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Effect of Different Planting Dates on Yield and Some Agronomic Characters of Twelve Maize Hybrids

M.A.A. Abd-Elaziz, M.S. Abd El-Latif, H.A.A. Mohamed and R.H.A. Alsebaey

Maize Research Dept., Field Crops Research Institute, ARC, Giza, Egypt

Abstract: Field experiments were carried out in 2017 and 2018 summer at Sakha Agricultural Research Station in North Deltato study the effect of three planting dates (20 April, 20 May and 20 July) on grain yield and other agronomic characters of 12 maize hybrids (SC 10, SC 128, SC 130, SC 131, SC 132, SC 162, SC 166, SC 167, SC 168, SC 176, SC 177 and SC 178). A randomized complete block design with four replications was used in each planting date in both two years. Results revealed that the mean square due to years (Y), planting dates (D) and hybrids (H) were highly significant for all traits. Also the interaction between H×Y, H×D and H×Y×D were significant for all traits except for H×Y for days to 50% silking and H×Y×D for days to 50% silking, plant height and number of kernels per row. Planting date of April 20 increased agronomytraits, yield and its components for this study, meaning that it was the optimum planting date in north Egypt. SC 178 and SC 10 had the highest grain yield across all environments. The highest hybrids for grain yield were SC 178 followed by SC 10 and SC166 in planting date of April 20, SC 128 followed with SC 10 and SC 178 in planting date of May 20 and SC 178 followed SC 10 and SC 162 in planting date of July 20.

Key words: Maize · *Zea mays* · Planting dates · Hybrid

INTRODUCTION

Environmental changes associated with different planting dates have a great effect on yield and other agronomic characters of maize plants. Identifying the most appropriate time for maize planting date is so important to face the climate changes. Lauer, *et al*. [1] stated that farmers can use adjusted planting dates to maintain or increase crop yield to accommodate with changing climate. Norwood [2] suggested that farmers should plant on more than one planting date in order to safeguard against unpredicted seasons. Under Egyptian conditions Gouda, *et al*. [3] suggested that mid-May planting date produced the highest grain yield than planting in first of July while delayed planting date decreased days to 50% silking. Al-Ahmad, *et al*. [4] evaluated the performance of 15 hybridsat early (14th of May) and late (29th of July) planting dates. They found that the differences between two planting dates were highly significant for silking date, ear height, ear length, ear diameter and grain yield per plant and the meanvalues for normal planting date being higher than those for the late planting date for all traits. El-Galfy, *et al*. [5] illustrated that delaying planting date decreased significantly number of days to 50% tasseling and silking, plant height, ear height and grain yield. Zaremohazabieh, *et al*. [6] found that the small change in planting date had significant effect on maize harvest index, biological yield and kernel yield. Similarly, Liaqat, *et al*. [7] stated that the planting dates significantly affected on silking date, plant height, ear length, grains per row and grain yield. Shrestha, *et al*. [8] stated that maize growth and development involves numerous biochemical reaction which are sensitive to variance in weather parameters as affected by planting dates. Also cultivars response differently with different planting date.

Therefore, since there were substantial shifting in planting dates for most of the field crops due to climate change in the last two decades the objective of this study was to find out the optimum planting date for white and yellow maize hybrids under North Delta condition.

MATERIALS AND METHODS

Five white maize single crosses (SC 10, SC 128, SC 130, SC 131 and SC 132) and seven yellow maize single crosses (SC 162, SC 166, SC 167, SC 168, SC 176, SC 177

Corresponding Author: M.A.A. Abd-Elaziz, Maize Research Dept., Field Crops Research Institute, ARC, Giza, Egypt.

and SC 178) were evaluated at Sakha Agri. Res. Station (North Egypt) in three planting date (PD) *i.e.* April 20, May 20 and July 20 in two successive seasons of 2017 and 2018. A randomized complete block design (RCBD) with four replications was used at each planting date in each year. Plot size was four rows, 6.00 m long, 0.80 m apart and 0.24 m between hills. Two seeds were planted per hill and later thinned out to one plant per hill before the first irrigation. The recommended packages of agronomic practices were followed to achieve a good growth.

