Determination of Chemical Composition, Digestible Dry Matter Yields of Some Silage Type Corn Varieties

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SUMMARY

The aim of this study was to determine the highest digestible dry matter yielding silage type corn variety/ies suitable for eastern Anatolia region, which are planted and harvested on same dates. Thirteen corn hybrids (OSSK-191, OSSK-247, OSSK-332, OSSK-382, OSSK-552, OSSK-644, Bc-566, Bc-6661, Bc-678, Bc-723, Bc-778, Duanan, and Alpos) with different characteristics were selected to achieve our goal. The corn hybrids were harvested by hand on September 24. Harvested corn from each plot were weighed, sampled for DM (about 1500 g whole plant corn). Dry matter yields were determined. Dried whole plant corn samples were ground to pass through a 1 mm screen before analysis and analyzed for DM, ash, OM, NDF, ADF, CP, and IVDMD. Dry matter, OM, NDF, ADF, CP, IVDMD contents, IVDMD yield, and CP yield kg/da ranged from 19.63 to 32.10%; 92.74 to 94.66%; 50.68 to 62.62%; 20.12 to 32.49%; 5.83 to 8.74%; 60.77 to 76.28 %; 415 to 1003 kg/da, and 51 to 108 kg/da, respectively. In conclusion, Bc-566 and OSSK-247 corn varieties seemed to be the best corn varieties suitable for eastern Anatolia region based on digestible DM and CP yields.

Key words: *Corn, In vitro Digestibility, Digestible Dry Matter Yield.*

Bazı Silajlık Mısır Çeşitlerinin Besin Madde Kompozisyonu, Sindirilebilir Kuru Madde Verimlerinin Belirlenmesi

ÖZET

Bu araştırmanın amacı, aynı gün ekilip hasat edildiğinde, Doğu Anadolu bölgesi iklim şartlarında en yüksek sindirilebilir kuru madde verimine sahip silajlık mısır varyetesini/lerini belirlemektir. Bu amaçla değişik özellikte 13 mısır (OSSK-191, OSSK-247, OSSK-332, OSSK-382, OSSK-552, OSSK-644, Bc-566, Bc-6661, Bc-678, Bc-723, Bc-778, Duanan ve Alpos) çeşidi seçilmiştir. Mısır çeşitleri 24 Eylül tarihinde elle hasat edilmiştir. Hasat edilen bitkiler tartılıp, kuru madde için (yaklaşık 1500 g tüm bitki) örnek alınmıştır. Kuru madde verimi hesaplanmıştır . Kurutulmuş bütün bitki örnekleri 1 mm elekten geçebilecek şekilde öğütülmüş, kuru madde, ham kül, organik madde, nötral detergent fiber (NDF), asit detergent fiber, ham protein ve in vitro sindirilebilir kuru madde için analiz edilmiştir. Kuru madde, organik madde, nötral detergent fiber, asit detergent fiber, ham protein, in vitro sindirilebilirlik, sindirilebilir kuru madde verimi ve ham protein verimi sırasıyla, % 19.36-32.10; % 92.74-94.66; % 50.68-62.62; % 20.12-32.48; 5.83-8.74; 60.77-76.28; 415-1003 kg/da ile 51-108 kg/da arasında değişmiştir. Sonuç olarak, Bc-566 ve OSSK-247 mısır çeşitleri, sindirilebilir kuru madde ve ham protein verimleri baz alındığında, Doğu Anadolu Bölgesi için en uygun çeşitler olduğu sonucuna varılmıştır.

Anahtar Sözcükler: *Mısır, İn vitro Sindirilebilirlik, Sindirilebilir Kuru Madde Verimi.*

INTRODUCTION

Like any other business, the profitability of a farming system is dependent upon minimizing expenses, maximizing the income of the system, and maximizing utilization of the system's sources. The utilization of a system at maximum rate requires extensive knowledge, research about system and how to manipulate it to improve its profitability.

Feed cost comprises from 50 to 70 % of total farming expenses in Turkey (5). In order to reduce feed costs and create more sustainable management systems for moderate-sized, family operations, value-added livestock enterprises must be integrated with existing cropping enterprises.

