

UTILIZATION OF DIFFERENT METHODS FOR EARLINESS MEASUREMENTS ON SOME EGYPTIAN COTTON GENOTYPES

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ABSTRACT

The performances of three Egyptian cotton genotypes (Giza 90, Giza 90 x Aust. and [G.83 x (G.75 x5844)] x G.80) were evaluated for earliness using seven methods of measurements during 2013 and 2014 seasons. Date of flowering was estimated daily, and the average number of flowers for 10 plants per week was calculated to construct curves for weekly flowering. Moreover, this study included six measurements of earliness, *i.e.*, position of first sympodial node (PFN), days to first flower (DFF), days to first open boll (DFB), earliness percentage (Er %), mean maturity date (MMD) and production rate index (PRI).

Rate of weekly flowering followed a normal distribution curve. The genotype (Giza 90 x Aust.) produced the highest total number of flowers compared to other tested genotypes. The maximum average rate of flowering was found at fifteen week after planting (13/7-19/7). The total number of flowers was significantly different between genotypes. Also, the data showed significant differences in most flowering weeks.

Measurements of earliness (PFN, DFF, DFB, Er %, MMD and PRI) indicated that (Giza 90 x Aust.) was the earliest compared to other genotypes. Significant differences existed between the genotypes in (DFF, DFB, Er % and MMD). While, the differences between genotypes were not significant for (PFN and PRI). The results obtained clarify that (Giza 90 x Aust.) was the earliest compared to other genotypes.

Key words: cotton, earliness measurements, genotypes.

1. INTRODUCTION

Cotton (*Gossypium barbadense* L.) is considered the main fiber crop through industry in Egypt and in the world. In Egypt, it was always and still the main cash crop for most growers. It is the main raw material used in textile industry, which is one of the most successful industries in Egypt.

Earliness in cotton has many advantages. It helps to fit the crop into a multi-cropping system. The losses of yield, its components and fiber properties quality from disease and insect injury, may be reduced by the use of early maturing varieties. Earliness in cotton is not a character that can be easily measured since the cotton plant flowers and sets bolls over a long period of time. Earliness is influenced by the time of flowering, rapid development of flowers and the length of time required for the bolls to mature.

The progress of any breeding program depends on the available genetic variation to produce new superior genotypes that can replace the existing ones. Cotton breeders have special interest in developing new promising genotypes.

Thus, the study of the methods of measuring earliness in cotton is very important in cotton breeding programs in order to evaluate and select early mature varieties. Abd El-Rahman and Abo-Tour (1994), Awaad (1994), Badr *et al.* (2001), Haneef *et al.* (2001), Badr (2003), El-Adly (2003), Sawan (2009), Sawan *et al.* (2005 and 2010), Dhamayanthi and Rathinavel (2013) and Sawan (2014), studied the flowering behavior in cotton genotypes using flowering curves. However, Richmond and Radwan (1962), Al-Enani and Eid (1980), Shafshak *et al.* (1993), El- Agamy *et al.* (1994), Nassar *et al.* (1998), Badr *et al.* (2001), Badr (2003), El-Adly (2003), Shah *et al.* (2010), Ismail *et al.* (2012),

Shakeel *et al.* (2012), and Habib *et al.* (2013), studied earliness by measuring position of the first fruiting node, day to first flower and earliness percentage. Awaad (1994), Nassar *et al.* (1998) Abo El-Zahab *et al.* (2003) and Ismail *et al.* (2012), estimated the mean maturity date and production rate index as an indication to crop maturity.

Our objective in this study was to evaluate three Egyptian cotton genotypes for maturity by using seven earliness measurements.

2. MATERIALS AND METHODS

Two field experiments were carried out at Sids Agricultural Research Station, Bani-Swef Governorate, Middle Egypt during 2013 and 2014 seasons. The main aim was to study some earliness measurements on the three Egyptian cotton genotypes (Giza 90, Giza 90 x Aust. and [G.83 x (G.75 x5844)] x G.80). Randomized Complete Block Design with three replications was used. The plots were of five rows; 4.0 meters long and 60 cm wide. Seeds were planted in hills 20 cm apart and thinned to two healthy plants on the last week of March in both seasons. All cultural practices were applied as recommended in cotton fields.

