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FIBER QUALITY AND AGRONOMIC TRAITS OF NEW MEXICO ACALA COTTON RELEASED SINCE 1930S: 2005 RESULTS

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Abstract

Acala 1517 cultivars released from the New Mexico State University cotton breeding program since the 1930s were evaluated in Las Cruces, NM in 2005 for fiber quality and agronomic traits. The study confirmed our previous report that yield improvement in Acala 1517 cultivars has been accompanied by an increase in lint percentage and micronaire (coarser fiber), and reduction in boll and seed size. Fiber length, strength and elongation in Acala 1517 cultivars have been also enhanced over the 70-yr period. Further tests in more environments will be conducted.

Introduction

Since the establishment of the New Mexico cotton breeding program in 1926, more than 30 Acala 1517 cotton cultivars (Table 1) and numerous germplasm lines have been developed and released (Staten, 1970; Smith and Cothern, 1999). New Mexico Acala cotton germplasm, known for their high fiber quality, good verticillium wilt tolerance, and large boll size (Smith and Cothern, 1999), are adapted to the Southwestern growing region (semi-arid and hot in the summer) of the U.S. Cotton Belt. Based on Bowman et al. (1996), approximately 45% of cotton cultivars including most California Acala cotton released in the U.S. from 1950 to 1990 contained New Mexico cotton germplasm in their pedigrees. However, no information is available on the genetic gain in lint yield and other traits of agronomic importance in Acala cotton cultivars and germplasm lines released in the New Mexico cotton breeding program. Zhang et al. (2005a) reported that some current commercial Acala cotton cultivars were more distant from other upland cotton and had high frequency of several unique SSR markers that were correlated with fiber quality traits. Using data from the annual statewide cotton variety tests, Zhang et al. (2005b) evaluated the genetic improvement of Acala 1517 cultivars released over the past 75 year period and their genetic diversity based on SSR markers.

The objectives of the present study were (1) to field test Acala 1517 cultivars released from New Mexico since 1930; and (2) to evaluate the trends of trait improvement in Acala 1517 cultivars.

Materials and Methods

Cultivars and germplasm lines tested are listed in Table 1.

The field test was conducted in Las Cruces, NM in 2005. Seeds were requested from the National Germplasm Collection, USDA-ARS, Crop Germplasm Research Unit, College Station, TX.

Seeds were germinated in 4'' pots containing potting soil in the greenhouse and transplanted to the field. The experimental design was a complete randomized block design with 2 replications. The plot size was single row with 5 plants per plot. Five mature bolls were harvested from each plant to make a 25-boll sample per plot. The seedcotton was weighed and ginned for the determination of boll size, seed index and lint percentage. Fiber quality traits were measured with in-house single instruments. ANOVA and single-factor regression were conducted.

Results and Analysis

Boll size (Fig 1)

Except for Acala 1064 which had very small boll (<4.0 g per boll), earlier Acala 1517 cultivar had larger bolls (6.3-6.8 g). It appears that boll size has decreased to <6 g over time. The increment rate for boll size is -0.02 g per boll per year.

Seed index (Fig 2)

Except for Acala 1064, the earliest Acala cotton cultivars seemed to have large seed. The cultivars released in the 1960s had also large seed (12-13 g of seed index). Since then, the seed size has been gradually reduced. The trend with a reduction of 0.02 g per year was linear and significant.

Lint percentage (Fig 3)

Lint percentage in the cultivars released before the1960s ranged from 37 to 38%. Since then, lint percentage in Acala 1517 cultivars has steadily improved with a rate of 0.05% per year. The most recently released cultivars have even higher lint percentage (>42%).

2.5% span length (Fig 4)

Most Acala 1517 cultivars released before the 1960s were shorter in 2.5% span length (1.04-1.16 inch). Most of 1517 cultivars released after the 1980s had longer fiber length (1.10-1.17 inch). Several 1517 cultivars released in the 1970s had longer fiber (>1.2 inch). The increment rate is 0.0001 inch per year , but insignificant.

50% span length (Fig 5)

The tendency is similar to 2.5% span length. The increment rate (0.0006 inch per year) is significant.

Fiber strength (Fig 6)

The early 1517 cultivars had weaker fiber (21.5-23.5 g/tex), while lately released Acala 1517 cultivars had improved fiber strength over time. The increment rate, 0.046 g/tex per year, is highly significant.

Fiber elongation (Fig 7)

The trend is similar to fiber strength. The increment rate, 0.0097 % per year, is significant.

Micronaire (Fig 8)

Micronaire in Acala 1517 cultivars has steadily increased over years from 3.8 to 4.6. The increment rate, 0.008 per year, is linear and significant.

Conclusions

The 2005 results confirmed our previous analysis (Zhang et al., 2005b) that yield improvement in Acala 1517 cultivars has been accompanied by an increase in lint percentage and micronaire, and a reduction in boll and seed size. This is in agreement with previous reports (Meredith, 2000; Meredith & Bridge, 1982; Meredith et al., 1997). Fiber length, strength, and elongation in Acala 1517 cultivars have also gradually improved.