Data Collected:

- Number of days to 50% silking (DTS) which was recorded as the number of days from planting date to the time when 50% of plants in the plot produced visible silks.
- Plant height was measured after flowering on 10 guarded plants plot^{-1} in cm from ground to the point of flag leaf insertion.
- Ear height was recorded after flowering on 10 guarded plants per plot as distance in cm from the ground to the ear leaf.
- Ear length was an average of five ears length (cm) from five guarded plants.
- Number of kernels per row was measured as an average of five ears from five guarded plants.
- Grain yield per feddanwas estimated from two middle rows and adjusted at 15.5% grain moisture and expressed in ardab per feddan (ard/fed), one ardab = 140 kg of maize grain and one feddan = 4200 m^2.

The Statistical Analysis: The data were subjected to statistical analysis of variance of RCBD design was carried outusing SAS PROC GLM [9] Since the trend was similar in both seasons the homogeneity test Bartlet'stest was applied Bartlett [10] and the combined analysis of the two seasons and the three planting dates was done according to Snedecor and Cochran [11]. Means were compared by using least significant difference (LSD) at 5%

RESULTS AND DISCUSSIONS

Analysis of Variance: Combined analysis of variance for six traits of 12 hybrids across three planting dates and two years is presented in Table (1). Results revealed that significant mean squares were observed due to years (Y), planting dates (D) and their interaction (Y×D) for all traits, meaning that these traits differed significantly between two years and between three planting dates. Also the years was affected by planting dateswhich due tothe differences in climatic conditions. Mean squares of hybrids (H) were highly significant for all traits, indicating that the hybrids genetics are absolutely different. Mean squares of H×Y interaction were significant in all traits except days to 50% silking, so these hybrids differed in their performance from one year to another. The interaction (H×D) was significant in all traits, meaning that the hybrids differed in their performanceat the three planting dates. Also interaction (H×Y×D) was significant in ear height and ear length and highly significant in grain yield, meaning that the interaction between H×Y was affected by planting dates. [4] demonstrated that planting dates mean squares were highly significant for silking date, ear height, ear length, ear diameter and grain yield per plant with mean values for normal planting date being higher than those for the late planting date for all traits. EL-Hosary, *et al*. [12] found that genotype x planting date mean squares were significant for No. of rows ear^{-1} and grain yield plant^{-1} and not significant for days to 50% silking, No of Kernel row^{-1} and 100-kernel weight.

Mean Performance of Three Planting Dates, Two Years and Their Interaction: Table (2) showed that, planting date of April 20th exhibited the highest values followed by planting date of May 20th and planting date of July 20th for all traits. Also the mean values in 2017 were higher than 2018 for days to 50% silking, plant and ear height while the reverse was obtained for grain yield, ear length and ear diameter. The highest values were obtained in April 20 PD in 2017 season for days to 50% silking andear height and April 20 PD in 2018 season for plant height, grain yield, ear length and number of kernels per row. While the lowest values were obtained in July 20 PD in 2018 season for all traits except for days to 50% silking and ear length. From above results, planting in April 20 increased agronomy traits, yield and yield components, meaning that it was the optimum planting date in north Egypt, which weather parameters such as temperature, solar radiation and humidity during crop season were favorable for plants. [1] mentioned that optimum planting date for any crop planted delaying one or more-week interval are determined aiming maximum yield by analysis the performance data recorded for multiple production year of same crop. Aldrich, *et al*. [13] found late planting favored plant exposure to short growth period, more pest and disease infection, drought, cold temperature, less radiation availability finally reducing grain yield. Maddonni, *et al*. [14] stated that reduction of filing grains caused after delaying of planting date which let plant to get exposed to low temperature and radiation condition.