Data of flowering were estimated daily on ten guarded plants, which were taken from the outer rows of each plot. Flowering date was recorded on labels which were hanged to the flowers. The number of flowers of ten plants on each plot at the three replicates were counted at weekly intervals during the eleven weeks of the flowering period. The other plants were used to measure the following characters:

- 1-Flowering behaviour:** The curves of flowering were constructed using the number of flowers counted weekly during the eleven weeks.
- 2-Position of the first sympodial node (PFN)** Position of the main stem node at which the first fruiting branch emerges was expressed as number of nodes.
- 3-Days to first flower (DFF):** The number of days from planting to the opening of the first flower.
- 4-Days to first open boll (DFB):** Number of days from sowing to the opening of the first boll.

5-Earliness percentage (Er %): Was calculated according to the following equation:

$$\text{Earliness index} = \frac{\text{yield of the first pick}}{\text{Weight of the two picks}} \times 100$$

Pickings were carried out by hand on weekly basis on the three middle rows of each plot. Seven pickings were made in each of the two seasons at the dates specified in Table (1). The following characters were determined for each genotype.

Table (1): Dates of weekly picking in 2013 and 2014 seasons.

Picking dates						
P1	P2	P3	P4	P5	P6	P7
11 / 8	18 / 8	25 / 8	1 / 9	8 / 9	15 / 9	22 / 9

6-Mean maturity date (MMD): Weight mean of harvest date of several periodic harvests calculated according to Christidis and Harrison (1955) by the following formula:

$$\text{MMD} = (W_1H_1 + W_2H_2 + \dots + W_nH_n)$$

Where:

- W = weight of seed cotton in grams.
- H = number of days from planting to harvest.
- 1, 2,.....and n = consecutive period harvest number (7 harvests).

7- Production rate index (PRI): Calculated by dividing the total seed cotton yield by MMD value which results in relative production rate (amount per unit time) according to Bilbro and Quisenberry (1973).

The general formula for this value would be:

$$\text{PRI} = \frac{(W_1+W_2+\dots W_n)^2}{(W_1H_1+W_2H_2++W_nH_n)}$$

Where:

- W = weight of seed cotton in grams.
- H = number of days from planting to harvest.
- 1, 2,.....and n = consecutive period harvest number (7 harvests).

The data obtained were subjected to statistical analysis according to the procedures outlined by Snedecor and Cochran (1967). Means values of the studied characters were compared by L.S.D. test at 5 % level of significance.

3. RESULTS AND DISCUSSION

The results reported in this study include the evaluation of the three Egyptian cotton genotypes (Giza 90, Giza 90 x Aust. and [G.83 x (G.75 x5844)] x G.80) using seven methods for measuring earliness. These results are summarized as follows:

3.1. Flowering behaviour

The data of weekly flowering intervals are contained in Table (2). The flowering season extended for eleven weeks at the two growing seasons 2013 and 2014, respectively. The genotype (Giza 90 x Aust.) produced total number of flowers per plant more than any other genotypes. With respect to weekly flowering, it followed a normal curve which was nearly similar in all genotypes in both growing seasons, Figs. (1 and 2). The average rate of flowering

results are in general agreement with those previously reported by Abd El-Rahman and Abo-Tour (1994), Awaad (1994), Badr *et al.* (2001), Haneef *et al.* (2001), Badr (2003), El-Adly (2003), Sawan (2009), Sawan *et al.* (2005 and 2010), Dhamayanthi and Rathinavel (2013) and Sawan *et al.* (2014).

3.2. Position of the first sympodial node (PFN)

Data in Table (3) indicate insignificant differences between the genotypes under study in the two seasons for (PFN). The genotype (Giza 90 x Aust.) had the lowest position of the first fruiting node (6.59), while (PFN) for Giza 90 and [G.83 x (G.75 x5844)] x G.80 were (7.00 and 6.83), respectively. These results are in agreement with those obtained by Awaad (1994) El-Agamy *et al.* (1994), El-Adly (2003) and Habib *et al.* (2013).

Table (2): Number of flowers/10 plants in the three Egyptian cotton genotypes at weekly intervals in 2013 and 2014 seasons.

