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COMPARATIVE PERFORMANCE OF PIMA AND EGYPTIAN COTTON CULTIVARS: II. DRY MATTER ACCUMULATION AND PARTITION

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Abstract

Sizeable variation in total dry weight (TDW) production and reproductive to vegetative ratio (R/V's) of Pima and Egyptian cotton in favour of Pima cotton were observed. For Egyptian cotton the early maturing cultivars G.83 and G.85 were smaller in stature and produced less dry weight and were more efficient in squaring and bolling than G.80 and G.86 in all sampling occasions in the three environments sampled. As for increasing the total biomass of Egyptian cotton, it would be necessary to increase the crop growth rate (CGR). For the duration of time that samples were collected in this study, higher values for the crop growth rate (CGR) and relative growth rate (RGR) of Pima cultivars versus Egyptian ones were detected, although differences did reach the significant level. Therefore, if the CGR of Egyptian cotton were improved along with improved partitioning of dry matter into reproductive organs, yield improvements would be realized.

Maximum CGR was reached about two weeks earlier than the corresponding maximum LAI. This indicates that the expanded LA was over optimal for these cultivars. At LP planting system, maximum LAI was reached about 2-3 weeks, earlier compared to CN planting system.Therefore useful variability for R/V would likely result in increased genetic advance for yield.

INTRODUCTION

In breeding programs, growth analysis can be useful for the identification of important plant developmental phases or components related to high yield under a particular environment (Clark *et al.*, 1984). Growth studies related specifically to adaptation of cotton to the stress of late planting are limited.

Growth analysis has been widely used to study crop and cultivar response to environmental conditions in an effort to identify factors important to the development of economic yield. In breeding programs, growth analysis can be useful for identification of important plant developmental phases or components related to high yield under a particular environment (Clark *et al.*, 1984). Growth studies related specifically to the tolerance of cotton to late planting are more limited.

The major dry matter sinks in cotton are vegetation, seed, and lint. Gains in lint yield can be obtained by redirecting photosynthate to lint at the expense of other sinks. Wells and Meredith (1984b) demonstrated that lower yielding, obsolete cultivars released prior to 1940 had a lower reproductive ratio than higher-yielding, modern cultivars. Determination of reproductive ratio is too laborious to be practical in routine screening of genotypes. However, it may be helpful to utilize parental material with high material reproductive ratios and, in the breeding process, to select genotypes that appear to have a favorable balance of reproductive and vegetative growth (Calhoun and Bowman, 1999).

The dependence of seed cotton yield potentiality of ten Egyptian cotton cultivars and their yield contributing variables on dry matter accumulation and partitioning was evident. (Abo El-Zahab and Zahran, 1975). They reported that the high seed cotton yield of Giza 69 cultivar may be due to its higher mean performance in three yield contributing variables, viz. number of harvested bolls, boll weight and seed index. This cultivar did not rank first among the other cultivars in leaf area or NAR, and this was reflected in its moderate capacity to accumulate dry matter. However, it significantly exceeded all the other cultivars in relative squaring, relative fruitfulness and fruiting index. This indicate a higher rate of squaring and boll production per 100 grams of top dry weight and better distribution of assimilates in forms of bolls. However, the yield of other cultivars resulted from the integration of the various growth attributes in different ways. Therefore, it may safely be stated that the yield of seed cotton was directly related to the early development of plants.

The importance of dry matter accumulation and partitioning to selection process aimed towards greater lint yield, justified the distinct need to develop an understanding of Pima cotton growth and development in a more definitive sense. Evaluation of Pima cotton would be most useful if conducted with comparisons to Egyptian cotton if there is a need to be incorporated as breeding material in the Egyptian cotton breeding program to profuse the genetic variability.

MATERIALS AND METHODS

Three environments viz.: E1, conventional planting (CN), on 1st of April 1998 at Giza Agric. Exper. Sta., ARC; E2, CN planting, on 25th of March 1999 and E3: late planting (LP), on 1st of May, 1999. E2 and were conducted at Sids Agric. Exper. Sta. ARC; Beni-Suef governorate. Eight G. barbadense cultivars were sown in a randomised complete block design with four replications. Each Plot consisted of 7 rows, 4 meters long, 60 cm apart. Plants were sown in 2 plants / hill spaced 20 cm within the row. A section of 4 rows of each plot was used for sampling occasions of cotton plants for growth analysis.

Designations, pedigree, main fiber characteristics of genotypes used, coupled with full details of layout of the experiment and the different respect of the maintenance of experiment are mentioned in details by Abo El-Zahab *et al.* (2002 a).

Growth analysis was determined from ten plants from five successive guarded hills. A fixed number of plants rather than plants from fixed area was taken at each sampling date. In E_1: sampling commenced 35 days after sowing and continued at 15 days intervals until 125 days from planting, suming up to 7 samplings. In E_2; sampling commenced 38 days after sowing and continued at 21 days intervals until 150 days from planting, suming up to 6 samplings. In E_3; sampling commenced 31 days after sowing and continued at 21 days intervals until 137 days from planting, suming up to 6 samplings. Separate samplings were allocated at random to the rows and in the meantime the border effects were avoided on the subsequent samples.

The plants of each sample were carefully uprooted and separated into roots, stems and branches, leaves, squares and bolls.