Further tests in multiple environments will be conducted.

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Table 1. Acala 1517 Cultivars Released

Cultivar	Year released	Pedigree
Acala Young's*	1929	Watson's
College Acala	1930	Acala P12
Acala 1064*	1937	Acala Young
Acala 1517*	1939	Acala 1064
Acala 1517A	1941	Acala 1064
Acala 1517WR	1946	Acala 1517
Acala 1517B	1949	Watson's Acala
Acala 1517C(7133)*	1951	NM 1544 x NM 1577
Acala 1517C(8893)	1954	Reselection from 7133
Acala 1517BR	1954	ST 20/Acala/1517WR/Acala 1517B
Acala 1517-BR1	1957	Acala 1517BR/Acala 1517C
Acala 1517C (1028)*	1958	Reselection from 7133
Acala 1517D*	1960	A cross of two strains of unknown parentage
Acala 1517-BR2 (B479)*	1961	(8373/ST 20)/Acala 216/(Acala 49/ Hartsville)
Acala 1517V (6612)	1964	Acala 2503/Coquette
Acala 1517-BR2 (60-209B)*	1965	Reselction from Acala 1517-BR2
Hopicala	1965	Acala 1517 selection 5-12/HA76
Acala 3080	1968	9136/49W
Acala 1517V (9450)	1969	Acala 2503/Coquette
Acala 1517-70*	1970	B1413/Hopicala
Acala 1517-75*	1975	Acala 688/Acala 9608
Acala 1517-77	1977	Reselection from Acala 1517-70
Acala 1517-77BR*	1982	Selection from Acala 1517-77
Acala 1517-E1	1976	Acala 3080/PD 2165
Acala 1517-E2*	1978	Selection from Acala 1517 E-1
Acala 1517-SR1	1982	Acala 1517-E1/Unknown storm-proof
Acala 1517-SR2*	1986	Acala 1517-E1/Unknown storm-proof
Acala 1517-SR3*	1990	Acala 1517-E1/Unknown storm-proof
Acala 1517-88*	1988	Acala 1517-77BR/DP 70
Acala 1517-91*	1991	Acala 8130/Acala 8874
Acala 1517-95*	1995	From 1517-E2 (3080/PD2165)
Acala 1517-99*	1999	B742/E1141
Acala 1517-02	2004	Prema/(Acala 1517-95/GC-362)
Acala 1517-03	2004	B4222/H1014
Acala 1517-04	2004	Acala 1517-95/87D3-24

*Used for the field test in 2005

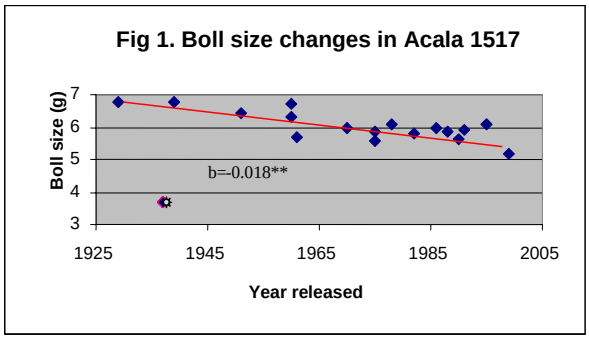
Fig 1. Boll size changes in Acala 1517
Boll size (g)
7
6
5
4
3
b=-0.018**
1925
1945
1965
1985
2005
Year released

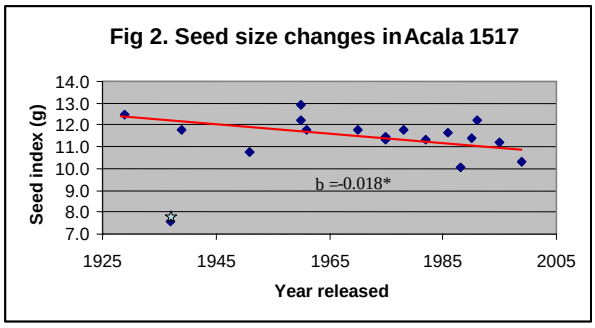
Fig 2. Seed size changes in Acala 1517
Seed index (g)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
b =-0.018*
1925
1945
1965
1985
2005
Year released

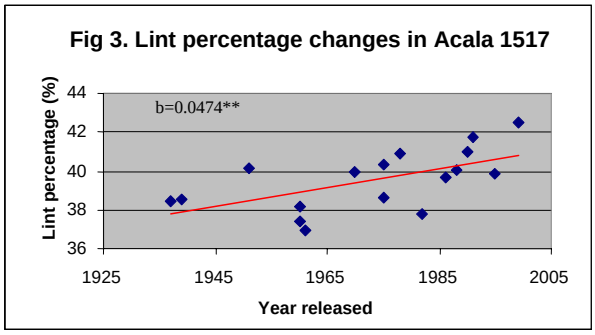
Fig 3. Lint percentage changes in Acala 1517
Lint percentage (%)
44
42
40
38
36
b=0.0474**
1925
1945
1965
1985
2005
Year released

