Some factors affecting on nutritive value of whole plant corn silage

H.M.A. Gaafar

Animal Production Research Institute, Agricultural Research Center, Dokki, Egypt.
Email: gaafar356@hotmail.com

Abstract: In Egypt, the total planted area of corn crop was about 1 million feddans (420,000 hectare), but only 140 thousand feddans cultivated with yellow corn hybrids, the area of corn crop used as a silage was about 250 thousand feddans. Whole plant corn silage is a popular forage source for ruminants due to its high yielding properties, energy content, relatively high palatability and incorporating easily into TMR. Recently, agronomists, nutritionists, and dairy producers have placed increased emphasis on factors affecting the nutritive value of whole plant corn silage.
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INTRODUCTION

In Egypt, the total planted area of corn crop was about 1 million feddans (420,000 hectare), but only 140 thousand feddans cultivated with yellow corn hybrids, the area of corn crop used as a silage was about 250 thousand feddans (National Campaign of Corn Crop Rising, 2007). Whole plant corn silage is a popular forage source for ruminants due to its high yielding properties, energy content, relatively high palatability and incorporating easily into TMR (Cherney et al., 2004). Recently, agronomists, nutritionists, and dairy producers have placed increased emphasis on factors affecting the nutritive value of whole plant corn silage (Bal *et al*., 2000).

Stay-green hybrids have asynchronous ear and stalk dry-down rates, therefore their ears turn brown and their kernels dry-down and mature faster than their stalks and leaves which remain green. The presence of this characteristic implies that the traditional relationship between whole plant silage, moisture and kernel milk line may no longer hold because it probably results in silages that have milk lines that are more advanced relative to whole plant maturity (Bagg, 2001). High stay-green rankings are genetically correlated with high stalk and leaf moisture contents (Bekavac et al., 1998). The stay-green characteristic hinders prediction of corn harvest dates with the kernel milk line because kernels get very mature while whole-plant DM remains under 30% (Thomas, 2001). Therefore, using kernel milk line to predict harvest dates for stay-green corn destined for silage may result in greater seepage (Lauer, 1998).

Corn hybrids with high stay-green rankings were found to have higher moisture and protein concentrations and lower starch content than average stay-green hybrids, but the fermentation process was unaffected by stay-green ranking. Stay- green hybrids should be harvested at about 34% DM (66% moisture) as this maturity stage gave the best combination of yield, nutritive value and low fungal counts. Due to the higher moisture content of high stay-green hybrids, they should not be harvested at DM concentrations below 30% particularly during rainfall or in wet years because excess moisture can cause undesirable fermentations (Adesogan, 2006).

The present investigation was undertaken to study the effect of hybrid type, cultivation season, stage of maturity and plant density on yield, fermentation characteristics, chemical composition, nutrients digestion, nutritive values and nutrients yield of whole corn plant silage.

MATERIALS AND METHODS

The current work was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

Corn hybrids: Nine commercial corn hybrids included 6 white hybrids (*single way crosses 10, 124 and Watania-4 and three way crosses 320, Nema-47 and Pioneer- 3057*) and 3 and yellow hybrids (*single way crosses 158 and Pioneer-3062 and three way crosses Pioneer-Dahab*) were cultivated at 20, 25 and 30 thousand plants / feddan, during summer and nili seasons, harvested at milk, dough and hard stages of maturity and used to study the effects of cultivation season, type of hybrids, stage of maturity and plant density on yield, composition, fermentation, digestibility, nutritive value, yield of nutritive values and output of whole corn hybrids plant silage. Three plots with an area of 4.2 m^2 for each hybrid were taken randomly to estimate the yield of whole plant corn forage crop per feddan. Representative samples from each plot were taken to estimate the yield of ear, grain, cob, fresh stover, stalks and leaves.

Making silage: Corn hybrids were chopped into pieces with 1.0-1.5 cm of length. Five hundred kg of each chopped hybrid was ensiled in double plastic bags with 50 kg weight for each, pressed by hand to exclude the air and ensiled for eight weeks. The bags were reweighed after ensiling period to determine the yield of silage crop and ensiling weight losses.

Silage quality: Color and odor of silages were examined and samples were taken for chemical analysis. Silage samples were extracted using 20 g homogenized wet material with 100 ml distilled water in warm blender for 10 minutes (Waldo and Schultz, 1956). The homogenized sample was filtered through a double layer of cheesecloth and then the solution refilterated through a filter paper until it becomes perfectly clear. Silage pH was determined directly using 680 Orian digital pH meter. The concentrations of lactic, acetic, propionic, isobutyric, butyric, isovaleric and valeric acids were determined using gas chromatography according to the method of Erwin *et al.* (1961) and ammonia-N according to the method of AOAC (1990).