The different plant fractions were washed and oven dried to a constant weight for 48 hours at 70^{0} C. The total dry weight was used as the measure of seedling vigour. The various growth attributes listed in column 1 of Table 1 were measured:

For leaf area measurements in all samples the disk method was used and the cross sectional area of the punch used was 3.2 cm^2. Only whole disks were used in calculating the area-weight relationships of the subsamples. From the first to the third sample ten to fifty disks were taken. However, for the other samples usually 400 disks were taken .In this study leaves refer only to plate of leaves in calculating leaf area by using the area-weight relationships of the subsamples

Several growth attributes (Crop Growth Rate, CGR= g/m^2/week: Relative Growth Rate, RGR = g/g/week and Net Assimilation Rate, NAR =g/m^2/week) were calculated according to Radford (1967).

Squaring (Relative squaring, RS and Squaring index, SI): and fruiting (Relative fruitfulness, RF and Fruiting index, FI) efficiency were estimated according to (Abo EL Zahab and Zahran, 1975). Reproductive /vegetative ratio (RVR) was calculated according to Unruh and Silvertooth (1996). Data from each macro-environment; CN and LP planting dates and combined over environments were subjected to analysis of variance using plot means.

RESULTS AND DISCUSSION

No sizeable differences among the tested genotypes were found for most vegetative growth (plant height, stem weight, leaf weight and total weight) traits measured in the first three samples 35,50 and 65 DAP in E1 and in the first sample, 31 DAP in E3.Therfore, only data for sampling occasions exhibiting significant for the traits studied will be tabulated and discussed. For E_1 there were significant variations in total dry weight (TDW) production and reproductive at 80 and 95 DAP. On a per plant basis TDW were 32.18, 29.81 and 70.78, 59.06 for Pima and Egyptian cotton groups, respectively at 80, 95 DAP in the same order. R/V's, values were 0.52 and 0.26 for Pima and Egyptian cotton groups, respectively at 125 DAP (Table 1). Superiority of Pima cotton in R/V's was also reflected in fruiting efficiency expressed as fruiting index (FI), bolls dry to top dry weight, and relative fruitfulness (RF), number of bolls per 100 grams top dry weight, where it was significant and evident at 125 DAP. FI and RF comparable values were 0.48 and 24.15 for Pima group compared with 0.20 and 15.83 for Egyptian cotton at 125 DAP (Table 2). Moreover, it is worthy is to mention here that Pima cotton was also superior in squaring efficiency expressed as relative squaring (RS), number of squares per 100 grams dry top weight, at 125 DAP, where RS values were 14.53 and 12.34 for Pima and Egyptian cotton, respectively.

In E_2 there were sizeable differences in TDW production partitioning expressed as R/V's in favour of Pima cotton. On a per plant basis TDW were 16.40 and 20.29 and 49.77and 47.10 g. for Pima and Egyptian cotton groups, respectively at 80 and 101 DAP in the same order (Table 1). R/V's values were 0.012 and 0.005; 0.12 and 0.07 and 2.26 and 1.77 for the aforementioned sampling occasion 58, 80 and 150 DAP for Pima and Egyptian cotton, respectively. Also Pima cotton was significantly efficient in squaring efficiency where the estimated values for squaring index (SI), squares dry weight to top dry weight, were 0.11 and 0.07 whereas the relative squaring (RS) values were 79.69 and 63.97 for Pima and Egyptian cotton, respectively at 80 DAP. However, at 123 DAP the RS values were 11.88 and 6.01 for Pima group versus Egyptian cotton. Also significant variations in FI were detected at 150 DAP in favour of Pima cotton, where the estimates were 1.87 and 1.76 for Pima and Egyptian cotton, respectively (Table 2).

For E_3 also the trend of high variations in TDW production and partitioning in terms of R/V's for Pima and Egyptian cotton in favour of Pima cotton was detected. On a per plant basis TDW were 41.22 and 41.71; 97.18 and 84.19

and 118.23 and 92.02 g. for Pima and Egyptian cotton groups, respectively at 73, 117 and 137 DAP in the same order, with significant difference at 137 DAP. The corresponding R/V's values were 0.02 and 0.02; 0.12 and 0.10; 0.89 and 0.87and 1.51 and 1.24 for the aforementioned sampling occasions in the same order with significant differences at 73 and 137 DAP. Moreover, Pima cotton was more significantly efficient in squaring expressed as RS in all the three occasions and cotton groups sampled at 54, 73 and 98 DAP. The estimates were 47.07, 71.42 and 88.71 for Pima

cotton compared with Egyptian group where RS values were 35.94, 61.27 and 70.71 at the aforementioned three sampling dates, respectively. Also Pima cotton was significant efficient in fruiting efficiency at 137 DAP where FI values were 1.54 and 1.28 and RF estimates were 42.51 and 36.18 for Pima cotton compared with Egyptian cotton Table 2.

For Egyptian cotton the early maturing modern cultivars (G.83 and G.85) were smaller in stature and produce less dry weight than the other two varieties G.80 and G.86 in all sampling occasions in the three environments (Table 1). Also the two cultivars G.83 and G.85 were more efficient in squaring and bolling than the other two cultivars G.80 and G.86 in all sampling occasions in the three environments.

Therefore, these results indicate that future improvements in Egyptian cotton would require an increase in total dry matter in the direction of reproductive organs.

Currently, to our knowledge, Egyptian cotton breeders do not deliberately introduce R/V ratio in the breeding programs. This study suggests that the addition of useful variability for R/V ratio would likely result in increasing genetic advance for yield.

