Nature and Science

Websites:
http://www.sciencepub.net/nature
http://www.sciencepub.net

Emails:
naturesciencej@gmail.com
editor@sciencepub.net

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Studies on cutting dates and sowing distances on silage yield of interspecific hybrid of teosinte

EL-Gaafarey, T. G.; Badawy, A. S. M., Safwat Hussein Hatab and Diaa A.M.

Forage Crops Res. Sec. Field Crops Res. Inst., A. R. C. Giza, Egypt
tamerelgafarey@gmail.com

Abstract: This study was carried out at Sakha Agricultural Research Station, ARC, Egypt, in 2019 through 2020. The main objectives of the present study to, 1) Estimate cutting date and plant distance for hybrid teosinte, 2) Determine the traits plant height, number of stems plant-1, stem diameter, number of ears plant-1, fresh yield, dry yield and 3) Studied protein and fiber content for high production of fresh fodder or silage yields. Using the split plot design with four replications the main plot was sowing distances (25, 30 and 35 cm) and sub plot was cutting date of silage (100,110 and 120 days). One of the limitations of efficient livestock production in Egypt is the lack of adequate amount of high quality forage in summer. So great effort has been made to increase forage yield quality and quantity per unit area. Sowing distances had highest significant increase in fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm), in first, second summer seasons and combined analysis as compared with the other method of plant distance, which gave the highest value when sowing distances 35cm. Means of combined analysis recorded 184.1 kg/ plot, 54.47 kg/ plot, 476.9 cm and 2.73 cm for fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm), respectively. This increase in growth characters could be due to that sowing distances in 35 cm between hills was more favor to plant growth which affected by competition among plants for nutrients, moisture, sunlight and other growth sources. Increasing cutting date from 100 days to 120 days caused significant gradually increasing in plant height, stem diameter and number of stems /plant in summer seasons 2019 and 2020 and combined analysis. Therefore, 120 days gave the highest values of above mention characters which recorded 172.6 kg/ plot, 51.16 kg/ plot, 467.1 cm and 2.38 cm for fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm), respectively for the mean of the combined analysis. On the other hand, results showed that increasing cutting date from 100 to 120 days caused significantly increased in No. of stem/plant 2.94 and No. of ears/plant 109.67 for combined analysis. Meanwhile, increasing cutting date from 100 to 120 days caused decreased in fresh leaf stem /percent 31.88% and dry leaf stem /percent 40.13% for combined analysis. Over all means CP, and CF were highly significant for sowing distances and cutting date. Data revealed that 3rd distance (35 cm) had highest mean value for crude protein in first, second and combined data which had 11.02 ,11.33 and 11.17%, respectively. Also, the highest mean for crude fiber was 3rd plant distance (35cm) with 3rd cutting date (120days) which had 36.28% for combined analysis. In conclusion, sowing distances (35cm) with cutting date (120 days) had the best mean value for fresh and dry yield. we recommended make more studies on hybrid maize teosinte reduced for Egyptian feed gap.
[EL-Gaafarey, T. G.; Badawy, A. S. M., Safwat Hussein Hatab and Diaa A.M **Studies on cutting dates and sowing distances on silage yield of interspecific hybrid of teosinte.** *Nat Sci* 2023;21(9):1-12]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 01. doi:10.7537/marsnsj210923.01.

Keywords: hybrid Maize (*Zea mays* L.) x Teosinte (*Zea Mexicana*), Maizente, sowing distances, Cutting date, Silage quality

1. Introduction

Due to the fodder gap in the summer and the severe shortage of green fodder, much of the animal production came to making silage from maize to decrease the gap, but this leads to low of maize production, which means lack required for concentrated feed. This search fixes this problem; one of the limitations of efficient livestock production in Egypt is the lack of adequate amount of high quality forage in summer. So great effort has been made to increase forage yield quality and quantity per unit area. Maize –Teosinte hybrids could provide an answer to overcome the problem of shortage in fodder production. The aim to increase livestock productivity and farm income in Egypt has led to introduction and adoption of new technologies, forages conservation as silage is one of feed technologies it can be used to improve quality and availability of forages all year round. Moreover, it would be enhancing and maintain milk production and avoid the dietary disorder as the result of traditional winter and summer feeding systems. Furthermore, green forge conservation plays important role in significant decrease the feeding cost.

The production of forages in sufficient quantity and quality throughout the year becomes a necessity in all production systems. It aims to higher productivity and improve milk and meat production at considerably low cost. In additions to partially fill the gap in protein and energy shortage. Ensilage has been used as an alternative in fodder preservation with view to greater productivity and animal performance. Therefore, the development of Egyptian agriculture must move to efficient and more demanded production systems to increase competitiveness and ensure sustainability Walaa Mousa et al.,(2017).

