

GROWTH, YIELD AND QUALITY OF TEOSINTE FORAGE (*ZEА MEXICANA*) AS AFFECTED BY PLANTING DATE

ABD EL-SHAFY A.S.

Field Crops Res. Inst., Agric. Res. Centre, Egypt.

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Abstract

The main objective of this study was to investigate the effect of planting date on performance of teosinte (*Zea mexicana*) as a new summer crop. Teosinte was sown from March 15 to July 15 of the two growing seasons 1995 and 1996 at Sers Ellyain Research Station, Menufiya Governorate, Egypt.

Planting on 1 or 15 June resulted in plants with greatest height. Planting within May or June gave the highest fresh and dry forage yields with significant differences compared to that obtained by early or late planting. Delaying planting date from March to June led to increasing in crude protein and digestible protein contents and protein yields.

INTRODUCTION

When new crop species and varieties are introduced into region, cultural practices like optimum planting dates should be investigated. Teosinte (*Zea mexicana*), is a new summer forage crop, and very little information is available on the influence of planting date on its forage yield and quality under Menufiya conditions. The recommended planting date for summer forage crops is during May and June (George, 1970; Nasr, 1973; Hussein *et al.*, 1979; and Abdel-Gawad, 1981). On the other hand Abdel-Raouf *et al.* (1988), found that planting Sudangrass and four sorghum hybrids in May resulted in plants with greater height and fresh, dry and protein yields. Crude protein content increased by delaying planting date. Soliman *et al.* (1983), reported that green forage and dry matter yield of fodder maize per feddan were significantly reduced due to delaying in planting date from May to August in Nubaria location, while it was not significantly affected by delayed planting in Alexandria location. But dry yield and total digestible nutrients per feddan were reduced due to delayed planting of fodder maize from May to August.

The present study aimed to find out the optimum date of planting teosinte under Menufiya conditions.

MATERIALS AND METHODS

This study was conducted at the farm of experimental research station of Sers-Elliyan, ARC, Menufiya Governorate. The experimental design was randomized complete blocks with four replicates to investigate nine sowing dates viz., March 15, April 1, April 15, May 1, May 15, June 1, June 15, July 1, July 15 on growth, yield and quality of teosinte (*Zea mexicana*). Plot area was 3 x 4 m consisting of five ridges 4 m in length 60 cm apart. Five plants taken at random were measured for plant height. Four cuttings were taken from the first seven planting dates and three cuttings from the two last dates in the two seasons. Superphosphate (15 % P₂O₅) was applied during soil preparation at a rate of 150 kg / fed. Nitrogen fertilizer used was added as ammonium nitrate (33.5 % N.) at 90 kg N / fed in three equal doses before the first irrigation and after the 1st and 2nd cut. Plants were cut to a stubble height of about 15 cm. Fresh forage yield / fed. was estimated at every cut. A representative sample of forage per plot was chopped and dried at 70°C to a constant weight to determine the dry matter percentage and calculate the dry matter yield / fed. Micro Kjeldahl method was used to determine total nitrogen. Crude protein (CP) percentage was calculated by multiplying N % by 6.25. Digestible protein content was estimated according to Bredon, *et al.* (1963) equation (DP % = 0.9596 - 3.55 CP %). Protein and digestible protein yields were calculated by multiplying the dry forage yield by CP and DP percentage, respectively. Data were subjected to appropriate statistical analysis as described by Snedecor and Cochran (1980). Treatment means were compared by L.S.D. test.

RESULTS AND DISCUSSION

Growth :

The results of planting dates (Table 1) show significant effect on plant height of teosinte at the four cuts in both seasons. At the first cut, the tallest plants were obtained when teosinte was planted during the period from June 1 to July 15 in the two seasons. It should be noted that the averages of plant height was greater when planting within June than for early planting (March and April) or late planting (July). This

may be due to the climatic conditions such as day length and prevailing temperature which gave longer stems. These results are in agreement with those obtained by Abdel-Gawad (1981s) on sorgo and Abdel-Raouf *et al.* (1988) on Sudangrass and sorghum hybrids.