With regard to plant growth expressed as plant height (Table 1), it was noticed that during all sampling occasions, there were no significant differences in plant height between the Egyptian and Pima cultivars. However, there was a general trend for plant height of LP system to be taller than their respective height in CN system. With the advance in plant age, significant differences were detected between cultivar means in plant height. Intra-group variability was reported for plant height, where cultivars G.83 and G.85 within the Egyptian and PS-6 and PS-7 within Pima group were shorter as compared to the other cultivars at 125 DAP in E1, 101 DAP in E2 and 73 DAP in E3 Table 1. It is worthy to mention here that in CN planting (E1) both G.83 and G.85 were most efficient in squaring and fruiting.G.83 was more efficient in squaring and fruiting expressed

Table 1. Characteristics of cotton vegetative and reproductive growth as affected by genotypes and environments. All vegetative and reproductive characteristics are expressed on a per plant basis.

E_1: Conventional planting date (CN), 1998.

Traits	DAP (1)	Egyptian					Pima				
		G.80	G.83	G.85	G 86	x	Earlipima	P'S-4	P S-6	P S-7	x
Squa. wt., g	80	1.32d	3 36a	2.66ab	2.08bcd	2.36	2.13bcd	2 34abcd	2.45abc	1.50cd	2 11
Boll wt., g		0.17b	0.89a	0.53ab	0 90a	0.62	0.35a	0.47ab	0.42ab	0.12b	0.34
Rep. wt., g		1.49c	4.24a	3.19ab	2 99b	2.98	2.48bc	2.81b	2.87b	1.62c	2.45
Stem wt., g		10.27c	15.08ab	12.35bc	14.25ab	12.99	13.78ab	15.25ab	15.98a	12.60bc	14.4
Leaf wt., g		12.38d	15 57ab	12.64cd	14.88abcd	13.87	16.23a	15.10abc	16.75ab	13.25bcd	15.33+
Veg. wt., g		22.65d	30.65ab	24.99cd	29.13abc	26.86	30.00ab	30.35ab	32.73a	25.85bcd	29.74
Total wt., g		24.06d	34.91a	28.17bcd	32.11abc	29.81	32.48abc	33.16ab	35.59a	27.47cd	32.18+
RVR (g g-1) (1)		0.07cd	0.14a	0.13ab	0.10bc	0.11	0.08cd	0.09cd	0.09cd	0.06d	0.08
Stem wt., g	95	29.74abc	26.89bc	24.47c	23.40c	26.13	34.25ab	37.25a	32.73ab	33.20ab	34.36+
Leaf wt., g		26.73b	20.73c	25.30bc	32.25a	26.25	30.50ab	29.05ab	30.15ab	26.22b	28.98
Veg. wt., g		56.47abc	47.62c	49.77bc	55.65abc	52.38	64.75a	66.30a	62.88a	59.40ab	63.33+
Total wt., g		61.86abc	52.30c	58.74bc	63.35abc	59.06	72.35a	73.38a	70.18ab	67.20a	70.78+
Height, cm	110	151.00a	122.00c	122.35bc	137.25abc	133.15	136.25ab	133.25bc	137.75abc	138.75bc	136.5
Height, cm	125	164.00a	123.00d	128.50cd	149.00ab	141.13	142.00bc	142 00bc	143.50bc	124.00d	137.65
Squa. wt., g		1.50b	1.11b	9.40a	1.38b	3.35	1.80b	1.95b	1.80b	2.20b	1.94
Boll wt., g		16.05c	22.40bc	17.45c	15 00c	17.72	29.75ab	36.25a	34.25a	39.65a	34.98+
Rep. wt., g		17.55d	23.51cd	26.85bcd	16.38d	21.07	31.55abc	38.20ab	36.05ab	41.85a	36.91+
Leaf wt., g		27.55bc	29.70bc	36.30ab	43.10a	34.16	28.75bc	41.83a	28.45bc	22.30c	30.33
RVR (g g-1)		0.25bc	0.31bc	0.31bc	0 17c	0.26	0.40ab	0.51a	0.58a	0.57a	0.52+

E2: CN planting date, 1999.

Height, cm	58	16.92c	19.9abc	18.80bc	22.10ab	19.44	23.08a	22.70ab	21.95ab	19.75abc	21.87
Squa. wt., g		0.01bc	0.03abc	0.03abc	0.00c	0.02	0.06a	0.05ab	0.05ab	0.03abc	0.05+
Rep. wt., g		0.01bc	0 03abc	0.03abc	0.00c	0.02	0.06a	0.05ab	0.05ab	0.03abc	0.05+
RVR (g g– 1)		0.003bc	0.008abc	0.008abc	0.00c	0.005	0.011ab	0.01a	0 014ab	0.013abc	0.012+
Squa. wt., g	80	0.52b	1.16ab	1.57ab	0 55b	0.95	2.21a	1 88a	1.75a	2.07a	1.98+
Rep. wt., g		0.55c	1.16bc	1.77ab	0.55c	1.01	2.41a	2.03ab	1.97ab	2.29ab	2.18+
Total wt., g		12.43	15.75	16.23	21.19	16.4	19.55	17.74	24.15	19.7	20.29+
RVR (g g-1)		0.05bc	0.08abc	0.10ab	0.03c	0.07	0 14a	0.13a	0.09abc	0.13a	0.12+
Height, cm	101	72.25cd	74.75bcd	67.50d	88.75a	75.81	81.25ab	74.00bcd	71.75cd	79.00ab	76.5
Boll wt., g		6.32bc	9.82ab	7.59ab	2.86c	6.65	7.37ab	6.45bc	3.52c	10.96a	6.83
Rep. wt., g		9.11bc	13.29ab	10.22bc	6.78c	9.85	11.89ab	10.04bc	5.99c	15.22a	10.79
Stem wt., g		17.37bc	19.59bc	15.71c	29.10a	20.44	22.25abc	21.06bc	20 59bc	24.06ab	21.99
Total wt., g		41.3	47.76	39.76	59.58	47.1	50.86	47 7	43.44	57.08	49.77+
RVR (g g-1)		0.29ab	0.39a	0.36a	0 13c	0.29	0.32ab	0.28abc	0.17bc	0.38a	0.29