Digestibility trails: Digestibility trails were conducted to determine the nutrients digestibility coefficients and nutritive value of different corn hybrids silages using barky rams with an average body weight of 50±0.50 kg and 3±0.05 years of age (3 in each). Rams were housed individually in digestible carts for 15 days as a preliminary period followed by 7 days as a collection period. Digestible carts permitted total collection and separation of feces and urine. Rams were fed corn silage *ad libtium* in almost two equal meals daily at 8 a.m. and 4 p.m. The water was available in plastic buckets all day round. Samples of silages were taken at the beginning, middle and end of digestibility trails. Total collection of feces from each ram was weighed daily during the collection period and samples (10% by weight) of each daily collection were taken.

Chemical analysis: Samples of silages and feces were dried in a forced air oven at 65°C for 48 hours, thoroughly mixed and representative samples were ground and chemically analyzed to determine the contents of CP, CF, EE and ash according to the methods of AOAC (1990).

Statistical analysis: Data was statistically analyzed using general linear model procedure adapted by SPSS for windows (2004) for user's guide with a one-way ANOVA. Also, Duncan test within program SPSS was done to determine the level of significance between means.

RESULTS AND DISCUSSION

Yield of fresh and ensiled whole corn plant and its parts: Results concerning the yield of whole corn plant forage, silage and its relative parts are presented in Tables (1&2). There were no significant differences ($P>0.05$) in the yield and percentages of forage, silage and plant parts; ensiling losses between white and yellow corn hybrids. The yield of whole plant forage, silage, ear, grain, cob, stover and stalks were significantly higher ($P>0.05$) for summer compared with nili crop. However, there were no significant differences (P>0.05) in the yield of leaves and ensiling weight losses between summer and nili crops. Moreover, the percentages of ear and grain were significantly higher (P<0.05), while the percentages of stover, leaves and ensiling losses were significantly lower (P<0.05) for summer compared with nili crop. These may be attributed to that the weather conditions during nili season such as lower environmental temperature and falling rain are not suitable for growing corn crop. These results may be due to the higher DM content of summer crop than nili crop (Table 3). These results are in accordance with those obtained by Fernandez and Klopfenstein (1989) and Mahanna (1994). Bendary *et al.* (2001) found that the higher yield of plant corn forage and silage crops were recorded by summer crops.

Table 1: Yield of whole plant forage, silage and plant parts (ton DM / feddan) (fed. = 0.42 ha.).

Item	Forage[1]	Silage	Ear[2]	Grain	Cob	Stover[3]	Stalks	Leaves
Type of hybrids								
White	5.66	5.36	2.23	1.71	0.52	3.43	2.18	1.25
Yellow	5.21	4.93	2.17	1.69	0.48	3.04	2.05	0.99
Cultivation season								
Summer	6.28^{a}	6.00^{a}	2.74^{a}	2.17^{a}	0.57^{a}	3.54^{a}	2.35^{a}	1.19
Nili	4.55^{b}	4.24^{b}	1.55^{b}	1.12^{b}	0.43^{b}	3.00^{b}	1.87^{b}	1.13
Stage of maturity								
Milk	4.49^{c}	4.16^{c}	1.51^{b}	1.11^{b}	0.40^{c}	2.98^{b}	1.85^{b}	1.13
Dough	6.31^{a}	6.01^{a}	2.58^{a}	1.99^{a}	0.59^{a}	3.73^{a}	2.53^{a}	1.20
Hard	5.45^{b}	5.23^{b}	2.52^{a}	2.00^{a}	0.52^{b}	2.93^{b}	1.93^{b}	1.00
Plant density (thousand/feddan)								
20	5.00^{c}	4.77^{c}	2.24^{a}	1.72^{a}	0.52	2.76^{c}	1.70^{c}	1.06^{c}
25	5.45^{b}	5.15^{b}	2.19^{ab}	1.68^{ab}	0.51	3.33^{b}	2.06^{b}	1.27^{b}
30	5.99^{a}	5.62^{a}	2.10^{b}	1.60^{b}	0.50	3.89^{a}	2.40^{a}	1.49^{a}

a, b and c: Means in the same row with different superscripts differ significantly (P<0.05).
[1] Forage crop = ear + stover [2] Ear = grain + cob [3] Stover = stalks + leaves

