

Sowing Dates Effect on Growth and Grain Yield of Some Maize Hybrids

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ABSTRACT

A field experiment was carried out at Agricultural Research Station, Faculty of Agriculture, Saba-Basha, Alexandria University, Egypt, during 2017 summer season to study growth and productivity of four maize hybrids (S.C.10, S.C. 168, T.C. 310 and T.C. 352) under four sowing dates (mid April, mid May, mid June and mid July) using split-plot design in three replications. Early sowing (mid April) produced the tallest plants and ears (242.30 cm and 25.49 cm), respectively, and largest ear leaf area (880.38 cm²). However, maize sowing in mid May led to increase in ear height (168.14 cm) and produced the maximum number of rows/ ear (14.62), weight of grains/ ear (200.11 g), 100-kernel weight (33.26 g), shelling percentage (83.68%) and grain yield (3.64 t/ fed.). Conversely, delayed sowing produced the significantly lowest values for all the studied traits. Single crosses, especially, white grains S.C.10 was superior than yellow grains S.C.168 and the three way crosses for all the studied traits. However, white grains T.W.310 showed the highest ear height (168.76 cm). Single cross 10 sown early (mid April) produced the tallest plants and largest ear leaf area, while sowing it in (mid May) produced the maximum grains weight/ ear, 100-kernel weight, shelling percentage and grain yield (4 t/ fed.). Sowing S.C. 168 in mid May gave the tallest ears (28.03 cm).

Key words: *Zea mays*, sowing dates, genotypes, growth, yield and its attributes.

INTRODUCTION

Maize (*Zea mays* L.) is considered the third most important crop in Egypt and the world because it is used for food, feed and raw materials for some industries. In Egypt, there is a gap between production and consumption of this crop, especially during the last two decades. Field Crops Research Institute, Agricultural Research Center, produced high yielding hybrids (single and three way crosses) suited to summer environmental conditions at different locations under recommended improved cultural practices. Significant differences were detected among maize hybrids in growth, earliness, grain yield and yield attributes (Abo-Shetaia *et al.*, 2000; Hassan, 2000; Griesh and Yakout, 2002; Bruns and Abbas, 2005; Azam *et al.*, 2007; El-Galfy *et al.*, 2009; Gouda *et al.*, 2009; Mirdad *et al.* 2010 and Alias *et al.*, 2010).

Regarding sowing date, it is well known that sowing date of maize is dependent on the climatic conditions prevailing in the crop growing area. Several researchers

pointed out that the highest values of growth, grain yield and most yield attributes were obtained from May to first half of June plantings as Sharaan *et al.* (2002), Tarrad *et al.* (2006), Law-Ogbono and Remison (2009), Beiragi *et al.* (2011), Koca and Canavar (2014), Franco *et al.* (2016) and Zhou *et al.* (2017).

The objective of the present investigation was to study the productivity of four maize hybrids under different sowing dates.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm, Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt, during 2017 summer season to study growth and productivity of four maize hybrids under different sowing dates using split plot design in three replications. The experiment included four sowing dates, i.e., 15/4, 15/5, 15/6 and 15/7 that were randomly arranged in the main plots, while four maize hybrids namely Single crosses (S.C. 10 and S.C. 168) and three way crosses (T.C. 310 and T.C. 352) were allocated in the sub-plots. Each plot consisted of five rows of 3 m length and 0.7 m width. At harvest, five guarded plants were randomly chosen to measure plant height (cm), ear height (cm), ear leaf area (cm²), ear length (cm), number of rows/ ear, grains weight/ ear (g), 100-kernel weight (g) and shelling percentage, while grain yield (t/ fed) that calculated from the three inner rows after 110 days.

The collected data were statistically analyzed according to Steel and Torrie (1980). Least Significant Difference (L.S.D._{0.05}) was used to compare the differences between treatment means.