Maize – Teosinte hybrids have been of considerable interest to both maize and teosinte breeders. The close genetic relationship between the two species has stimulated interest in enriching the gene pool of teosinte with useful genes from maize. Hybridization between these two crops was started in early thirty's in India khan(1957)and Gill and Patil, (1985). Hybrids between maize (Zea mays L.) and teosinte (Zea. mexicana Schrad) were evaluated for fodder production by Chaudhuri and Prasad (1969). They reported that the maize-teosinte hybrids are superior in forage yield and quality compared with corn . Hybrids plants were taller, having higher leaf area and greater number of tillers than corn . Maize-teosinte hybrids had longer vegetative period than maize but were much earlier than teosinte in flowering habit and had a profuse number of cobs plant-1. Hybrids grew more quick than their parents and on average had 2-3 tillers and more leaves plant-1 than maize. Fodder from hybrids had higher crude protein and sucrose contents than parents. The information about "maizente" has been given by several authors Alan and Sundberg (1994); Habeba (2006); Rady(2007); Sakar and Ghazy(2010); Rady(2011) and Abdel –Aty et al (2013). Estimation of the average better parent for fresh yield in maize- teosinte hybrids (maizente)ranged from 195.3% to 51.97% according to Abdel –Aty et al (2013).value and crude protein (CP) content was differed significantly among the treatments Walaa, et al (2017).The main objectives of the present study, 1) to estimate cutting date and sowing distances for hybrid teosinte, 2) determine the traits plant height, number of stems plant-1, stem diameter, number of ears plant-1, fresh yield, dry yield and 3) studied protein and fiber content for high production of fresh fodder or silage yields. The production of forages in sufficient quantity and quality throughout the year becomes a necessity in all production systems. Thus, ensilage has been med as an alternative in fodder preservation with view to greater and animal performance. Therefore, the development of the Egyptian agriculture must move to efficient and more demanded production systems to increase competitiveness and ensure sustainability. The large use of maize for silage making is mainly due to its chemical composition, which meets the requirements to making good forage for silage combined with high productivity. However, there have been attempts to identify hybrids with better production potential and nutritional quality for silage, with good rate between stems, leaves and grains, since there is a high correlate on between the nutritional value of a culture and its silage Khristova et al. (1985). Teosinte "Zea mexicana" is one of the most important summer forage crops which closely relate to maize in most allelometric characters. It has the advantage of tillering and regeneration as a fodder crop; it is a good source of energy and crude fiber. Teosinte was recently expanded as a summer forage crops in Egypt Shieh et al. (1995). Zea mexicana is a summer multi cut grass and has high productivity and it recover quickly after grazing or cutting. The first cut can be taken after 70 days of sowing where the plant height is 80-100 cm. total fresh forage yield reaches 30 – 40 t fed-1. (3-4 cuts). Teosinte has a high nutritive value because it has a high leaf / stem ratio. It also has high protein content, therefore, it more palatable. Average protein content % , crude fiber % , were 11.2 , 30.0, , respectively Ibrahim Hoda (1998) and Abd El-Maksoud, et al.(1998). Maize as fresh forage crop, produce only one cut. Meanwhile, teosinte is a highly productive summer forage crop. Characterized by strong leafy stem, much tillers and high palatability. Both teosinte (Zea mexicana) and maize (Zea maize) are botanically closely related. So that, highly productive and nutritive hybrid teosinte x maize might be expected Jode et al (1996) , Jode and James (1996) and Abdel-Aty et al (2013).

Maize teosinte hybrids have been of considerable interest to both maize and teosinte breeders. In this respect, Chaudhury and Prasad (1969) reported a successful production of hybrids between maize and teosinte and a considerable amount of heterosis was observed in most hybrids, Information about the hybrids between maize and teosinte has been given by many authors Smith et al., (1984); Aulicino and Magoja, (1991); Alan and Sundberg, (1994); Rady, (2007); Habeba, (2006); Sakr et al., (2009); Sakr and Ghazy, (2010); Nancy et al., (2012) Brriera et al. (1984) studied protein content and agronomic value of maize x teosinte and reached that high fodder and protein yields. Shieh et al. (1995) studied tillering, ratooning and some agronomic characteristics of maize, teosinte and their hybrids. They found that the hybrids had fewer tillers than the teosinte and the hybrid had the best ratooning ability.

In Egypt, maize silage is the most common one used. The total planted area of maize crop was approximately 2.5 million fed. Agriculture Economics and Statistics Institute, Ministry of Agriculture, (2016).Importance of maize production is increasing year after year because of its value for silage production as well as grain production.

Maize silage plays an important role as a main feed in the livestock industries for many countries. The main reasons for popularity of maize for silage purpose are the high yield obtained in single harvest it can be ease ensiled and its high energy value as a feed Topps and Oliver, (1993) and Todorova and lidanki(1985). Definitely, introducing new forage crops instead of maize crop with high DM yields and can be ensiled to avoid the rapid increase of making maize silage and decreases import great quantity of maize grains. Walaa Mousa et al. (2017) evaluated production characteristics of eight genotypes (six maize hybrids) and local teosinte and its hybrid with maize with their silages and found that hybrid of (maize x teosinte) produced the highest total fresh, dry forages yield value with good quality silage.

2. Material and Methods

This study was carried out at Sakha Agricultural Research Station, ARC, Egypt, in 2019 through 2020. Using the split plot design with four replications the main plot were sowing distances 25,30 and 35 between hills and take off the hill to one plant before the first irrigation and sub plot had cutting dates of silage where it were 100,110 and 120 days from sowing. Each plot consisted of five ridges 4m long and 0.6 meter apart. Sowing took place in 20 and 22 May in first and second season. All cultural practices for silage interspecific hybrid of teosinte production were applied as recommended. Nitrogen fertilizer (120kg N/fad) was added at three equal doses; just before the first, second and the third irrigations. At harvest, a random sample of five guarded plants from each plot was used .Data recorded on silage interspecific hybrid of teosinte (Teosinte Sakha* SC168) in forage silage stage for:

1- Plant height (cm).
2- Stem diameter (cm).
3- No. of tillering /plant.
4- No. of ears/plant.
5- Fresh leaf stem / percent.
6-Dry leaf stem / percent.
7-Fresh forage yield (kg/ plot).
8-Dry forage yield (kg/ plot).
9- Crude protein %.
10- Crude fiber %.