The yield of forage, silage and plant parts crop increased significantly (P<0.05) with advancing maturity from milk to dough stage and decreased significantly (P<0.05) afterwards at hard stage of maturity (Table 1). The percentages of ear, grain and cob increased significantly (P<0.05), while the percentages of ensiling loss, stover, stalks and leaves decreased significantly (P<0.05) with advancing stage of maturity (Table 2). Moreover, the yield of forage, silage and plant parts increased significantly (P<0.05) with increasing plant density (Table 1). The percentages of ensiling loss, stover, stalks and leaves increased significantly (P<0.05), while the percentages of ear, grain and cob decreased significantly (P<0.05) with increasing plant density. These results are in accordance with those obtained by Adesogan (2006) who stated that corn hybrids should be harvested at about 34% DM (66% moisture) as this maturity stage gave the best combination of yield. Cuomo *et al.* (1998) found that total forage mass was greater at higher plant densities than at lower plant densities. Within the stem and grain components, grain concentration decreased and stem concentration increased. Wang *et al*. (2005) and Armstrong and Albrecht (2008) reported that with the increase of plant population, fresh and dry matter yield per hectare of maize significantly increased.

Table 2: Relative yield of plant parts and ensiling losses (% of forage yield). loss

Item	Ensiling	Ear[1]	Grain	Cob	Stover[2]	Stalks	Leaves
Type of hybrids							
White	5.30	39.40	30.21	9.19	60.60	38.52	22.08
Yellow	5.18	41.65	32.44	9.21	58.35	39.35	19.00
Cultivation season							
Summer	4.46[b]	43.94[a]	34.70[a]	9.24	56.06[b]	37.20	18.76[b]
Nili	6.72[a]	34.05[b]	24.61[b]	9.43	65.95[a]	41.12	24.83[a]
Stage of maturity							
Milk	7.34[a]	33.72[c]	24.73[c]	8.99	66.28[a]	41.19[a]	25.09[a]
Dough	4.77[b]	40.46[b]	31.00[b]	9.46	59.54[b]	40.25[a]	19.28[b]
Hard	4.04[c]	46.43[a]	36.88[a]	9.55	53.57[c]	35.32[b]	18.25[b]
Plant density (thousand/feddan)							
20	4.61[c]	44.80[a]	34.40[a]	10.40[a]	55.20[c]	34.00[c]	21.20[b]
25	5.51[b]	39.67[b]	30.43[b]	9.24[b]	60.33[b]	37.32[b]	23.01[ab]
30	6.18[a]	35.06[c]	26.71[c]	8.35[c]	64.94[a]	40.07[a]	24.87[a]

a, b and c: Means in the same row with different superscripts differ significantly ($P<0.05$).
[1] Ear = grain + cob [2] Stover = stalks + leaves

Silage quality characteristics: Observation of different corn silages indicated that all tested silages were free from moldy, characterized with suitable fermentation characteristics yellowish green color and good smell. Results of fermentation characteristics of different silages are shown in Table (3). The concentration of lactic acid was significantly higher ($P<0.05$), while pH value and the concentrations of acetic, propionic and isovaleric acids were significantly lower ($P<0.05$) for white than yellow corn hybrids silage. However, there were no significant differences ($P>0.05$) in the concentrations of NH_3-N, isobutyric, butyric and valeric acids between white and yellow corn hybrids silage. The concentrations of NH_3-N, lactic and butyric acids was significantly higher ($P<0.05$) for nili than summer corn silage. However, the differences in pH value and the concentrations of acetic, propionic, isobutyric, isovaleric and valeric acids between summer and nili corn silages were not significant ($P>0.05$).

The concentrations of ammonia-N, lactic, butyric, isovaleric and valeric acids decreased significantly ($P<0.05$), while pH value and the concentrations of acetic, propionic and isobutyric acids increased significantly ($P<0.05$) with advancing stage of maturity of corn silage. The pH value and the concentrations of ammonia-N, isobutyric, butyric, isovaleric and valeric acids increased significantly ($P<0.05$), however the concentrations of lactic, acetic and propionic acids decreased significantly ($P<0.05$) with increasing plant density. There was an inverse relationship between silage pH value and lactic acid concentration. Gaafar (2001) found that the concentration of NH_3-N increased in corn silage with high moisture content. Higher moisture contents often predispose to undesirable heterolactic fermentations and greater proteolysis (Adesogan and Kim, 2005). Wang *et al*. (2005) found that silage quality of whole forage maize varied with plant density. As increased plant densities have resulted in reduced maize forage quality (Cox and Cherney 2001). Arriola *et al*. (2005) found that compared the fermentation quality of corn silage harvested at DM contents of 26, 34 and 39% (corresponding to moisture contents of 74, 66 and 61%), revealed that fermentation quality was optimized at 34% DM (66% moisture).

