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Evaluation of Some Promising Cotton Genotypes and Commercial Variety for Yield, Quality and Bacterial Blight Resistance

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Ten cotton genotypes were evaluated (*Gossypium Barbadense* L) for seed cotton yield, better quality and bacterial blight resistance. in the Agricultural Research Corporation, ARC at the Gezira Research Station, Gezira State, Wad Medani, Sudan.in seasons 2012/2013 and 2013/2014, The experiment was laid in a randomized complete block design (RCBD) with four replications. The results indicated that 94-B-2 line has an average seed cotton yield advantage of 19% over Barakat-90, mean seed cotton yield 2219 compare to 1868 for Barakat-90, with fiber length of 35.1, micronaire value of 3.7 and fiber strength of 37.5 better than Barakat-90. It gave 52% of its yield in the first pick compared to 44 for Barakat-90. It has a GOT of 34% compared to 32.6 for Barakat-90. It recorded disease incidence and disease severity of 0.58 and 38.8%, respectively compared to

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0.72 and 51.8 for Barakat-90. Hence this line emerged as a new candidate with new traits: higher seed cotton yield, earliness of maturity, resistance to bacterial blight, higher GOT and better fiber characteristics is better than the commercial cotton cultivar Barakat-90.

Keywords: Blight resistance; cotton; genotypes; foliar sprays; integrated control.

1. INTRODUCTION

Cotton is the most important fiber and cash crop in the Sudan. Cotton in Sudan is affected by three major diseases; bacterial blight (black arm), leaf curl and Fusarium wilt. Bacterial blight of cotton caused by *Xanthomonas compestries* PV. *malvacearum* (Smith) Dye is a major disease occurring in most cotton growing areas around the world [1-4]. It predominates in countries which have periods of storm during the growing season such as Sudan. In Sudan, the disease was first reported in 1922 [5]. The cultural and climatic conditions under which cotton is grown, favor the development and spread of the disease. Effect of the disease in the early days of the Gezira scheme is well known, and, at one time, it was considered that it might prevent cotton growing in the Gezira [6].

Sudan produces four types of cotton varieties, namely; extra-long staple cotton (extra fine count, 35.05-39.62 mm), long staple cotton (fine count, 31.75-35.05 mm), medium staple cotton (medium count, 26.16-31.75 mm) and short staple cotton (course count, >26.16 mm). Each of the above market classes is represented by at least one variety; the main representative varieties were; Barakat, Shamabt, Barac (67) B and Albar A (57) 12, respectively (Fadalla, 1990); [7] are now being grown in Sudan.

The Bacterial blight has two groups an old race, pre-Barakat race, and a new race known as post-Barakat race. These two races were reported to be different from those recorded elsewhere [8-10]. This new race overcame the very high resistance conferred by the gene's combination B2 and B6. The old race is more aggressive and its effect in reducing crop yield is known to be greater. Later on, [11] identified races 6, 7 and 20 (previously known as post-Barakat race), and undefined race formerly known as pre-Barakat race, which was isolated from a continuous cotton plot at the Gezira Research Farm, Wad Medani.

1.1 Control of the Disease

Several methods for control of bacterial blight disease have been developed worldwide, including chemical seed treatment, Foliar sprays, integrated control, biological control, cultural practices and resistant varieties [12-14]. In Sudan, the control of the disease has been achieved by adopting several practices such as chemical seed treatment; use of resistant varieties, cultural practices and, in addition, sanitary and regulatory measures (ElNur, 1970).

Use of resistant varieties is the best method for controlling the disease. Resistant varieties of tetraploid cotton species have been released in a number of countries, mainly by transfer of resistance genes originally derived from other Gossypium spp. [15-17]. In the Sudan, a number of resistant varieties possessing different B genes combinations have been released (Siddig, 1973 and Mustafa and Babiker, 2006).