Table 1: Mean squares of the combined analysisfor six traits of 12 hybrids across three planting dates and two years

S.O.V.	d.f.	Days to 50% silking	Plant height (cm)	Ear height (cm)	Grain yield (ard/fed)	Ear Length (cm)	Number of kernels per row
Year (Y)	1	227.56**	4568.09*	2278.13*	214.66**	46.40**	316.68**
Date (D)	2	3720.69**	146833.44**	53421.14**	3209.25**	145.19**	356.27**
Y x D	2	380.36**	5547.52**	1327.22*	609.98**	8.17**	156.94**
Rep/(Yx D)	18	3.19	678.62	334.60	22.50	1.22	6.86
Hybrid (H)	11	44.32**	85547.52**	3084.20**	63.17**	15.19**	51.78**
H x Y	11	2.49	251.08*	376.84**	28.68**	1.12*	6.34*
H x D	22	3.27**	211.33*	137.56*	10.50**	1.42**	8.31**
H x Y x D	22	1.37	145.48	136.63*	14.42**	1.00*	2.73
Error	198	1.42	117.87	78.29	3.98	0.56	2.81

*,**significantat 0.05 and 0.01 levels of probability, respectively

Table 2: Mean performance for three planting dates and two years and their interaction for six studied traits across all hybrids

	Days to 50% silking			Plant height (cm)			Ear height (cm)		
Planting dates	2017	2018	Average	2017	2018	Average	2017	2018	Average
20 April	72.73	67.04	69.89	282.44	282.50	282.47	156.44	152.88	154.66
20 May	63.08	61.17	62.13	254.94	256.48	255.71	141.02	141.58	141.30
20 July	56.44	58.71	57.58	218.19	192.69	205.44	115.73	101.85	108.79
Average	64.08	62.31	63.20	251.86	243.89	247.87	137.73	132.10	134.92

Table 2: Continued

	Grain yield(ard/fed)			Ear length (cm)			Number of kernels per row		
Planting dates	2017	2018	Average	2017	2018	Average	2017	2018	Average
20 April	29.04	35.55	32.30	23.06	24.53	23.80	43.92	48.30	46.11
20 May	27.06	29.27	28.17	22.69	23.26	22.98	43.74	46.32	45.03
20 July	22.65	19.11	20.88	21.19	21.56	21.38	42.70	42.03	42.37
Average	26.25	27.98	27.11	22.31	23.12	22.72	43.45	45.55	44.50

Mean performance of 12 hybrids across two years and three planting dates

Mean performance of 12 hybrids across two years and three planting dates is shown in Table (3). For days to 50% silking, the early hybrids were SC 176 followed by SC 128 and SC 131. While the late hybrids were SC 162 and SC 178. For plant height, the tallest hybrids were SC 10 followed by SC 162 the reverse obtained for SC 167 and SC 166. For ear height, SC 10 and SC 162 were the highest while SC 128 and SC 176 were the lowest. For grain yield, SC 178 followed by SC 10 had the highest grain yield, while SC 176 a nd SC 167 gave the lowest grain yield. The longest ears were obtained in hybrid SC 162 followed by SC 178, meanwhile the smallest ears were obtained in SC 176 followed by SC 132. For number of kernels/row, the SC 10 and SC 162 had the highest values compared to SC 176 and SC 132 had the lowest values. Differences between these hybrids may be due to the genetic differences among them. Many researchers found significant variation between hybrids for growth and yield traits such as Abdou, *et al.* [15] and Mosa, *et al.* [16].

The results in Table (4), showed that the hybrids, SC 10 and SC 162 were the highest values in plant and ear heights in two years while the short hybrid was SC 167 in 2017 season and SC 168 in 2018 season, SC 178 and SC 128 gave the highest grain yield for 2017 and 2018, respectively while SC 167 and SC 176 had the lowest grain yield in 2017 and 2018, respectively, SC 162 had the longest ear in two years while the reverse obtained by SC 176 in two years, SC 10 had the highest values in two years while SC 132 and SC 176 had the lowest values for number of kernels per row in 2017 and 2018, respectively.