Statistical analyses:

Separate and combined analyses of variances were carried out according to Snedecor and Cochran (1989) using the computer program Mstat-C (1986) combined analysis, homogeneity test of variance was computed according to Bartlett (1937). Mechanical and chemical properties were analyzed of the experimental soil at Sakha region, Agric. Res. Station, according to Piper (1950) and Page et al. (1982) presented in Table (1) as follows:

Table 1: The different properties (mechanical and biochemical) of the used soil

Season	Feature	Value
1st	Texture	Clayey
	pH (1: 2.5)	8.44
	EC	3.65 dSm-1
	OM	15.33 g Kg-1
	Nitrogen	15.20 mg Kg-1
	Phosphorus	9.76 mg Kg-1
	Potassium	355.00 mg Kg-1
2nd	Texture	Clayey
	pH (1: 2.5)	8.47
	EC	3.63 dSm-1
	OM	18.10 g Kg-1
	Nitrogen	16.33 mg Kg-1
	Phosphorus	10.91 mg Kg-1
	Potassium	359.12 mg Kg-1

3. Results and discussion

A.Growth characters:

A.1. Mean squares:

Mean squares for all studied traits are presented in Table (2) and Table (3).Data raveled that sowing distances and cutting date were highly significant for fresh forage yield (kg/ plot), Dry forage yield (kg/ plot), Plant height (cm.) ,Stem diameter (cm), No.of stem/plant, Fresh leaf stem /percent, dry leaf stem /percent ,and No.of ears/plant in first and second season and combined data, except fresh leaf stem/percent in sowing distances and cutting date in first ,second seasons and their combined data. Also, dry leaf stem/percent in sowing distances in first ,second seasons. This results were similar with Cocuera (1991)and Guang and Hung(1995). Meanwhile, the interaction between sowing distances and cutting date for most traits insignificant this means no relationships between sowing distances and cutting date.

A.1. Effect of sowing distances:

Results presented in Tables (4 & 5) indicated clearly that 3rd distance (35 cm)showed the highest significant increase in fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm), in first ,second summer seasons and combined analysis as compared with the other method of sowing distances, which gave the highest value when plant distance 35cm .Means of combined analysis recorded 184.1 kg/ plot, 54.47 kg/ plot, 476.9 cm and 2.73 cm for fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm), respectively.

Table (2) Mean squares of two seasons and combined data for fresh ,dry forage yield, plant height and Stem diameter (cm)

	First season				
S.O.V.	d.f	Fresh forage yield (kg/ plot)	Dry forage yield (kg/ plot)	Plant height (cm.)	Stem diameter (cm)
replication	3	20.5	1.225	25.520	0.0010
sowing distances (A)	2	5321.64**	541.454**	9295.75**	3.254**
error	6	15.7	0.998	8.600	0.0001
cutting date (B)	2	309.24**	114.944**	781.08**	0.127**
AB	4	8.58N.S	0.857N.S	82.83**	0.004N.S
error	18	11.7	1.173	4.660	0.004
Total	35	-	-	-	-
	Second season				
replication	3	295.274	30.445	17.509	0.003
sowing distances (A)	2	1426.53**	319.039**	230.028**	1.694**
error	6	12.399	0.976	18.065	0.003
cutting date (B)	2	194.410**	57.726**	755.111**	0.301**
AB	4	2.031 N.S	0.318N.S	11.778N.S	0.004N.S
error	18	3.316	0.228	17.963	0.010
Total	35	-	-	-	-
	Combined data				
years	1	5465.351	403.898	33497.347	0.117
Rep	6	157.897	15.835	21.514	0.002
sowing distances (A)	2	6129.315**	844.523**	6224.847**	5.103**
year(Y)*distance plant (A)	2	618.855**	15.980**	3300.931**	0.175**
error	12	14.059	0.987	13.330	0.003
cutting date (B)	2	490.715**	167.413**	1533.764**	0.405**
year(Y)*age cutting(B)	2	12.935 N.S	5.257**	2.431 N.S	0.023*
ab	4	5.186 N.S	0.588 N.S	75.722 N.S	0.002 N.S
yab	4	5.426 N.S	0.587 N.S	18.889 N.S	0.006 N.S
error	36	7.498	0.700 N.S	11.31	0.007 N.S
Total	71	-	-	-	-

Table (3) Mean squares of two seasons and combined data No. of stem/plant, Fresh leaf stem /percent, dry leaf stem /percent and No. of ears/plant.