Table 1. Cont.,

Traits	DAP	Egyptian					Pima				
		G.80	G.83	G.85	G.86	x	Earlipima	P S-4	P S-6	P S-7	x
Height, cm	123	89.50b	86.00b	83.75b	114.00a	93.31	91.33b	86.40b	118.10a	91.15b	96.75
Squa. wt., g		0.43b	0.21b	0.57b	1.32a	0.63	0.51b	0.40b	1.87a	0.42b	0.8
Boll wt., g		30.76bc	35.30b	42.92ab	22.28c	32.82	42.62ab	52.35a	30.52bc	31.98bc	39.37
Rep. wt., g		31.19bc	35.51bc	43.49ab	23.60c	33.45	43.13ab	52.75a	32.38bc	32.40bc	40.17
Stem wt., g		23.60bc	19.74c	18.81c	29.79ab	22.99	21.88c	23.16c	31.70a	22.20c	24.74
Leaf wt., g		18.78bcd	16.55d	17.43d	23.37ab	19.03	20.59abcd	22.45abc	24.50a	17.60cd	21.29
Veg. wt., g		42.38c	36.29c	36.24c	53.16ab	42.02	42.67c	45.61bc	56.20a	39.80c	46.07
RVR (g g-1)		0.75bcd	1.01ab	1.25a	0.45d	0.87	1.01ab	1.16a	0.58cd	0.81bc	0.89
Height, cm	150	89.63cd	90.43bcd	91.05bcd	117.18a	97.07	97.95b	85.10d	123.05a	95.43bc	100.38
Leaf wt., g		14.95a	7.03d	12.78abc	16.03a	12.7	12.18abc	8.2cd	14.23ab	9.98bcd	11.17
Veg. wt., g		34.83ab	21.83c	36.18ab	45.15a	34.5	36.00ab	26.93bc	36.00ab	28.33bc	31.82
RVR (g g-1)		1.47	2.13	1.76	1.71	1.77	2.01	2.76	1.81	2.48	2.26+

E: late planting date (LP), 1999.

Height, cm	31	11.60bcd	10.60d	10.80cd	11.90bcd	11.23	11.60bcd	12.50ab	12.20abc	13.60a	12.48+
Stem wt., g		0.25	0.21	0.27	0.3	0.26	0.3	0.29	0.32	0.33	0.31+
Leaf wt., g		0.41	0.38	0.52	0.47	0.45	0.56	0.51	0.59	0.57	0.56+
Total wt., g		0.66	0.59	0.79	0.77	0.7	0.86	0.8	0.91	0.9	0.87+
Squa. wt., g	54	0.22ab	0.21ab	0.30a	0.10b	0.21	0.32a	0.28a	0.28a	0.32a	0.30+
Rep. wt., g		0.22ab	0.21ab	0.30a	0.10b	0.21	0.32a	0.28a	0.28a	0.32a	0.30+
Total wt., g		12.17	12.87	11.49	12.89	12.36	14.29	12.94	12.9	13.24	13.34
RVR (g g- 1)		0.02ab	0.02bc	0.03a	0.01c	0.02	0.02ab	0.02ab	0.02ab	0.02ab	0.02
Height, cm	73	78.90bcd	81.15bcd	77.53cd	90.10a	81.92	87.00ab	80.43bcd	75.25d	80.00abc	81.92
Stem wt., g		16.10c	22.65a	17.69bc	24.76a	20.3	25.27a	17.07c	15.18c	22.12ab	19.91
Veg. wt., g		33.34bc	42.13ab	33.86bc	41.95ab	37.82	45.11a	33.84bc	27.26c	41.13ab	36.84
Total wt., g		37.95bc	47.25ab	37.25bc	44.38ab	41.71	50.28a	37.96bc	30.79c	45.94ab	41.22
RVR (g g-1)		0.13a	0.12a	0.10ab	0.06b	0.1	0.12a	0.12a	0.13a	0.12a	0.12+
Leaf wt., g	117	8.33c	12.25bc	13.28bc	17.20ab	12.77	10.33bc	22.60a	13.03bc	13.18bc	14.79
Veg. wt., g		31.08	51.98	46.76	59.93	47.44	43.13	61.65	46.21	48.18	49.79+
Total wt., g		67.85	85.48	85.13	98.28	84.19	85.6	130.25	87.1	85.78	97.18
RVR (g g-1)		1.3	0.72	0.95	0.68	0.91	1.26	0.94	0.78	0.99	0.99
Height, cm	137	142.60ab	117.60d	129.63bcd	139.35abc	132.3	125.45cd	121.68d	127.10cd	150.49a	131.18
Boll wt., g		63.33b	47.70c	42.65c	46.25c	49.98	56.65bc	103.68a	54.18b	69.33b	70.96+
Rep. wt., g		63.33b	47.70c	42.65c	46.25c	49.98	56.65bc	103.68a	54.18b	69.33b	70.96+
Stem wt., g		43.10ab	27.80d	26.13d	37.93bc	33.74	40.60bc	50.85a	32.73cd	39.98bc	41.01+
Leaf wt., g		9.93ab	[illegible]	5.98c	12.83a	8.30+	6.18bc	7.69bc	4.37c	6.70bc	6.24
Veg. wt., g		53.03ab	32.25d	32.11d	50.75ab	42.04	46.78bc	58.54a	37.09cd	46.68bc	47.27+
Total wt., g		116.35b	79.95d	74.76d	97.00bcd	92.02	103.43bc	162.22a	91.27cd	116.00b	118.23+
RVR (g g-1)		1.19cd	1.53ab	1.33bc	0.92d	1.24	1.21cd	1.79a	1.54ab	1.51ab	1.51+