Objectives of this study are to evaluate ten Egyptian cotton lines for yield, best quality and bacterial blight resistance.

2. MATERIALS AND METHODS

2.1 Plant Material

The plant material used in this study included nine cotton experimental lines: 94-B-2, 94-B-19, 96-9, 63-1-3, 96-2, 130-10, 63-2-8, 110-1 and 110-2 belonging to *Gossypium Barbadense* L. Produce and adapted in Sudan weather and belong to cotton breeding program in Sudan and Barakat-90 as control.

2.2 Experimental Site

The experiment was conducted during summer season 2012/2013 and 2013/2014 at Gezira Research Farm Wad Medani, Sudan.

Land preparation was carried out in June following the standard procedures described by ARC and sowing was in 15 July.

2.3 Experimental Design

The experiment was laid in a randomized complete block design (RCBD) with four replications. The experimental materials along with Barakat-90 were planted in plots (6 rows) 5 m long with 0.8 x 0.5 m inter and intra row spacing.

A sample of three plants was taken at random (from the inter rows), tagged in each plot to score the intended parameters. The two outer rows were used for data related to yield components and other related aspects. The inner four rows were used for yield comparison**.**

2.4 Sampling and Bacterial Isolation

The bacteria were isolated from infected leaves of the variety Barakat-90 in Petri dishes containing nutrient agar. Forty-eight hours old purified cultures were used (Hillocks, 1992). The inoculum was diluted using sterilized distilled water and the inoculum concentration was adjusted approximately to $1x10^6$ bacterial cells/ml. Cotton plants at the six leaves stage were inoculated using the pressure inoculation method [18,19] The undersurfaces were sprayed with the bacterial suspension using small pressurized sprayers. After an incubation period of 2-3 weeks, leaf disease severity was graded on 0-5 scale [20], where 0 represent immunity, 1 resistant, 2 moderately resistant, 3 moderately susceptible, 4 susceptible and 5 highly susceptible.

2.5 Data Collection

The following traits were measured and used in the evaluation:

1- Earliness of maturity (%).
2- Ginning out turn (G.O.T%): this is the percentage of lint to total seed cotton weight determined by the formula [21]: weight of lint/seed weight of seed cotton x 100.
3- Seed index (3.1) was determined by taking the weight of 100 sound seeds (grams).
4- Boll weight (g)
5- Number of seed per boll
6- Weight of lint per boll (g).
7- Weight of seed cotton per boll (g).
8- Disease incidence (DI).
9- Disease severity (DS).
10- Plant height (cm).
11- Number of bolls per plant
12- Number of sympodia per plant.
13- Number of monopodia per plant
14- Yield (kg/ha^{-1})

Fiber tests were carried out at the fiber testing and spinning laboratory of the cotton research program, ARC, Sudan, according to fiber testing standards under testing conditions

3. RESULTS AND DISCUSSION

Earliness Table (1) shows earliness of maturity for the genotypes tested. The statistical analysis revealed that there were significant differences ($P≥0.05$) among genotypes in earliness of maturity. Genotype (96-9) recorded the earliest maturity value (61.2) whereas, genotype (96-2) recorded the latest value (35.6).

Yield kg/ha^{-1} Means seeds cotton yield of the tested genotypes are presented in Table 1. the genotype (94-B-2) obtained the highest value 2219 kg/ha^{-1} whereas, Barakat-90 1868 **kg**/ha^{-1} and genotype (96-2) smallest value (857).

Ginning Out-Turn (GOT) Table (1) shows ginning out-turn. The statistical analysis revealed that there were no-significant differences among genotypes in ginning out-turn showed that genotype (94-B-2) gave the highest value (34.0) whereas, genotypes (96-9) and (63-2-8) smallest value (32.0).

Seed index Table (1) shows seed index the statistical analysis revealed that there was no-significant difference among genotypes in seed index, the genotype (63-2-8) obtained the highest value (11.1) whereas, genotype (96-2) recorded the smallest value (10.3).