Weeks after planting	Flowering period	Cotton genotypes			L.S.D. 5 %
		Giza 90	Giza 90 x Aust.	[G.83 x (G.75 x 5844)] x G.80	
2013 season					
11	15/6-21/6	4.6	6.5	7.3	N.S.
12	22/6-28/6	13.8	16.4	16.8	1.3
13	29/6-5/7	26.4	31.8	26.6	3.5
14	6/7-12/7	31.9	42.2	30.1	9.3
15	13/7-19/7	45.0	57.0	53.0	11.6
16	20/7-26/7	33.5	38.3	38.5	N.S.
17	27/7-2/8	25.6	33.9	26.8	N.S.
18	3/8-9/8	11.4	14.4	9.0	2.4
19	10/8-16/8	9.4	10.6	5.3	4.2
20	17/8-23/8	3.2	6.8	2.5	1.5
21	24/8-30/8	1.4	3.7	1.0	1.3
Total		206.2	261.6	216.9	25.7
2014 season					
11	15/6-21/6	7.7	7.3	7.5	N.S.
12	22/6-28/6	17	25.8	11.4	2.7
13	29/6-5/7	24.9	31.9	21.3	7.3
14	6/7-12/7	30.1	40.8	29.7	9.5
15	13/7-19/7	43	53.7	49.0	8.6
16	20/7-26/7	35.7	33.5	34.3	N.S.
17	27/7-2/8	27	21.7	25.7	N.S.
18	3/8-9/8	7.8	16.5	15.4	4.3
19	10/8-16/8	5.1	7.6	9.5	1.5
20	17/8-23/8	2.1	4.8	5.8	2.7
21	24/8-30/8	1.2	2.0	3.1	N.S.
Total		201.6	245.6	212.7	29.5

started slow, then it increased gradually, reached the peak in the fifteen week after planting (13/7-19/7) and then decreased gradually till it reached its minimum at the fourth week of august. These

3.3. Days to first flower (DFF)

Results in Table (3) revealed significant differences between the genotypes for days to first flower. The genotype (Giza 90 x Aust.) was

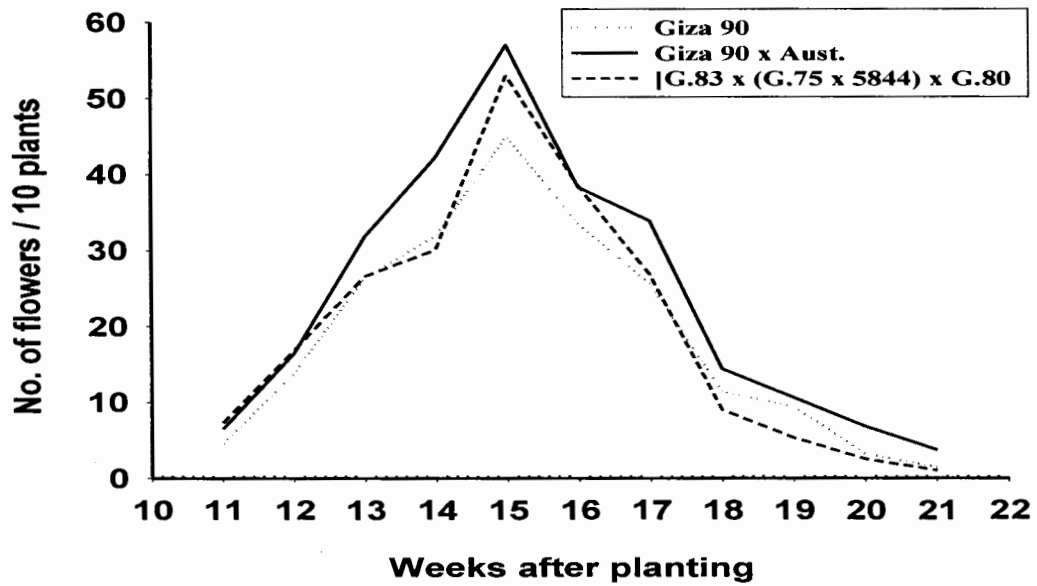


Fig. (1): The flowering curve of the studied genotypes (Giza 90, Giza 90 x Aust. and G.83 x (G.75 x5844)] x G.80 in 2013 season.