	First season 2019				
S.O.V.	d.f	No.of stem/plant	Fresh leaf stem /percent	dry leaf stem /percent	No.of ears/plant
replication	3	0.100	0.22	16.708	11.435
sowing distances (A)	2	0.775 **	1.30 N.S	52.727 N.S	58.528*
error	6	0.024	0.67	19.432	2.935
cutting date (B)	2	0.273**	1.094 N.S	41.769**	28.86 **
AB	4	0.024N.S	0.599 N.S	14.133*	0.2778 N.S
error	18	0.028	0.22	3.110	0.768
Total	35	-	-	-	-
	Second season2020				
replication	3	0.291	0.987	103.662	14.546
sowing distances (A)	2	0.680*	1.30 N.S	52.727 N.S	47.194 N.S
error	6	0.096	0.668	19.432	2.824
cutting date (B)	2	0.1919**	1.094 N.S	41.769**	31.694**
AB	4	0.008 N.S	0.599 N.S	14.133 *	0.403 N.S
error	18	0.0273	0.220	3.110	0.982
Total	35	-	-	-	-
	Combined data				
years	1	1.027 N.S	3.251	95.220	4.5
Rep	6	0.195	0.602	60.185	12.991
sowing distances (A)	2	1.453 **	2.601 N.S	105.454*	104.85**
year(Y)* sowing distances (A)	2	0.0022 N.S	0.00011 N.S	0.0001 N.S	0.875 N.S
error	12	0.0608	0.668	19.432	2.879
cutting date (B)	2	0.4605 **	2.187 N.S	83.537**	60.389**
year(Y)* cutting date(B)	2	0.0038 N.S	0.0001 N.S	0.0001 N.S	0.1667
ab	4	0.0122 N.S	1.197**	28.266**	0.4514
yab	4	0.0014 N.S	0.0001 N.S	0.0001 N.S	0.229 N.S
error	36	0.028	0.220	3.110	0.875
Total	71	-	-	-	-

This increase in growth characters could be due to that sowing distance in 35 cm between hills was more favor to plant growth which affected by competition among plants for nutrients, moisture, sunlight and other growth sources. These results are in agreement with those reported by Iptas et al (2002),Salama(2019),Lak at al.(2006). Haggag et al. (1986) and Hssan et al. (2019). Also, Salem, (2015) reported that increasing plant density from 17500 to 35000 caused noticeable increase in plant height of sorghum plants. Although , No.of stem/plant, Fresh leaf stem /percent, dry leaf stem /percent and No.of ears/plant showed insignificant and significant ,but the highest mean values was sowing distance in 35 cm which had 3.03 ,31.88,44.22 and 111.04 for combined analysis, respectively in Table (5**).**

A.2. Effect of cutting date:

Tables (4 & 5) showed that increasing cutting date from 100 days to 120 days caused significant gradually increasing in plant height , stem diameter and number of stems /plant in summer seasons 2019 and 2020 and combined analysis. Therefore, 120 days gave the highest values of above mention characters which recorded 172.6 kg/ plot , 51.16 kg/ plot , 467.1 cm and 2.38 cm for fresh forage yield (kg/ plot), dry forage yield (kg/ plot), plant height(cm.) and stem diameter (cm),respectively for the mean of the combined analysis Table(4).

On another hand, results in Tables (5) showed that increasing cutting date from 100 to 120 days caused significantly increased in No.of stem/plant 2.94 and No.of ears/plant 109.67 for combined analysis .Meanwhile, increasing cutting date from 100 to 120 days caused decreased in fresh leaf stem /percent 31.88% and dry leaf stem /percent 40.13% for combined analysis. These results may be attributed to the intra-plant competition on nutrient and radiation. Many investigators found similar results Ibrahim Hoda (1998) found that leaf / stem ratio was significantly decreased with increasing seeding rates. The reduction in leaf / stem ratio as a result of increasing seeding rates is probably due to the high competition between plants for light, water and nutrients. Also, Guang and Hung(1995) reported that cutting date caused noticeable increase in plant height.

A.3. Effect of interaction between sowing distances and cutting date:

Data showing the effect of the interaction between sowing distance and cutting date on Tables (4 & 5) indicated insignificant in fresh forage yield , dry forage yield in first, second season and their combined analysis, but plant height had highly significant in first season and combined data. Similar results were obtained by Mekasha et al (2022).

Also, growth parameters, i.e. No.of stem/plant was insignificant for first , second season and combined data. Fresh leaf stem /percent was insignificant for first ,second season but highly significant in combined analysis .Meanwhile dry leaf stem /percent had significant for first and second season and highly significant in combined data and .No.of ears/plant had insignificant in both season and significant for combined data in Table (5).

Table (4) Mean performance of morphological characters of the first seasons and combined data for Fresh ,dry yield (kg/ plot), Plant height (cm.) and Stem diameter (cm)

Treatments		Fresh forage yield (kg/ plot)			Dry forage yield (kg/ plot)			Plant height (cm.)			Stem diameter (cm)		
		First season	Second season	Combined	First season	Second season	Combined	First season	Second season	Combined	First season	Second season	Combined
A-Main(S.D.)		–	–	–	–	–	–	–	–	–	–	–	–
a1 (25cn)		138.3	166.1	152.2	39.6	45.66	42.62	412.5	477.3	444.9	1.68	1.93	1.81
a2 (30cn)		160.4	177.4	168.9	46.4	51.60	49.00	434.3	480.6	457.4	2.18	2.27	2.23
a3 (35cn)		180.4	187.9	184.1	53.0	55.93	54.47	467.8	486.0	476.9	2.78	2.68	2.73
Sign		**	**	**	**	**	**	**	**	**	**	**	**
L.S.D. 0.05		3.96	3.5	1.6	2.00	0.99	0.99	2.93	4.2	2.0	0.045	0.06	0.05
Sub-B(C.D.)		–	–	–	–	–	–	–	–	–	–	–	–
b1 (100)		154.1	173.1	163.6	43.0	48.81	45.91	429.75	472.8	451.3	2.10	2.13	2.12
b2 (110)		161	177.1	169.1	46.8	51.19	49.02	438.92	482.8	460.8	2.42	2.30	2.27
b3 (120)		164	181.2	172.6	49.1	53.19	51.16	445.83	488.4	467.1	2.30	2.45	2.38
Sign		**	**	**	**	**	**	**	**	**	**	**	**
L.S.D. 0.05		2.93	1.6	1.6	1.86	0.41	0.49	1.85	3.6	2.0	0.050	0.09	0.05
Interaction A x B		–	–	–	–	–	–	–	–	–	–		
a 1	b 1	134.4	161.8	148.1	36.8	43.34	40.08	409.3	471.0	440.1	1.58	1.80	1.69
	b 2	139.2	166.1	152.7	39.9	45.81	42.88	410.8	477.5	444.1	1.73	1.90	1.81
	b 3	141.3	170.4	155.8	42.0	47.84	44.90	417.5	483.5	450.5	1.75	2.10	1.93
a 2	b 1	154.5	173.7	164.1	42.8	49.64	46.22	426.0	471.3	448.6	2.08	2.10	2.09
	b 2	162	178.0	170.0	47.1	51.75	49.45	434.8	482.8	458.8	2.18	2.30	2.24
	b 3	164.7	180.6	172.7	49.3	53.41	51.34	442.0	487.8	464.9	2.30	2.40	2.35
a 3	b 1	173.4	183.9	178.6	49.4	53.46	51.44	454.0	476.0	465.0	2.65	2.50	2.58
	b 2	181.8	187.3	184.5	53.4	56.01	54.73	471.3	488.0	479.6	2.83	2.70	2.76
	b 3	186	192.5	189.3	56.2	58.33	57.25	478.0	494.0	486.0	2.85	2.85	2.85
Sign		N.S	N.S	N.S	N.S	N.S	N.S	**	N.S	**	N.S	N.S	N.S
L.S.D . 0.05		–	–	–	–	–	–	3.21	–	3.41	–	–	–