Table 3: Fermentation characteristics of whole plant corn silage.

Item of TN	pH	NH_3-N %	VFA's fractions % of DM						
			Lact.	Acet.	Prop.	Isobut.	But.	Isoval.	Val.
Type of hybrids									
White	3.74^{b}	5.38	5.00^{a}	1.12^{b}	0.08^{b}	0.30^{a}	0.92	0.10^{b}	0.10
Yellow	4.11^{a}	5.58	3.63^{b}	1.52^{a}	0.18^{a}	0.18^{b}	0.95	0.16^{a}	0.07
Cultivation season									
Summer	3.92	4.18^{b}	4.39^{b}	1.26	0.17	0.26	0.79^{b}	0.12	0.09
Nili	3.79	7.03^{a}	4.67^{a}	1.27	0.15	0.25	1.13^{a}	0.13	0.09
Stage of maturity									
Milk	3.79^{b}	7.80^{a}	6.65^{a}	4.20^{c}	1.10^{c}	0.13^{c}	0.34^{a}	1.02^{a}	0.18^{a}
Dough	3.79^{b}	4.48^{b}	5.48^{b}	4.46^{b}	1.35^{b}	0.19^{b}	0.20^{b}	0.87^{b}	0.12^{b}
Hard	4.11^{a}	3.84^{c}	4.15^{c}	4.70^{a}	1.55^{a}	0.30^{a}	0.12^{c}	0.66^{c}	0.06^{c}
Plant density (thousand/feddan)									
20	3.78^{b}	4.15^{b}	4.70^{a}	1.55^{a}	0.30^{a}	0.12^{c}	0.66^{c}	0.06^{c}	0.05^{c}
25	3.92^{ab}	5.48^{ab}	4.46^{b}	1.35^{b}	0.19^{b}	0.20^{b}	0.87^{b}	0.12^{b}	0.11^{b}
30	4.03^{a}	6.65^{a}	4.20^{c}	1.10^{c}	0.13^{c}	0.34^{a}	1.02^{a}	0.18^{a}	0.16^{a}

a, b and c: Means in the same row with different superscripts differ significantly ($P<0.05$).

Chemical composition of ensiled whole corn plant: Chemical composition of corn silage is shown in Table (4). The content of DM was higher significantly ($P<0.05$) for yellow compared with white corn hybrids silage. These results attributed to that yellow corn hybrid matured early than the white corn hybrids. Otherwise, there were no significant differences ($P>0.05$) in the contents of OM, CP, CF, EE, NFE and ash of silage between white and yellow corn hybrids. The content of DM, OM and NFE of silage were significantly higher ($P<0.05$), while CP, CF, EE and ash contents were significantly lower ($P<0.05$) for summer compared with nili corn crops. The contents of DM, OM and NFE of whole plant corn silage increased significantly ($P<0.05$), while the contents of CP, CF, EE and ash decreased significantly ($P<0.05$) with advancing stage of maturity. However, the contents of DM, OM and NFE of whole plant corn silage decreased significantly ($P<0.05$), while the contents of CP, CF, EE and ash increased significantly ($P<0.05$) with increasing plant density. It could be noticed that, DM, OM and NFE contents increased with increasing the percentages of ear and grain, while the contents of CP, CF, EE and ash increased with increasing the percentages of stover, stalks and leaves. These results agreed with those obtained by Pinter *et al*. (1994) who found that CP and fiber fractions increased, while starch and soluble carbohydrates decreased with increasing plant density. Wang *et al*. (2005) found that crude protein, ether extract, crude fiber and nitrogen free extract significantly increased with plant density. Bolsen and Bolsen (2004) reported that corn silage should be harvested at 30 – 35% DM (or 70 – 65% moisture).

Table 4: Chemical composition of whole plant corn silage.