RESULTS AND DISCUSSION

Effect of sowing date:

The studied four monthly dates of sowing, between mid April to mid July, significantly affected all growth characters, grain yield and its attributes (Tables 1 and 2). Results presented in Table (1) revealed that early sowing date (mid April) produced significantly tallest plants (242.30 cm) and largest ear leaf area (880.38 cm²), however maize sown in (mid May) showed the highest ears compared with the latest sowing date (mid July). Increasing percentages of the three growth characters over the latest sowings were (24.55%, 11.60% and 7.07%), respectively.

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Received April 15, 2018, Accepted May 15, 2018

Similar trend of results was reported by Tarrad *et al.* (2006) and Rah-Khosravani *et al.* (2017) for plant height and ear height and Tarrad *et al.* (2006), Dahmardeh and Dahmardeh (2010), Tisimba *et al.* (2013) and Rah-Khosravani *et al.* (2017) for ear leaf area.

With respect to sowing dates effect on maize grain yield and its attributes, data presented in Table (2) pointed out that growing maize in the second sowing date (mid May) produced the tallest ears (26.31cm), highest number of rows/ ear (14.62), kernels/ ear (200.11), 100-kernel weight (33.26 g), shelling percent (83.68%) and grain yield (3.64 t/ fed.). However, the latest sowing date (mid July) showed the lowest values of the abovementioned traits. That might be due to that late sowing decreased the effective rate of grain filling, shortened the effective duration of grain filling and plant growth rate during grain filling was slower because of low daily incident radiation and radiation use efficiency (Cirilo and Andrade, 1995). They, also added that there were no differences in the number of endosperm cells formed among sowing dates, thus the potential capacity of kernels to accumulate assimilates did not contribute to the low final weight observed in later plantings. Similar findings were reported by Mohamed and Shams (1991), Beiragi *et al.* (2011) and Koca and Canavar (2014) for ear length, Beiragi *et al.* (2011) for number of rows/ ear, Mohamed and Shams (1991), Beiragi *et al.* (2011) and Koca and Canavar (2014) for kernels weight per ear, Cirilo and Andrade (1995), Khan *et al.* (2002), Law-Ogbomo and Remison (2009), Beiragi *et al.* (2011), Koca and Canavar (2014) and Zhou *et al.* (2017) for 100-kernel weight, Beiragi *et al.* (2011) and Koca and Canavar (2014) for shelling percent and Khan *et al.* (2002), Sharaan *et al.* (2002), Tarrad *et al.* (2006), Dahmardeh and Dahmardeh (2010), Casini (2012), Koca and Canavar (2014),

Franco *et al.* (2016) and Rah-Khosravani *et al.* (2017) for grain yield.

Effect of genotypes:

Concerning the differences between maize hybrids for studied growth characters, results in Table (1) demonstrated that, single hybrids, generally, had taller plants, lower ear height and higher ear leaf area than the three way crosses, and there were differences within each group of crosses. Results presented in that table showed that (S.C. 10) had the tallest plants (233.68 cm), highest ear leaf area (891.24 cm²) and lowest ear height (150.34 cm) followed by the yellow grains S.C. 168. Conversely, both three way hybrids had shorter plants, lower ear height and ear leaf area. These results agreed with those reported by Shalaby *et al.* (1994), Att-Allah (1996), Radwan (1998), Said and Gaber (1999), Mowafy (2003), Mahgoub and EL-Shenawy (2005), Abdel-Maksoud and Sarhan (2008) and EL-Galfy *et al.* (2009) for plant height, Gouda *et al.* (1992 and 1998), Radwan (1998), Mahgoub and EL-Shenawy (2005), Abdel-Maksoud and Sarhan (2008) and El-Galfy *et al.* (2009) for ear height and Gouda *et al.* (1992 and 1998), Attia (1999), Mowafy (2003), Oraby *et al.* (2005), Abdel-Maksoud and Sarhan (2008) and Alias *et al.* (2010) for ear leaf area.

