.2021 Yazılı baskı tarihi (Printed): 31.12.2021

Absract: The study was performed in the experimental field in Köprübaşı district of Manisa province in 2014, aiming to determine the effects of 5 different plant densities, 10 cm (15384 plants da^{-1}), 15 cm (10256 plants da^{-1}), 20 cm (7692 plants da^{-1}), 25 cm (6153 plants da^{-1}), and 30 cm (5128 plants da^{-1}), in silage maize cultivars (C-955, Truva, and Indaco) on yield and some yield-related agricultural characteristics. In the experiment designed by the randomized complete block design with three treatments, maize cultivars, commonly cultivated in our region, were used.

The yield and quality of silage maize varieties were significantly changed according to plant density and cultivar. According to the results, the effects of plant density on herbage yield, stem ratio, dry matter yield, crude protein content (%), and crude protein yield were significant. Among the maize cultivars, leaf ratio (%), ear ratio(%), and dry matter content (%) were statistically significant.

Plant densities had significant effects on silage yield. Thus, herbage yield varied between 3775.4-6900.0 kg da^{-1}, stem ratio between 28.0-32.2 %, dry matter yield between 1267.8-2301.2 kg da^{-1}, crude protein content between 10.3-15.1 %, and crude protein yield between 145.0-300.5 kg da^{-1}.

As a result, the best values were taken from 15 cm intra row spacing and C-955 maize cultivar.

Keywords: Herbage yield, dry matter yield, crude protein yield

Bitki Sıklığının İkinci Ürün Olarak Yetiştirilen Silajlık Mısır(*Zea mays* L.) Çeşitlerinde Verim ve Kalite Özelliklerine Etkisi

Öz: Bu çalışma, Manisa ili Köprü başı ilçesi ekolojik koşullarında, 2014 yılında, 5 farklı bitki sıklığının 10 cm (15384 bitki da^{-1}), 15 cm (10256 bitki da^{-1}), 20 cm (7692 bitki da^{-1}), 25 cm (6153 bitki da^{-1}), 30 cm (5128 bitki da^{-1}) silajlık mısır çeşitlerinde (C-955, Truva ve İndaco) verim ve verimle ilgili bazı tarımsal özellikler üzerine etkisini belirlemek amacıyla şahsa ait arazide yürütülmüştür. Üç tekerrürlü "Tesadüf Blokları Deneme Desenine" göre kurulan denemede; bölgemizde yaygın olarak yetiştirilmekte olan mısır çeşitleri kullanılmıştır.

Silaj amacıyla yetiştirilen mısırın verim ve kalitesi, çeşit ve bitki sıklığına göre önemli derecede değişmiştir. Elde edilen sonuçlara göre, bitki sıklığının yeşil ot verimi, sap oranı, kuru madde verimi, protein oranı (%) ve ham protein verimi üzerine etkileri önemli bulunmuşken; çeşitler arasında yaprak oranı, koçan oranı ve kuru madde oranı özellikleri istatistiki anlamda önemli bulunmuştur.

Bitki sıklıklarının silaj verimi için önemli etki ettiği özelliklere ait değerler; yeşil ot verimi 3775.4-6900.0 kg da^{-1}, sap oranı % 28.0- 32.2, kuru madde verimi 1267.8-2301.2 kg da^{-1}, protein oranı %10.3-15.1, ve ham protein verimi 145.0-300.5 kg da^{-1} arasında bulunmuştur.

Sonuç olarak 15 cm sıra üzeri mesafesi ve C-955 mısır çeşidinden en iyi değerler alınmıştır.

Anahtar Kelimeler: Yeşil ot verimi, kuru madde verimi, ham protein verimi

1. Introduction

Animal proteins are among the most important factors in human nutrition. Therefore, animals should be fed with high-quality feeds in animal production. The amount of roughage obtained from meadow, pasture, and forage crops is insufficient. Furthermore, it does not meet the needs for quality roughage with the amount of digestible protein and nutrients required for animals (Serin and Tan, 1998). Thus, the planting of forage crops should be increased, and forage sources with high nutritional value such as maize should be included. Maize is an important animal feed as grain. In recent years, the importance of silage maize has also increased. Due to its high nutritional value, it increases milk and meat yield. The production of silage maize increases its importance in regions where milk producers live (Harmansah and Kaman, 1987).