Table (5) Mean performance of morphological characters of two seasons and combined data for No.of stem/plant, Fresh, dry leaf stem /percent, No.of ears/plant

Treatments		No.of stem/plant			Fresh leaf stem /percent			dry leaf stem /percent			No.of ears/plant		
		First season	Second season	Combined	First season	Second season	Combined	First season	Second season	Combined	First season	Second season	Combined
A-Main(S.D.)		–	–	–	–	–	–	–	–	–	–	–	–
a1 (25cn)		2.41	2.667	2.54	32.98	32.75	32.54	39.29	41.59	40.44	107.08	106.67	106.88
a2 (30cn)		2.68	2.933	2.80	32.00	32.43	32.21	39.60	41.90	40.75	109.33	109.17	109.25
a3 (35cn)		2.925	3.142	3.03	31.67	32.09	31.88	43.07	45.37	44.22	111.50	110.58	111.04
Sign		**	*	**	N.S	N.S	*	N.S	N.S	*	**	*	**
L.S.D. 0.05		0.157	0.311	0.264	_	_	0.28	_	_	1.03	1.71	1.68	1.067
Sub-B(C.D.)		_	_	_	_	_	_	_	_	_	_	_	_
b1 (100)		2.53	2.80	2.67	32.26	32.68	32.47	42.67	44.97	43.82	107.67	107.17	108.26
b2 (110)		2.65	2.89	2.77	32.07	32.49	32.28	40.31	42.61	41.46	109.50	108.83	109.27
b3 (120)		2.83	3.05	2.94	31.67	32.09	31.88	38.98	41.28	40.13	110.75	110.42	109.67
Sign		**	**	**	*	*	**	**	**	**	**	*	**
L.S.D. 0.05		0.143	0.142	0.199	0.40	0.40	0.28	3.03	1.51	1.03	0.752	0.85	0.55
Interaction A x B		–	–	–	–	–	–	–	–	–	–	–	–
a 1	b 1	2.32	2.60	2.46	32.08	32.50	32.29	42.48	44.78	43.63	105.25	104.75	105.00
	b 2	2.37	2.65	2.51	32.70	33.13	32.91	39.83	42.13	40.98	107.5	107.00	107.25
	b 3	2.55	2.75	2.65	32.20	32.63	32.41	35.58	37.88	36.73	108.50	108.25	108.38
a 2	b 1	2.52	2.80	2.66	32.50	32.93	32.71	41.90	44.20	43.05	107.75	107.50	107.62
	b 2	2.67	2.90	2.78	31.90	32.33	32.11	39.15	41.45	40.30	109.25	109.25	109.25
	b 3	2.85	3.10	2.97	31.60	32.03	31.81	37.75	40.05	38.90	111.00	110.75	110.88
a 3	b 1	2.75	3.00	2.87	32.20	32.63	32.41	43.63	45.93	44.78	110.00	109.25	109.63
	b 2	2.92	3.13	3.02	31.60	32.03	31.81	41.95	44.25	43.10	111.75	110.25	111.00
	b 3	3.10	3.30	3.03	31.20	31.63	31.41	43.63	45.93	44.78	112.75	112.25	112.50
Sign		N.S	N.S	N.S	N.S	N.S	**	*	*	**	N.S	N.S	N.S
L.S.D . 0.05		_	_	_	_	_	0.48	2.62	3.97	1.79	_	_	_

B-Quality characters:

B1-Mean squares

Chemical analysis of samples were taken to determine CP and CF according to the methods of AOAC (2012). Results in Table (6) showed that sowing distances had high significant for crude protein in first ,second season and combined analysis .Meanwhile ,cutting date had significant for first , second season but insignificant for combined analysis. While crude fiber had insignificant in first ,second season and combined analysis Gaafar et al.(2019).