(1) DAP= Average days after planting for sampling for growth characteristics.
(2) Reproductive to vegetative ratio.

Any two means within a row within a sampling date followed by the same letter are not significantly different at 0.05 probability level.

\+ Significant mean of Egyptian. vs. Pima group.

Table 2. Squaring and fruiting efficiency for 8 G. barbadense varieties as affected by genotypes and environments.

E_1: Conventional planting date (CN), 1998.

Variables	DAP	Egyptian					Pima				
		G.80	G.83	G.85	G.86	O	Earlipima	P S-4	P S-6	P S-7	X
Relative squaring	80	80.88b	112.30a	78.98b	59.34b	82.88	62.44b	70.14b	61.37b	65.81b	64.94
	110	17.89bc	23.46ab	19.70c	14.14bc	18.8	24.55a	13.19c	25.24c	23.11a	21.52
	125	6.64c	16.17a	17.37a	9.19bc	12.34	15.17bc	12.63bc	14.86bc	15.47bc	14.53+
Fruiting Index	80	0.01c	0.03ab	0.02abc	0.03a	0.02	0.01bc	0.01abc	0.01bc	0.02c	0.01
	125	0.14e	0.31cd	0.20de	0.16de	0.2	0.37bc	0.56ab	0.54a	0.46ab	0.48+
Relative fruitfulness	110	4.48c	18.37a	11.95b	9.30b	11.03	11.02b	10.42b	12.09b	9.86b	10.85
	125	9.71c	25.07a	16.15bc	12.39c	15.83	21.82ab	26.22a	24.33a	24.21a	24.15+

E2: CN planting date, 1998.

Variables	DAP	G.80	G.83	G.85	G.86	O	Earlipima	P S-4	P S-6	P S-7	X
Squaring Index	80	0.05d	0.08a	0.11d	0.03cd	0.07	0.13ab	0.08bcd	0.12bc	0.12ab	0.11
Relative squaring	58	14.89cd	49.05abc	73.78a	–	34.43	63.48ab	29.21bcd	65.93ab	72.07ab	57.67
	80	61.19e	69.96de	95.85a	28.88f	63.97	90.11ab	69.32de	76.12cd	83.22bc	79.69
	123	3.40c	2.42c	4.32c	13.90ab	6.01	14.89ab	19.83a	8.55bc	4.25c	11.88
Fruiting Index	101	0.20ab	0.28a	0.27a	0.08b	0.21	0.21ab	0.08b	0.27a	0.19ab	0.19
	123	0.74bcd	0.01f	1.23a	0.43de	0.6	0.10ab	0.54cd	0.80bc	0.15ef	0.62
	150	1.57abc	2.11ab	1.94ab	1.40bc	1.76	2.32a	1.47bc	1.34c	2.34a	1.87
Relative fruitfulness	101	21.15abc	24.26ab	29.11a	8.49c	19.75	27.62a	13.47bc	29.61a	25.21ab	23.98
	123	39.77b	56.79a	56.30a	29.73c	45.65	50.46a	31.84bc	48.79a	56.10a	46.8

E3: CN planting date, 1998.

Variables	DAP	G.80	G.83	G.85	G.86	O	Earlipima	P S-4	P S-6	P S-7	X
Squaring Index	73	0.12a	0.10ab	0.09ab	0.05b	0.09	0.10a	0.10a	0.10a	0.10a	0.1
Relative squaring	54	34.79bc	34.53bc	49.71ab	24.71c	35.94	41.59ab	44.49ab	53.60a	48.61ab	47.07
	73	53.16de	84.67a	58.16cde	49.09e	61.27	63.23cde	72.23abc	81.53ab	68.62bcd	71.42
	98	42.26c	89.18ab	78.46bc	72.94c	70.71	81.45bc	84.55bc	101.10a	87.73ab	88.71
Fruiting Index	137	1.28b	1.44ab	1.41ab	0.97c	1.28	1.35ab	1.63a	1.60a	1.56ab	1.54
Relative fruitfulness	137	31.34c	35.85bc	37.48bc	40.05abc	36.18	32.13bc	49.27a	47.56a	41.06ab	42.51

as RS at 80, 110 and 125 DAP, expressed as FI at 80 DAP and/or expressed as RF at 110 and 125 DAP. However, G.85 was more efficient in squaring expressed as RS at 125 DAP and more efficient in fruiting expressed as FI at 80 DAP. However, for Pima cotton, the obsolete cultivar PS-4 and the two newly released Pima cultivars PS-6 and PS-7 were more efficient in fruiting expressed as FI and RS at 125 DAP. Such trend was reported for experiment line Earlipima in RF at 125 DAP.