Forage Yield :

a. Fresh forage yield :

The results given in Table (2) show fresh forage yield (ton/fed.) of teosinte as affected by planting date in the two growing seasons. Significant differences were observed among planting dates at the four cuts in the two growing seasons. The highest fresh forage yields of teosinte (6.86 and 6.99 ton / fed.) were obtained from planting on 15 May, while the lowest values (5.40 and 5.51 ton / fed.) were obtained from planting on 1 June with significant differences from other planting dates at the first cut in the two seasons. At the second cut, the highest value of fresh forage (6.81 and 8.88 ton / fed.) were obtained from planting on 1 July, while the lowest value (6.31 and 6.51) were obtained from planting on 15 March with significant differences from other planting dates in the two seasons. The highest fresh forage yield (8.75 and 9.63 ton / fed.) at the third cut were obtained from planting on 15 June with significant differences compared to other dates and insignificant difference with planting on 1 June in the two seasons. At the fourth cut planting on 1 or 15 July gave zero fresh forage yield in the two seasons, this may be due to climatic conditions especially day length during late growth period which may force plants to go into reproductive stage which was clear at the third cut.

With respect to the total fresh forage yield, the highest values (25.72 and 27.03 ton / fed.) were obtained when teosinte was planted on 15 May without any significant differences from planting on 1 or 15 June in the two growing seasons. It could be concluded that to obtain high fresh forage yield of teosinte as a summer forage it should be planted from 15 May to 15 June. George (1970), Nasr (1973), Abdel-Gawad (1981), and Abdel-Raouf *et al.* (1988) found that the best time for planting summer forages; sorghum, Sudangrass or sorghum hybrids was during May to early June.

Table 1. Effect of planting date on plant height (cm) of teosinte in 1995 and 1996 seasons.

Planting date	1995 Season				1996 Season				Mean		
	1st cut	2nd cut	3rd cut	4th cut	Mean	1st cut	2nd cut	3rd cut		4th cut	Mean
15 March	50.02	78.60	77.55	68.21	68.60	51.03	80.65	79.10	64.23	68.75	68.68
1 April	49.50	78.15	78.10	67.98	68.43	50.49	80.10	79.66	64.30	68.64	68.54
15 April	50.43	79.30	78.15	68.15	69.01	51.44	81.28	79.71	64.24	69.17	69.09
1 May	50.56	78.20	79.16	70.22	69.54	52.40	80.16	80.74	65.49	69.70	69.62
15 May	50.60	79.15	79.80	70.16	69.93	51.63	81.39	80.40	67.23	70.16	70.05
1 June	61.65	81.26	81.33	73.46	74.43	56.26	83.18	86.90	69.38	73.93	74.18
15 June	55.16	81.15	85.20	73.51	73.76	57.85	82.31	78.88	78.38	74.36	74.06
1 July	56.72	80.30	86.13	0.00	55.79	63.08	83.23	78.64	0.00	56.24	56.02
15 July	61.95	80.16	81.03	0.00	55.79	63.19	82.16	78.69	0.00	56.01	55.90
F. test	*	*	*	*	-	*	*	*	*	*	-
L.S.D. at 0.05	1.88	1.03	0.45	0.60	-	2.80	2.23	2.26	1.59	-	-

Table 2. Effect of planting date on fresh forage yield of teosinte (ton/fed.) in 1995 and 1996 seasons.

Planting date	1995 Season				1996 Season				Mean		
	1st cut	2nd cut	3rd cut	4th cut	Total	1st cut	2nd cut	3rd cut		4th cut	Total
15 March	5.61	6.31	6.42	4.38	22.72	5.72	6.50	7.06	4.60	23.88	23.30
1 April	5.80	6.61	6.65	4.46	23.52	5.92	6.81	7.33	4.68	24.74	24.13
15 April	6.61	6.95	7.10	2.77	23.43	6.74	7.16	7.81	2.90	24.61	24.02
1 May	6.65	7.36	7.28	2.45	23.74	6.78	7.58	8.01	2.58	24.95	24.35
15 May	6.86	7.66	7.74	3.46	25.72	6.99	7.89	8.51	3.64	27.03	26.38
1 June	5.40	8.29	8.45	3.46	25.60	5.51	8.54	9.30	3.63	26.98	26.29
15 June	5.78	8.45	8.75	2.45	25.43	6.01	8.70	9.63	2.58	26.92	26.18
1 July	5.65	8.61	3.41	0.00	17.67	5.76	8.88	3.75	0.00	18.39	18.03
15 July	5.76	8.43	3.46	0.00	17.65	5.88	8.68	3.81	0.00	18.37	18.01
F. test	*	*	*	*	*	*	*	*	*	*	*
L.S.D. at 0.05	0.28	0.11	0.11	0.08	0.33	0.74	1.30	0.99	0.95	1.94	1.76