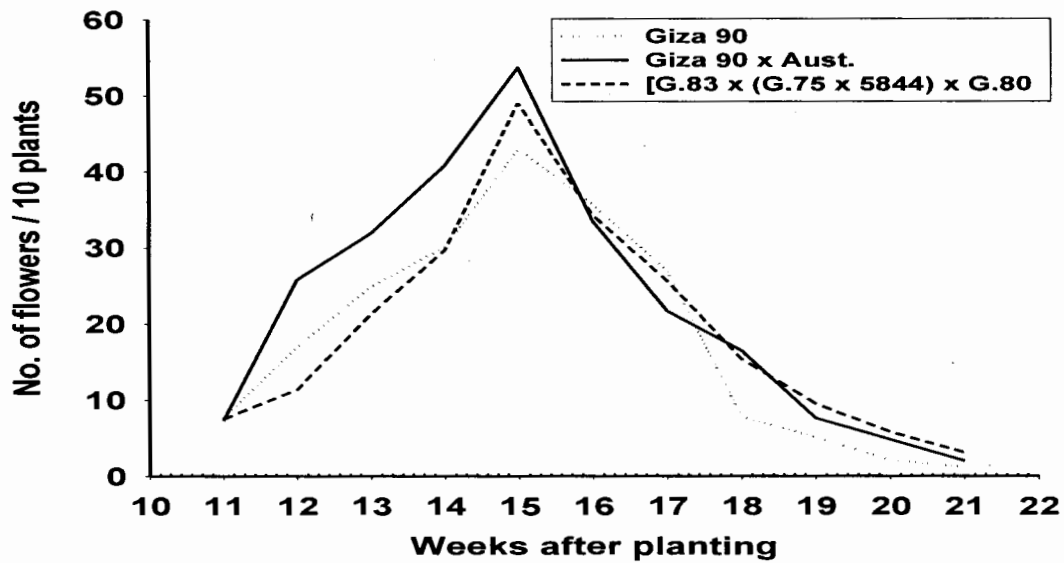


Fig. (2): The flowering curve of the studied genotypes (Giza 90, Giza 90 x Aust. and G.83 x (G.75 x5844)] x G.80 in 2014 season.

the earliest genotype in this trait (82.55 and 80.32 days) in the two seasons, respectively. These results may be attributed to the differences among cotton genotypes in genetical constitution and their adaptability with environmental conditions which were reflected on flowering and fruiting. Similar results were obtained by Shafshak *et al.* (1993), Awaad (1994), Badr (2003), El-Adly (2003), Ismail *et al.* (2012) and Habib *et al.* (2013).

3.4. Days to the first open boll (DFB)

It could be seen from Table (3) that during 2013 and 2014 seasons, significant differences were found between the genotypes for days to first open boll. The genotype (Giza 90 x Aust.) had the lowest number of days from planting to the first open boll. The results indicated that there is potential for the development of early maturing genotypes by using available germplasm advancing early maturing. The results are in harmony with those obtained by Shafshak *et al.* (1993), Badr (2001) El-Adly (2003) and Ismail *et al.* (2012).

3.5. Earliness percentage (Er %)

Data in Table (3) showed means of earliness percentage in both seasons. These genotypes revealed that earliness percentage in 2013 ranged from 60.23 % to 68.54 %, also in 2014 ranged from 61.58 % to 69.57 %. Significant differences existed between the genotypes in this character. The genotype (Giza 90 x Aust.) had

the highest earliness percentage in the two seasons. In this respect, Awaad (1994), Badr (2001), Badr (2003) and Ismail *et al.* (2012), noted that the effect of genotypes was significant on earliness percentage.

3.6. Mean maturity date (MMD)

The results shown in Table (3) indicate that the differences varied significantly with respect to the mean maturity date at 5 % value, although, the differences between the lowest and the highest period rate were only 7 days. The genotype (Giza 90 x Aust.) had the lowest MMD (142.11 and 141.12 days) during 2013 and 2014 seasons, respectively. Abo El-Zahab *et al.* (2003) and Ismail *et al.* (2012), pointed that MMD was considered to be the most discriminating and reliable method of estimating earliness regardless to yield.