Among the cultivated plant species, maize is at the top. In recent years, maize has been the most produced cereal group after wheat and barley. In Turkey, 5.9 million tons of maize is produced on 639,084 hectares of land (Tuik, 2017). The maize plant has a wide range of uses, such as animal feed, human nutrition, and industrial production. Maize is preferred as animal feed due to its high energy, starch, and oil content. Its uses as animal feed are crushing, shell, bran, compound forage, and silage. It has many uses in the food industry, such as boiling, canning, crushing, roasting, popcorn, semolina, flour, snacks, chips, oil, gluten, starch, pastry products, confectionery, and chocolate. Additionally, maize is used as an industrial raw material. An estimated 57% of world maize production is used as forage, 14% as human food, and 29% in the industry (Igm, 2017).

The type of maize consumption varies according to the development levels of countries. Approximately 60% of it is used as animal feed in developed countries. It is generally used in human nutrition in underdeveloped and backward countries. In recent years, the importance of maize has increased even more with the increasing production and geographical change in the cultivation areas, the competition with cotton, and the increasing use of products such as "Biofuel" (Taşdan et al., 2011).

Maize is used as animal feed more than it is used as human food in Turkey. Of the grain maize produced in Turkey, 65% is used in the forage sector (Kuşaksız, 2010). Studies are performed to determine the effects of plant density on yield and quality in maize production, the importance of which is increasing every day in Turkey and ensure that the most appropriate cultivar and density are taken into consideration for production.

In corn cultivation, the yield is significantly affected by cultural factors such as sowing time, plant density, irrigation, used cultivar and fertilization applications. According to other production factors, good adjustment of plant density is one of the priority issues. The appropriate amount of seeds per decare allows plants to make the most effective use of the available water and nutrients in the soil and the light energy (Taş et al. 2016).

Silage maize needs cannot be met sufficiently from silage cultivars. The determination of quality cultivars with high herbage yield for agriculture in our region is an important factor in meeting the need for silage maize.

The aim of this study is to determine the effect of plant density on the yield and quality parameters of some silage maize cultivars, to ensure that the maize cultivars, which are important in the agriculture of our region, are grown at the most appropriate plant density, and to contribute to the economy of the region.

2. Materials and Methods

The experiment was carried out in a producer field in Manisa province, Köprübaşı district, Gölbaşı (Tepeköy) neighborhood in 2014. The research site has an altitude of 263 meters and is located at the latitude of 38.720 and the longitude of 28.397. The climate data were obtained from the General Directorate of Meteorology. The daily average temperature, daily total precipitation, and average humidity for the year were presented in Table 1.

To determine the soil properties of the experimental site, a total of 2 kg soil was taken from 10 different regions from a 0-30 cm depth by making zigzag movements in the field, physical and chemical analysis was conducted in the soil analysis laboratories of Salihli Chamber of Agriculture, and the results were shown in Table 2.

Table 1. Climate Conditions of Experimental Area (2014 and Long term)
Çizelge 1. *Deneme alanına ait iklim verileri (2014 ve Uzun yıllar)*

	2014			***Long term***		
Months	**Average Temperature (°C)**	**Monthly Total Precipitation (mm)**	**Relative Humudity (%)**	**Average Temperature (°C)**	**Monthly Total Precipitation (mm)**	**Relative Humudity (%)**
June	23.0	3.5	61.7	24.6	10.3	65.8
July	27.2	6.6	48.7	28.2	6.2	45.7
August	27.9	1.8	49.6	28.6	3.4	51.3
September	21.4	19.0	63.0	22.8	19.8	68.7
October	16.7	13.8	73.9	17.4	16.9	78.1
Mean	23.2		59.4	24.3		61.9
Total		44.7			56.6	

Table 2. Soil Properties of Experimental Field
Çizelge 2. Deneme alanına ait toprak özellikleri

Properties	**Analysis result**	**Evaluation**
Soil pH	6.98	Neutral
Lime ($CaCO_3$) (%)	1.59	Limy
Organic Matter (%)	1.21	Low
Soil Texture (Class) (%)	50.60	Clay-Loamy
Soluble Total Salt (%)	0.013	Salt-free
Total Nitrogen (%)	0.06	Moderate Nitrogen
Available Phosphorus (kg da^{-1})	8.24	Moderate Phosphorus
Available Potassium (kg da^{-1})	26.55	Moderate

