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Tolerance of Egyptian Cotton Varieties (*G. barbadense* L.) to Late Planting

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Abstract

This study was done to evaluate two sets of Egyptian cotton varieties (*G. barbadense* L.) for tolerance to late planting. The first set included 16 cultivated and obsolete varieties which evaluated for two seasons under early and late plantings. The second set included eight varieties selected from the first set for tolerance to late planting; four susceptible and four tolerant, and evaluated for three seasons. In the first set, mean squares of all the studied traits indicated significant ($p \leq 0.01$) differences among varieties in separate and combined analyses under early and late plantings. Also, the combined analysis showed significant ($p \leq 0.01$) differences between dates for all traits. However, the interactions of varieties × dates and varieties × dates × years were not significant. The mean square of varieties × years was significant only for lint percentage, boll weight and days of first flowers. Furthermore, the interaction mean squares of varieties x years under both of early and late planting was not significant indicating that the different traits were stable from year to year either for early or late planting. Late planting caused severe reduction in seed cotton yield reached 19.28, 19.14 and 19.21 % in the first, second year and combined date. Stress susceptibility index varied slightly from year to year. The highest stress susceptibility index was recorded for the varieties Giza 81 and Menoufi (1.19) followed by Giza 85 (1.20), Giza 88(1.20), Giza 69 (1.15), Giza 95 (1.15), Ashmouni (1.10) and Giza 92 (1.04). The highest yielding varieties (G90× Aus, Giza 90, Dandara, Giza 86 and Giza 80 were tolerant to late planting and scored stress susceptibility index less than unity. The highest varieties in lint yield were G90× Aus, followed by Giza 90, Giza 80, Giza 86 and Giza 95 under both planting dates. The reduction % in lint yield caused by late planting was very high and larger than that in seed cotton yield, and reached 22.88, 22.56 and 22.72 in the first, second year and combined data, respectively. The stress susceptibility index of the different varieties respect lint yield / plant showed the same picture as seed cotton yield /plant. The reduction in lint% for different varieties was low and averaged 4.53, 4.41 and 4.47 % in the first, second season and combined means, respectively. The reduction % in boll weight caused by delaying planting data was high and reached 21.79, 20.85 with an average of 21.31 %. The reduction% in boll weight was more than that in seed cotton yield. Therefore, number of bolls /plant increased under late planting. These results indicate that the stress of delay planting shortened the vegetative period of cotton growth. The results of the second set of varieties were in the same trend of the first one. These results indicate that the main cause of reduction in cotton yield is late planting date. This is due to that all the Egyptian cottons were bred to grow under full season and not for short season conditions. How-

ever, the stress susceptibility index indicated to the presence of tolerant varieties to late planting, and there is a chance to select for short season condition from the progenies of the crosses of such tolerant varieties.

Keywords: *Egyptian cotton, stress susceptibility index, effect of late planting date.*

Introduction

Egyptian cottons *''Gossypium barbadense L.''* are known as extra-long staple, and are famous in the world for their high fiber quality. Cotton is important for Egyptians for food (oils), feed (animal's cake) and fiber for both export and local textile industry (Abdalla 2013). Some of Egyptian cotton growers used to delay cotton planting date after March to have one extra cut from berseem (the preceding crop of cotton from October to March) (Elayan *et al.* 2015). Most growers may delay planting dates to late April or early May because of long duration period of winter crops like wheat (Abdalla and Abd- El-Zaher, 2012). Various research reports showed that cotton genotypes are greatly affected in both seed cotton yield and fiber quality traits by delaying planting date, with different magnitudes which vary with cotton genotypes (Abo El-Zahab 1994, Bauer *et al.*1998, Bange *et al.* 2008, Gadallah 2002, Abo El-Zahab *et al.* 2007, Baker *et al*. 2012, Abdalla 2013, Abdalla 2014 and Elayan *et al*. 2015). Gadallah (2002) noted that seed cotton yield decreased by 38.91 and 63.16% due to delaying cotton planting to 10 and 25 April, in respective order as compared with first planting date on 20 March over two seasons. Therefore, this problem is one of the big challenges to Egyptian cotton breeders nowadays; they should improve and produce new tolerant or adapted genotypes to late planting. Field evaluation of different genotypes (old varieties, hybrids, lines, populations or even new varieties) grown under different late planting dates compared to the optimums planting dates is considered as starting point to select genotypes that can tolerate late planting and being stable across environmental conditions of usual and late planting. Furthermore, the adverse conditions of late planting not only influence the cotton yield but also mask any genetic improvement in cotton yield and fiber traits (Pettigrew and Meredith, 2009). Thus, genotype by environment (GE) interaction complicates the selection of genotypes to be adapted to new environments.

Many published studies reported that breeding Egyptian cottons (*G. barbadense*) under late sowing are still rare. This could be due to the growth habit of *barbadense* cottons that described as tall, indeterminate-full-season plants, which, despite its great quality, is not breed to adapt late sowing date (Abdalla 2014). El-Zeky *et al.* (2007) stated that, the Egyptian cotton cultivar Giza 86 gave a significant decrease in number of open bolls per plant, boll weight lint percentage and cotton yield per plant and Feddan due to late sowing. Elayan *et al.* (2015) found that delaying planting pushed cotton plants for an early flowering and maturity, and the seed cotton yields per plant and per Feddan were consistently decrease with each 15-days delay in planting due to a significant decrease in each of the number of open

bolls/plant and boll weight. Baker *et al*. (2012) identified parents and crosses of Egyptian cottons tolerant to late planting. The previous reviews indicated that development of Egyptian genotypes that can produce an acceptable yield in a short period and simultaneously maintaining the prized quality are of great interest of cotton breeder.

Selection for yield or other agronomic traits is a problem to plant breeders. The question is: should breeding for late-planting (stress conditions) rely on selection under stress condition alone or on selection in both non-stress and stress conditions? Some researchers believe in selection under non-stress conditions (Betran *et al*. 2003). Several researchers have chosen the mid-way and believe in selection under both stress and non-stress conditions (Fischer and Maurer 1978 and Rajaram and Van Ginkle 2001). Abo El-Zahab *et al*. 2007 indicated that some genotypes can perform better than current varieties under late planting conditions. The objective of the investigation work was to study the effect of delaying planting date on seed cotton yield and its components along with earliness of some Egyptian cotton varieties.

Materials and Methods

The present study was carried out at Assiut Univ. Exper. Farm and Shandaweel Research Station. Sohag, Cotton Res. Inst., ARC, during the three summer seasons of 2014-2016. The basic materials were sixteen divergent Egyptian cotton varieties belong to *G. barbadense*, L. The pure seeds of these varieties were obtained from Cotton Research Institute, Agricultural Research Center at Giza, Egypt. The name, pedigree and the main characteristics of these varieties are presented in Table1.

First season (2014): The sixteen genotypes shown in Table 1 were sown at Assiut Univ. Experimental Farm on the 29th March and 28th April as early and late plating dates, respectively, in a randomized complete blocks design with three replications for each date. Each plot consisted of two rows, four-meter-long, 0.6 m apart and 40 cm between hills within a row. After full emergence, seedlings were thinned to one plant per hill. The recommended cultural practices were adopted throughout the growing season. The characters recorded on each plot were seed cotton yield/plant; g (SCY/P), lint yield/plant; g (LY/P), number of bolls /plant (NB/P), boll weight; g (BW), seed index; g (SI), lint index; g (LI); estimated as (weight of lint cotton in a sample/weight of seeds in this sample) x seed index, earliness index (EI); measured as weight of the first pick / weight of the two picks and days to first flower (DFF); was measured as the number of days from sowing to the appearance of the first flower on five plants in each plot. In 2015 season, the two experiments of the first season were repeated. Four varieties tolerant to late plating (Giza 95,Giza 90,Giza 80, and Giza 90 × Australian) and four sensitive to late plating (Giza 92, Giza 87, Giza 86, and Giza 45) were selected. In the third season (2016), the eight selected varieties were sown on the 29th of March (early) and 1stMay (late planting date) as in the first season at Shandaweel Research Station. Sohag, Cotton Res. Inst., ARC. All cultural

practices were followed throughout the growing season as usually done with ordinary cotton cultivation. The characters were recorded as in the previous seasons. The analysis of variance was performed for a randomized complete block design as outlined by Steel and Torrie (1980). Mean comparisons were calculated using revised L.S.D. as outlined by El Rawi and Khalafalla 1980. Stress susceptibility index (SSI) was calculated as outlined by Fischer and Maurer (1978).