B2-Mean performance

B2-1- Effect of sowing distances:

Chemical composition of crude protein and crude fibers Table (7) indicated that overall means of CP was highly significant for sowing distances and cutting date. Data revealed that 3rd distance (35 cm) had highest mean value for crude protein in first , second and combined data which had 11.02 ,11.33 and 11.17%,respectively are in agreement with those of Walaa Mousa et al. (2017), Gaafar et al(2019) ,Javadi et al. (2005), Mekhail (1970) and Mousa(1986).Also, crude fiber had highest mean values for 3rd distance which had 35.93,35.63 and 35.78 % for first ,second and combined data, respectively but insignificant in first ,second and combined data .

B2-2- Effect of cutting date:

Means of values in Table (7)revealed that high significant between cutting date from 100 days to 120 days caused gradually decreased crude protein and ob sessive for crude fiber which increasing. Crude protei n decreased with cutting date from 100 to 120 days for first ,second season and their combined data which ha d 9.60,10,02 and 9.81%,respectively .Meanwhile, crud e fiber increasing from cutting date 100 to 120 days ,w hich had 34.43,34.13 and 34.28%,respectively Similar results obtained by Silva et al.(2017) and Srour et al.(2 022).

B2-3- Effect of interaction between sowing distances and cutting date.

Although ,the interaction between sowing distances and cutting date had insignificant in Table (7) .The highest mean of crude protein was 3rd sowing distances (35 cm) with 1st cutting date (100 days)which had 11.60 % for combined analysis .Meanwhile, the highest mean for crude fiber was 3rd sowing distances (35cm) with 3rd cutting date (120days)which had 36.28% for combined analysis Thelen(2006),Palacios and Magoja(1988), Sohoo et al (1993), Abd El-Maksoud, et al.(2001).

Table (6)Mean squares of two seasons and combined data for Crude Protein % and Crude Fiber %

S.O.V.	First season		
	d.f	Crude Protein %	Crude Fiber %
replication	3	0.982	0.956
sowing distances (A)	2	21.103**	76.00 N.S
error	6	0.038	0.00001
cutting date (B)	2	2.190**	8.333 N.S
AB	4	0.003N.S	0.333N.S
error	18	0.037	0.0001
Total	35	-	-
	Second season		
replication	3	0.701	0.763
sowing distances (A)	2	19.55**	76.0 N.S
error	6	0.065	0.0001
cutting date (B)	2	1.641**	8.333 N.S
AB	4	0.008 N.S	0.333 N.S
error	18	0.067	0.0001
Total	35	-	-
	Combined data		
years	1	2.47	1.814
Rep	6	0.841	0.859
sowing distances (A)	2	40.64**	152.00 N.S
year(Y)* sowing distances (A)	2	0.015 N.S	0.0001 N.S
error	12	0.051	0.0001
cutting date (B)	2	3.811 **	16.667 N.S
year(Y)* cutting data(B)	2	0.021 N.S	0.0001 N.S
ab	4	0.005 N.S	0.667 N.S
yab	4	0.007 N.S	0.0001 N.S
error	36	0.052	0.0001
Total	71	-	-

Table (7)Mean performance of Crude Protein % and Crude Fiber % of two seasons and combined data.

Treatments		Crude Protein %			Crude Fiber %		
		First season	Second season	Combined data	First season	Second season	Combined data
A-Main (S.D.)		–	–	–	–	–	–
a1 (25cm)		8.49	8.91	8.70	30.93	30.63	30.78
a2 (30cm)		10.47	10.83	10.66	33.93	33.63	33.75
a3 (35cm)		11.02	11.33	11.17	35.93	35.63	35.78
Sign		**	**	**	N.S	N.S	N.S
L.S.D. 0.05		0.19	0.24	0.13	-	-	-
Sub-B(C.D.)		–	–	–	–	–	–
b1 (100)		10.43	10.75	10.60	32.76	32.46	32.61
b2 (110)		9.93	10.30	10.13	33.59	33.29	33.44
b3 (120)		9.60	10.02	9.81	34.43	34.13	34.28
Sign		**	**	**	N.S	N.S	N.S
L.S.D. 0.05		0.16	0.22	0.13	-	-	-
Interaction A x B		–	–	–	-	–	–
a 1	b1	8.95	9.25	9.10	29.93	29.63	29.78
	b2	8.45	8.90	8.68	30.93	30.63	30.78
	b3	8.10	8.58	8.34	31.93	31.63	31.78
a 2	b1	10.95	11.25	11.10	32.93	32.63	32.78
	b2	10.45	10.75	10.60	33.93	33.63	33.78
	b3	10.05	10.50	10.28	34.93	34.63	34.78
a 3	b1	11.45	11.75	11.60	35.43	35.13	35.28
	b2	10.95	11.25	11.10	35.93	35.63	35.78
	b3	10.65	10.98	10.81	36.43	36.13	36.28
Sign		N.S	N.S	N.S	N.S	N.S	N.S
L.S.D. 0.05		–	–	–	–	–	–

Conclusion

a-Maize teosinte hybrid forge produced the highest yield per fed compared with maize crop.

b- Sowing distance in 35 cm between hills was more favor to plant growth which not affected by competition among plants for nutrients, moisture, sunlight and other growth sources.

c- Increasing cutting date from 100 days to 120 days caused significant gradually increasing in plant height, stem diameter and number of stems /plant.

Corresponding Author:
Dr. Tamer El-Gaafarey
Forage Crops Res. Sec. Field Crops Res. Inst., A. R. C. Giza, Egypt
Telephone: +2 01006791620
E-mail: tamerelgafarey@gmail.com

References

[1]. Abd El-Maksoud, M.M.; A.M. El-Adl; A. Rammah and H.O. Sakr. Diallel analysis over two locations for fodder yield components in teosinte. Proceeding of the 26th Annual Meeting of Genetics, Alex, 1998, 29-30 Sept., 317-329.