Boll weight Table (1) shows boll weight the statistical analysis revealed that there were significant differences ($P≥0.05$) among genotypes in boll weight. The genotype (94-B-19) recorded the highest value (2.9) whereas, genotypes (96-2) and (110-1) recorded the smallest value (2.2).

Number of seed per boll Table (2) shows number of seed per boll. The statistical analysis revealed that there were no-significant differences among genotypes in number of seed per boll. The genotype (94-B-19) obtained the highest value (18.8) whereas, genotype (110-1) recorded the smallest value (15.8).

Weight of lint per boll (gm) Table (2) shows weight of lint per boll the statistical analysis revealed that there were high significant differences ($P≥0.01$) among genotypes in weight of lint per boll. The genotype (94-B-19) obtained the highest value (0.98) whereas, genotype (110-1) smallest value (0.53).

Plate 1

Plate 2

Plate 3

Plate 4

Plate 1-4. Symptoms on diseased cotton plant parts

Table 1. Mean genotypes of different agronomic traits for ten genotypes evaluated at wad median research station (2011)

Genotype	Seed Cotton (kgs/ha-1)	Earliness %	Ginning-Out Turn	Seed index	Boll Weight (gm)
Barakat-90	1868	43.5	32.6	10.6	2.7
94-B-2	2219	52.0	34.0	10.7	2.4
94-B-19	2037	54.0	33.9	10.8	2.9
96-9	1521	61.2	32.0	10.6	2.4
63-1-3	1553	38.0	32.9	10.4	2.6
96-2	857	35.6	32.7	10.3	2.2
130-10	1444	48.6	32.9	9.8	2.5
63-2-8	1151	48.3	32.0	11.1	2.6
110-1	1478	45.9	32.9	10.4	2.2
110-2	1271	58.7	32.6	10.4	2.4
Mean	1540	48.6	32.9	10.5	2.5
CV%	17	23.9	3.0	5.4	10.5
SE±	65.8	2.9	0.35	0.14	0.07
Lsd	23.3	97.8	0.72	0.23	0.05

Weight of seed cotton per boll Table (2) shows weight of seed cotton per boll the statistical analysis revealed that there were no-significant differences among genotypes in weight of seed cotton per boll. The genotype (94-B-19) obtained the highest value (2g) whereas, genotypes (94-B-2) and (110-1) smallest value (1.6).

3.1 Disease Incidence

Table (3) shows disease incidence for the bacterial blight the statistical analysis revealed that there were no-significant differences among genotypes in disease incidence. The genotype (110-1) obtained the highest value (0.98) whereas, genotype (94-B-19) smallest value (0.40).

Disease severity Table (3) shows disease severity for the bacterial blight, the statistical analysis revealed that, there were high significant differences (P≥0.01) among genotypes in disease severity. The genotype (110-1) obtained the highest value (63) whereas, genotype (63-2-8) smallest value (31).

Plant height Table (4) shows plant height, the statistical analysis revealed that there were high significant differences (P≥0.01) among genotypes in plant height. The genotype (110-2) recorded the highest value (120) whereas, genotype (63-2-8) recorded smallest value (92).

Number of bolls per plant Number of bolls per plant is an important yield component indicating the number of harvestable bolls per plant. Table (4) shows number of bolls per plant the statistical analysis revealed that there were high significant differences (P≥0.01) among genotype (94-B-2) obtained the highest value (60) whereas, genotype (110-1) smallest value (28).

Number of monopodia per plant Table (4) shows number of monopodia per plant the statistical analysis revealed that there were high significant differences (P≥0.01) among genotypes for number of monopodia per plant. The genotype (110-1) obtained the highest value (17) whereas, genotype (94-B-19) smallest value (5).