b. Dry forage yield (ton / fed.) :

Data presented in Table (3) show the effect of planting date on teosinte dry forage yield at the four cuts in 1995 and 1996 seasons. Significant differences were observed among planting dates of teosinte at the four cuts in the two growing seasons. The highest dry forage yields at the first cut (1.36 and 1.42 ton / fed.) were obtained when teosinte was planted on 15 June with significant differences from other planting dates in the two growing seasons. Delay of planting date from 15 March to 15 June significantly led to increase in dry forage yield by 57 - 55 % in the first and second season, respectively. Dry forage yield increased non-significantly when planting date was delayed to 1 April then increased significantly when planting on the 15th of June and decreased significantly when planting on 15 July at the second cut. This may be due to heat prevailing at the second cut and its effect on dry matter percentage. At the third cut, delay in planting date from 15 March significantly increased dry forage yield until 15th of June and significantly decreased when planting was delayed from 15th June to the last date 15 July in the two seasons. Highest dry forage yields (0.62 and 0.65) at the fourth cut were obtained from planting on 1 April or 15 June in the two growing seasons, respectively. As in the fresh forage yield no dry forage yield were obtained from planting on 1 or 15 July in the two growing seasons.

The highest total dry forage yields (4.91 and 5.20) were obtained from planting on 15 June with significant differences from other planting dates in the first season and insignificant difference from planting on 1 June in the second season, respectively. The lowest total dry forage yields (3.08 and 3.26) were obtained when planting was on 15 July in the two growing seasons, respectively. Combined analysis showed that planting on 15th June significantly increased dry forage yield up to 5.06 ton / fed., while delayed planting in 15 July significantly decreased dry forage yield up to 3.17 ton / fed.

In conclusion, the planting dates of teosinte can be arranged in the following descending order according to total forage yields combined analysis :

Fresh forage yield : 15 May > 1 June > 15 June > 1 May > 1 April > 15 April > 15 March > 1 July > 15 July.

Dry forage yield : 15 June > 1 June > 15 May > 1 May > 15 April > 1 April > 15

Table 3. Effect of planting date on dry forage yield of teosinte (ton/fed.) in 1995 and 1996 seasons.

Planting date	1995 Season				1996 Season				Mean		
	1st cut	2nd cut	3rd cut	4th cut	Total	1st cut	2nd cut	3rd cut		4th cut	Total
15 March	0.78	1.06	0.99	0.60	3.43	0.79	1.09	1.09	0.64	3.62	3.53
1 April	0.86	1.17	1.05	0.62	3.69	0.88	1.17	1.17	0.65	3.87	3.78
15 April	0.99	1.44	1.15	0.39	3.98	1.02	1.49	1.27	0.42	4.20	4.09
1 May	1.01	1.44	1.19	0.35	3.99	1.04	1.49	1.32	0.38	4.22	4.11
15 May	1.11	1.46	1.27	0.50	4.34	1.13	1.63	1.41	0.53	4.69	4.51
1 June	1.21	1.59	1.42	0.51	4.73	1.25	1.65	1.58	0.54	5.01	4.87
15 June	1.36	1.67	1.51	0.37	4.91	1.42	1.72	1.67	0.65	5.20	5.06
1 July	1.09	1.58	0.55	0.00	3.22	1.11	1.63	0.61	0.00	3.35	3.29
15 July	1.08	1.45	0.55	0.00	3.08	1.10	1.50	0.66	0.00	3.26	3.17
F. test	*	*	*	*	*	*	*	*	*	*	*
L.S.D. at 0.05	0.06	0.05	0.04	0.01	0.07	0.13	0.25	0.05	0.10	0.25	0.17

March > 15 July > 15 June.

