ARKANSAS COTTON VARIETY TEST 2023

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SUMMARY

The primary goal of the Arkansas Cotton Variety Test is to provide unbiased data regarding the agronomic performance of cotton varieties and advanced breeding lines in the major cotton growing areas of Arkansas. This information helps seed companies establish marketing strategies and assists producers in choosing varieties to plant. These annual evaluations will then facilitate the inclusion of new, improved genetic material into Arkansas cotton production. Adaptation of varieties is determined by evaluating the lines at five University of Arkansas research sites (Manila, Keiser, Judd Hill, Marianna, and Rohwer). The 2023 tests at Keiser were adversely affected by excessive rain and subsequent slow drainage, which hindered plant development and insect control. Yields from the Keiser tests are reported, but not included in over location means. Entries in the 2023 Arkansas Cotton Variety Test were evaluated into two groups – transgenic and conventional varieties. The 44 entries in the transgenic test included 1 B2XF, 20 B3XF, 13 W3FE and 10 B3TXF lines which were evaluated at all five locations. Varieties having the ThryvOn® technology (B3TXF) had not been previously evaluated in the Arkansas Cotton Variety Test. The conventional test included 12 entries and were evaluated at all locations except Manila. Reported data include lint yield, lint percentage, plant height, percent open bolls, yield component variables, fiber properties, leaf pubescence, stem pubescence, and bract trichome density. All entries in the experiments were evaluated for response to tarnished plant bug and bacterial blight in separate tests at Keiser. This 2023 report includes results of large-plot variety tests in eight counties that were coordinated by Joe McAlee.

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2023 Arkansas Cotton Variety Test

Introduction

The purpose of the University of Arkansas Cotton Variety Testing Program is to provide unbiased comparisons of cotton varieties and advanced breeding lines over a range of environments. Data from these tests help to identify the adaptability of varieties to particular cotton growing regions of the state. Bourland et al. (2000) documented several unintentional biases, which are inherent to the Arkansas cotton variety testing program. These include management associated with varieties expressing herbicide and insect resistance. The biases tend to cancel each other so that no great advantage is given to any particular variety. However, insect resistance genes may provide some control of sub-threshold insect pressure. Since evaluation of genetic differences among entries is the ultimate goal of the evaluations, all varieties are treated identically within the primary locations (Manila, Keiser, Judd Hill, Marianna, and Rohwer) of the variety test. No specialized production inputs were employed with respect to the various genetically enhanced varieties. All entries in the tests at Manila possessed the RF or G genes, and were uniformly treated with Round-up. Since the plots were over-sprayed with Round-up, the conventional varieties were not evaluated at Manila.

Materials and Methods

The 44 entries in the transgenic test included 1 B2XF, 20 B3XF, 13 W3FE and 10 B3TXF, of which 18 were included in the 2022 Arkansas Cotton Variety Test (Table 1). The 10 B3TXF lines are the first varieties having ThryvOn® technology to be evaluated in the Arkansas Cotton Variety Test. The conventional test included 12 entries, all developed in the University of Arkansas Cotton Breeding Program. Six of these were in the 2022 test. All entries of each test were replicated 4 times at each test site.

Test sites included the Northeast Research and Extension Center at Keiser; the Judd Hill Cooperative Research Station at Judd Hill (near Trumann); the Lon Mann Cotton Research Station at Marianna; the Manila Airport Cotton Research Farm at Manila; and the Rohwer Research Station at Rohwer. Yields from Keiser are reported, but not included in over location means. The transgenic test was evaluated at each site, and the conventional test was evaluated at all sites except Manila. The conventional tests were in the same fields as the transgenic test, but were in different areas of the fields. Cultural practices and weather data (heat units and rainfall) associated with the test sites are listed in Table 2 and Table 3, respectively.

Originators of seed supplied double treated (two fungicides) seed for all entries. Prior to planting, all seed were treated with imidacloprid (Gaucho®) at a rate of 6oz/100 lb seed by the originator or the testing personnel. Plots were planted with a constant number of seed (about 3.5 seed/row ft). All varieties were planted in two-row plots on 38-inch centers and ranged from 48 to 50 feet in length (before alleys were cut). Experiments were arranged in a randomized complete block. Although exact inputs varied across locations, cultural inputs at each location were generally based on University of Arkansas Cooperative Extension Service recommendations for cotton production. All plots were machine-harvested with 2-row or 4-row cotton pickers modified with load cells for harvesting small plots.

Data Collected at Single Location:

Leaf Pubescence: Leaf pubescence was visually rated on a scale of 1 (smooth leaf) to 9 (pilose, very hairy) in the irrigated experiments at Keiser using the system described by Bourland et al. (2003). A full-sized main-stem leaf located about 5-6 nodes from plant apex was rated for 6 plants per plot for all 4 replications prior to defoliation.