Table 1. The name, pedigree and the main characteristics of the varieties

Genotype	Pedigree	Characteristics
Giza 95	**[(G.83 × (G.75 × 5844)) × G.80]**	A new long staple cotton variety, characterized by high yielding ability, high lint percentage, early maturity and heat tolerance (cultivated).
Giza 92	**G84(G74 x G68)**	An extra-long staple variety, (cultivated).
Giza 90	**Giza83× Dandara**	Long staple variety for upper Egypt, high yield and lint percentage (cultivated).
Giza 90 Aus	**Giza90 × Australian**	Characterized by high yielding and earliness (cultivated).
Giza 88	**G77 x G45B**	An extra-long staple variety, (cultivated).
Giza 87	**(G.77×G.45A)**	An extra-long staple (cultivated).
Giza 86	**(G.77×G.45B)**	Long staple variety, characterized by high yield and extra fineness of fiber (cultivated).
Giza 85	**G. 67×CB 58**	A long staple variety, characterized by high yield and earliness variety (obsolete).
Giza 81	**G67×(5844)**	Long stable variety (cultivated).
Giza 80	**G. 66×G. 73**	Long staple variety. It is high yield and lint percentage (cultivated).
Giza 77	**G77×G68**	An extra-long staple variety (obsolete).
Giza 69	**G51|×G30**	Long stable variety (obsolete).
Giza 45	**G. 7×G. 28**	An extra-long staple variety, (obsolete).
Ashmouni	**G1**	Long stable variety (obsolete).
Menoufi	**G.12×Shaka 3**	An extra-long staple, characterized by high lint percentage and compact (obsolete).
Dandara	**Selected from Giza-3**	Long stable variety (obsolete).

Results and Discussion

A- Evaluation of 16 varieties for two seasons

Means, variance, reduction % and susceptibility index

Mean squares of all the studied traits (Tables 2 and 3a, 3b, 3c) indicates significant ($p \leq 0.01$) differences among varieties in separate and combined analysis under early and late plantings.The combined analysis (Table 3a) showed significant ($p \leq 0.01$) differences between dates for all traits. These results agree with those reported by Bozbek *et al*. (2006), Baker *et al.* (2012) and Elayan *et al*. (2014 and 2015). However, the interactions of varieties × dates and varieties × dates × years were not significant. The varieties × years' mean squares was significant only for lint percentage, boll weight and days of first flowers. Furthermore, the interaction mean squares of varieties x years under early planting (Table 3b), and under late planting (Table 3c) was not significant indicating that the different traits were stable from year to year either for early or for late planting.

Mean seed cotton yield /plant (Table 4) indicated that Giza 87 showed the lowest and Giza 90× Aus had the highest yielding ability in both years and planting dates. The combined means ranged from 64.95 for Giza 87 to 127.22 for Giza 90×Aus with an average of 92.99 g/plant under early, and from 55.98 to 107.62 with an average of 75.12 g/plant under late planting for the same respective parents. Late planting caused severe reduction in seed cotton yield reached 19.28, 19.14 and

19.21 % in the first, second year and combined data; respectively. Bozbek *et al*. (2006) stated that delay sowing decreased seed cotton yield. Also, Gadalla (2002) and Elayan *et al.* (2013 and 2015) found decrease in seed cotton yield with delaying sowing dates.

The results indicate that stress susceptibility index varied slightly from year to year, the combined date showed that the highest susceptibility index(s) was recorded for the varieties Giza 81 and Menoufi (1.29) followed by Giza 85 (1.20), Giza 88 (1.20), Giza 69 (1.15), Giza 95 (1.15), Ashmouni (1.10) and Giza 92 (1.04). These varieties could be considered susceptible to late planting, but the other eight varieties could be considered tolerant to late planting. It should be indicated that the highest yielding varieties (G90×Aus, Giza 90, Dandara, Giza 86 and Giza 80 were tolerant to late planting and scored stress susceptibility index less than unity.

Table 2. Mean squares of the separate analysis for the studied traits under early and late planting dates of the 16 varieties in the first and second seasons

S.O.V	d.f	Mean Squares								
		d.f								
		SCY/P	LY/P	LP	BW;g	NB/P	SI;g	LI;g	EI%	DFF
Early planting										
Reps	**2**	25.73	4.58	0.04	0.11	6.55	0.28	0.11	1.21	1.56
Varieties	**15**	784.86**	186.56**	17.15**	0.23**	94.31**	2.00**	1.77**	231.73**	89.19**
Error	**30**	66.33	10.06	0.21	0.04	14.13	0.10	0.05	9.52	2.43
Late planting										
Reps	**2**	4.79	0.79	0.17	0.003	0.08	0.03	0.006	2.32	0.583
Varieties	**15**	612.21**	132.03**	18.15**	0.06**	111.51**	1.56**	2.19**	223.54**	22.13**
Error	**30**	52.55	7.22	0.13	0.022	18.04	0.04	0.038	11.49	2.56
Early planting		Second season (2015)								
Reps	**2**	163.33	16.97	0.68	0.15	38.47	0.02	0.05	1.09	0.021
Varieties	**15**	827.35**	189.25**	14.94**	0.28**	105.40**	1.95**	1.64**	268.62**	87.05**
Error	**30**	55.80	8.58	0.50	0.04	8.49	0.11	0.07	7.78	2.09
Late planting										
Reps	**2**	12.56	2.26	0.28	0.054	6.49	0.06	0.06	3.01	3.52
Varieties	**15**	691.19**	145.83**	18.59**	0.05**	156.85**	1.70**	2.12**	285.83**	28.19**
Error	**30**	48.55	6.80	0.14	0.024	8.44	0.04	0.03	6.24	2.79

**, significant at 0.01 level of probability.

Table 3a. Means squares of the combined analysis of 16 varieties over years and planting dates.

		Mean squares								
S.O.V	**d.f**	**SCY/P**	**LY/P**	**LP**	**BW**	**NB/p**	**SI**	**LI**	**EI %**	**DFF**
Years(Y)	**1**	34.12	4.26	0.19	0.08	0.91	1.37	1.61	2.06	6.75
Dates(D)	**1**	15318.75**	2978.33**	130.94**	18.75**	29.34	88.56**	11.42**	23.44**	4181.37***
Y× D	**1**	-0.37	0.20	0.20	0.004	0.69	0.22	0.08	3.12	0
Error a	**8**	51.66	6.15	0.29	0.08	12.90	9.96	5.81	1.91	1.42
Varieties(V)	**15**	2866.08**	642.81**	67.40**	0.48	443.94**	6.41	7.12	993.95**	188.45**
V×Y	**15**	42.11	9.22	1.15	0.12	18.39	0.57	0.50	8.63	37.05
V× D	**15**	5.27	1.14	0.15	0.0045	2.70	0.11	5.48	5.37	0.57
V×D×Y	**15**	2.25	0.50	0.13	0.01	3.03	0.12	6.04	1.76	0.46
Error b	**120**	55.81	8.17	0.25	0.03	12.27	7.16	4.82	8.76	2.47

Table 3b. Mean squares of the combined analysis of the studied traits of the 16 varieties over years and early plating date.

		Mean squares								
S.O.V	**d.f**	**SCY/P**	**LY/P**	**LP%**	**BW**	**NB/p**	**SI;g**	**LI;g**	**EI %**	**DFF**
Years(Y)	**1**	17.69	1.92	-0.03	0.02	0.03	0.06	0.01	-0.06	2.69
R × Y	**4**	94.58	10.78	0.36	0.13	22.51	0.15	0.08	1.16	0.78
Varieties(V)	**15**	1608.70**	374.70**	31.82**	0.50**	198.23**	3.74**	3.31**	499.01**	175.89**
V× Y	**15**	3.52	1.11	0.27	0.01	1.48	0.22	0.10	1.34	0.35
Error	**60**	61.07	9.32	0.36	0.04	11.31	0.10	0.06	8.65	2.26

Table 3c . Mean squares of the combined analysis of the studied traits of the 16 varieties over years and late plating date.

S.O.V	**d.f**	**Mean squares**								
		SCY/P	**LY/P**	**LP**	**BW;g**	**NB/p**	**SI;g**	**LI;g**	**EI %**	**DFF**
Years(Y)	**1**	16.06	2.53	0.04	0.07	1.55	0.18	0.09	5.28	4.16
R × Y	**4**	8.70	1.53	0.22	0.03	3.29	0.05	0.03	2.64	2.05
Varieties(V)	**15**	1299.43**	277.33**	36.73**	0.10**	264.11**	3.24**	4.30**	503.57**	49.62**
V× Y	**15**	3.98	0.54	0.01	0.01	4.25	0.02	0.01	5.80	0.71
Error	**60**	50.55	7.01	0.14	0.02	13.24	0.04	0.04	8.87	2.67

**, significant at 0.01 level of probability.

Mean lint yield / plant of the 16 varieties showed the same trend as seed cotton yield /plant. The lowest lint yielding varieties was Giza 87 in both years and combined analysis, while, G90× Aus, was the highest yielding cultivar.