This reflects the impact of planting date on growth and yield of teosinte forage. Growing conditions are apparently more favorable in terms of temperature, day length and light intensity for June planting date than for earlier (March or April) or later planting date (July).

Protein content :

Variation in forage protein content of teosinte due to planting date (Table 4) indicate that crude protein content slightly increased with delay in planting date from 15 March to 15 June and then decreased. The highest protein content (9.95 %) was obtained when teosinte was planted on 15 June while the lowest value (6.90 %) was obtained when planting on 15 March. The same trend was found by Hussein *et al.* (1979), Abdel-Gawad (1981) and Abdel-Raouf *et al.* (1988).

Digestible protein content :

Table 4 shows digestible protein content means as affected by planting date in the two growing seasons. It can be noted that digestible protein content was closely related to protein content and results are in harmony with that reported by Miaki *et al.* (1968) on Sudangrass. The highest value of digestible protein content (5.99 %) was obtained when planting date was on 15 June, while the lowest value (3.08 %) was obtained on 15 March. Digestible protein content shows the same trend of protein content and increased slightly with delay in planting date from 15 March to 15 June and then slightly decreased.

Protein Yield :

Data presented in Table (5) show the effect of planting date on protein yield (kg/fed) of teosinte forage at the four cuts in the two growing seasons.

Generally, it can be noticed that protein yield increased significantly due to delaying planting date from 15 March to 15 June and then significantly decreased. Planting on June significantly resulted in the highest total yield of protein (508.10, 526.44 kg / fed) in the two growing seasons, respectively. This is in accordance with the findings of Hussein *et al.* (1979) and Abdel-Raouf *et al.* (1988). Combined analysis showed

Table 4. Effect of sowing date on crude and digestible protein contents (%) of teosinte in 1995 and 1996 seasons.

Planting date	Protein content			Digestible protein content		
	1995	1996	Mean	1995	1996	Mean
15 March	7.21	6.59	6.90	3.39	2.77	3.08
1 April	8.41	7.78	8.10	4.52	3.85	4.19
15 April	8.49	7.68	8.09	4.60	3.81	4.21
1 May	9.35	8.48	8.92	5.43	4.58	5.01
15 May	9.57	8.75	9.16	5.63	4.84	5.24
1 June	10.13	9.34	9.74	6.17	5.41	5.79
15 June	10.29	9.60	9.95	6.32	5.66	5.99
1 July	8.97	8.21	8.59	5.95	5.21	5.58
15 July	8.97	8.38	8.68	5.95	5.38	5.67

Table 5. Effect of planting date on protein yield (kg/fed) of teosinte in 1995 and 1996 seasons.

Planting date	1995 Season					1996 Season					Mean
	1st cut	2nd cut	3rd cut	4th cut	Total	1st cut	2nd cut	3rd cut	4th cut	Total	
15 March	56.63	86.50	61.88	42.96	247.97	49.53	79.13	63.87	44.54	237.07	242.52
1 April	73.62	110.21	77.91	51.21	312.95	67.94	102.49	79.33	51.09	300.85	306.90
15 April	85.73	139.25	86.37	31.63	342.98	79.76	129.33	83.57	32.00	324.66	333.82
1 May	99.18	147.74	103.65	30.17	380.74	91.10	142.44	103.22	29.49	359.25	370.00
15 May	108.34	149.36	110.74	47.80	416.24	100.12	157.46	110.40	45.79	413.77	415.01
1 June	123.78	179.67	132.34	49.37	485.16	118.25	170.94	136.20	48.17	473.56	479.36
15 June	140.22	189.71	140.58	37.59	508.10	139.16	184.38	141.28	61.62	526.44	517.27
1 July	133.20	195.29	62.26	-	390.75	124.99	181.91	63.50	-	370.40	380.58
15 July	132.08	179.95	61.93	-	373.96	127.82	173.40	68.24	-	369.46	371.71
L.S.D. at 0.05	6.21	5.86	8.26	5.66	26.18	10.78	24.37	4.04	7.93	28.36	35.42

Table 6. Effect of planting date on digestible protein yield (kg/fed) of teosinte in 1995 and 1996 seasons.