[2]. Abd El-Maksoud, M.M.; AZ. Abd El-Haliem and H.O. Sakr Evaluation of some promising teosinte hybrids and their genetic behaviour for fodder yield. J. Agric. Sci., Mansoura Univ.,2001, 29(1): 97-111.

[3]. Abdel-Aty, M. S.; Soad A.Yousef; Mona F. Ghazy and S.H. Basueny Study of Genetic Behavior of interspecific crosses of Maize-Teosinte J. Plant Production, Mansoura Univ. , 2013, 4(12):1779-1791.

[4]. AOAC Official Methods of Analysis 19th Ed, AOAC Internal, Gaithersburg, MD. 2012.

[5]. Agriculture Economics and Statistics Institute, Ministry of Agriculture, Agricultural Economics, part 1 pull. by Agric. Res. Center, (*Zea mays* L.) para silagem. Revista Ciências Ministry of Agriculture, Egypt., 2016.

[6]. Alan, R.O. and M.D. Sundberg . Inflorescence development in a perennial teosinte Zea perennis (Poaceae). Amer. Bot.1994, 81(5): 598-608.

[7]. Aulicino , M.B. and J.L.Magojaa. Variability and heterosis in maize Balsas teosinte and maize – Guatemala teosinte hybrids . Maize Genetics Cooperation News Letter , 1991, 65:43-44.

[8]. Bartlett, M. S. Properties of sufficiency and statistical test. Proc. Roy. Soc., 1937, A160: 268-282.bioRxiv preprint first posted online Feb. 3, doi: https://doi.org/10.1101/105940.

[9]. Brriera .Y.; Montalant . Y and Boyat . A.. Study of protein content and agronomic value in progenies from the cross maize x teosinte . Agronomie . 1984, 4:5 , 417-422, 10 ref.

[10]. Chaudhuri , A.P. and B.Prasad Maize teosinte hybrid for fodder . Indian J.Agric. Sci., 1969, 39(6):467-472.

[11]. Corcuera , V.R. Maize – Balses teosinte and maize – Guatemala teosinte hybrids inheritance of plant traits . Maize Genetics Cooperation New Letters ,1991, 65: 78-79.

[12]. Gill , A.S. and B.D. Patil Forage production potential of maizente , teosinte and maize . Agric. Sci. Digest , 1985, 5(1): 44-45.

[13]. Guang, J. S. and S. and S. Hung Studies on the tillering ratoon ability and some agronomic characteristics in maize, teosinte and their hybrids. J. Agric. Res. China.1995.

[14]. Gaafar, H.A., M.M. El-Nahrawy and SH. H. Mohamed Milk production and composition of Lactating buffaloes feed rations containing corn silage and/ or fresh berseem. Slovak J. Anim. Sci, 2019, 52, (2): 69-80.

[15]. Haggag, M. E., M. S. Osman, A. M. Rammah and M. E. Mousa Planting methods and seeding rates of two sorghum varieties in Egypt. Al-Azhar J. Agric. Res., 1986, 6 (12), 429-440.

[16]. Habeba , Hend , E.A.. Breeding studies on some forage crops Ph.D. Thesis , Fac . of Agric., Minufiya Univ., Egypt .2006.

[17]. Hssan,M.U., chatta,M.B. ,A.Mahmood and S.T.Sahi Chemical composition and methane yield of sorghum as influence by planting methods and cultivars. Journal of animal & plant Sciences, 2019, 251-259.

[18]. Iptas, S., A.R. Brohi and H. Aslan . Effect of seeding rate and nitrogen fertilizers on forage yield and quality of sorghum (*Sorghum bicolor*) Sudan grass (*Sorghum sudanense*) hybrid. Indian J. Agr. , 2002, 47, 298-303.

[19]. Ibrahim , Hoda , M.. A study of variation teosinte (Zea mays spp.Maxicana (Shrader) , I1tis). M.Sc. thesis , Fac. of Agric. , Cairo Univ., Egypt. 1998.

[20]. Javadi, H., M.H. Rashed Mohasel, G. Zamani, A. Azari Nasrabad and G. Mousavi Study on effect of plant density on yield, yield components and protein percentage of four grain sorghum cultivars. Iranian J. of Agricultural researches, 2005. 3(2): 233-243.

[21]. Jode, W.F. and G.C. James Teosinte cytoplasmic genomes: 11. Performance of maize hybrids with teosinte cytoplasms. Crop Sci., 1996, 36: 1092-1098.

[22]. Jode, W.E.; O.A. James and G.C. James Teosinte cytoplasmic genomes 1-performance of maize inbred lines with teosinte cytoplasms. Crop Sci., 1996, 36: 1088-1091.

[23]. Khan , A. Some studies of hybrid vigor in F1 generation of maize teosinte hybrids . West Pakistan J. Agric. Res. , 1957, 3: 2-3 June , 1965.

[24]. Khristova , I.; L. Khristov; L. Todorova ; T . Lidanski and Khrisova . Inheritance of economic characters in intergeneric hybrids of maize with teosinte . Genetika – I- Selktsiya 1985,, 18(4): 341-347.