One of the most important factor affecting Turkish farming system is the lack of cheap, abundant and high quality feedstuff production. The feeding of low-quality forages such as crop residues (wheat, barley straw) and low-quality hays with protein (meal) or energy supplementation (grain barley) to wintering ruminant is a common practice in Turkey. However, these low-quality forages may limit performance of dairy and fast growing beef cows due to their high gut-filling capacity (9). Dairy cows can only produce high milk yields and beef cows can only reach their maximum potential if their intermediary metabolism is supplied with sufficient nutrients (5). Thus, high-quality forages such as whole plant corn (corn silage) are the major source of energy for lactating and fast growing beef cows in some regions of United States.

Previous studies with different corn varieties have showed that corn can be reach their maximum potential in many parts of our country with proper management (16). However, since the winter is very long and the summer is very short in eastern Anatolia region, climate may limit the growth of many plants (8). Some of the corn variety may not mature enough for silage making during normal vegetation period.

Therefore, the objective of this study was to determine the highest digestible dry matter yielding silage type corn variety/ies suitable for eastern Anatolia region, which are planted and harvested on same dates.

MATERIALS and METHODS

Thirteen corn hybrids (OSSK-191, OSSK-247, OSSK-332, OSSK-382, OSSK-552, OSSK-644, Bc-566, Bc-6661, Bc-678, Bc-723, Bc-778, Duanan, and Alpos) with different characteristics were selected. All of corn hybrids were grown under irrigation system. The corn plots were planted on May 16 and each hybrid was randomly assigned into three replications. The corn fields were watered every 10 d and were fertilized with 16 kg nitrogen and 8 kg phosphorus per da. Fifty percent of nitrogen was applied each plot before sowing and the rest was applied when plants reached 45-50 cm height. Rows were 5 m long and with a 70 cm spacing, and plots were thinned to uniform stands of 16 plants per m^2.

The corn hybrids were harvested by hand on September 24. Harvested forage from each plot weighed, sampled for dry matter (DM; about 1500 g whole plant corn).

Dry matter of samples were determined by oven drying of triplicate sub-samples at 65 ^oC for 72-h, after an air-drying (1).

Dried whole plant corn samples were ground to pass through a 1 mm screen before analysis. Ash concentrations of samples were determined in a muffle furnace at 550 ^oC for 8 h. All samples were analyzed for crude protein (CP) by Kjeldahl procedure (1), neutral detergent fiber (NDF; 15) and acid detergent fiber (ADF; 7). In vitro dry matter digestibilities (IVDMD) of samples were determined by the procedure of Tilley and Terry (14), as modified by Marten and Barnes (9). Ruminal ingesta from an alfalfa-fed ruminally fistulated ram was hand-collected and strained through four layers of cheesecloth to provide the innocula for IVDMD determination.

Statistical analysis

All data were subjected to analysis of variance for completely randomized design using the GLM procedure of SAS (12) and means were separated by Duncan's t-test (13).

RESULTS

Dry matter concentrations of corns significantly differed (Table 1; P□0.05). OSSK-644 variety had the lowest OM concentration among all corn varieties (P□0.05). Crude protein concentrations of corns ranged between 5.83 and 8.74 and significantly differed among varieties (P□0.05). While Bc-566 variety had the lowest NDF (50.68 %) and Alpos variety had the lowest ADF (20.12 %) concentrations among all corn varieties (P□0.05).

In vitro dry matter digestibilities were significantly greater (P□0.05) in OSSK-191 compared with OSSK-552, OSSK-382 or Bc-723, but IVDMD of the remaining varieties were statistically similar (Table 2; P>0.05). In vitro dry matter digestibility was the highest in OSKK-191 (76.28 %) and the lowest (60.77 %) in OSSK-382 variety.

In vitro digestible DM and CP yields ranged from 415 to 1003 kg/da and from 51 to 108 kg/da, respectively (Table 2 Figure 1 and Figure 2). Whereas Bc-566 variety had the highest in vitro digestible DM and CP yields, OSSK-552 variety had the lowest in vitro digestible DM and CP yields (P□0.05).

Table 1. Chemical compositions of different corn varieties, % DM.