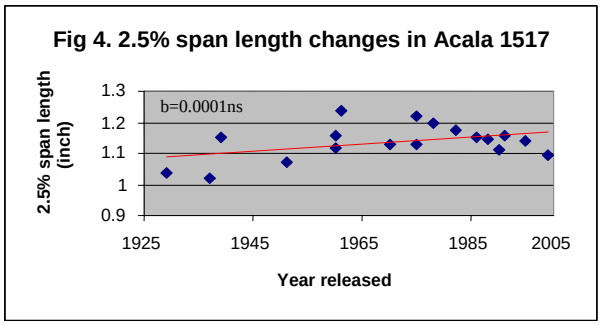
Fig 4. 2.5% span length changes in Acala 1517
2.5% span length (inch)
1.3
1.2
1.1
1
0.9
b=0.0001ns
1925
1945
1965
1985
2005
Year released

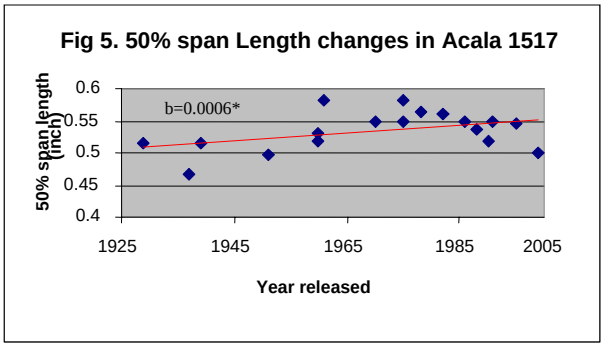
Fig 5. 50% span Length changes in Acala 1517
50% span length (inch)
0.6
0.55
0.5
0.45
0.4
b=0.0006*
1925
1945
1965
1985
2005
Year released

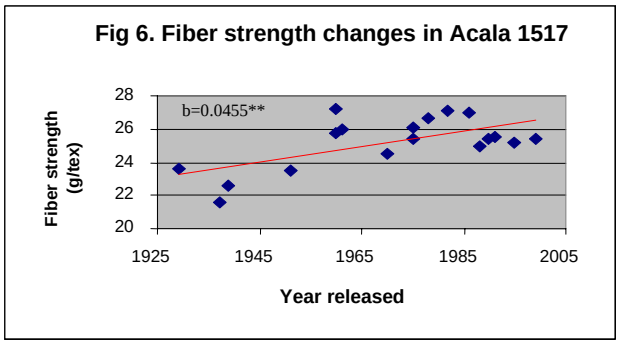
Fig 6. Fiber strength changes in Acala 1517
b=0.0455**
Fiber strength (g/tex)
28
26
24
22
20
1925
1945
1965
1985
2005
Year released

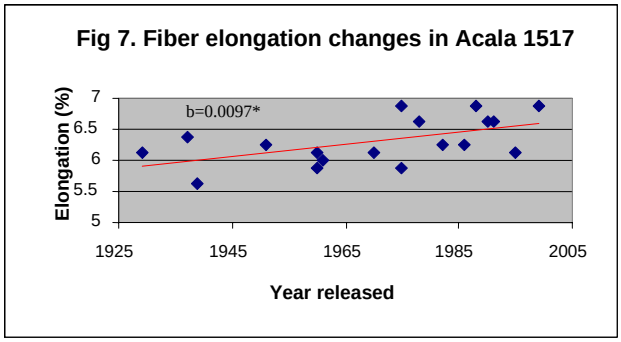
Fig 7. Fiber elongation changes in Acala 1517
b=0.0097*
Elongation (%)
7
6.5
6
5.5
5
1925
1945
1965
1985
2005
Year released

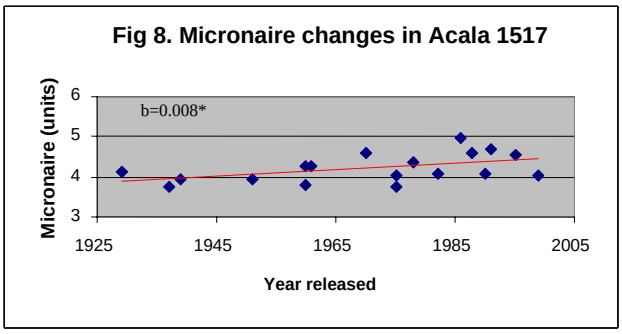
Fig 8. Micronaire changes in Acala 1517
b=0.008*
Micronaire (units)
6
5
4
3
1925
1945
1965
1985
2005
Year released