Stem Pubescence: Stem pubescence was visually rated on a scale of 1 (smooth stem) to 9 (very hairy) in the irrigated experiments at Judd Hill using a system similar to that used for leaves. After harvest, the upper 5-6 inches of the plant apex were rated for 6 plants per plot for all 4 replications.

Bract variables: As all plants approached physiological cutout, a bract from a 1st position white flower was sampled from six random plants per plot (4 replications) in the Keiser experiments. Each bract was examined for marginal trichome density (no. of trichomes/cm) as described by Bourland and Hornbeck (2007). Means for the six bracts were evaluated as plot means.

Tarnished plant bug (TPB): Entries in the two variety tests were evaluated for response to TPB in a separate field at Keiser. The TPB test included 8 replications of 1-row plots (22 feet long on 38-inch wide rows). Four rows of a susceptible Frego-bract line were planted between the tests. The TPB tests and border rows were planted on May 16 and received no insecticide treatment for TPB infestations. Response to TPB was determined by examining white flowers (up to 6 flowers/plot/day for 6 days in early to mid-August) for presence of anther damage. Accumulate percentage of damaged flowers ("dirty flowers") was determined for each plot**.** Each plot was visually rated for boll load from 0 (no bolls) to 10 (excellent boll load) on November 8. In progeny row tests, the visual ratings normally range from 3 to 8.

Bacterial blight: Entries in the two tests were planted in flats (3 replications, 13 seed/plot) in the greenhouse, and scratch inoculated with *Xanthomonas citri* pv. *malvacearum*. The inoculum was obtained from naturally infected leaves collected at the 2019 Marianna location. Scratches were examined for water-soaking, and % susceptible plants were determined.

Verticillium wilt: Relative yields of varieties over years at Judd Hill should be indicative of tolerance to Verticillium wilt.

Data Collected at All Locations:

Plant Height: Plant height measurements (in cm) were collected after physiological cutout and before harvest. Average plant heights for varieties were determined by measuring from the soil surface to the terminal of one average-sized plant in each of the two rows. Plot means (average of the two measurements) were evaluated.

% Open bolls: Near the time of first application of defoliants, percentage of open bolls was estimated from the front and back of each plot, then averaged for each plot. Open bolls data were not obtained in the 2023 Manila and Keiser tests.

Boll samples and lint percentage: Prior to mechanical harvest, hand-harvested samples were obtained from two replications at each location. Within each row of two-row plots, a site having average or above average plant density was chosen and 20 bolls (5 bottom, 10 mid-canopy and 5 top bolls) were harvested and bulked to form a 40-boll sample. The 40-boll samples were ginned (lab gin without the use of lint cleaners) to determine lint fraction (the percentage of lint weight to seedcotton weight).

Fiber properties: Fiber samples were taken from each boll sample and were evaluated using HVI classification. Parameters included micronaire, fiber length, length uniformity index (UI), strength and elongation. To reflect market demand for fiber quality, a weighted quality score (Q-score) was calculated as described by Bourland et al. (2010). Parameters (and weightings) included in Q-score were fiber length (50%), micronaire (25%), length uniformity index (15%), and strength (10%).

Seed index: Two sets of 25 fuzzy seed from the ginned seed of each 40-boll sample were counted and weighed. If the two weights varied more than 0.2 g, a second set of samples were taken. Two consistent weights of 25 seed were used to calculate fuzzy seed index (weight of 100 seed).

Seed per acre: For each plot, an estimate of number of seed per acre was determined by multiplying seedcotton yield (lb/a converted to g/a) times average seed percentage (the percentage of seed weight to seedcotton weight in ginned sample, averaged by entry and location over reps), then divided by average seed weight (average seed index by entry over reps divided by 100).

Lint index: Lint index (weight of lint on 100 seed) was determined from 40-boll sample data by dividing lint weight from ginned sample by the number of seed per sample (estimated using average seed weight) then multiplying by 100.

Seed-score. Seed-score (S-score) attempts to normalize seed index and lint index into a single index with penalties for both high and low SI values and no penalty for high LI values (Bourland et al., 2022). S-score may vary from 0 to 100 with higher values indicating varieties having the optimum seed size and weight of lint per seed.

Fibers per seed: Number of fibers per seed were estimated by dividing lint index by an estimated weight of individual fibers. Weight of an individual fiber was estimated by: (fiber length x length uniformity x (micronaire/1,000,000)).

Fiber density: Fiber density, reported as the number of fibers per mm^2, was estimated by dividing fibers per seed by seed surface area. Seed surface area (SSA) was estimated by the regression equation suggested by Groves and Bourland (2010): SSA = 35.74 + 6.59SI, where SI is equal to seed index associated with the sample.

Lint Yield: Seedcotton yield per plot (determined by mechanical cotton picker) was converted to seedcotton yield per acre then multiplied by average lint percentage (determined by variety and location) to estimate lint per acre.