Varieties	DM	Ash	OM	CP	NDF	ADF
OSSK-247	31.03 ^{ab}	5.79 ^{b}	94.21 ^{a}	6.58 ^{de}	54.74 ^{abc}	20.38 ^{d}
OSSK-644	21.76 ^{fg}	7.26 ^{a}	92.74 ^{b}	5.83 ^{e}	58.91 ^{abc}	32.49 ^{a}
Bc-778	23.86 ^{def}	6.70 ^{ab}	93.30 ^{ab}	7.20 ^{bcde}	60.86 ^{abc}	32.01 ^{a}
OSSK-191	29.13 ^{abc}	5.56 ^{b}	94.44 ^{a}	8.74 ^{a}	51.05 ^{bc}	25.25 ^{cd}
Bc-6661	23.10 ^{efg}	6.61 ^{ab}	93.39 ^{ab}	7.52 ^{abcd}	60.88 ^{abc}	30.91 ^{ab}
Bc-678	23.56 ^{ef}	6.40 ^{ab}	93.60 ^{ab}	7.40 ^{abcd}	55.31 ^{abc}	27.74 ^{abc}
Bc-566	30.40 ^{ab}	5.80 ^{b}	94.20 ^{a}	7.22 ^{bcde}	50.68 ^{c}	25.62 ^{bcd}
OSSK-332	26.30 ^{cde}	6.45 ^{ab}	93.55 ^{ab}	8.38 ^{abc}	61.83 ^{ab}	24.71 ^{cd}
Duanan	28.10 ^{abc}	6.08 ^{ab}	93.92 ^{ab}	7.02 ^{ced}	60.81 ^{abc}	25.64 ^{bcd}
Alpos	30.77 ^{ab}	5.38 ^{b}	94.62 ^{a}	8.60 ^{ab}	57.79 ^{abc}	20.12 ^{d}
OSSK-552	27.33 ^{bcd}	5.67 ^{b}	94.33 ^{a}	7.41 ^{abcd}	60.68 ^{abc}	25.41 ^{cd}
OSSK-382	31.47 ^{a}	5.34 ^{b}	94.66 ^{a}	6.94 ^{cde}	55.65 ^{abc}	24.14 ^{cd}
Bc-723	19.63 ^{g}	6.23 ^{ab}	93.77 ^{ab}	6.56 ^{de}	62.62 ^{a}	32.33 ^{a}
SEM	1.93	0.39	0.39	0.44	3.10	1.64

$^{a-g}$ ...Means with different superscript within a column are significantly different, *(P□0.05)*.

Table 2. In vitro DM digestibilities (% DM), DM, IVDMD, and CP yields of different corn varieties, kg/da.

Varieties	DM yield, kg/da	IVDMD, % DM	IVDMD yield, kg/da	CP yield, kg/da
OSSK-247	1393 [a]	71.65 [ab]	998 [a]	92 [ab]
OSSK-644	1208 [abc]	63.66 [ab]	769 [bc]	71 [cd]
Bc-778	1361 [a]	64.66 [ab]	880 [ab]	98 [ab]
OSSK-191	725 [de]	76.28 [a]	553 [ef]	63 [cde]
Bc-6661	1335 [ab]	66.93 [ab]	894 [ab]	101 [ab]
Bc-678	887 [de]	71.33 [ab]	633 [cde]	65 [cd]
Bc-566	1500 [a]	66.89 [ab]	1003 [a]	108 [a]
OSSK-332	686 [e]	64.24 [ab]	441 [f]	57 [de]
Duanan	1029 [bcd]	64.55 [ab]	664 [cde]	72 [cd]
Alpos	803 [de]	69.45 [ab]	558 [ef]	69 [cd]
OSSK-552	683 [e]	60.77 [b]	415 [f]	51 [e]
OSSK-382	982 [cde]	62.88 [b]	618 [de]	68 [cd]
Bc-723	1119 [bcde]	63.00 [b]	705 [cd]	73 [c]
SEM	47.25	3.69	43.17	4.55

[a-f] ...Means with different superscript within a column are significantly different, *(P□0.05)*.