Late planting system (E_3):

It is generally known that in late plantings, early-maturing cultivars will perform better than late-maturing cultivars. However, there is little available data on relative ability of a cultivar in producing dry weight and its partitioning as affected by planting dates. Planting date studies revealed that specific Egyptian cotton cultivars bred for CN production systems exhibited pronounced success also in LP systems. G.83 and G.85 cultivars were ranked first in this respect and rated as late planting stress tolerant genotypes (Abo EL-Zahab and Amein, 2000 a,b,c,d).

In this study the collected data revealed that for late planting system (E3), G.83 and G.85 were more efficient in FI at 137 DAP, whereas for Pima cultivars PS-4, PS-6 and PS-7 were more efficient in FI and RF at 137 DAP (Table 1). In this respect it was reported that genetic yield increases coupled with modern crop management practices have come about through greater partitioning of biomass into reproductive structures. The term used by Evans (1980) for cereal crops was "harvest index" and refers to grain to straw ratio. Data reported herein suggested that yield increase are likely to be achieved through further increases in R/V. The potential of breeding materials closely indicated that the two Egyptian cultivars G.83 and G.85 and the two Pima ones PS-6 and PS-7 would be the foundation for the next yield breeding cycles in Egyptian breeding program via continuos selection for productive partitioning per se.

Growth attributes:

This experiment was designated to permit observations on the efficiency of dry matter production referred to leaf area (net assimilation rate, NAR), the time rate of dry matter production referred to a unit plant weight (relative growth rate, RGR), and the time rate of dry matter accumulation referred to a unit land area (crop growth rate, CGR) for G. barbadense genotypes.

Only data exhibiting significant differences among tested genotypes or necessary for interpretation and discussion were presented in Table 3.

Table 3. Growth attributes for 8 G. barbadense varieties as affected by genotypes and environments.

E_1: Conventional planting date (CN), 1998.

Variables	DAP	Egyptian					Pima				
		G 80	G 83	G.85	G 86	x	Earlipima	P S-4	P S-6	P S-7	x
LAI	80	3 60c	3.80c	3 20c	3 70ab	3.58	3.90bc	4.00a	4.80a	3.20bc	4
	95	7 6	6.2	7 2	8 8	4 95	7 5	7.8	8 7	6 8	7 7
	110	9 6	8.5	9 6	9 4	9.28	10 7	10.6	9.75	11	10 51+
RGR (g/g/w)	80-95	0 47ab	0.19d	0.36bc	0 35a	0 34	0.52a	0.35b	0.32cd	0 46abc	0.41+
NAR (g/m2/w)	50-65	72	73 75	84	67 25	74.25	70 5	67 75	64	78.25	70.13+
	80-95	67 25abc	30.00d	56.50abc	52 25bcc	51.5	77 50ab	68.25abc	47.50cd	81.25a	68.63+
E2: CN planting date 1998											
LAI	38	0 10b	0 08b	0 08b	0 08b	0.09	0 08b	0 08b	0.10ab	0.11a	0 09
	101	2 97c	3 26b	3 34b	5.82a	3.85	3 89b	4.37ab	4.29ab	3 68b	4 06
	123	4 43bc	4 08c	4 38c	6 08ab	4.74	4.87bc	6 16b	4 32c	4 96abc	5 08
	150	2 20b	1 10c	1.76ab	2 20ab	1.82	1 76abc	2.29a	1.58bc	1 13c	1.69
CGR (g/m2/w)	101-123	81 78bc	132 74abc	222.85ab	112 22bc	164.4	196.21abc	246.63a	83 13c	279 86ab	204 46
RGR (g/g/w)	38-58	0 57c	0 65abc	0 74ab	0 71abc	0.67	0 81a	0.81a	0.61bc	0 62bc	0.71
	101-123	49 02a	36 80ab	59 37a	29 06b	43.56	47 19ab	49.92a	49 19b	65.21a	52 88
NAR (g/m2/w)	38-58	3 73	61 33abc	58.21bc	65 60abc	58.97	71.18ab	78.96a	53 97bc	56.15bc	64.52
	101-123	9 02	36.80ab	59 37a	29 06b	43.56	47.19ab	49.92a	49 19b	65 21a	52 88
E3. late planting date(LP), 1998											
LAI	31	0 16	0 13	0 18	0 17	0.16	0 23	0 19	0 21	0 2	0 21+
	98	5 5	7 33	7 88	7 5	7 05	8.63	8.38	7 47	7 96	8 11
	117	2 05c	2.89c	3 85bc	5 39ab	3.55	3.23bc	6.16a	2 53c	3.85bc	3 94
	137	1 87ab	0 91c	1 36bc	2 14a	1.57	1.41bc	2.04ab	1 07c	1 48abc	1 5
CGR (g/m2/w)	54-73	182 00ab	236 00a	188 00ab	215 00a	197.75	246.00a	181.80ab	137 00b	224.00a	146 8
	73-98	82 76d	106 00cd	133 00bcd	195 00ab	129.19	191.00abc	211.00ab	251 00a	212 00ab	216.25
RGR (g/g/w)	31-54	0 90ab	0 98a	0 82b	0 88b	0.9	0 88b	0.86b	0.82b	0 83b	0 85
	73-98	0 10c	0 10c	0 14bc	0.17abc	0.13	0.15bc	0.20ab	0.25a	0.18abc	0 2
NAR (g/m2/w)	117-137	19 31	18 96	21.57	35 73	23.89	31.88	35.42	47 29	36.13	37 68+