[25]. Lak, S., A. Naderi, S.A.A. Siadat, A. Aynehband, G. Noormo hammadi and S.H. Mousavi . Effect of different irrigation and plant densities levels on yield, yield components and assimilate remobilization of grain maize under climatic conditions of Khuzestan. Iran. J. of Agric. and Natural Resources Sciences, 2006, 10 (43): 92-101.

[26]. Mekasha,A.,D.Min,N.Bascom and J.Vipham. Seeding rate effects on forage productivity and nutritive value of sorghum. Agronomy journal., 2022, 114:201-215.

[27]. Mekhail, G. M. Effect of some cultural treatments on yield and chemical composition of some summer forage crops. M.Sc. Theses, Fac. Agric. Alex. Univ. 1970.

[28]. Mousa, M. E. Study of the effect of some cultural treatments on yield and chemical components of some summer forage crops. Ph. D. Thesis, Fac. Agric. Azhar Univ., Egypt.1986.

[29]. MSTAT-C, Ver. 4, A micro computer program for the Design and Analysis of Agronomic Research Experiments. Michigan State Univ., USA. 1986.

[30]. Nancy, B.C.; J.J. Flores; J. Martin; C.N. Ellstrand; R. Guadagnuolo; S. Heredia and S.R. Welles. Maize x teosinte hybrid cobs do not prevent crop gene introgression. Economic Botany,2012, 66(2): 132-137.

[31]. Palacios , I.G. and J.M. Magoja . Heterosis for dry matter and protein production per plant in diploperennial teosinte maize hybrids . Maize Genetics Cooperation New Letters ,1988, 62: 81-82.

[32]. Page, A. L., R.H. Miller and D. R. Keeney. Methods of soil analysis. II Chemical and microbiological properties 2nd Ed. Madison, Wisconsim. U.S.A. 1982.

[33]. Piper, C. S. Soil and plant analysis. Inter. science pubi. Inc. New York. Plant and soil. 1950. 91(3): 429-432.

[34]. Rady , Y.H. . Study on the possibility of producing , forage hybrid between maize and teosinte . M.Sc. Thesis , Fac . of Agric. Al-Azhar University , Egypt . 2007

[35]. Rady,H.Y.(2011). Studies on the breeding of maize-teosinte hybrid. PhD. Thesis, Fac. Of Agric. AL-Azhar University., Egypt.

[36]. Salem, Emad M.M.. Response of Grain Sorghum (Sorghum Bicolor, L. Monech) to Irrigation, Nitrogen and Plant Density Under New Valley Conditions, Egypt. Egyptian J. Desert Res.,2015, 65, No. 1, 11-30

[37]. Salama, H. S. A. Yield and nutritive value of maize (Zea mays L.) forage as affected by plant density, sowing date and age at harvest.Italian Journal of Agronomy, 2019, 14, 1383. https://doi.org/10.4081/ija.2019.1383

[38]. Sakr , H. E. O. and M. F. Mona, Ghazy. Combining ability and type of gene action for grain yield and some other traits using line x tester analysis in teosinte inbred lines (Zea mexicana) . J . Agric . Chemistry and Biotechnology Mans . Univ. 2010, Vol . 9:457-470.

[39]. Sakr, H.O.; E.M. Zayed and R.S.H. Aly Molecular and genetic analysis of the crosses between maize and teosinte. Egypt J. plant Breed.2009, 13 : 251- 267.

[40]. Snedecor, G. W. and W. G. Cocharn.. Statistical Methods.8th ed. Iowa State Univ. Press, Ames, Iowa, USA.1989.

[41]. Sohoo , M.S. ; B.L.Bhardwaj and S.M.Beri . Heterosis for some fodder characters in a maize x teosinte cross . Short Comun ., Symp ., Heterosis Breeding in Crop Plants , Theory and application , 1993, 72-73.

[42]. Silva, J. M. F. D.a, Dutra, A. S., Camara, F. T. D.a, Pinto, A. A., & Silva, F. E. D.a. . Row spacing, plant density, sowing and harvest times for sweet sorghum. Pesquisa Agropecuária Tropical, 2017, 47, 408–415.

[43]. Srour, A.A.; S.A. Mahmoud, N.M.Eweedah and M.M. Bendary (2022). Performance of lactating buffaloes as affected by partial replacement of berseem with maize and maize teosinte hybrid silages in winter season in Egypt. 2022.

[44]. Shieh – Guang J ; Shung Lu- Hung ; G.J Shieh- and H.S. Lu. Lu-HS (1995) . Studies on the tillering, rationing ability and some agronomic characteristics in maize , teosinte and their hybrids. Journal of Agricultural Research of China. 1995, 44:2, 93-108 ; 18 ref.

[45]. Smith, J.S.C.; M.M. Goodman and C.W. Stuber Variation within teosinte. III, aumerical analysis of allozyme data. Economic Botany, 1984, 38(1): 97-113.

[46]. Todorova, L. and T. Lidanski. Inheritance of quantitative characters in hybrids of maize with teosinte. Genetika. 1. Selsksiya,1985, 18(2): 99-110.

[47]. Thelen, K.D. Interaction between row spacing and yield: why it works. Crop Management.2006, 5(1) doi: 10.1094/CM-2006-0227-03-RV.

[48]. Topps, J. H. and J. Oliver . Animal foods of Central Africa. Zimb. Agric. J. Tech. Hand B- ,1993, 2, 135.

[49]. Walaa, M. E. Mouse, M.S.E. Sadek and M.M. EL-Nahrawy. Silage yield and quality of some maize and teosinte genotypes and their hybrid. American. Eurasian J. Agric. F Environ Science 2017, (1725): 373-378.

8/2/2023