Table 3. Maize Cultivars Used as Research Materials
Çizelge 3. *Araştırma Materyali Olarak Kullanılan Mısır Çeşitleri*

No	**Cultivar Name**	**Company**	**Features**	**FAO Group**
1	C-955	Monsanto	Mid Early	800
2	Truva	Limagrain	Germination rate is high and devolepment is fast	700
3	Indaco	Limagrain	Mid Late	680

As a result of the analysis, soil pH was a neutral soil reaction, the water-soluble total salt values indicated that there couldn't be any problems in plant cultivation in terms of salinity. The soil in the experiment field was limy, the texture was clay-loamy. The organic matter findings demonstrated that the organic matter contentin this soil was low; level of total nitrogen, level of available phosphorus, and level of available potassium were moderate. Soil properties couldn't play a limiting role in terms of maize cultivation.

The study was carried out in three replications in a randomized complete block design in accordance with the factorial trial design by placing the first factor as plant densities (intrarow spacing of 10 cm, 15 cm, 20 cm, 25 cm, and 30 cm) and the second factor as cultivars (C-955, Truva, Indaco).

In each replication, one plot consisted of 5 rows, while the inter-row spacing in the plot was kept constant at 65 cm, the intrarow values changed, the plot length was determined as 6 m, and the plot dimensions were arranged as 6 m x 3.25 m = 19.5 m^2(Gross). In the experiment consisting of a total of 45 plots, a distance of 1 meter was left between the blocks. Seeds were sown to a depth of 5-6 cm by hand, as a second crop on 14 July 2014, with two seeds in each pit.

With the planting process, DAP (18-46-0) fertilizer was used with 10 kg N da^{-1} pure nitrogen per decare. After the seeds germinated and when the plants were at the height of 10-15 cm, the thinning process was applied. Hoeing was carried out for weed control, and irrigation was performed 8 times during the growing period of plants (Özgenc, 2019).

Harvest stage was determined considering the suggestion of (Geren, 2000; Kuşaksız and Kuşaksız, 2008) and it was practiced on two-third milking stage. Ten plants were harvested from each plot and the 1st and 5th rows, representing the edge effects, were not harvested.

The obtained data were evaluated statistically in accordance to studies of Steel and Torrie (1980) and Yıldırım and Kuşaksız (2002), using MSTAT-C, Freed et al. (1989) statistical packaged software on the computer. Each characteristic measured according to the randomized complete block design was subjected to variance analysis in accordance with this design, the significance of variances was checked with the F-test, and multiple comparisons were made according to the LSD test.

3. Results and Discussions

When Table 4 is examined, the effect of different intrarow spaces (Density) on the herbage yield, dry matter yield, protein content, and crude protein yield of maize cultivars was determined as statistically significant at the level of 1%, and their effect on the stem ratio was detected as statistically significant at the level of P<0.05, while it was not found to be significant for the characteristics of ear ratio, leaf ratio, and dry matter content.

Table 4. Mean Square Values and Variance Analysis Results for Different Characteristics of Maize Cultivars at Different Plant Densities

Çizelge 4. *Farklı Bitki Sıklıklarında Silajlık Mısır Çeşitlerinin Farklı Özelliklerine ait Varyans Analizi ve Kareler Ortalaması Değerleri*

Sources of Variation	SD	Herbage Yield	Ear Ratio	Leaf Ratio	Stem Ratio	Dry Matter Content	Dry Matter Yield	Protein Content	Crude Protein Yield
Replication	2	226832.8	16.52*	11.83	8.98	49.37**	76117.6	0.01	1034
Density	4	16214989.3**	1.21	17.9	25.0*	3.26	1766516.9**	30.45**	27567.6**
Cultivar	2	3970778.9**	24.83**	37.27*	23.13	36.37**	136521.3	1.88**	2026.4
Density*Cultivar	8	5446996.5**	5.3	3.31	11.09	2.77	651992.7**	2.65**	13388.6**
Error	28	641870.2	3.68	7.97	7.89	3.52	82020.6	0.19	1173.8
General	44	3063716.3	5.29	9.53	10.78	6.94	340996.9	3.46	5826.5
C.V.		33.82	7.22	7.99	11.15	7.81	33.63	14.64	34.82

*: P< 0.05, **: P<0.01, ns: Not significant

Among maize cultivars, there was no statistically significant significance for the characteristics of stem ratio, dry matter yield, and crude protein yield, while significance was determined at the level of 1 and 5% for other characteristics.