Item	DM %	Composition of DM %					
		OM	CP	CF	EE	NFE	Ash
Type of hybrids							
White	25.92^{b}	94.40	8.32	24.02	3.14	58.92	5.60
Yellow	32.63^{a}	94.34	7.93	23.75	2.88	59.78	5.66
Cultivation season							
Summer	32.78^{a}	95.10^{a}	7.78^{b}	22.39^{b}	2.79^{b}	62.14^{a}	4.90^{b}
Nili	22.37^{b}	93.49^{b}	8.71^{a}	25.86^{a}	3.39^{a}	55.53^{b}	6.51^{a}
Stage of maturity							
Milk	20.62^{c}	93.10^{c}	8.77^{a}	26.44^{a}	3.52^{a}	54.38^{c}	6.90^{a}
Dough	28.38^{b}	94.79^{b}	8.10^{b}	23.16^{b}	2.96^{b}	60.56^{b}	5.21^{b}
Hard	39.02^{a}	95.48^{a}	7.50^{c}	21.71^{b}	2.54^{c}	63.72^{a}	4.52^{c}
Plant density (thousand/feddan)							
20	31.00^{a}	95.10^{a}	8.03^{b}	22.01^{b}	2.86^{b}	62.20^{a}	4.90^{b}
25	28.16^{b}	94.43^{ab}	8.14^{a}	24.06^{ab}	3.08^{ab}	59.16^{ab}	5.56^{ab}
30	25.30^{c}	93.52^{b}	8.23^{a}	25.54^{a}	3.19^{a}	56.56^{b}	6.48^{a}

a, b and c: Means in the same row with different superscripts differ significantly (P<0.05).

Silage DM intake: The DM intake of different corn silages are shown in Table (5). There was no significant difference (P>0.05) in the DM intake of silage between white and yellow corn hybrids. Silage DM intake was significantly higher (P<0.05) for summer than Nili crop. Silage DM intake increased significantly (P<0.05) with advancing stage of maturity. The DM intake of different silages increased significantly (P<0.05) with increasing plant density. From these results and the composition and quality of summer and nili corn silage (Tables 3&4) it can be seen that DM intake decreased with increasing moisture content and the concentrations of TVFA's and NH_3-N. These results are in accordance with those obtained by McDonald *et al*. (1995).

Nutrients digestibility coefficients: Nutrients digestibility coefficients by rams for different silages are presented in Table (5). The digestibilities of DM, OM and NFE tended to be lower, while the digestibilities of CP, CF and EE tended to be higher for white than yellow corn hybrids silage. However, the digestibilities of DM. OM and NFE were significantly higher (P<0.05), while CP, CF and EE digestibilities were significantly lower (P<0.05) for summer crop silage compared with nili crop silage. The digestibilities of DM, OM and NFE increased significantly (P<0.05), while the digestibilities of CP, CF and EE decreased significantly (P<0.05) with advancing stage of maturity. However, the digestibilities of DM, OM and NFE decreased significantly (P<0.05), while the digestibilities of CP, CF and EE increased significantly (P<0.05) with increasing plant density. Nutrients digestibility coefficients revealed similar trend to chemical composition (Table 3), which the digestibilities of DM, OM and NFE increased with increasing ear and grain contents, while the digestibilities of CP, Cf and EE increased with increasing stover and leaves contents. These results are illustrated with those obtained by Okamoto (1989) and Gaafar (2004) they found that the digestibilities of CP, CF and EE decreased with increasing DM content of corn silage.

Nutritive values: Nutritive values of different corn silages are shown in Table (5). The TDN value was nearly similar for white and yellow corn hybrids silage, while DCP value tended to be higher for white than yellow hybrids silage. The TDN value was significantly higher (P<0.05), while DCP value was significantly lower (P<0.05) for summer crop silage compared with nili crop silage. The TDN value increased significantly (P<0.05), while the DCP value decreased significantly (P<0.05) with advancing stage of maturity. However, the TDN value decreased significantly (P<0.05), while the DCP value increased significantly (P<0.05) with increasing plant density. Mahanna (1994) found that TDN value increased, while DCP value decreased with the progress of maturity of corn silage. Pinter *et al.* (1994) reported that TDN value decreased, but DCP value increased with increasing plant density of corn silage. Arriola *et al*. (2005) found that compared the nutritive value of corn silage harvested at DM contents of 26, 34 and 39% (corresponding to moisture contents of 74, 66 and 61%), revealed that nutritive value was optimized at 34% DM (66% moisture).