Table 2. Mean treatments of different agronomic traits for ten genotypes evaluated at wad medani research station (2011)

Genotype	number of seed per boll	lint weight per boll	seed cotton weight per boll
Barakat-90	18.3	0.86	1.8
94-B-2	16.0	0.70	1.6
94-B-19	18.8	0.98	2.0
96-9	16.8	0.70	1.7
63-1-3	17.6	0.88	1.7
96-2	16.0	0.59	1.7
130-10	16.3	0.77	1.7
63-2-8	16.7	0.79	1.9
110-1	15.8	0.53	1.6
110-2	16.3	0.68	1.7
Mean	16.9	0.75	1.7
CV%	9	11.8	10.5

Table 3. Mean treatments of different agronomic traits for ten genotypes evaluated at wad medani research station (2011)

Genotype	Disease incidence	Disease severity
Barakat-90	0.73	52
94-B-2	0.58	39
94-B-19	0.40	42
96-9	0.88	47
63-1-3	0.93	48
96-2	0.45	38
130-10	0.78	45
63-2-8	0.44	31
110-1	0.98	63
110-2	0.58	52
Mean	0.68	46
CV%	70.8	19.2
SE±	0.12	2.2
LSD	0.17	0.8

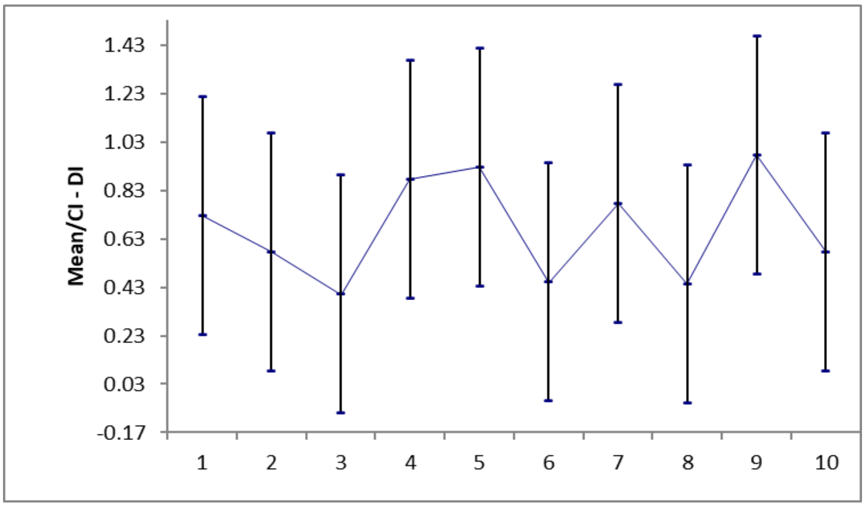

Fig. 1. Disease incidence

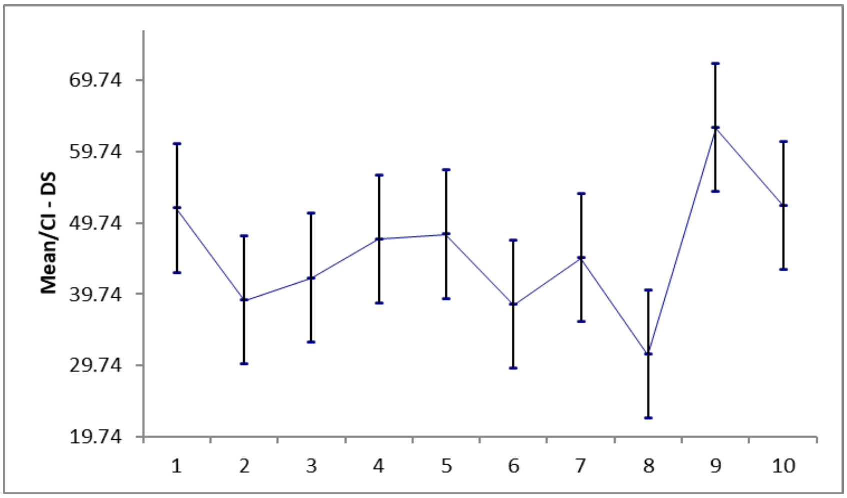

Fig. 2. Disease severity

Table 4. Mean treatments of different agronomic traits for ten genotypes evaluated at wad medani research station (2011)