At E_1 leaf area index (LAI) developed slowly at the early period of growth to reach a value of 3.58 for Egyptian cotton and 4.00 for Pima cotton at 80 DAP, then increased rapidly to 9.28 for Egyptian and 10.51 for Pima cotton during the next four weeks, 110 DAP (Table 3). However, at E2 LAI reached its maximum value 4.87 for Egyptian and 5.08 for Pima cotton at 123 DAP then decreased sharply during the next sampling occasion 150 DAP. For E3, LAI increased to the maximum (7.05 for Egyptian and 8.11 for Pima cotton) at 98 DAP then decreased sharply.

Sizeable variation in LAI due to environments was evident, where maximum LAI of 9.28 and 10.51; 4.74 and 5.08 and 7.05 and 8.11 for Egyptian and Pima cottons in the same order at 110, 123 and 98 DAP were obtained for E_1, E_2 and E_3 respectively

Watson (1958) concluded that the rate of dry matter production by a crop would increase as LAI increases until a maximum value is obtained. Therefor, as LAI increases the rate of dry matter production would decline. Maximum LAI's were obtained at 110,123 and 98 DAP for E_1, E_2 and E_3, respectively. Whereas, their corresponding maximum CGR,s were at growth intervals 80-95, 80-101 and 98-117 DAP for three environments sampled E_1, E_2 and E_3, respectively in the same order. This means that maximum CGR was reached about two weeks earlier than the corresponding maximum LAI. This indicates that the expanded LA was over optimal for these cultivars. Such trend for the relationship between LA and CGR was also detected in Faba bean (Abo EL-Zahab *et al.*, 1980). The comparable dates of maximum LAI for individual environments indicated that at LP planting system, maximum LAI was reached about 2-3 weeks earlier compared to CN planting system.

The estimated values of RGR at E1 were more or less the same for the Egyptian and Pima cotton, where it ranged from 0.60-0.72 and 0.63-0.70 g/g/week for the two cotton groups in the same order during the first three sampling intervals ending 65-80 DAP, then it decreased sharply to reach a minimum value of 0.10-0.11 g/g/week at the latest sampling interval 110-125 DAP. No significant variability among cultivars in RGR was detected except at the growth interval 80-95 DAP. Out of five sampling intervals only significant variation in RGR values due to genotypes were observed at 38-58 and 101-123 DAP at E_2.

At E_3 significant cultivars variations in RGR were observed at the two growth sampling intervals 31-54 and 73-98 DAP. More or less comparable estimates for RGR values were obtained in the three environments sampled with the same trend of decreasing RGR values with the advance of cotton plant age.

The overall picture revealed that at the late growth stages G.80 and G.85 out of the Egyptian cultivars, and three cultivars out of the four ones of Pima cotton viz.: Earlipima, PS-4 and PS-7 ranked first in NAR. This means that there is feasibility for incorporating these cultivars in future breeding program aming for increasing the efficiency in NAR.

NAR at E_1 and E_2 increased with the advance of the plant age until it reached a maximum of 81.75 and 85.38 g/ m^2/week at E1 and 77.67 and 80.54 g/ m2/week at E2 for Egyptian and Pima cotton, respectively at the growth interval ending 80 DAP, then it decreased sharply during the last growth intervals.

However, in E_3 somewhat different pattern of growth was detected where NAR decreased with the advance of plant age. The observed decrease in NAR with the advance of plant age may be due to excessive mutual shading or transpiration by the very large leaf expanded which started early at 50 DAP in LP system, whereas such decrease was observed with the first flower initiation at 80 DAP for CN planting system. Similar results were reported by Health (1937) and Abo El-Zahab and Zahran (1975) in cotton. In conclusion, very large leaf area expansion does occur in cotton with the start of the phenological stage of flower initiation and induce excessive mutual shading and in turn sizeable reduction in NAR.

REFERENCES

1. Abo El-Zahab, A. A. and M.Zaharan. 1975. A Comparative analysis of growth of ten Egyptian cotton cultivars (Gossypium barbadense L.). Z.Acher - u.p. fla. 14: 284-299.

2. -------------, and ------------. 2000a. Prospectives for breeding short-season cotton .I.Combining ability for cotton yield and its covariables. Proc. 9th Con .Agronomy, Menoufiya Univ. Shbin El-Koem, Egypt.pp.305-330.

3. -------------, and ------------. 2000b. Prospectives for breeding short-season cotton. II. Earliness of crop maturity. Proc. 9th Con. Agronomy, Menoufiya Univ. Shbin El-Koem, Egypt .pp.331-344.

4. -------------, and ------------. 2000c. Prospectives for breeding short-season cotton. III. Tolerance to late planting stress . Proc. 9th Con. Agronomy, Menoufiya Univ. Shbin El-Koem , Egypt . pp. 345-368.

5. -------------, and ------------. 2000d. Prospectives for breeding short-season cotton. IV. Genotype-environment interaction and stability. proc. 9th Con. Agronomy, Menoufiya Univ. Shbin El-Koem, Egypt. pp.369-386.