The combined data (Table 4) indicate that lint yield/plant ranged from 21.22 and 17.17g for Giza 87 to 51.20 and 41.83 g /plant for G90× Aus with average of 41.08 and 32.24 g /plant under early and late planting, respectively. The highest varieties in lint yield were G90× Aus, followed by Giza 90, Giza 80, Giza 86 and Giza 95 under both planting dates. The reduction % in lint yield caused by late planting was very high and larger than that in seed cotton yield, and reached 22.88, 22.56 and 22.72 in the first, second year and combined data; respectively. Norton and Silvertooth (1999) found general trend in decreasing lint yield with later dates of planting. Baker *et al*. (2012) and Elayan *et al*. (2014) came to the same conclusion. The stress susceptibility index of the different varieties respect lint yield / plant showed the same picture as seed cotton yield /plant. Eight varieties were susceptible to the stress of delay planting data and showed stress susceptibility index more than unity. They were Giza 81 (1.36), Giza 88 (1.19), Menoufi (1.19), Giza 95 (1.17), Giza 85 (1.10), Giza 92 (1.07) and Ashmouni (1.03). The other eight varieties were tolerant to late planting. Giza 90, G90× Aus and Giza 80 were the best tolerant and high yielding varieties. Baker *et al*. (2012) identified some Egyptian cotton varieties and crosses tolerant to late planting.

Mean lint percentage of the evaluated varieties indicated that the highest lint percentage was for G90× Aus but the lowest for Giza45 under early and late planting, and the combined means.The combined means of lint percentage ranged from 33.14 (Giza45) to 40.24 % (G90× Aus) under early planting, and from 30.66 to 38.86 % for the same varieties under late planting. The reduction % for different varieties was low and averaged 4.53, 4.41 and 4.47 % in the first, sec-

ond season and combined means; respectively. The cause of low reduction % in lint percentage could be due to that lint percentage is a complex trait dependon weight of lint and weight of seed cotton, and both were affected by delaying planting data. Ali and Elsayed (2001) and Elayan *et al*. (2013 and 2015) found decrease in lint % with delay of planting dates. Stress susceptibility index of the evaluated varieties for lint percentage indicated that Giza 81 was the most affected varieties followed by Giza 45, Giza 81, Giza 95, Giza 92, Dandara, and Giza 88, and the least affected varieties were Giza 85, Giza 69, and Giza 90.

Mean boll weight of the evaluated varieties indicated that Giza 86 have the heaviest boll in both seasons and combined means under early planting (3.57g). Under late planting the varieties Giza 80, Giza 86, Giza81, Giza77 and Giza 69 tended to be have the lowest boll weight. The reduction % in boll weight caused by delaying planting data was high and reached 21.79, 20.85 with an average of 21.31 %.The most affected varieties respect to boll weight as measured by stress susceptibility index were Giza 95, Giza 92, Giza 86, Giza 85, Giza 80, Menoufi, Ashmouni and Dandara varieties. These varieties could be considered susceptible. The tolerant varieties were Giza 69, Giza 45 and Giza 87 which showed susceptibility index less than unity (0.65- 0.67). Elsayed and El-Menshawi (2001) and Elayan *et al.* (2015) pointed to decrease in boll weight with delay planting dates. Mean number of bolls /plant indicated increase in late planting than in early planting. This is due to that number of bolls /plant was estimated from dividing seed cotton yield on boll weight and the reduction in boll weight was more than that in seed cotton yield.Therefore, the increase in number of bolls /plant under late planting is expected. The highest number of bolls /plant in both seasons and combined data either under early or late planting was recorded by G 90× Aus followed by Giza 90, Dandara and Giza 81, but the lowest one was for Giza 87. The combined data showed that the varieties G 90× Aus recorded 47.37 and 49.71 bolls /plant at early and late planting; respectively.The decrease in number of bolls /plant under the stress of late planting caused the stress susceptibility index of no meaning. Elsayed and El- Menshawi (2001), Gadalla 2002, EL-Hindi *et al*.(2006) and Elayan *et al*. (2013) showed decrease in number of bolls /plant with delay sowing data.

Mean seed index indicated that the heaviest seed index was for the variety Menoufi under the early (11.45) and late (9.87), but the lightest one was for Giza 88 under early (8.63) and Giza 85 under late (7.25) planting dates for combined means. Giza 80, Giza 86, Ashmouni and Giza 92 recorded high values for seed index after Menoufi in ranking order. Late planting caused reduction % reached 14.53, 13.19 and 13.86% in the first, second year and combined means; respectively. Stress susceptibility index indicated that Giza 92, Giza 90, Giza 87, Giza 86, Giza 85 and Giza 80 were susceptible in seed index to delay planting and scored more than unity. However, varieties Dandara, Ashmouni, Giza95 and G90× Aus were tolerant to late planting. The best tolerant varieties in seed index were varieties Dandara and Giza95. These results agree with those reported by Elayan *et al*. (2015).

Table 4. Means of the studied traits of the 16 varieties under early and late planting dates in both seasons and stress susceptibility index (s).

Entry	SCY/P; g								
	Year 1			Year 2			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s
G95	99.27	77.63	1.13	102.07	79.23	1.17	100.67	78.43	1.15
G92	76.10	60.47	1.07	77.17	62.07	1.02	76.63	61.27	1.04
G90	110.67	92.03	0.87	112.97	96.20	0.78	111.82	94.12	0.82
G88	81.93	62.60	1.22	81.83	63.33	1.18	81.88	62.97	1.20
G87	64.80	55.33	0.76	65.10	56.63	0.68	64.95	55.98	0.72
G86	106.47	86.47	0.97	104.77	87.53	0.86	105.62	87.00	0.92
G85	86.77	66.40	1.22	84.83	65.67	1.18	85.80	66.03	1.20
G81	95.73	72.93	1.24	95.53	70.87	1.35	95.63	71.90	1.29
G80	102.60	87.13	0.78	105.00	88.00	0.85	103.80	87.57	0.81
G77	82.27	68.47	0.87	82.67	68.07	0.92	82.47	68.27	0.90
G69	84.57	66.13	1.13	85.53	66.40	1.17	85.05	66.27	1.15
G45	76.77	64.07	0.86	76.93	65.33	0.79	76.85	64.70	0.82
G90*Aus	127.03	106.33	0.85	127.40	108.90	0.76	127.22	107.62	0.80
Menoufi	79.70	61.10	1.21	81.47	60.10	1.37	80.58	60.60	1.29
Ashmouni	97.40	77.97	1.03	99.10	77.07	1.16	98.25	77.52	1.10
Dandara	108.77	90.23	0.88	112.37	93.20	0.89	110.57	91.72	0.89
Average	92.55	74.71		93.42	75.54		92.99	75.12	
Reduction %	19.28			19.14			19.21		
$RLSD_{0.05}$	12.71	11.32		11.53	10.78		7.94	7.22	
$RLSD_{0.01}$	16.03	14.86		15.31	14.28		11.09	10.26	
	LY; g								
G95	39.67	29.13	1.16	40.83	29.88	1.19	40.25	29.51	1.17
G92	27.60	20.73	1.09	27.96	21.28	1.06	27.78	21.01	1.07
G90	42.37	34.23	0.84	43.40	35.90	0.77	42.88	35.07	0.80
G88	29.67	21.53	1.20	29.72	21.77	1.19	29.69	21.65	1.19
G87	20.93	17.00	0.82	21.50	17.34	0.86	21.22	17.17	0.84
G86	42.70	33.03	0.99	40.45	33.40	0.77	41.57	33.22	0.88
G85	33.07	24.70	1.11	32.35	24.40	1.09	32.71	24.55	1.10
G81	35.83	25.10	1.31	35.66	24.38	1.40	35.75	24.74	1.36
G80	41.00	33.40	0.81	41.96	33.83	0.86	41.48	33.61	0.83
G77	29.53	23.47	0.90	29.66	23.36	0.94	29.60	23.41	0.92
G69	29.80	22.67	1.05	30.19	22.83	1.08	30.00	22.75	1.06
G45	25.47	19.70	0.99	25.47	20.04	0.94	25.47	19.87	0.97
G90*Aus	51.00	41.37	0.83	51.39	42.30	0.78	51.20	41.83	0.81
Menoufi	28.17	20.93	1.12	28.75	20.64	1.25	28.46	20.79	1.19
Ashmouni	35.37	27.43	0.98	35.93	27.22	1.08	35.65	27.32	1.03
Dandara	40.37	31.70	0.94	41.78	32.77	0.96	41.08	32.24	0.95
Average	34.53	26.63		34.81	26.96		34.67	26.80	
Reduction %	22.88			22.56			22.72		
RLSD0.05	4.85	4.12		4.46	3.98		3.10	2.69	
RLSD0.01	6.24	5.29		5.76	5.13		4.33	3.76	

Table 4. cont.