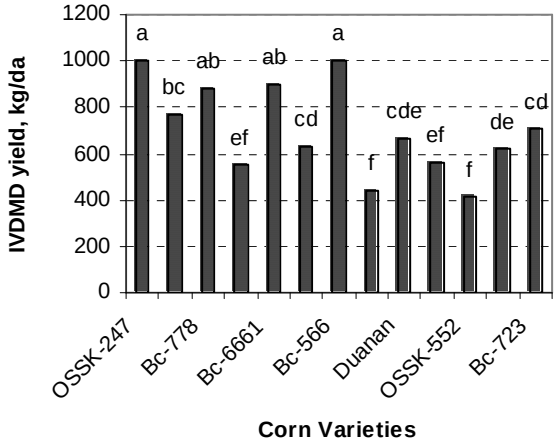

Figure 1. In vitro digestible DM yields of different corn varieties, kg/da.

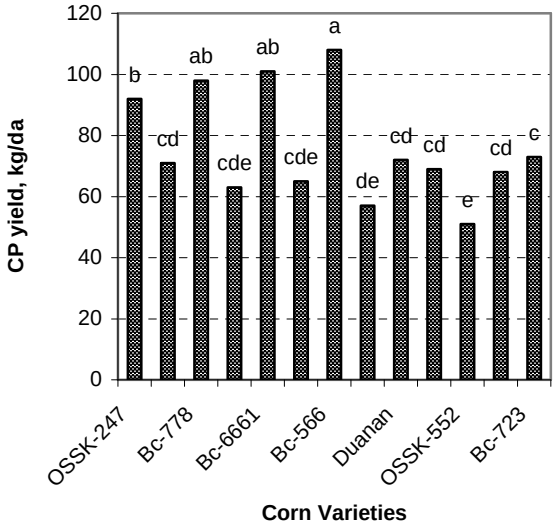

Figure 2. Crude protein yields of different corn varieties, kg/da.

DISCUSSION

The major objective of this study was to determine the highest digestible dry matter yielding silage type corn variety/ies suitable for eastern Anatolia region, which are planted and harvested on same dates. Thirteen different corn varieties were planted and harvested at same time to achieve our goal.

The concentrations of DM significantly differed among corn varieties, ranging from 19.63 to 31.47 % (Table 1; P□0.05). It is well known that cultivators often differ on physiological maturity, which results in differences in the concentration of DM among varieties (11). Some of corn varieties had very low dry matter concentrations, which may not even utilized for silage making, indicating that these corn varieties are not suitable for eastern Anatolia. Organic matter content of OSSK-644 was significantly different from OSSK-247, OSSK-191, Bc-566, OSSK-552 or OSSK-382. Similarly, previous studies with different corn varieties have also reported significant differences in OM concentrations (4). Crude protein concentrations of corn varieties ranged from 5.83 to 8.74, which are in the range of results reported in the literature (2, 4, 6). Both NDF and ADF concentrations of corn varieties were significantly different among varieties. The varieties having higher proportions of stem also had higher NDF and ADF concentration compared with other. Stems decrease in quality faster than leaves of most forage plants, especially as the plants approach maturity. Concentration of NDF in reproductive stems of four species of cool-season grasses often ranged from 60 to 70 % and approached 75 or more if plants were mature (3).

OSSK-191 variety had a significantly higher in vitro DM digestibilities compared with OSSK-552, OSSK-382, and Bc-723. In vitro DM digestibilities changed between 60.77 and 76.28 %, which are similar to those reported in the literature (4, 6). Some experiments have shown cultivar differences in quality when harvested on common dates, but it is difficult to determine if quality differences are confounded with maturity, which often differs among entries (11).

In vitro digestible DM and CP yields ranged from 415 to 1003 kg/da; from 51 to 108 kg/da, respectively. Both in vitro digestible DM and CP yields were the highest in Bc-566, the lowest in OSSK-552 corn variety among 13 corn varieties. In vitro digestible DM and CP yields observed in the current study were in the range of the study reported by Deniz et al. (4) and Yılmaz ve Hosaflıoğlu (16).

In conclusion, Bc-566 and OSSK-247 corn varieties seemed to be the best corn varieties suitable for our region based on digestible DM and CP yields.

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