Density*Cultivar interaction was found to be significant at the level of 1% for herbage yield, dry matter yield, protein content, and crude protein yield characteristics, but not for other characteristics.

According to the results obtained from the study, plant densities and cultivar characteristics were significant in terms of herbage yield values. Four groups were formed for plant density in the LSD ranking. Herbage yield varied between 3775.4 kg da^{-1} and 6900. kg da^{-1}. At a 15 cm intrarow plant density, 6900. kg da^{-1} was in the first place, and at a 25 cm intrarow plant density, 3775.4 kg da^{-1} was in the last group. In terms of cultivars, two groups were formed according to the LSD ranking, with C-955 with 5767.4 kg da^{-1} in the first place, and Indaco cultivar with 4906.4 kg da^{-1} and Truva cultivar with 4849.0 kg da^{-1} in the second place.

In a study, Taş(2010) used intrarow plant densities varying between 10 cm and 26 cm. It was determined that the difference between plant densities was statistically significant. It was revealed that the herbage yield was 7244 kg da^{-1} at a 10 cm intrarow plant density, 6782 kg da^{-1} at a 14 cm intrarow plant density, 6221 kg da^{-1} at an 18 cm intrarow plant density, 5942 kg da^{-1} at a 22 cm intrarow plant density, and 5629 kg da^{-1} at a 26 cm intrarow plant density. It was found that the lowest herbage yield was at a 26 cm intrarow planting density, and the highest herbage yield was at a 10 cm intrarow planting density. Our findings were similar to those of this study.

In similar studies, the effect of plant densities on herbage yield was found to be significant. It was stated that as the plant density increased, the herbage yield also increased (Turgut et al. 2005; Yılmaz et al. 2008; Özturk et al. 2008; Mandic et al. 2015; Bayram et al. 2017). It was indicated that characteristics such as plant height, maturation period, stem thickness, number of leaves and ears affected the herbage yield. Therefore, in the study conducted, significant differences were found in terms of herbage yield due to the genetic differences of maize cultivars, ecological conditions, cultivation differences, and application methods (Özturk et al. 2008).

Tansı (1987) stated that the maturation period, dry matter content (%), and herbage yield characteristics were important in the selection of cultivars for silage maize production. It was reported that the herbage yield characteristic was a quantitative trait affected by the number of plants per unit area, genotype, maturation period, harvest date, and the use of available technology. Some researchers (Alessi and Power, 1974; Esser and Entrup, 1980) indicated that the herbage yield was significantly affected by environmental conditions. It was stated that many plant species and cultivars have their own total temperature demand until they mature and bear fruit. It was reported that this value has been 2370-3000 °C for maize. Therefore, while plants reach the earlier harvest stage in regions where the average temperature is high, they harvest late in regions where the average temperature is low. Under the Mediterranean climate conditions, while early cultivars complete their vegetative growth rapidly and bloom with the warming of the weather and the soil, vegetative growth ceases, and herbage yield decreases. In mid-early cultivars, the vegetative period is longer than early cultivars, so herbage yield is high. (Boguslawski, 1981).

Table 5. The Effect of Different Plant Densities on Some Characteristics of Maize Cultivars
Çizelge5. *Mısır Çeşitlerinin Bazı Özellikleri Üzerine Farklı Bitki Sıklıklarının Etkisi*

Density	Herbage Yield (kg da^{-1})	Ear Ratio (%)	Leaf Ratio (%)	Stem Ratio (%)	Dry Matter Content (%)	Dry Matter Yield (kg da^{-1})	Protein Content (%)	Crude Protein Yield (kg da^{-1})
10 cm	6066.0 **ab**	31.7	36.1	32.2 **a**	34.0	2068.3 **a**	10.3 d	216.4 **b**
15 cm	6900.0 **a**	32.6	39.4	28.0 **b**	33.8	2301.2 **a**	13.1 b	300.5 **a**
20 cm	5170.8 **b**	31.3	38.9	29.8 **ab**	32.6	1669.7 **b**	13.4 b	224.4 **b**
25 cm	3775.4 **c**	32.1	39.0	28.9 **b**	33.7	1267.8 **c**	11.4 c	145.0 **c**
30 cm	3959.1 **c**	32.0	39.7	28.3 **b**	34.2	1373.2 **bc**	15.1a	209.6 **b**
Mean	5174.2	31.9	38.6	29.4	33.6	1736	12.6	219.1
LSD value	1046.535	1.853	2.726	2.713	1.813	374.104	0.571	44.754
Cultivars								
Truva	4849.0 b	31.9 ab	37.2 b	31.0	34.2 a	1653.7	12.3 b	206.0
Indaco	4906.4 b	33.1 a	38.2 ab	28.7	34.8 a	1713.9	13.1 a	223.4
C-955	5767.5 a	30.6 b	40.3 a	29.2	31.9 b	1840.6	12.6 b	228.1
LSD value	810.6	1.9	2.1	2.1	1.9	289.7	0.4	34.6