Entry	LP								
	Year 1			Year 2			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s
G95	39.98	37.52	1.36	40.03	37.70	1.32	40.01	37.61	1.34
G92	36.27	34.29	1.20	36.22	34.29	1.21	36.25	34.29	1.21
G90	38.29	37.21	0.62	38.40	37.32	0.64	38.34	37.26	0.63
G88	36.21	34.40	1.10	36.32	34.37	1.22	36.27	34.39	1.16
G87	32.30	30.73	1.08	33.06	30.61	1.68	32.68	30.67	1.38
G86	40.11	38.20	1.05	38.69	38.17	0.31	39.40	38.18	0.69
G85	38.11	37.21	0.52	38.13	37.14	0.59	38.12	37.17	0.55
G81	37.41	34.42	1.76	37.31	34.39	1.78	37.36	34.41	1.77
G80	39.96	38.33	0.90	39.98	38.44	0.87	39.97	38.38	0.89
G77	35.88	34.28	0.98	35.88	34.31	0.99	35.88	34.29	0.99
G69	35.24	34.27	0.61	35.30	34.39	0.58	35.27	34.33	0.60
G45	33.18	30.68	1.66	33.11	30.64	1.70	33.14	30.66	1.68
G90*Aus	40.15	38.89	0.69	40.33	38.83	0.84	40.24	38.86	0.77
Menoufi	35.34	34.26	0.67	35.29	34.34	0.61	35.32	34.30	0.64
Ashmouni	36.31	35.19	0.68	36.26	35.32	0.59	36.28	35.26	0.63
Dandara	37.09	35.14	1.16	37.17	35.17	1.22	37.13	35.15	1.19
Average	36.99	35.31		36.97	35.34		36.98	35.33	
Reduction	4.53			4.41			4.47		
RLSD0.05	0.67	0.54		1.05	0.56		0.61	0.38	
RLSD0.01	0.87	0.70		1.36	0.72		0.85	0.53	
BW; g									
G95	2.97	2.30	1.03	3.07	2.37	1.09	3.02	2.33	1.06
G92	3.13	2.37	1.12	3.07	2.37	1.09	3.10	2.37	1.11
G90	2.87	2.30	0.91	2.97	2.30	1.08	2.92	2.30	0.99
G88	2.67	2.20	0.80	2.77	2.23	0.92	2.72	2.22	0.86
G87	2.73	2.20	0.90	2.67	2.43	0.42	2.70	2.32	0.67
G86	3.57	2.50	1.37	3.57	2.53	1.39	3.57	2.52	1.38
G85	2.97	2.20	1.19	3.10	2.20	1.39	3.03	2.20	1.29
G81	2.80	2.17	1.04	2.70	2.23	0.83	2.75	2.20	0.94
G80	3.27	2.57	0.98	3.30	2.57	1.07	3.28	2.57	1.02
G77	2.60	2.17	0.77	2.70	2.23	0.83	2.65	2.20	0.80
G69	2.53	2.17	0.66	2.53	2.20	0.63	2.53	2.18	0.65
G45	2.67	2.20	0.80	2.57	2.30	0.50	2.62	2.25	0.66
G90*Aus	2.73	2.20	0.90	2.63	2.33	0.55	2.68	2.27	0.73
Menoufi	3.00	2.23	1.17	3.17	2.20	1.46	3.08	2.22	1.32
Ashmouni	3.23	2.53	0.99	3.33	2.57	1.10	3.28	2.55	1.05
Dandara	2.93	2.20	1.15	3.03	2.27	1.21	2.98	2.23	1.18
Average	2.92	2.28		2.95	2.33		2.93	2.31	
Reduction	21.79			20.85			21.31		
RLSD0.05	0.33	0.30		0.33	0.30		0.21	0.16	
RLSD0.01	0.41	0.37		0.41	0.47		0.30	0.22	

Table 4. cont.

Entry	NB/P								
	Year 1			Year 2			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s
G95	33.60	33.82	0.23	33.56	34.03	0.67	33.58	33.93	0.42
G92	24.44	25.87	2.08	25.26	26.72	2.79	24.85	26.30	2.38
G90	38.65	40.16	1.38	38.13	39.89	2.23	38.39	40.03	1.74
G88	30.86	28.47	-2.73	29.69	27.77	-3.13	30.27	28.12	-2.90
G87	23.78	25.24	2.18	24.50	22.25	-4.42	24.14	23.75	-0.66
G86	29.98	34.83	5.71	29.43	36.67	11.88	29.71	35.75	8.30
G85	29.56	30.14	0.70	27.60	31.27	6.43	28.58	30.71	3.04
G81	34.17	33.76	-0.43	35.41	33.33	-2.83	34.79	33.54	-1.46
G80	31.36	34.10	3.09	31.83	33.20	2.08	31.59	33.65	2.65
G77	31.82	31.71	-0.12	30.78	29.82	-1.51	31.30	30.76	-0.70
G69	33.36	30.64	-2.87	33.86	29.07	-6.84	33.61	29.86	-4.56
G45	29.08	29.28	0.25	30.05	26.53	-5.67	29.56	27.90	-2.30
G90*Aus	46.50	48.48	1.50	48.24	50.93	2.69	47.37	49.71	2.01
Menoufi	26.56	27.55	1.31	25.91	25.61	-0.55	26.23	26.58	0.54
Ashmouni	30.25	30.75	0.58	29.76	31.99	3.63	30.00	31.37	1.86
Dandara	37.48	41.10	3.41	37.25	42.73	7.10	37.37	41.91	4.97
Average	31.97	32.87		31.95	32.61		31.96	32.74	
Reduction %	-2.83			-2.07			-2.45		
RLSD0.05	6.13	6.98		4.54	4.45		3.53	3.8	
RLSD0.01	7.70	8.70		5.97	5.95		4.85	5.25	
SI; g									
G95	9.37	8.73	0.47	9.47	8.87	0.48	9.42	8.80	0.47
G92	10.17	8.07	1.42	10.10	8.13	1.48	10.13	8.10	1.45
G90	9.77	8.13	1.15	9.87	8.23	1.25	9.82	8.18	1.20
G88	8.53	7.43	0.89	8.73	7.53	1.04	8.63	7.48	0.96
G87	9.97	8.23	1.20	10.00	8.30	1.29	9.98	8.27	1.24
G86	10.80	8.87	1.23	10.83	8.80	1.42	10.82	8.83	1.32
G85	8.93	7.30	1.26	8.97	7.20	1.49	8.95	7.25	1.37
G81	9.47	8.10	0.99	9.33	8.00	1.08	9.40	8.05	1.04
G80	10.90	9.27	1.03	10.97	9.47	1.04	10.93	9.37	1.03
G77	9.27	7.90	1.02	9.17	8.07	0.91	9.22	7.98	0.97
G69	9.50	8.33	0.85	9.60	8.43	0.92	9.55	8.38	0.88
G45	9.17	7.90	0.95	9.13	7.93	1.00	9.15	7.92	0.97
G90*Aus	9.00	7.80	0.92	9.13	8.13	0.83	9.07	7.97	0.88
Menoufi	11.43	9.80	0.98	11.47	9.93	1.01	11.45	9.87	1.00
Ashmouni	10.37	9.17	0.80	10.50	9.27	0.89	10.43	9.22	0.84
Dandara	10.57	9.33	0.80	9.13	9.47	-0.28	9.85	9.40	0.33
Average	9.83	8.40		9.78	8.49		9.80	8.44	
Reduction %	14.53			13.19			13.86		
RLSD0.05	0.47	0.29		0.50	0.31		0.32	0.20	
RLSD0.01	0.61	0.38		0.64	0.40		0.44	0.28	

Table 4. cont.