The results in Table (5) showed that, most hybrids recorded high values in April 20 PD followed May 20 PD and July 20 PD for all traits. Days to 50% silking means ranged from 67.25 days (SC 176) to 72.00 days (SC 178) in April 20 PD, from 59.38 days (SC 176) to 63.88 days (SC 162) in May 20 PD and from 55.13 days (SC 128 and SC 131) to 59.63 days (SC 132). For plant height, the lowest value was obtained for SC 167 while the highest value was obtained for SC 10 at three planting dates, so SC 10 could be utilized in make silage. For ear height, the low value obtained for SC 128 in April 20 PD and 20 July PDsoSC 176 and SC 177 in May 20 PD, while SC 10 gave the high value in three planting dates. For grain yield, the superior hybrids were SC 178 followed by SC 10

Table 3: Mean performance of 12 hybrids across two years and three planting dates

Hybrid	Days to 50% silking	Plant height (cm)	Ear height (cm)	Grain yield (ard/fed)	Ear length (cm)	Number of kernels per row
SC 10	63.79	284.71	157.88	29.50	22.56	47.14
SC 128	61.46	237.92	120.00	27.71	22.48	44.26
SC 130	64.09	241.79	132.29	26.22	22.57	42.96
SC 131	61.46	235.17	128.13	27.48	23.14	44.30
SC 132	64.13	238.71	138.00	27.59	21.89	42.89
SC 162	64.84	274.42	151.50	26.22	24.39	46.60
SC 166	63.67	228.84	135.96	26.76	22.73	44.10
SC 167	64.04	227.71	134.21	25.10	23.04	45.43
SC 168	63.33	230.21	136.42	25.56	22.62	44.96
SC 176	60.71	252.79	122.09	25.00	21.08	42.21
SC 177	62.34	260.88	123.17	28.23	22.80	43.98
SC 178	64.50	261.33	139.38	30.05	23.32	45.21
LSD 0.05	0.67	6.14	5.01	1.13	0.42	0.95

Mean performance of 12 hybrids in two seasons across three planting dates

Table 4: Mean performance of 12 hybrids in two seasons across three planting dates

	Plant height (cm)		Ear height (cm)		Grain yield(ard/fed)		Ear length (cm)		Number of kernels per row	
Hybrid	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
SC 10	294.00	275.42	163.67	152.08	28.53	30.46	22.33	22.78	46.75	47.53
SC 128	240.75	235.08	125.17	114.83	24.86	30.56	21.83	23.12	42.80	45.72
SC 130	245.58	238.00	136.08	128.50	24.76	27.67	22.00	23.13	41.50	44.42
SC 131	237.33	233.00	129.50	126.75	24.65	30.30	22.35	23.93	42.50	46.10
SC 132	241.17	236.25	139.25	136.75	26.26	28.91	21.50	22.27	41.07	44.70
SC 162	283.42	265.42	157.33	145.67	25.89	26.55	24.23	24.55	45.97	47.23
SC 166	232.75	224.92	136.67	135.25	26.24	27.28	22.62	22.83	42.87	45.33
SC 167	224.58	230.83	128.42	140.00	24.41	25.78	22.80	23.28	45.12	45.73
SC 168	235.50	224.92	138.00	134.83	25.27	25.84	22.27	22.97	43.92	46.00
SC 176	258.08	247.50	127.75	116.42	25.31	24.69	20.82	21.33	41.30	43.12
SC 177	264.00	257.75	129.08	117.25	28.56	27.90	22.32	23.27	43.05	44.90
SC 178	265.08	257.58	141.83	136.92	30.29	29.81	22.70	23.93	44.60	45.82
LSD 0.05	6.14		5.01		1.13		0.42		0.95	

Mean performance of hybrids in the three planting dates across two years:

Table 5: Mean performance of 12 hybrids in the three planting dates across two years