Planting date	1995 Season					1996 Season					Mean
	1st cut	2nd cut	3rd cut	4th cut	Total	1st cut	2nd cut	3rd cut	4th cut	Total	
15 March	27.22	45.37	24.26	19.92	116.77	19.51	37.28	22.56	20.03	99.38	108.08
1 April	40.08	64.23	37.28	27.16	168.75	31.59	56.86	34.63	25.94	149.02	158.89
15 April	47.12	82.51	42.09	16.50	188.22	40.29	71.22	35.05	14.79	162.35	175.29
1 May	59.29	70.92	57.24	16.52	203.97	50.54	83.74	52.14	14.82	201.24	202.61
15 May	64.60	91.54	61.21	28.10	242.45	55.94	93.24	55.84	25.12	230.14	236.30
1 June	83.13	115.91	76.54	29.27	304.85	69.00	105.44	74.58	27.05	276.07	290.46
15 June	86.22	122.75	81.24	23.38	313.59	83.07	115.93	76.32	35.69	311.01	312.30
1 July	89.10	131.30	40.21	0.00	260.61	80.59	116.71	39.28	0.00	236.58	248.60
15 July	88.45	121.22	39.93	0.00	249.60	83.60	113.10	42.04	0.00	238.74	244.17
L.S.D. at 0.05	2.86	5.96	4.15	2.01	6.85	2.29	8.72	4.68	3.24	8.10	20.63

that planting on 15th of June gave the highest protein yield (517.27 kg/fed.) and early planting gave the lowest protein yield (242.52 kg/fed).

Digestible protein yield :

Data in Table (6) show the effect of planting date on digestible protein yield (kg / fed) of teosinte forage. The highest total digestible protein yield (313.59 and 312.30 kg / fed) were obtained from planting on 15th of June, while the lowest values (116.77 and 108.08 kg / fed) were obtained from planting on 15 March in the two seasons, respectively. Combined analysis showed that the highest digestible protein yields (290.46 and 312.30 kg / fed) were obtained when teosinte was planted in June, while the lowest values (108.08, 158.89 and 175.29 kg / fed) were obtained when planting was in March and April. It should be noted that digestible protein yield per fed-dan was significantly reduced by delaying teosinte planting date from June to July. These results are in agreement with Soliman *et al.* (1993) on total digestible nutrient of fodder maize.

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تأثير مواعيد الزراعة على النمو والمحصول وصفات الجودة للذرة الريانة

أحمد سيد أحمد عبد الشافى

معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية، الجيزة

أجرى هذا البحث بمحطة البحوث الزراعية بسرس الليان - محافظة المنوفية، خلال موسمي ١٩٩٥، ١٩٩٦ لدراسة تأثير مواعيد الزراعة بدءاً من ١٥ مارس وحتى ١٥ يوليو على نمو ومحصول وصفات الجودة للذرة الريانة وأظهرت النتائج أن متوسط طول الثبات كان أكبر ما يمكن عند الزراعة خلال شهر يونية كما أعطت الزراعة المبكرة بصفة عامة متوسطات طول نبات أكبر من الزراعة المتأخرة.

وقد تم الحصول على أعلى محصول أخضر وجاف كلى عند الزراعة خلال شهرى مايو ويونية وبفروق معنوية عن الزراعة المبكرة فى مارس وأبريل والزراعة المتأخرة فى يوليو مع اختلافات معنوية فى الحشوات الأربعة عدا الزراعة المتأخرة فى يوليو التى لم تنتج حشة رابعة.

وأدى تأخير الزراعة من مارس حتى يونية إلى زيادة فى نسبة البروتين والهضم والمهضوم وإلى زيادة فى محصول البروتين وكذا محصول البروتين المهضوم للقدان عن الزراعة المتأخرة فى يوليو.