Entry	LI; g								
	Year 1			Year 2			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s
G95	7.12	6.88	-0.39	7.06	6.83	-0.44	7.09	6.85	-0.41
G92	5.60	6.48	1.78	5.63	6.42	1.91	5.62	6.45	1.84
G90	6.36	7.29	1.68	6.32	7.23	1.96	6.34	7.26	1.81
G88	6.65	7.06	0.69	6.53	6.95	0.87	6.59	7.01	0.78
G87	4.79	5.39	1.43	4.94	5.32	1.02	4.87	5.35	1.24
G86	6.21	6.97	1.41	5.83	7.02	2.75	6.02	6.99	2.01
G85	6.90	8.12	2.01	6.88	8.21	2.63	6.89	8.17	2.29
G81	6.32	6.48	0.30	6.41	6.56	0.32	6.36	6.52	0.31
G80	6.11	6.71	1.12	6.08	6.60	1.16	6.09	6.65	1.13
G77	6.04	6.61	1.06	6.11	6.48	0.82	6.08	6.54	0.95
G69	5.73	6.26	1.05	5.68	6.22	1.27	5.71	6.24	1.15
G45	5.42	5.60	0.38	5.42	5.57	0.37	5.42	5.59	0.37
G90*Aus	7.47	8.16	1.06	7.40	7.81	0.74	7.43	7.98	0.92
Menoufi	4.78	5.32	1.28	4.76	5.27	1.45	4.77	5.29	1.36
Ashmouni	5.50	5.93	0.89	5.42	5.90	1.20	5.46	5.91	1.03
Dandara	5.59	5.81	0.45	6.48	5.73	-1.57	6.04	5.77	-0.55
Average	6.04	6.57		6.06	6.51		6.05	6.54	
Reduction	-8.76			-7.37			-8.07		
RLSD0.05	0.34	0.29		0.40	0.27		0.25	0.20	
RLSD0.01	0.43	0.37		0.52	0.34		0.34	0.28	
EI %									
G95	77.19	79.98	-2.54	78.08	80.68	-4.84	77.63	80.33	-3.29
G92	60.20	60.17	0.03	61.20	59.96	2.94	60.70	60.07	0.99
G90	80.07	80.93	-0.75	80.97	81.54	-1.03	80.52	81.23	-0.84
G88	62.13	60.39	1.97	61.38	59.86	3.61	61.75	60.12	2.50
G87	59.51	59.97	-0.54	58.90	60.05	-2.83	59.21	60.01	-1.28
G86	59.86	60.50	-0.74	60.28	60.48	-0.49	60.07	60.49	-0.66
G85	61.97	59.81	2.46	61.25	59.12	5.05	61.61	59.46	3.30
G81	60.65	60.38	0.31	60.40	60.28	0.28	60.52	60.33	0.30
G80	78.03	72.39	5.08	79.55	78.78	1.40	78.79	75.59	3.85
G77	60.76	61.25	-0.58	60.17	59.99	0.43	60.46	60.62	-0.25
G69	60.60	60.38	0.25	59.19	58.73	1.13	59.90	59.56	0.54
G45	59.65	60.40	-0.88	59.53	60.23	-1.71	59.59	60.31	-1.15
G90*Aus	80.27	75.65	4.05	81.08	79.44	2.94	80.68	77.54	3.68
Menoufi	63.58	60.37	3.55	61.97	60.59	3.24	62.77	60.48	3.47
Ashmouni	63.48	60.23	3.60	62.92	60.32	6.01	63.20	60.27	4.39
Dandara	80.66	80.61	0.04	81.56	81.02	0.97	81.11	80.81	0.34
Average	66.79	65.84		66.78	66.32		66.78	66.08	
Reduction	1.42			0.69			1.06		
RLSD0.05	4.69	5.18		4.12	3.69		2.99	3.03	
RLSD0.01	5.92	6.50		5.35	4.79		4.17	4.22	

Table 4. cont.

Entry	Days to first flowers								
	Year 1			Year 2			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s
G95	77.33	70.67	0.76	77.00	70.00	0.80	77.17	70.33	0.78
G92	79.33	72.67	0.75	79.00	72.33	0.74	79.17	72.50	0.74
G90	69.33	68.00	0.17	69.00	66.33	0.34	69.17	67.17	0.25
G88	78.33	70.67	0.87	78.00	69.67	0.94	78.17	70.17	0.90
G87	86.33	73.00	1.37	85.33	72.00	1.37	85.83	72.50	1.37
G86	87.00	74.00	1.33	86.67	74.33	1.25	86.83	74.17	1.29
G85	87.00	74.00	1.33	86.33	74.67	1.18	86.67	74.33	1.25
G81	82.00	71.00	1.19	82.33	71.67	1.13	82.17	71.33	1.16
G80	87.67	74.00	1.38	87.33	74.33	1.30	87.50	74.17	1.34
G77	77.00	71.33	0.65	76.33	70.00	0.73	76.67	70.67	0.69
G69	82.33	72.00	1.11	83.33	71.33	1.26	82.83	71.67	1.19
G45	87.33	73.67	1.39	87.33	73.00	1.44	87.33	73.33	1.41
G90*Aus	89.33	79.00	1.03	88.33	79.00	0.93	88.83	79.00	0.98
Menoufi	86.67	78.00	0.89	86.00	77.33	0.88	86.33	77.67	0.88
Ashmouni	78.33	74.00	0.49	78.00	73.67	0.49	78.17	73.83	0.49
Dandara	83.67	74.33	0.99	83.33	74.00	0.98	83.50	74.17	0.99
Average	82.44	73.15		82.10	72.73		82.27	72.94	
Reduction %	11.27			11.42			11.34		
RLSD0.05	2.30	2.55		2.14	2.63		1.53	1.71	
RLSD0.01	2.99	3.28		2.77	3.42		2.13	2.35	

Mean lint index of the evaluated varieties indicated that the varieties G90× Aus showed the highest lint index followed by Giza45 and Giza85 in the first and second seasons under both planting dates. G90× Aus recorded 7.47 and 8.16g in the first season,7.40 and 7.81g in the second season and 7.43 and 7.98g in the combined means under early and late planting; respectively, However, the varieties Menoufi recorded the lowest lint index; 4.78 and 5.32 g in the first season and 4.77 and 5.29g in the combined means under early and late planting; respectively.The reduction % was negative in lint index; - 8.76, -7.37 and -8.07 % in the first and second seasons and combined means.This could be due to that lint index is an estimated character (seed index * weight of lint / weight of seeds in a sample) and the lint was more affected than seeds by delaying planting date as mentioned before for lint yield / plant and seed cotton yield / plant. Therefore, the stress susceptibility index become of no meaning.

Means of earliness index of the evaluated varieties indicated that the varieties G90× Aus, Dandara, Giza 90 and Giza 80 showed high values under early and late planting, and combined means. Over the two seasons earliness index ranged from 59.21 for Giza 87 to 81.11 for Dandara with an average of 66.78 % under early planting, and from 59.46 for Giza 85 to 81.23 for Giza 90 with an average of 66.08 % under late planting.The reduction % caused by delay planting date was very small, 1.42, 0.69 and 1.06 % in the first, second seasons and combined means. The results indicated narrow range between early and late plantings, and six varieties (Giza 95, Giza 90, Giza 87, Giza 86, Giza 77, Giza 45)

showed slight increase in earliness index under late compared to early planting.Therefore, stress susceptibility index is less profitable. This could be due to that the first pick is determined visually when the open bolls of most varieties reached about 60 %. On the other hand, earliness index considered the easy applicable method to differentiate earliness of different varieties.

Mean days to first flower of the evaluated varieties indicated that Giza 90 was the earliest and G90× Aus was the latest under the two planting dates in both seasons. Days to first flower form the combined means ranged from 69.17 for Giza90 to 88.83 for G90× Aus with an average of 82.27 under early planting, and from 67.17 to 79.00 with an average of 72.94 for the same respected varieties. Giza90 was early either measured by earliness index or days to first flower. Otherwise, the varieties G90× Aus, Giza80 and Ashmouni were early as measured by earliness index and late as measured by days to first flower. This is due to the differences in the pattern of flowering curve. Some varieties flower early and continue flowering for several weeks showing platykurtic curve of flowing. Some varieties showed leptokurtic curve of flowering; flower late for few weeks resulted in late days to first flower and high earliness index such as G90× Aus, Dandara and Giza80.

The reduction % in days to first flower was 11.27, 11.42 and 11.34 % in the first and second seasons and combined means; respectively. These results indicate that the stress of delay planting shortened the vegetative period of cotton growth. Elayan *et al*. (2013 and 2015) found decrease in days to first flower with delay sowing date.

The combined means of the stress - susceptibility index indicate that Giza90 was the best tolerant variety for delay planting followed by Ashmouni, Giza 90, Giza 95 and Giza 77, while Giza 87, Giza 86, Giza 85, Giza 81, Giza 80, Giza 69 and Giza 45 were susceptible to delay planting.