On the other hand, data of grain yield and yield components of the studied maize genotypes are presented in Table (2). Results in that table showed that there were significant differences between the studied single crosses and the three way crosses and within each cross type, where crosses with white grains were significantly higher in grain yield and yield components than those of yellow grains. Abo-Shetaia *et al.* (2000), Hassan (2000) and Griesch and Yakout (2002) reported the same trend of results.

Table 1. Plant height, ear height and ear leaf area means as affected by sowing dates, maize hybrids and their interactions

Factor	Plant height (cm)	Ear height (cm)	Ear leaf area (cm ²)
Sowing date			
15/4	242.30 ^a	160.23 ^b	880.38 ^a
15/5	230.92 ^b	168.14 ^a	869.19 ^{ab}
15/6	212.46 ^c	162.38 ^{ab}	846.45 ^b
15/7	194.54 ^d	150.66 ^c	822.24 ^c
L.S.D _{0.05}	8.62	6.17	30.17
Hybrid			
S.C. 10 (White grains)	233.68 ^a	150.34 ^d	891.24 ^a
S.C. 168 (Yellow grains)	225.59 ^b	158.21 ^c	878.58 ^a
T.C. 310 (White grains)	210.13 ^c	168.76 ^a	836.35 ^b
T.C. 352 (Yellow grains)	210.81 ^c	164.10 ^b	812.07 ^b
L.S.D _{0.05}	6.21	4.60	24.37
Sowing date * hybrid	**	N.S.	*

Means followed by the same letter(s) within the same column are insignificantly different at 0.05 level of probability.

* and ** significant at 0.05 and 0.01 probability levels, respectively.

Table 2. Means of grain yield and its attributes as affected by sowing dates, maize hybrids and their interactions

Factor	Ear length (cm)	Number of rows/ ear	Kernels weight/ ear (g)	100-kernel weight (g)	Shelling percentage	Grain yield (t/ fed.)
Sowing date						
15/4	25.49 ^a	14.47 ^b	194.72 ^b	33.07 ^b	83.26 ^b	3.17 ^b
15/5	26.31 ^a	14.62 ^a	200.11 ^a	33.26 ^a	83.68 ^a	3.64 ^a
15/6	25.66 ^b	13.82 ^c	196.64 ^b	31.73 ^c	82.81 ^c	3.46 ^{ab}
15/7	22.17 ^c	12.99 ^d	164.15 ^c	29.89 ^d	80.22 ^d	2.65 ^c
L.S.D _{0.05}	0.78	0.09	2.10	0.15	0.20	0.31
Hybrid						
S.C. 10	25.96 ^a	15.12 ^a	200.19 ^a	33.18 ^a	83.79 ^a	3.68 ^a
S.C. 168	25.67 ^{ab}	14.48 ^b	195.12 ^b	32.82 ^b	83.24 ^b	3.43 ^b
T.C. 310	25.09 ^b	13.69 ^c	185.92 ^c	31.95 ^c	83.32 ^b	3.01 ^c
T.C. 352	22.90 ^c	12.61 ^d	174.38 ^d	29.99 ^d	80.61 ^c	2.78 ^d
L.S.D _{0.05}	0.59	0.04	1.76	0.10	0.11	0.19
Sowing date * hybrid	*	N.S.	*	*	*	**

Means followed by the same letter(s) within the same column are insignificantly different at 0.05 level of probability.

* and ** significant at 0.05 and 0.01 probability levels, respectively.