Yield Comparisons:

Uncontrolled variation is inherent to collection of variety performance data (particularly yield data). In addition to their genetic ability, variation among varieties may be due to slight differences in soil, pest or climatic conditions within a field, various interactions with specific management practices, or experimental error. Statistics allow users to define the degree of uncontrolled variation and to interpret data. The statistical tool used to compare means in these tests was Fisher's Protected Least Significant Difference (LSD). An LSD was calculated when the F value from ANOVA was significant. Yields of varieties are considered significantly different if the difference between mean yields of two varieties is greater than the LSD value. Differences that are smaller than the LSD may have occurred by chance or may be associated with uncontrolled variation, and are therefore considered not significant.

Additional estimates of variation are provided by measures of R-squared and coefficient of variation (CV). R-squared (times 100) indicates the percentage of variation that is explained by defined sources of variation (e.g. replication and variety effects within a location). Confidence in data increases as R-squared increases. Generally, the meaningfulness of difference among means is questionable when data have R-squared values of less than 50%. Also, confidence in data becomes greater as CV declines.

Results

Entries and participants in the tests are listed in Table 1. Cultural inputs and production information for variety trials at Manila, Keiser, Judd Hill, Marianna, and Rohwer are reported in Table 2. Table 3 includes weather information for north, central, and south Arkansas locations during the 2021 production season.

Heat units in 2023 exceeded historical averages at each Arkansas location with less deviation at Keiser (north) than a Marianna (central) and Rohwer (south) (Table 3). Daily high temperatures exceeded 95°F on only 6 days at Keiser (June 20, 30, July 1, 2 and August 26, 27). However, Ddily high temperatures exceeded 95°F on16 days at Marianna (mostly late July and 11 days in August) and 21 days at Rohwer (mostly late July and 15 days in August). Rainfall in 2023 at Keiser was 36% higher than the historical average, and particularly higher in July and August. Both Marianna and Rohwer had lower rainfall than historical averages - particularly in August through October.

Performance data of entries in the 2023 Transgenic Cotton Variety Test at Manila, Keiser, Judd Hill, Marianna, and Rohwer are provided in Tables 4 through 15 with yield and yield-related variables in the even-numbered tables and fiber properties in the odd-numbered tables. Performance data across all four locations are presented in Tables 4 and 5. Morphological and host plant resistance measurements for the main transgenic test entries are in Table 16. Two- and three-year yield means for entries evaluated in previous years are in Table 17. Performance data for the 2023 Conventional Cotton Variety Test at Keiser, Judd Hill, Marianna, and Rohwer are provided in Tables 18 through 27 with yield and yield-related variables in the even-numbered tables and fiber properties in the odd-numbered tables. Morphological and host plant resistance measurements for the conventional entries are in Table 28. Two- and three-year yield means for the conventional entries evaluated in previous years are in Table 29.

Other observations associated with each test site include:

Manila (Tables 6 and 7). The 2023 test at Manila was in the same field used since 2014, and in the same area of the field used since 2020. Plots were planted on May 8, and achieved excellent stands in one row of each plot. Seedcotton yields were adjusted for the skips that occurred in the second row. Average lint yields at Manila were second to the highest yielding location in 2023.

Keiser (Tables 8, 9, 20 and 21). Excellent stands were obtained from the May 16 planting of the variety tests at Keiser. Excessive rainfall (3.17 in. on July 7 and 3.3 in. on July 10) occurred after the field was irrigated on July 6. Ditches were full, and water remained standing in the field for several days. Consequently, the plants wilted due to lack of air in the clay soil. Over 10 in. of rainfall occurred in July compared to 2.9 in. historical average. The wet July was followed by a wet August (5.9 in. compared to 2.9 in. historical average). The wet conditions hindered application of needed insecticides. Plots were harvested on Oct 24-25. Since yields were less than half of expected, they were not included in the over location means. Although yields were low, the 10 ThryvOn varieties were the top 10 yielding varieties at Keiser.

Judd Hill (Tables 10, 11, 22 and 23). Excellent stands were achieved from the May 24 planting at Judd Hill. Plants grew well and established excellent boll loads. Intensity of Verticillium wilt intensity was greater than in 2021 and 2022. Plots were harvested on October 9-10.

Marianna (Tables 12, 13, 24 and 25). Due to weed pressure (particularly bermudagrass patches), tests were moved to a different field in 2023. Plots were planted on May 9, and achieved good stands. Pigweed pressure in the 2023 tests was relatively low. Harvest was completed on October 11-12. Average lint yields in both the transgenic and conventional tests were higher than any other location in 2023.

Rohwer (Tables 14, 15, 26, and 27). The Rohwer location was planted on May 4, and achieved acceptable stands. Yields at Rohwer were lower than excepted. Lint yields were likely reduced by near consecutive days exceeding 95°F including 9 days from July 28 to August 7 and 11 days from August 13 to 28. Harvest was completed on October 26.

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