B - Evaluation of eight varieties for three seasons

The combined analysis of variance of different characters of eight varieties over three seasons for early and late planting separately are shown in tables 5 a and b. The differences among varieties were significant ($P \leq 0.01$) either under early or late planting. The interaction of varieties with year was not significant for all traits in both cases. These results indicate that the main cause of reduction in cotton yield is late planting date. This is due to that all the Egyptian cottons were bred to grow under full season and not for short season conditions. However, the stress susceptibility index indicated to the presence of tolerant varieties to late planting, and there is a chance to select for short season condition from the progenies of such tolerant varieties. These results are in agreement to those reported by Bauer *et al*. (1998), Bange *et al.* (2008), Pettigrew and Meredith (2009), Abdalla (2013), Abdalla *et al*. (2014) and Abdalla *et al.* (2015).

Table 5a . Mean squares of the combined analysis of the studied traits of eight varieties over three years under early planting date.

S.O.V	d.f	Mean squares								
		SCY/P	LY/P	LP	BW;g	NB/p	SI;g	LI ;g	EI %	DFF
Years(Y)	1	5.56	0.85	0.52	0.00	1.21	0.05	74.45	65.09	791.30
R × Y	4	57.85	6.17	1.21	0.02	6.89	0.19	71.04	7.05	1.23
Varieties (V)	7	3908.97**	963.33**	92.35**	0.87**	483.01**	4.04**	83.59**	841.24**	290.28**
V× Y	7	6.14	2.16	0.50	0.02	1.63	0.02	76.66	40.09	17.46
Error	28	82.89	12.26	0.61	0.04	14.59	0.08	71.24	7.60	2.51

Table 5b . Mean squares of the combined analysis of the studied traits of eight varieties over three years under late planting date.

S.O.V	d.f	SCY/P	LY/P	LP	BW;g	NB/p	SI ;g	LI ;g	EI %	DFF
Years(Y)	1	26.50	6.94	1.43	0.03	3.29	0.12	1.21	16.19	5.52
R × Y	4	16.71	2.46	0.43	0.04	10.04	0.01	1.57	14.55	2.24
Varieties (V)	7	2793.65**	652.61**	101.54**	0.14**	603.84**	2.22**	7.00**	870.46**	90.20**
V× Y	7	1.79	0.49	0.08	0.01	3.87	0.02	0.73	9.26	1.95
Error	28	64.34	9.32	0.24	0.03	14.53	0.04	1.49	9.98	2.51

**, significant at 0.01 level of probability.

Means of the studied traits of the eight selected varieties under early and late plantingfor three seasons, reduction % and stress susceptibility indexare shown in Table 6.

Mean seed cotton and lint yield / plant indicated that the varieties G90× Aus was the highest yielding in the three seasons and combined means, while Giza 87 showed the lowest yield. The combined means showed that seed cotton yield / plant ranged from 65.41 to 126.73 with an average of 95.92g/plant under early, and from 56.10 to 107.03 an average of 79.27g/plant under late planting.

Likewise, lint yield/plant ranged under early planting from 21.31 to 51.01 with an average of 36.55 g/plant, and from 17.17 to 41.32 with an average of 28.67g/plant under late planting.The high yielding varieties were G90× Aus, Giza 90, Giza 90, Giza 86, Giza 80 and Giza 45. Generally, the reduction % in yield caused by delay planting was higher in lint than in seeds. It averaged 17.36% for seed cotton yield / plant compared to 21.57 % for lint yield / plant. The stress susceptibility indexin both of seed cottonand lint yields was alike to large extent, Giza 95, Giza 92 were susceptibility to late planting. The varieties Giza 90, Giza 86 and Giza 45 tended to showed average susceptibility, whereas G90× Aus, Giza87and Giza80 were tolerant to delay planting.

Mean lint percentage indicated that G90× Aus, Giza 95, and Giza 80 showed the high lint percentage in the three seasons, while, Giza87 was the lowest. The combined means showed that lint percentage varied form 32.74 (Giza80) to 41.49 (Giza95) under early planting, and from 30.61 (Giza87) to 38.60 (G90× Aus).The reduction % was 4.80, 4.63 and 7.40 with an average of 5.78. The low reduction % in lint percentage was due to lint yield was more affected by delay planting than seed cotton yield. The varieties Giza95 and Giza45 were susceptibility to delay planting, Giza87 and Giza92 showed average susceptibility, while Giza90, G90× Aus, Giza86 and Giza80 were tolerant in lint percentage and showed stress susceptibility index lower than unity.

Mean boll weight indicated that Giza86 showed the heaviest boll in the three seasons and Giza45 tended showed the small boll under the two

planting dates. The combined means showed that Giza86, Giza80, Giza92 and Giza45 were the best varieties in boll weight. The reduction % in boll weight caused by late planting was high; 22.14, 19.44 and 20.03 % in the first, second and third seasons, with an average of 20.54 %, respectively. The stress susceptibility index of the different varieties respect to boll weight indicate that Giza86 (1.35), Giza95 (1.10) and Giza92 (1.11) were susceptible, Giza90 (1.04) and Giza80 (0.94) were average susceptible and G90× Aus (0.84), Giza87 (0.67) and Giza45 (0.61) were tolerant to delay planting.

Mean number of bolls / plant indicated that G90× Aus gave the highest number in the three seasons, while Giza87 gave the lowest number in two seasons and combined means. At early planting the combined means ranged from 24.49 (Giza87) to 46.68 (G90× Aus) with an average of 32.40, and from 24.15 to 49.15 for the same respective varieties under late planting with an average of 33.67 bolls / plant.The reduction % in number of bolls / plant was negative.This was due to that number of bolls / plant was estimated from seed cotton yield and boll weight, and the reduction in boll weight was larger than that in seed cotton yield. In consequence, stress susceptibility index become of no meaning.

Mean seed index of Giza80 was the highest in the three seasons, and G90× Aus or Giza45 showed the lowest seed index. The combined means of seed index ranged from 9.14 (G90× Aus) to10.89 (Giza80) with an average of 9.94g under early planting, and form 7.97 (Giza45) to 9.34 (Giza80) with an average of 8.45g underlate planting. The reduction % in seed index was 15.33, 14.63, 14.82 and 14.93% in the first, second and third seasons and combined means; respectively. Average of stress susceptibility index of Giza92, Giza90, Giza87 and Giza86 was more than unity (susceptible). The best tolerant variety was Giza95 which showed stress susceptibility index of 0.46.

Mean lint index indicated that the highest lint index was mostly recorded for G90× Aus under two planting dates, and Giza87 recorded the lowest lint index.The combined means of lint index ranged from 4.87 (Giza87) to 7.37 (G90× Aus) with an average of 6.12g, and from 5.33 to 7.84 for the samerespectively varieties with an average of 6.58g under late planting.The reduction % was negative because of the high reduction % in lint yield compared seed cotton yield.

Respect to earliness index Giza90 and G90× Aus were the highest, but Giza87 was the lowest in the three years. The combined means of earliness index ranged from 59.52 (Giza87) to 80.69 (Giza90) with an average of 69.75 % under early planting, and from 60.57 to 80.69 with an average of 69.70 % under late planting. The reduction % in earliness index was very small and negative in two seasons. This mainly due to that the first pick is estimated visually when open bolls of most varieties reached about 60 %. Therefore, stress susceptibility index become of no meaning.

Table 6. Means of the studied traits under early and late planting dates, reduction % and stress susceptibility index (s) for eight varieties for three seasons