	Days to 50% silking			Plant height(cm)			Ear height(cm)		
Hybrid	20 April	20 May	20 July	20 April	20 May	20 July	20 April	20 May	20 July
SC 10	69.75	62.25	59.38	322.63	294.88	236.63	179.13	165.38	129.13
SC 128	68.38	60.88	55.13	264.00	254.88	194.88	131.88	132.50	95.63
SC 130	70.88	62.75	58.63	280.38	256.00	189.00	156.38	139.00	101.50
SC 131	68.75	60.50	55.13	267.00	242.13	196.38	147.38	132.38	104.63
SC 132	69.88	62.88	59.63	275.00	245.38	195.75	155.13	149.00	109.88
SC 162	71.75	63.88	58.88	310.50	278.88	233.88	172.75	155.38	126.38
SC 166	69.88	63.13	58.00	264.63	232.50	189.38	157.13	142.63	108.13
SC 167	71.38	62.75	58.00	263.25	231.63	188.25	157.13	134.75	110.75
SC 168	70.00	62.50	57.50	267.13	233.75	189.75	157.88	140.00	111.38
SC 176	67.25	59.38	55.50	281.88	262.75	213.75	137.75	128.63	99.88
SC 177	68.75	61.50	56.75	295.13	265.38	222.13	140.25	128.63	100.63
SC 178	72.00	63.13	58.38	298.13	270.38	215.50	163.13	147.38	107.63
L.S.D. 0.05	1.17			10.69			8.72		

Table 5: Continued

	Grain yield(ard/fed)			Ear length(cm)			Number of kernels per row		
Hybrid	20 April	20 May	20 July	20 April	20 May	20 July	20 April	20 May	20 July
SC 10	33.78	30.82	23.89	23.20	22.93	21.55	48.40	46.25	46.78
SC 128	32.56	31.05	19.53	24.00	23.18	20.25	46.38	45.25	41.15
SC 130	31.48	27.06	20.10	23.75	23.13	20.83	44.30	45.03	39.55
SC 131	32.73	28.74	20.96	23.95	24.05	21.43	46.15	45.00	41.75
SC 132	32.50	28.72	21.52	22.70	22.13	20.83	43.98	43.98	40.70
SC 162	30.44	25.69	22.53	25.43	24.13	23.63	48.08	46.33	45.40
SC 166	33.28	27.95	19.05	23.90	22.78	21.50	46.75	43.85	41.70
SC 167	31.05	25.20	19.04	24.20	23.28	21.65	46.90	46.50	42.88
SC 168	31.22	26.77	18.66	24.08	22.63	21.15	47.53	45.58	41.78
SC 176	29.65	25.80	19.54	22.08	21.15	20.00	44.28	42.30	40.05
SC 177	33.21	29.76	21.72	23.58	23.05	21.75	44.10	45.28	42.55
SC 178	35.70	30.41	24.03	24.70	23.28	21.98	46.50	45.00	44.13
L.S.D. 0.05	1.97			0.28			1.65		

Mean performance of 12 hybrids in three planting dates in two seasons

Table 6: Mean performance of 12 hybrids in three planting dates across two seasons

	Ear height (cm)					
	2017			2018		
Hybrid	20 April	20 May	20 July	20 April	20 May	20 July
SC 10	182.50	168.25	140.25	175.75	162.50	118.00
SC 128	137.25	137.75	100.50	126.50	127.25	90.75
SC 130	159.25	139.75	109.25	153.50	138.25	93.75
SC 131	147.75	137.50	103.25	147.00	127.25	106.00
SC 132	153.00	149.25	115.50	157.25	148.75	104.25
SC 162	176.00	154.50	141.50	169.50	156.25	111.25
SC 166	152.00	145.75	112.25	162.25	139.50	104.00
SC 167	152.25	120.00	113.00	162.00	149.50	108.50
SC 168	157.25	135.50	121.25	158.50	144.50	101.50
SC 176	147.25	129.25	106.75	128.25	128.00	93.00
SC 177	148.25	127.75	111.25	132.25	129.50	90.00
SC 178	164.50	147.00	114.00	161.75	147.75	101.25
L.S.D. 0.05			12.33			