Table 5: Dry matter intake, nutrients digestibility coefficients and nutritive values of whole plant corn silage.

Item	DM intake g/day	Digestibility coefficients %						Nutritive values%	
		DM	OM	CP	CF	EE	NFE	TDN	DCP
Type of hybrids									

White	1196.67	65.88	68.54	64.40	62.10	75.90	69.31	66.47	5.36
Yellow	1255.00	66.65	68.68	63.53	61.57	73.69	70.93	67.52	5.06
Cultivation season									
Summer	1317.00^{a}	68.24^{a}	63.50^{b}	64.13^{b}	61.27^{b}	73.08^{b}	73.87^{a}	69.29^{a}	4.99^{b}
Nili	1090.00^{b}	63.50^{b}	66.61^{a}	68.59^{a}	67.24^{a}	77.77^{a}	64.83^{b}	65.41^{b}	5.97^{a}
Stage of maturity									
Milk	1053.33^{c}	64.21^{b}	67.48^{b}	68.83^{a}	69.31^{a}	79.77^{a}	65.03^{c}	66.13^{b}	6.03^{a}
Dough	1251.25^{b}	66.06^{b}	68.49^{b}	66.66^{b}	63.09^{b}	74.10^{b}	70.49^{b}	67.68^{ab}	5.40^{b}
Hard	1390.00^{a}	69.17^{a}	70.42^{a}	60.93^{c}	57.51^{c}	70.37^{c}	75.81^{a}	69.48^{a}	4.57^{c}
Plant density (thousand/feddan)									
20	1287.50^{a}	66.59^{a}	68.64^{a}	64.73^{b}	63.02^{b}	72.75^{b}	71.90^{a}	68.47^{a}	5.20^{b}
25	1211.00^{ab}	65.43^{ab}	68.15^{ab}	65.85^{ab}	64.29^{ab}	75.17^{ab}	69.70^{ab}	67.28^{ab}	5.36^{ab}
30	1157.50^{b}	64.93^{b}	67.75^{b}	66.95^{a}	65.42^{a}	77.55^{a}	67.69^{b}	66.07^{b}	5.51^{a}

a, b and c: Means in the same row with different superscripts differ significantly (P<0.05).

Yield of nutritive values: Data concerning the yield of nutritive values of different corn silages are illustrated in Table (6). There were no significant differences (P>0.05) in the yield of TDN, DE and DCP per feddan between white and yellow corn hybrids. The yield of TDN, DE and DCP per feddan for summer crop were significantly higher (P<0.05) compared with nili crop. Corn silage harvested at dough stage of maturity recorded significantly (P<0.05) the higher yield of TDN, DE and DCP per feddan compared with those harvested at milk or hard stages of maturity. The yield of TDN, DE and DCP per feddan increased significantly (P<0.05) with increasing plant density. These results are in accordance with those obtained by Pinter et al. (1994) who showed that the yield of TDN, DE and DCP of corn silage increased with increasing plant density. Cox et al. (1998) found that maximum economic yields occurred at about 39,500 plants/acre. Wang et al. (2005) better nutritive value yield of whole forage maize can be achieved through the increase of the plant density.

Table 6: Yield of total digestible nutrients, digestible energy and digestible crude protein per feddan (fed. = 0.42 ha.).

Item	TDN (ton)	DE (MCal)	DCP (kg)
Type of hybrids			
White	3.56	15.70	287.30
Yellow	3.34	14.77	247.01
Cultivation season			
Summer	4.16^{a}	18.34^{a}	301.42^{a}
Nili	2.78^{b}	12.26^{b}	253.55^{b}
Stage of maturity			
Milk	2.75^{c}	12.12^{c}	250.94^{b}
Dough	4.07^{a}	17.94^{a}	322.48^{a}
Hard	3.63^{b}	16.00^{b}	239.29^{b}
Plant density (thousand/feddan)			
20	3.27^{b}	14.42^{b}	248.04^{b}

25	3.52^{ab}	15.52^{ab}	280.33^{ab}
30	3.73^{a}	16.45^{a}	310.76^{a}

a, b and c: Means in the same row with different superscripts differ significantly ($P<0.05$).

CONCLUSION

From these results it is preferred to cultivating yellow corn hybrids for making silage as well as saving white grain for human nutrition and it should be planted in summer season with plant density of about 30 thousand plants per feddan and harvested at dough stage of maturity to achieve the higher yield of silage crop as well as the yield of digestible nutrients.

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