The difference between values with different letters in the same column is significant (P ≤ 0.01).

As can be seen in Tables 4 and 5, according to the results obtained from the study, although plant densities were found to be insignificant in terms of ear ratio values, the cultivar characteristic was significant. Ear ratio values varied between 31.3% and 32.6%.

Similarly, to our findings, Turgut et al. (2005) found the effect of plant densities on the ear ratios insignificant. Contrary to our study, Özturk et al. (2008), Çarpıcı et al. (2010), and Mandic et al. (2015) stated that the effect of plant density on the ear ratios was significant. It was determined that the stem ratio was inversely proportional to the increase in plant density. Jones et al. (1995), Cuoma et al. (1997), and Iptaş and Acar (2003) reported insignificant decreases in the ear ratio due to the increase in plant density. In terms of cultivars, the ear ratio was determined in Indaco cultivar with 33.1%, in Truva cultivar with 31.9%, and in C-955 cultivar with 30.6%. The different results obtained from the studies may be due to the cultivars used, ecological conditions, and the different methods applied.

As seen in Tables 4 and 5, according to the results obtained from the study, although plant densities were found to be insignificant in terms of leaf ratio values, the cultivar characteristic was significant. Leaf ratio values varied between 36.1% and 39.7%. It was found to be significant in terms of the cultivar. The cultivar C-955 took the first place with a leaf ratio of 40.3%.

Contrary to our findings, Özturk et al. (2008) found the differences between cultivars in terms of leaf ratio insignificant. It was stated that the effect of plant density on the leaf ratio was significant. Bayram et al. (2017) determined the leaf ratio between 19.6 and 30.1 in their study. They reported that they obtained the highest leaf ratio at the highest plant density. It is expected that the leaf ratio in silages made with maize plants will be higher than the stem ratio. This is because leaves and ears are more nutritious than stems. (Saruhan and Şireli, 2005). Our findings on the effects of plant densities on the leaf ratio were not found to be compatible with the data of Özturk et al. (2008) and Bayram et al. (2017), but they were compatible with the data obtained by Çarpıcı et al. (2010) and Mandic et al. (2015).

As can be seen in Tables 4 and 5, according to the results obtained from the study, the effect of plant density on the stem ratio was found to be significant. Three groups were formed in the LSD ranking. The highest stem ratio was obtained as 32.2% at a 10 cm intrarow plant density, and the lowest as 28% at a 15 cm intrarow plant density. Jones et al. (1995) and Cuomo et al. (1997) reported in their studies that there was a significant increase in stem ratio with the increase in plant density. Although Iptaş and Acar (2003) and Özturk et al. (2008) found the effect of plant density on stem ratio insignificant, Özturk et al. (2008) reported a stem ratio of 40.4% at 14 cm intrarow plant density, 38.3% at a 16 cm intrarow plant density, 39.2% at an 18 cm intrarow plant density, 39.1% at a 20 cm intrarow plant density, 37.7% at a 22 cm intrarow plant density, and 37.4% at a 24 cm intrarow plant density. Our findings were similar to those of this study. The different results obtained from the studies may be due to the variation in the cultivar used, different applications, climate and soil properties.

As can be seen in Tables 4 and 5, according to the results obtained from the study, although plant densities were found to be insignificant in terms of dry matter content values, cultivars had significant effect on dry matter content and contents ranged among 32.6-34.2% with density.