6. -------------, H.Y.Awad and K.M.A.Baker. 2002a. Comparative performance of Egyptian and Pima cotton cultivars: I. Cotton yield and its components, earlliness in maturity and fiber properties. Egypt. J. Agric. Res.,

7. Calhoun, D.S. and D.T.Bowman. 1999. Techniques for development of new cultivars. In C.W.Smith amd J.T.Cothren (eds.), Cotton. pp.361-414.

8. Clarke, J.M., T.F. Townley-Smith, T.N. McCaig and D.G. Green. 1984. Growth analysis of spring Wheat cultivars of varying drought resistance. Crop Sci. 24:537-542.

9. Evans, L.T. 1980. The natural history of crop yield. Am. Sci. 68:388-397.

10. Gardner,F.P., R.B. Pearce, and R.L.Mitchell. 1985. Transport and partitioning.P.58-75. Physiology of crop plants. Iowa State Univ. Press, Ames, IA.

11. Health,O.V.S. 1937. The effect of age on net assimilation and relative growth rate in cotton plant. Ann. Bot. N.S. 1:565-566.

12. Meredith,W.R,Jr., and R.Wells. 1989. Potential for increasing cotton yields through enhanced partitioning to reproductive structures. Crop Sci. 29:636-639.

13. Radford, P. J. 1967. Growth Analysis formulae:their use and abuse. Crop. sci . 7 (3): 171-176.

14. Unruh,B.L. and J.C.Silvertooth. 1996. Comparison between an Upland and a Pima cotton cultivar: 1-Growth and yield. Agron.J.88:583-589.

15. Watson,D.J. 1958. The dependence of Net Assimilation Rate on leaf-area index. Annals Bot.N.S.22:37-54.

16. Wells, R. and W.R. Meredith, Jr. 1984b. Comparative growth of obsolete and modern cotton cultivars: II. Reproductive dry matter partitioning Crop Sci. 24:863-868.

دراسة مقارنة لسلوك أقطان البيما والأقطان المصرية
٢- انتاج المادة الجافة

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اشتملت الدراسة على ٨ تراكيب وراثية من القطن اربعة من اقطان البيما)بيما مبكر- بيما س٤-بيما س٦-بيما س ٧) و اربع اصناف من الأقطان المصرية الطويلة التيلة (جـ٨٠-جـ٨٣-جـ٨٥-جـ٨٦) لمقارنة المحصول والتبكير وصفات التيلة لهاتين المجموعتين تحت الظروف المحلية .اجريت هذه الدراسة في ٣ بيئات وهى الأولى :زراعة في اول ابريل ١٩٩٨ في محطة بحوث الجيزة بينما الثانية والثالثة في ميعادى زراعة الأول عادى في ٢٥ مارس والثانى متأخر في اول مايو عام ١٩٩٩ في محطة بحوث سدس (بنى سويف) .تم زراعة هذه الأصناف في تصميم القطاعات الكاملة العشوائية باستخدام ٤ مكررات . تم تجميع البيانات عن صفات النمو المختلفة بالاضافة الى كفاءة انتاج البراعم والتلويز ويمكن تلخيص اهم النتائج المتحصل عليها من هذه الدراسة

١- انتاج المادة الجافة وتوزيعها: - لوحظ ان هناك تباين في انتاج المادة الجافة (TDW) وتوزيعها الى الأجزاء الجضرية والثمرية معبرا عنا بنسبة الأجزاء الثمرية الى الخضرية (R/V%) بين الأقطان المصرية واقطان البيما لصالح اقطان البيما. وقد انعكس ذلك على صفات معامل انتاج البراعم النسبى (RS) ومعامل انتاج اللوز (FI) ومعامل التلويز النسبى (RF) عند عمر ١٢٥ يوم من الزراعة لصالح أصنلف البيما. الا آن تفوق المجموعج المصرية على مجموعة البيما في المراحل الأولى في كفاءة الإثمار (FI, RF) عند عمر ٨٠ يوم لم يصل الى درجة المعنوية.

٢- نظام الزراعة المتأخرة: في هذه الدراسة وجد أن الصنفين ج ٨٣ و ج ٨٥ من مجموعة الأصناف المصرية وكذلك الأصناف بيما س٤ وبيما س٦ وبيما س٧ من مجموعة اصناف البيما أكثر كفاءة في الإثمار عند ١٢٧ يوم من الزراعة عند الزراعة متأخراً.

٣- صفات النمو: وجد تفوق مجموعة البيما على المجموعة المصرية في صفة معدل نمو المحصول (CGR) ومعامل النمو النسبى(RGR) الا أن هذا التفوق لم يصل مستوى المعنوية؛ كما لوظ وصول قيمة معدل نمو المحصول (CGR) الى القيم العظمى مبكراً بحوالى اسبوعين عن تلك المقدرة لدليل المساحة الورقية (LAI) وهذا دليل على أن المساحة الورقية لهذه الأصناف كانت عالية.

٤- تشير النتائج الى أنه في المراحل المتأخرة من النمو ان كلا من ج ٨٣ و ج ٨٥ من الأصنلف المصرية وبيما س٤ وبيما س٧ من اصناف البيما تميزت بتفوقها في صفة معدل صافى التمثيل (NAR) مما يدل على إمكانية استخدام هذه التراكيب الوراثية لزيادة قيمة NAR للأصناف المصرية.