Genotype	Plant Height (cm)	Number of bolls per plant	Number of Monopodia per plant	Number of Sympodia per plant
Barakat-90	97	35	12	18
94-B-2	110	60	7	16
94-B-19	103	52	5	19
96-9	97	55	7	17
63-1-3	102	36	9	18
96-2	96	36	11	16
130-10	98	34	12	16
63-2-8	92	30	13	17
110-1	100	28	17	16
110-2	120	36	14	16
Mean	102	40	11	17
CV%	4.9	12.7	14.7	9
SE±	1.3	1.3	0.38	0.38
LSD	18.2	18.7	1.7	1.7

Table 5. Mean fiber characteristic of tested samples

Sample	Upper Half Mean Length m.m	Uniformity Index %	Micronaire	Bundle Strength g/tex
Barakat-90	34.3	83.8	4.4	35.7
94-B-2	35.1	86.0	3.7	37.5
94-B-19	33.4	84.8	3.7	33.7
96-9	33.1	84.3	3.9	33.2
63-1-3	31.7	83.0	3.9	34.4
96-2	34.5	84.0	3.7	36.8
130-10	34.0	84.9	3.3	33.8
63-2-8	34.3	84.5	4.4	34.4
110-1	34.0	82.5	3.9	34.6
110-2	34.2	85.4	3.0	34.5

Number of sympodia per plant Table (4) shows number of sympodia per plant contributes to seed cotton yield and it means the number of fruiting branches per plant the statistical analysis revealed that there were no-significant differences per plant. The genotype (94-B-19) obtained the highest value (19) whereas, genotype (110-1) smallest value (16).

Upper half mean length 94-B-2 line has a longer fiber length than Barakat-90, the others have shorter fiber length than control (Barakat-90) followed by 96-2, 63-2-8, 110-2, 110-1, 130-10, 94-B-19, 63-1-3 and 96-9 (Table 4).

Uniformity indexes the uniformity test showed that 94-B-2 line has better fiber uniformity than the Barakat-90 Table 5.

Micronaire value was 3.7 for line 94-B-2, Barakat-90 4.4, for the other lines were acceptable range 130-10, 110-2 were 3.3, 3.0 respectively (Table 5).

Bundle strength test showed that sample 94-B-2 (37.5 g/tex) and sample 96-2 (36.8 g/tex) are stronger bundle strength than the control sample. Sample 110-1 (34.6 g/tex), sample 110-2 (34.5 g/tex), samples 63-2-8, 63-1-3 (34.4 g/tex), sample 130-10 (33.8 g/tex), sample 94-B-19 (33.7 g/tex) and sample 96-9 (33.2 g/tex) are longer bundle strength than Barakat-90 the control sample (Table 4).

4. CONCLUSION

Based on the results of this study it can be concluded that:

1- New genetic variability in *Gossypium barbadense* has been added such as: seed cotton yield, number of bolls per plant and number of sympodial per plant.
2- Genotype (94-B-2) emerged as a new candidate having most of desirable characters. Having higher yield, more bolls per plant and better quality among other genotypes.
3- Among the Compared ten genotypes, (94-B-19) gave higher boll weight and greater weight of lint per boll.
4- Genotype (96-9) was the earliest maturity among the tested genotype.
5- Genotype (63-2-8) recorded the smallest disease severity.

5. RECOMMENDATIONS

Based on the data presented, lines 94-B-2, 94-B-19 and 96-9 are higher yield, better fiber quality and resistance to bacterial blight disease, recommended as Extra-fine count cotton verities

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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