Table 3. Means of sowing date* hybrid interaction effects on plant height, ear leaf area, ear length, kernels weight/ ear, 100-kernel weight, shelling percentage and grain yield (t/ fed)

Sowing date	Hybrid	Plant height (cm)	Ear leaf area (cm ²)	Ear length (cm)	Kernels weight/ ear (g)	100-kernel weight (g)	Shelling percentage	Grain yield (t/ fed.)
15/4	S.C. 10	254.23 ^a	946.13 ^a	26.14 ^c	210.12 ^b	34.21 ^b	84.49 ^c	3.89 ^{ab}
	S.C. 168	248.30 ^{ab}	912.87 ^{ab}	26.26 ^c	200.27 ^d	34.86 ^a	83.88 ^d	3.40 ^{bc}
	T.C. 310	238.68 ^{bc}	868.92 ^c	25.30 ^d	191.96 ^e	32.69 ^c	82.79 ^f	3.06 ^c
	T.C. 352	227.99 ^c	793.60 ^e	24.26 ^e	176.53 ^f	30.52 ^{kl}	81.88 ^g	2.33 ^{bc}
15/5	S.C. 10	241.17 ^b	906.52 ^b	27.60 ^{ab}	212.87 ^a	34.97 ^a	85.62 ^a	4.0 ^a
	S.C. 168	236.26 ^{bc}	897.36 ^{bc}	28.03 ^a	209.65 ^{bc}	33.75 ^c	84.76 ^b	3.72 ^{ab}
	T.C. 310	228.92 ^c	836.47 ^{cd}	27.11 ^b	199.17 ^d	32.92 ^d	83.11 ^e	3.30 ^{bc}
	T.C. 352	217.33 ^{cd}	836.41 ^{cd}	22.50 ^f	178.75 ^f	31.40 ⁱ	81.23 ^h	3.54 ^{bc}
15/6	S.C. 10	230.16 ^{bc}	881.90 ^{bc}	26.38 ^{bc}	207.62 ^c	32.41 ^g	83.81 ^d	3.64 ^b
	S.C. 168	218.43 ^{cd}	867.43 ^c	26.21 ^c	198.17 ^d	32.06 ^h	83.01 ^{ef}	3.71 ^{ab}
	T.C. 310	192.85 ^e	819.07 ^{de}	25.89 ^{cd}	190.74 ^e	32.11 ^h	82.74 ^f	3.30 ^{bc}
	T.C. 352	208.40 ^d	817.40 ^{de}	24.16 ^e	190.03 ^e	30.34 ^k	81.68 ^g	3.19 ^c
15/7	S.C. 10	209.17 ^d	830.42 ^d	23.72 ^e	170.17 ^g	31.13 ^j	81.26 ^h	3.20 ^c
	S.C. 168	199.37 ^{de}	836.68 ^{cd}	22.19 ^f	172.39 ^g	30.62 ^k	81.31 ^h	2.92 ^c
	T.C. 310	180.10 ^f	820.96 ^{de}	22.08 ^f	161.83 ^h	30.09 ^m	80.65 ⁱ	2.41 ^d
	T.C. 352	189.52 ^{ef}	800.90 ^{de}	20.69 ^g	152.21 ⁱ	27.72 ⁿ	77.66 ^j	2.07 ^d
L.S.D _{0.05}	12.10	34.22	0.83	2.28	0.20	0.24	0.36	

Means followed by the same letter(s) within the same column are insignificantly different at 0.05 level of probability.

Obtained results revealed that (white grains single cross 10) had the tallest ears (25.96 cm), highest number of rows/ ear (15.12), shelling percentage (83.79%), grain yield (3.68 t/ fed.), heaviest kernels/ ear (200.19 g) and 100-kernel weight (33.18 g). Conversely, yellow grains three way cross 352 showed the lowest values (22.90 cm, 12.61, 80.91%, 2.78 t/ fed., 174.38 g and 29.99 g) for the above mentioned traits, respectively. The

significant genotypic differences were previously detected by several researchers (Shalaby *et al.*, 1994; Gouda *et al.*, 1998; Mowafy, 2003; Azam *et al.*, 2007 and Abdel-Maksoud and Sarhan, 2008).

Interaction effect:

The data listed in Table (3) present the significant interactions between the two studied factors detected for some growth character, grain yield and yield attributes.