Entry	SCY/P; g											
	Year 1			Year 2			Year 3			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s	Early	Late	s
G95	99.27	77.63	1.21	102.07	79.23	1.32	103.50	77.37	1.40	101.61	78.08	1.36
G92	76.10	60.47	1.14	77.17	62.07	1.15	77.70	61.03	1.19	76.99	61.19	1.21
G90	110.67	92.03	0.94	112.97	96.20	0.87	113.20	91.53	1.06	112.28	93.26	1.00
G90*Aus	127.03	106.33	0.91	127.40	108.90	0.85	125.77	105.87	0.88	126.73	107.03	0.91
G87	64.80	55.33	0.81	65.10	56.63	0.77	66.33	56.33	0.84	65.41	56.10	0.84
G86	106.47	86.47	1.04	104.77	87.53	0.97	104.30	85.73	0.99	105.18	86.58	1.04
G80	102.60	87.13	0.84	105.00	88.00	0.95	100.07	87.37	0.71	102.56	87.50	0.86
G45	76.77	64.07	0.92	76.93	65.33	0.89	76.20	63.90	0.90	76.63	64.43	0.94
Average	95.46	78.68		96.43	80.49		95.88	78.64		95.92	79.27	
Red.%	17.58			16.53			17.98			17.36		
RLSD0.05	15.70	14.66		15.15	13.36		14.24	11.79		7.79	6.87	
RLSD0.01	20.88	19.29		20.22	17.80		19.06	15.80		11.67	10.28	
LY/P; g												
G95	39.67	29.13	1.26	40.83	29.88	1.34	42.63	28.97	1.39	41.04	29.33	1.30
G92	27.60	20.73	1.18	27.96	21.28	1.19	28.17	20.70	1.15	27.91	20.90	1.14
G90	42.37	34.23	0.91	43.40	35.90	0.86	43.80	33.57	1.02	43.19	34.57	0.91
G90*Aus	51.00	41.37	0.90	51.39	42.30	0.88	50.63	40.30	0.89	51.01	41.32	0.86
G87	20.93	17.00	0.89	21.50	17.34	0.97	21.50	17.17	0.88	21.31	17.17	0.88
G86	42.70	33.03	1.08	40.45	33.40	0.87	41.57	32.13	0.99	41.57	32.86	0.95
G80	41.00	33.40	0.88	41.96	33.83	0.97	40.03	33.10	0.75	41.00	33.44	0.84
G45	25.47	19.70	1.08	25.47	20.04	1.06	25.30	19.53	0.99	25.41	19.76	1.01
Average	36.34	28.58		36.62	29.25		36.70	28.18		36.55	28.67	
Red.%	21.37			20.13			23.21			21.57		
RLSD0.05	5.79	5.52		5.54	5.06		5.21	4.15		3.00	2.61	
RLSD0.01	7.7	7.06		7.38	6.53		6.73	5.35		4.48	3.91	
LP												
G95	39.98	37.52	1.23	40.03	37.70	-1.16	44.46	37.45	1.97	41.49	37.56	1.58
G92	36.27	34.29	1.09	36.22	34.29	-1.07	36.33	33.91	0.83	36.27	34.17	0.97
G90	38.29	37.21	0.57	38.40	37.32	-0.57	38.66	36.64	0.65	38.45	37.05	0.60
G90*Aus	40.15	38.89	0.62	40.33	38.83	-0.74	40.28	38.07	0.69	40.25	38.60	0.69
G87	32.30	30.73	0.97	33.06	30.61	-1.48	32.85	30.50	0.90	32.74	30.61	1.08
G86	40.11	38.20	0.95	38.69	38.17	-0.27	40.15	37.48	0.83	39.65	37.95	0.71
G80	39.96	38.33	0.82	39.98	38.44	-0.77	40.53	37.89	0.82	40.16	38.22	0.81
G45	33.18	30.68	1.51	33.11	30.64	-1.49	33.47	30.57	1.08	33.25	30.63	1.32
Average	37.53	35.73		37.48	35.75		38.34	35.31		37.78	35.60	
Red.%	4.80			4.61			7.90			5.78		
RLSD0.05	0.42	0.75		1.48	0.72		1.48	0.84		0.67	0.42	
RLSD0.01	0.55	0.97		1.91	0.93		1.90	1.09		1.00	0.63	
Entry	BW; g											
	Year 1			Year 2			Year 3			Combined		
	Early	Late	s	Early	Late	s	Early	Late	s	Early	Late	s
G95	2.97	2.30	1.02	3.07	2.37	1.52	3.03	2.30	1.21	3.02	2.32	1.10
G92	3.13	2.37	1.11	3.07	2.37	1.52	3.20	2.47	1.15	3.13	2.40	1.11
G90	2.87	2.30	0.90	2.97	2.30	1.50	3.00	2.30	1.17	2.94	2.30	1.04
G90*Aus	2.73	2.20	0.89	2.63	2.33	0.76	2.80	2.20	1.07	2.72	2.24	0.84
G87	2.73	2.20	0.89	2.67	2.43	0.58	2.63	2.27	0.70	2.68	2.30	0.67
G86	3.57	2.50	1.36	3.57	2.53	1.93	3.43	2.53	1.31	3.52	2.52	1.35
G80	3.27	2.57	0.97	3.30	2.57	1.48	3.10	2.63	0.75	3.22	2.59	0.94
G45	2.67	2.20	0.80	2.57	2.30	0.69	2.60	2.33	0.51	2.61	2.28	0.61
Average	2.99	2.33		2.98	2.40		2.98	2.38		2.98	2.37	
Red.%	22.14			19.44			20.03			20.54		
RLSD0.05	0.35	0.37		0.34	0.34		0.44	0.48		0.18	0.17	
RLSD0.01	0.44	0.52		0.43	ns		0.60	ns		0.27	0.26	

Table 6. Cont.

NB/P												
G95	33.60	33.82	0.11	33.56	34.03	0.35	34.23	33.74	-0.48	33.80	33.86	0.05
G92	24.44	25.87	0.98	25.26	26.72	1.45	24.34	24.94	0.83	24.68	25.84	1.18
G90	38.65	40.16	0.65	38.13	39.89	1.16	37.71	39.94	1.97	38.16	40.00	1.20
G90*Aus	46.50	48.48	0.71	48.24	50.93	1.39	45.29	48.05	2.03	46.68	49.15	1.33
G87	23.78	25.24	1.03	24.50	22.25	-2.29	25.20	24.94	-0.35	24.49	24.15	-0.35
G86	29.98	34.83	2.69	29.43	36.67	6.15	30.58	33.99	3.71	30.00	35.16	4.30
G80	31.36	34.10	1.46	31.83	33.20	1.08	32.43	33.17	0.76	31.87	33.49	1.27
G45	29.08	29.28	0.12	30.05	26.53	-2.94	29.38	27.30	-2.37	29.50	27.70	-1.53
Average	32.17	33.97		32.62	33.78		32.40	33.26		32.40	33.67	
Red.%	-5.60			-3.53			-2.66			-3.92		
RLSD0.05	6.80	9.30		5.31	4.58		7.18	4.48		3.27	3.26	
RLSD0.01	15.33	20.03		11.72	10.23		15.86	10.03		4.89	4.88	
SI; g												
G95	9.37	8.73	0.45	9.47	8.87	0.42	9.50	8.77	0.51	9.44	8.79	0.46
G92	10.17	8.07	1.38	10.10	8.13	1.30	10.27	8.20	1.34	10.18	8.13	1.34
G90	9.77	8.13	1.11	9.87	8.23	1.10	9.87	8.23	1.10	9.83	8.20	1.11
G90*Aus	9.00	7.80	0.89	9.13	8.13	0.73	9.30	8.13	0.84	9.14	8.02	0.82
G87	9.97	8.23	1.16	10.00	8.30	1.13	9.87	8.30	1.06	9.94	8.28	1.12
G86	10.80	8.87	1.19	10.83	8.80	1.25	10.87	9.03	1.12	10.83	8.90	1.19
G80	10.90	9.27	1.00	10.97	9.47	0.91	10.80	9.30	0.93	10.89	9.34	0.95
G45	9.17	7.90	0.92	9.13	7.93	0.88	9.40	8.07	0.95	9.23	7.97	0.91
Average	9.89	8.38		9.94	8.48		9.98	8.50		9.94	8.45	
Red.%	15.33			14.63			14.82			14.93		
RLSD0.05	0.44	0.33		0.51	0.36		0.49	0.35		0.24	0.14	
RLSD0.01	0.56	0.41		0.68	0.48		0.64	0.46		0.36	0.25	
Entry	**LI; g**											
	Year 1			**Year 2**			**Year 3**			**Combined**		
	Early	**Late**	**s**	**Early**	**Late**	**s**	**Early**	**Late**	**s**	**Early**	**Late**	**s**
G95	7.12	6.88	-0.38	7.06	6.83	-0.40	7.42	6.84	-1.56	7.20	6.85	-0.61
G92	5.60	6.48	1.73	5.63	6.42	1.76	5.54	6.26	2.58	5.59	6.39	1.77
G90	6.36	7.29	1.64	6.32	7.23	1.80	6.40	7.03	1.95	6.36	7.18	1.62
G90*Aus	7.47	8.16	1.03	7.40	7.81	0.68	7.25	7.56	0.87	7.37	7.84	0.80
G87	4.79	5.39	1.39	4.94	5.32	0.94	4.87	5.29	1.74	4.87	5.33	1.19
G86	6.21	6.97	1.37	5.83	7.02	2.54	6.11	6.65	1.77	6.05	6.88	1.72
G80	6.11	6.71	1.08	6.08	6.60	1.07	6.18	6.56	1.22	6.12	6.62	1.01
G45	5.42	5.60	0.37	5.42	5.57	0.34	5.29	5.46	0.63	5.38	5.54	0.38
Average	6.13	6.68		6.09	6.60		6.13	6.46		6.12	6.58	
Red.%	-8.98			-8.43			-5.26			-7.55		
RLSD0.05	0.30	0.33		Ns	ns		0.43	0.41		ns	1.21	
RLSD0.01	0.39	0.43		Ns	ns		0.56	0.55		ns	1.84	
EI %												
G95	77.19	79.98	-3.62	78.08	80.68	2.82	77.91	78.16	1.00	77.73	79.61	-26.88
G92	60.20	60.17	0.05	61.20	59.96	-1.71	62.38	63.40	5.11	61.26	61.18	1.49
G90	80.07	80.93	-1.07	80.97	81.54	0.60	81.04	79.59	-5.60	80.69	80.69	0.09
G90*Aus	80.27	75.65	5.76	81.08	79.44	-1.71	79.79	79.78	-0.04	80.38	78.29	28.90
G87	59.51	59.97	-0.76	58.90	60.05	1.65	60.14	61.70	8.11	59.52	60.57	-19.67
G86	59.86	60.50	-1.06	60.28	60.48	0.29	61.08	60.18	-4.59	60.41	60.39	0.38
G80	78.03	72.39	7.22	79.55	78.78	-0.82	78.57	79.06	1.92	78.72	76.74	27.85
G45	59.65	60.40	-1.26	59.53	60.23	1.00	58.84	59.68	4.46	59.34	60.10	-14.30
Average	69.35	68.75		69.95	70.15		69.97	70.19		69.75	69.70	
Red.%	0.86			-0.28			-0.32			0.09		
RLSD0.05	4.62	6.13		4.02	3.50		4.37	5.24		2.36	2.70	
RLSD0.01	5.96	7.85		5.18	4.51		5.64	6.97		3.53	4.05	
Days to first flowers												
G95	77.33	70.67	0.72	77.00	70.00	0.76	70.00	70.00	0.00	74.78	70.22	0.68
G92	79.33	72.67	0.70	79.00	72.33	0.70	72.33	73.00	-0.92	76.89	72.67	0.61
G90	69.33	68.00	0.16	69.00	66.33	0.32	66.67	66.33	0.50	68.33	66.89	0.23
G90*Aus	89.33	79.00	0.96	88.33	79.00	0.88	79.00	75.33	4.64	85.56	77.78	1.01
G87	86.33	73.00	1.29	85.33	72.00	1.30	73.67	71.67	2.71	81.78	72.22	1.30
G86	87.00	74.00	1.25	86.67	74.33	1.19	74.00	74.00	0.00	82.56	74.11	1.14
G80	87.67	74.00	1.30	87.33	74.33	1.24	72.67	74.00	-1.83	82.56	74.11	1.14
G45	87.33	73.67	1.30	87.33	73.00	1.37	74.00	73.00	1.35	82.89	73.22	1.30
Average	82.96	73.13		82.50	72.67		72.79	72.17		79.42	72.65	
Red.%	11.85			11.92			0.86			8.52		
RLSD0.05	2.80	3.00		2.40	2.83		2.34	5.24		1.36	1.36	
RLSD0.01	3.72	3.87		3.10	3.57		3.00	6.98		2.03	2.03	