3.7. Production rate index (PRI)

Regarding the production rate index presented in Table (3), it was obvious that the differences among the genotypes were insignificant in the two seasons. The genotype (Giza 90 x Aust.) was earlier than the other genotypes, followed by [G.83 x (G.75 x 5844)] x G.80 and Giza 90 respectively. El-Adly (2003) and Ismail *et al.* (2012) reported that PRI method of measuring earliness revealed the cultivars that have superior combinations of yield and earliness.

Table (3): Mean number of position of the first sympodial node (PFN), days to the first flower (DFF), days to the first open boll (DFB), earliness percentage (Er %), mean maturity date (MMD in days) and production rate index (PRI in gram) for three Egyptian cotton genotypes in 2013 and 2014 seasons.

Characters	Cotton genotypes			L.S.D. 5 %
	Giza 90	Giza 90 x Aust.	[G.83 x (G.75 x 5844)] x G.80	
2013 season				
Position of the first sympodial node (PFN)	7.00	6.59	6.83	N.S.
Days to the first flower (DFF)	87.24	82.55	85.03	2.31
Days to the first open boll (DFB)	137.56	131.92	134.73	3.33
Earliness percentage (Er %)	60.23	68.54	64.03	4.10
Mean maturity date (MMD in days)	149.13	142.11	146.23	2.94
Production rate index (PRI in gram)	0.75	0.81	0.79	N.S.
2014 season				
Position of the first sympodial node (PFN)	6.87	6.43	6.75	N.S.
Days to the first flower (DFF)	85.81	80.32	83.21	2.53
Days to the first open boll (DFB)	137.85	131.25	134.21	3.12
Earliness percentage (Er %)	61.58	69.57	65.23	4.21
Mean maturity date (MMD in days)	148.35	141.12	145.67	2.70
Production rate index (PRI in gram)	0.65	0.73	0.63	N.S.

Conclusions

From the above results of earliness measurements, it could be concluded that the genotype (Giza 90 x Aust.) was earlier than the other genotypes. Flowering behavior, position of the first sympodial node, days to the first flower, days to the first open boll, earliness percentage, mean maturity date and production rate index methods gave the same genotype ranking.

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استخدام طرق مختلفة لقياس التبكير في بعض التراكيب الوراثية للقطن المصري

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ملخص

تهدف هذه الدراسة إلى تقييم ثلاثة تراكيب وراثية (جيزة 90 ، (جيزة 90 x استرالي) ، [جيزة 83 x (جيزة 75 x 5844)] جيزة 80) لصفة التبكير باستخدام سبع طرق مختلفة خلال موسمي 2013-2014 أخذت قراءات التزهير اليومي للحصول على عدد الأزهار لعشر نباتات لكل أسبوع لعمل منحنى التزهير الأسبوعي. ثم أخذت جنيات أسبوعية لحساب متوسط تاريخ النضج (MMD) ومعدل الإنتاجية في وحدة الزمن (PRI). هذا بالإضافة إلى قياس ارتفاع أول عقدة ثمرية وتاريخ تفتح أول زهرة وتفتح أول لوزة ومعامل التبكير. وكانت النتائج المتحصل عليها هي:

- 1- وجد أن معدل الأزهار الأسبوعي يتبع منحنى التوزيع الطبيعي وقد أخذت كل التراكيب الوراثية نفس الإتجاه. كما أعطى التركيب الوراثي (جيزة 90 x استرالي) أزهاراً أكثر من التراكيب الوراثية الأخرى. وإختلف العدد الكلي للأزهار معنوياً بين التراكيب الوراثية في كلا الموسمين.
2. وجدت إختلافات معنوية بين التراكيب الوراثية تحت الدراسة في تاريخ تفتح أول زهرة وتفتح أول لوزة ومعامل التبكير ومتوسط تاريخ النضج في حين لم توجد إختلافات معنوية بين التراكيب الوراثية في ارتفاع أول عقدة ثمرية ومعدل الإنتاجية في وحدة الزمن في كلا موسمي الدراسة.
3. أظهرت جميع قياسات التبكير أن التركيب الوراثي (جيزة 90 x استرالي) هو أبكر التراكيب الوراثية يليه في الترتيب [جيزة 83 x (جيزة 75 x 5844)] جيزة 80 وأخير جيزة 90 خلال موسمي الدراسة.

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