While Dok et al. (2002), Özturk et al. (2008), Çarpıcı et al. (2010), and Malaslı et al. (2017) found the effect of plant densities on dry matter content insignificant, Özturk and Akkaya (1996), Iptaş and Acar (2003), and Taş (2010) found the effects of plant density on dry matter content significant in their studies. Özturk et al. (2008) reported the dry matter content between 27.6% and 28.4% in their study. They stated that the dry matter content tended to decrease due to the increase in plant density, but this change was not significant. In their study, Taş (2010) reported a dry matter content of 28.9% at a 10 cm intrarow plant density, 28.9% at a 14 cm intrarow plant density, 29.9% at an 18 cm intrarow plant density, 27.6% at a 22 cm intrarow plant density, and 30.1% at a 26 cm intrarow plant density. Our findings were similar to those of this study. Malaslı et al. (2017) determined the dry matter content between 24.2 and 32.3%. The different results obtained from the studies may be due to the cultivars used, ecological conditions, altitude, different harvest dates, and the different methods applied.

Plant densities were determined to be significant in terms of dry matter yield values. Four groups were formed in the LSD ranking. Dry matter yield varied between 1267.8 kg da^{-1} and 2301.2 kg da^{-1}. 2301.2 kg da^{-1} at a 15 cm intrarow plant density and 2068.3 kg da^{-1} at a 10 cm intrarow plant density took the first place, 1669.7 kg da^{-1} at a 20 cm intrarow plant density was in the second place, 1373.2 kg da^{-1} at a 30 cm intrarow plant density was in the third place, and 1276.8 kg da^{-1} at a 25 cm intrarow plant density was in the last group. Similarly, to our study, Özturk et al.(2008) determined the highest dry matter yield as 1617.2 kg da^{-1} at a 16 cm intrarow planting density. In their study, Taş (2010) reported that the planting density was statistically significant for the dry matter yield. It was stated that they obtained the lowest value with 1776 kg at a 22 cm density and the highest value with 2179 kg at a 10 cm density. In studies consistent with our findings, Turgut et al. (2005), Çarpıcı et al. (2010), Mandic et al. (2015), and Bayram et al. (2017) observed an increase in dry matter yield as the plant density increased. Mandic et al. (2015) reported the highest dry matter yield with 2367 kg da^{-1} at a 20 cm density. It was stated that the plant density had a significant effect on dry matter yield. The different results obtained from the studies may be due to the different cultivars used and the methods applied different nitrogen dose fertilization.

Plant densities and cultivar characteristics were found to be significant in terms of protein content values. Four groups were formed for plant density in the LSD ranking. Protein content was determined between 10.3% and 15.1%. The highest protein content was obtained as 15.1% at the intrarow plant density of 30 cm, and the lowest protein content was obtained as 10.3% at the intrarow plant density of 10 cm. In terms of cultivars, the cultivar Indaco took the first place with 13.1%. While Özturk et al. (2008) and Bayram et al. (2017) found the effect of plant density on protein content significant, Iptaş and Acar (2006), Çarpıcı et al. (2010), and Malaslı et al. (2017) found it insignificant. While our findings were in line with the findings of Özturk et al. (2008), who reported that the crude protein content decreased with the increase in plant density. They were not compatible with the findings of Bayram et al. (2017).

Plant densities were found to be significant in terms of crude protein yield. According to the study results, three groups were formed in the LSD ranking. Crude protein yield varied between 145.0 kg da^{-1} and 300.5 kg da^{-1}. 300.5 kg da^{-1} at a 15 cm intrarow plant density took the first place, 216.4 kg da^{-1} at a 10 cm intrarow plant density, 224.4 kg da^{-1} at 20 cm intrarow plant density, and 209.6 kg da^{-1} at 30 cm intrarow plant density were in the second place, and 145.0 kg da^{-1} at 25 cm intrarow plant density was in the last group. Differently from our study, Özturk et al. (2008) stated that crude protein yield results might have been different as a result of the effects of plant density on dry matter yield and crude protein content. Despite the significant reductions in crude protein at a high plant density, the differences between plant densities in terms of crude protein yield were not significant. Malaslı et al. (2017) reported that crude protein yield values were between 103.8 kg da^{-1} and 114.1 kg da^{-1}. They determined that the effect of plant densities on crude protein yield was insignificant.

The different results obtained from the studies may be due to the different cultivars used.

4.Conclusion

According to the study results, it was determined that the most suitable density for silage yield and quality of silage maize cultivars was a 15 cm intrarow space. The most suitable cultivar in terms of herbage yield and crude protein yield was the cultivar C-955.

Acknowledgement

This article was summarized from the MSc Thesis prepared by Esra ÖZGENÇ.

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