With respect to growth traits, results indicated that sowing S.C.10 in mid April had the tallest plants (254.23 cm) and largest ear leaf area (946.13 cm²). However, sowing the same cross in mid May produced the highest kernels weight/ ear (212.87 g), 100-kernel weight (34.97 g) besides sowing S.C. 168 in mid April (34.68 g), shelling percentage (85.62%) and grain yield (4.0 t/ fed.). However, S.C. 168 produced the tallest ears (28.03 cm) when it was sown in mid May.

It could be concluded that, late sowing dates (mid June and July) had a negative effect on both single and three way crosses, and that could be attributed to unfavourable climatic conditions, especially air temperature, low daily incident radiation and radiation use efficiency. Also, sowing single crosses, especially white grains, in mid May produced the highest grain yield and yield attributes.

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الملخص العربي

تأثير مواعيد الزراعة على نمو ومحصول الحبوب لبعض هجن الذرة الشامية

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للتفريط (٨٣،٦٨%) وبالتالي أعلى محصول من الحبوب (٣،٦٤ طن/ فدان) - وعلى العكس من ذلك نجد أن تأخير زراعة الذرة الشامية إلى منتصف يوليو أدى إلى نقص معنوي في جميع الصفات التي تم دراستها. من جهة أخرى فقد تفوقت الهجن الفردية خاصة الهجين الفردي (١٠) أبيض الحبوب على الهجين الفردي (١٦٨) أصفر الحبوب والهجن الثلاثية بيضاء أو صفراء الحبوب التي تم دراستها في جميع الصفات التي تم قياسها، عدا الهجين الثلاثي (٣١٠) الذي أعطى أقصى ارتفاعاً للكوز (١٦٨،٧٦ سم).

كذلك أوضحت النتائج أن زراعة الهجين الفردي (١٠) مبكراً في منتصف إبريل أدت إلى الحصول على أطول النباتات وأكبر مساحة لورقة الكوز - في حين أن زراعة نفس الهجين في منتصف مايو أدت إلى الحصول على أقصى وزن لحبوب الكوز، أثقل وزن للمائة حبة، أعلى نسبة للتفريط وكذلك أعلى محصول من الحبوب (٤ طن/ فدان) - من ناحية أخرى أدت زراعة الهجين الفردي (١٦٨) في نفس الموعد أدى إلى إنتاج أطول الكيزان (٢٨،٠٣ سم).

نفذت تجربة حقلية بمزرعة كلية الزراعة - سابا باشا - جامعة الإسكندرية خلال الموسم الصيفي لعام ٢٠١٧ لدراسة تأثير أربعة مواعيد للزراعة (منتصف إبريل، منتصف مايو، منتصف يونيو، منتصف يوليو) على نمو وإنتاجية أربعة هجن من الذرة الشامية (هجين فردي ١٠ أبيض الحبوب، هجين فردي ١٦٨ أصفر الحبوب، هجين ثلاثي ٣١٠ أبيض الحبوب، هجين ثلاثي ٣٥٢ أصفر الحبوب) وذلك باستخدام تصميم القطع المنشقة مرة واحدة في ثلاث مكررات بحيث كانت مواعيد الزراعة تمثل عامل القطع الرئيسية بينما مثلت الهجن عامل القطع الفرعية وقد أوضحت النتائج أن الزراعة المبكرة (منتصف إبريل) أدت إلى الحصول على أطول النباتات (٢٤٢،٣٠ سم) وأكبر مساحة لورقة الكوز (٨٨٠،٣٨ سم^٢) وأطول الكيزان (٢٥،٤٩ سم) متساوية في ذلك مع الزراعة في منتصف مايو التي أعطت كيزان بطول (٢٦،٣١ سم) من جهة أخرى فقد أدت الزراعة في (منتصف مايو) إلى زيادة ارتفاع الكوز (١٦٨،١٤ سم)، أقصى عدد من الصفوف في الكوز (١٤،٦٢)، أقصى وزن لحبوب الكوز (٢٠٠،١١ جم) وأثقل وزن للمائة حبة (٣٣،٢٦ جم) وأعلى نسبة