Table 6: Continued

	Grain yield (ard/fed)					
	2017			2018		
Hybridc	20 April	20 May	20 July	20 April	20 May	20 July
SC 10	30.48	30.53	24.60	37.08	31.11	23.18
SC 128	27.81	28.83	17.95	37.31	33.27	21.11
SC 130	28.44	25.15	20.70	34.53	28.98	19.50
SC 131	29.31	24.66	19.99	36.14	32.83	21.93
SC 132	27.38	27.87	23.51	37.62	29.57	19.54
SC 162	27.87	24.58	25.22	33.00	26.81	19.85
SC 166	29.51	26.63	22.58	37.05	29.26	15.51
SC 167	28.45	21.82	22.98	33.66	28.59	15.10
SC 168	28.00	25.45	22.35	34.45	28.09	14.98
SC 176	27.26	27.19	21.47	32.03	24.42	17.61
SC 177	30.11	30.25	25.32	36.31	29.28	18.11
SC 178	33.92	31.81	25.13	37.48	29.02	22.93
L.S.D. 0.05			2.78			

Table 6: Continued

	Ear length (cm)					
	2017			2018		
Hybrid	20 April	20 May	20 July	20 April	20 May	20 July
SC 10	22.80	22.70	21.50	23.60	23.15	21.60
SC 128	23.40	22.40	19.70	24.60	23.95	20.80
SC 130	22.85	22.85	20.30	24.65	23.40	21.35
SC 131	23.15	23.05	20.85	24.75	25.05	22.00
SC 132	21.85	22.25	20.40	23.55	22.00	21.25
SC 162	25.15	23.70	23.85	25.70	24.55	23.40
SC 166	22.85	22.75	22.25	24.95	22.80	20.75
SC 167	23.40	23.35	21.65	25.00	23.20	21.65
SC 168	23.10	22.30	21.40	25.05	22.95	20.90
SC 176	21.40	21.25	19.80	22.75	21.05	20.20
SC 177	22.65	22.70	21.60	24.50	23.40	21.90
SC 178	24.15	22.95	21.00	25.25	23.60	22.95
L.S.D. 0.05			1.04			

and SC 166 in April 20 PD, SC 128 followed by SC 10 and SC 178 in May 20 PD and SC 178 followed by SC 10 and SC 162 in July 20 PD. From above mentioned results, SC 178 and SC 10 gave highest yield in three planting dates. For ear length, SC 176 gave the low value in three planting dates while the reverse was obtained for SC 162 and SC 178 gave the highest values in three planting dates. For number of kernels per row, the highest values obtained by SC 10 and SC 162 in three planting dates, while the lowest values obtained by SC 132 in 20 April PD and SC 176 in 20 May and 20 July plant dates. Sangoi [17] found that hybrid maize planted during earlier planting date elongated growth period of more than 2 weeks than planted in delayed date. Shepard, *et al.* [18] mentioned that early planting date of crop can significantly improves grain yield but besides other practices like appropriate plant population and appropriate dose of fertilizer. Derieux, *et al.* [19] found that number of kernels per row was significantly affected by delay in planting dates. Hicks and Stuker [20] stated that early planting helps in early harvesting which helps to avoid possible unfavorable environmental conditions as well as save more labour and time.

The results in Table (6) showed that, for ear height, SC 10 had the highest value in three planting dates in two years, while SC 128 had the lowest values in most plant dates in two years. For grain yield, the highest hybrid was SC 178 and SC 132 in 2017 and 2018 seasons, respectively in April 20 PD, SC 178 and SC 128 in 2017 and 2018, respectively in May 20 PD, SC 177 and SC 10 in 2017 and 2018, respectively in July 20 PD, while the lowest hybrid was SC 176 in both two years in April 20 PD, SC 167 and SC 176 in 2017 and 2018, respectively in May 20 PD, SC 128 and SC 168 in 2017 and 2018 seasons, respectively in July 20. For ear length, SC 162 had the highest value in three Planting dates in both two years, while the lowest value obtained by SC 176 in most planting dates in two years.

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