Mean days to first flower indicated that Giza90 was the earliest variety followed by Giza 95 and Giza 92, while the latest variety was G90× Aus under early planting. The combined means ranged from 68.33 for Giza90 to 85.56 for G90× Aus with an average of 79.42 days. Under late planting, days to first flower ranged from 66.84 (Giza 90) to 77.78 (G90× Aus) with an average of 77.65. Days to first flower was reduced by delay planting, and the reduction % reached 11.85, 11.92, 0.86, 8.52 % in the first, second and third seasons and combined means; respectively.

The combined stress susceptibility index indicated that Giza 95 (0.68), Giza 92 (0.61) and Giza 90 (0.23) were the tolerant varieties to delay planting; however, the other varieties were susceptible.

It could be concluded that the main cause of reduction in cotton yield is late planting date. This is due to that all the Egyptian cottons were bred to grow under full season and not for short season conditions. However, the stress susceptibility index indicated to the presence of tolerant varieties to late planting, and there is a chance to select for short season condition from the progenies of the crosses of such tolerant varieties.

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تحمل اصناف القطن المصري(جوسيبيوم باربادنس) للزراعة المتأخرة

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الملخص

اجريت هذه الدراسة على مجموعتين من اصناف القطن المصري (جوسيبيوم باربادنس لدراسه تحملها للزراعه المتأخرة. المجموعه الاولى شمات ١٦ صنف من اصناف القطن المصري التي قيمت في موسمين في ميعادين للزراعة مبكر ومتاخر. المجموعه الثانية تم زراعة ٨ اصناف انتخبت من الموسم الاول منها اربعه اصناف حساسه للزراعه المتأخرة ومنها ٤اصناف متحمله. زرعت الثمانيه اصناف فى الموسم الثالث. اظهر تحليل التباين فى المجموعه الاولى اختلافات عاليه المعنويه بين الاصناف ومواعيد الزراعه فى التحليلات المنفرده والمجمعه. أظهر التحليل المجمع للاصناف والمواعيد والسنين عدم معنويه التفاعلات "الاصناف والمواعيد ، الاصناف والمواعيد والمواسم ، المواسم و الأصناف". وكان التفاعل بين الاصناف والمواسم معنوى فقط لنسبه الشعر ووزن اللوزه وميعاد تفتح اول زهره. كما اظهر التحليل المجمع للأصناف فى الميعاد المبكر والميعاد المتاخر كل على حده ، عد وجود معنويه لتفاعل الاصناف مع السنوات. يشير ذلك الى ثبات الصفات من موسم لاخر فى كل ميعاد على حده. وسببت الزراعة المتأخرة نقص شديد في صفة محصول القطن الزهر وصلت الى ١٩,٢٨، ١٩,١٤، ١٩,٢١ في الموسم الاول، الثاني والمتوسط على الترتيب. كان التغير قليلا فى دليل تحمل الاجهاد (تحمل الزراعه المتاخره) من سنه الى اخرى. وسجلت اعلى قيم لدليل تحمل الاجهاد الأصناف جيزة ٨١، المنوفى وكانت (١,١٩) وتليها جيزة ٤٥ كانت (١,٢٠) و جيزة ٨٨ كانت (١,٢٠) و جيزة ٦٩ (١,١٥) و جيزة ٩٥ كانت (١,١٥) والأشموني (١,١٠) وجيزة ٩٢ (١,٠٤). وكانت اعلى الاصناف فى محصول الزهر واكثرها تحملا للميعاد المتاخر هى "جيزة٩٠* أسترالي " وجيزة ٩٠ ودندرة وجيزة ٨٦ وجيزة ٨٠. وكان دليل تحمل الاجهاد لها أقل من الوحدة. وكان اعلى محصول القطن الشعر للأصناف جيزة٩٠*أسترالي، جيزة ٩٠، جيزة ٨٠، جيزة ٨٦ ويليها جيزة ٤٥ تحت ميعادي الزراعة. وكان الانخفاض فى محصول القطن الشعر بسبب الزراعة المتأخرة اكثر منه فى صفة محصول القطن الزهر حيث سجلت ٢٢,٨٨، ٢٢,٥٦، الى ٢٢,٧٢ للموسم الاول ، الثاني ، والمتوسط على التوالي. وكان دليل تحمل الاجهاد للأصناف المختلفة لمحصول القطن الشعر متشابه معها فى محصول القطن الزهر. وكانت نسبة النقص في صفة معدل الحليج الأصناف المختلفة منخفضه وتتراوح من ٤,٥٣، ٤,٤١ ، ٤,٤٧ للموسم الاول والثاني والمتوسط على التوالي. وكانت نسبة النقص في وزن اللوزة بسب تأخير ميعاد الزراعة عالية وتتراوح من ٢١,٧٩ ، ٢٠,٨٥ ، ٢١,٣١ %. وكانت نسبة النقص في وزن اللوزة اكثر من النقص في محصول القطن الزهر وبالتالي يزيد عدد اللوز للنبات تحت ظروف ميعاد الزراعة المتأخرة. كما تشير النتائج الى ان الاجهاد الناتج من تأخير الزراعة يودى الى تقصير فترة النمو الخضرى في القطن. وكانت نتائج الموسم الثاني الاصناف مشابهة للنتائج الموسم الاول. واشارت النتائج ان السبب الرئيس في نقص محصول القطن هو ميعاد الزراعة المتأخرة. يرجع ذلك الى ان جميع اصناف القطن المصري تم تربيتها لموسم نمو طويل وليس لظروف موسم نمو قصير. وتشير نتائج دليل تحمل الاجهاد الى وجود اصناف تتحمل الزراعة المتأخرة ، ومن ثم فهناك فرصه جيده للانتخاب لموسم نمو قصير عن طريق الهجن الناتجة من الاصناف المتحملة.