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Yield and Fiber Quality Performance of Hybrid Cotton Varieties Under Potential Production Irrigated Areas of Ethiopia

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Abstract: In Ethiopia cotton varieties under production are characterized as medium fiber quality cultivars. In contrast, textile industries, ginneries and spinners become quality cotton fiber conscious. Thus, hybrid cotton (VBCHB 1527, VBCHB 1203 and VBCHB 1526) along two standard check cotton varieties (YD-211 and Deltapine 90) were tested with the objective of selecting better fiber quality cotton variety having considerable seed cotton and lint yield to meet the evolving needs of cotton producers, textile mills and others. The overall performance of six different irrigated areas indicated, VBCHB 1527 gave the highest of 2.64 ton/ha seed cotton yield, followed by VBCHB 1203 (2.35 ton/ha) and VBCHB 1526 (2.25 ton/ha). Accordingly, a seed cotton yield advantage of 40.37% (VBCHB 1527), 24.85% (VBCHB 1203) and 19.55% (VBCHB 1526) over the highest yielding standard check variety (Deltapine 90) is obtainable. A little differences among the hybrids and standard check varieties observed under different locations with regard to lint yield. Among the tested hybrid VBCHB 1527, exhibited extra-long fiber length within range of 35.59 mm to 38.51 mm and fiber strength ranging from 33.5 g/tex to 40.4 g/tex. Similarly, VBCHB 1203 exhibited 32.67 mm to 35.5 mm fiber length and 32.8 g/tex to 38.5 g/tex fiber strength. Overall, the two hybrids (VBCHB 1527 and VBCHB 1203) showed superior performance in seed cotton yield, lint yield, fiber quality and in other desirable agronomic parameters at all testing locations and could possibly better varieties for quality cotton fiber production.

Keywords: Fiber Quality, Hybrid Cotton, Lint Yield, VBCHB 1527, VBCHB 1203

1. Introduction

Cotton (*Gossypium spp.*) is an ancient fiber and one of the oldest recorded plants grown as commercial crop in the world [1-3]. It is supplying lint and linter for textile fabrics, household furnishings, sewing threads, yarns, canvas, cordages and manufacturing of a variety of textile products and other non-woven products [4-7]. Cotton is an integral part of many ancient civilizations and has early origins in tropical Africa, Asia and Latin America [1, 2, 8, 9]. Cotton is basically a pre-adaptive crop and it thrives well in both the tropical and sub- tropical areas as well as in the warmer temperate regions where the frost free period is less than 180 days. It can grow on many soil types, ranging from sandy to clays and is one of the most efficient crops in terms of water utilization as it produces one of the highest quantities of dry matter per liter of water [5, 10-13].

In Ethiopia cotton is the valuable commodity crop in the country`s domestic market trade. Because of its deep-rooted cultivation in the history of Ethiopian agriculture, cotton plant is believed to have originated or diversified from this country. During the ancient times, the farmers of Ethiopia were producing the old world perennial cultivated species

(*Gossypium arboreum* and *Gossypium herbaceum*) at their backyards traditionally for making clothes. However, commercial cotton production in Ethiopia begun after World War II with the introduction of exotic cotton species (*Gossypium hirsutum* L.). Now day's *G. hirsutum* L. is widely grown in irrigated lowlands on large-scale farms, and in warmer mid altitude on small-scale farms under rainfed conditions under different agro-ecologies ranging from 300 to 1500 meters above sea level. The low to mid altitude areas of the country are generally known to have an immense potential for the production of cotton subject to the availability of water. In terms of productivity, high yields are obtained in areas with an altitude ranging up to an altitude of 1000 meters above sea level. In the absence of hail, frost and other unfavorable weather conditions, cotton production can also be extended into areas with altitude of 1500 meters above sea level [14-18].

Research on cotton was initiated in 1966 at the then Melka Werer Agricultural Research Center and now Werer Agricultural Research Center with the objectives of developing varieties with high yielding potential, widely adaptable and resistant to insect pests and diseases. Later in 1970, a more detailed research work including breeding, selection from foreign introductions, variety trials and development of appropriate cultural and crop protection practices was launched with the bulk of the work being conducted at Werer Agricultural Research Center. As a result, satisfactory progress was made with respect to high yielding and disease resistant variety development [14, 15, 19]. However, until very recent release of *G. barbadense* L. varieties the released/recommended varieties for production are characterized as medium fiber quality (length and strength) cotton varieties. In contrast, ginneries and spinners become fiber quality conscious. Consequently, increased pressure is being placed on cotton breeders to develop cultivars that meet the requirements of growers for high yield potential and the demands of the textile industry for improved fiber quality. To solve these problems, hybrid cotton introduced from India to test the yield and fiber quality performance and select best performers for local registration to meet the evolving needs of producers and requirements of textile mills.

2. Materials and Methods

The experiment was carried out at Werer i.e. Werer Agricultural Research Center (9°16' N, 40°9' E), Gewane (10°00' N, 40°31' E), Amibara (9°22' N, 40°15' E), Melkasedi (9°34' N, 42°11' E), Shellie (5°51' N, 37°28' E) and Weyto (5°23' N, 36°58' E). A total of three introduced interspecific (*G. hirsutum* X *G. barbadense*) hybrid cultivars (VBCHB 1203, VBCHB 1526 and VBCHB 1527) were tested along with two check cotton varieties namely, YD-211 and Deltapine 90. Planting was done at the optimum time on the month of mid-May to June. Three seeds per hole were hand sown on the top of the ridges. Thinning was done fifteen days after emergence to allow a density of 2.5 plants per m^2. A post-sowing application of irrigation water, using furrow irrigation system was applied every two weeks for 126 days. Hand weeding was used to control weeds and chemical insecticides were used to control pest. A shallow cultivation using inter-row cultivator was carried out before square formation stage.

The treatments were arranged in a single non replicated plot with a size of 10m x 10m = $100m^2$. In each plot, a spacing of 0.9m between rows and 1.2m between plants was employed. Data on important agronomic parameters that include plant height, seed cotton yield, lint yield and fiber quality traits (micronaire, fiber length and fiber strength) were collected from all trial plots of each location.

3. Results and Discussions

3.1. Plant Height, Seed Cotton and Lint Yield Performance

The plant height performance of the hybrid varieties along the standard check is indicated at Table 1. The introduced hybrid variety exceeded the check variety with overall average plant height ranging from 141.72 cm to 174.18 cm with the lower end corresponding VBCHB 1526 while the upper end corresponds to VBCHB 1527. Generally, the introduced hybrids have long plant height and it was only at Werer location where two introduced hybrid variety (VBCHB 1203 and VBCHB 1526) were shorter than the tallest standard check variety (YD-211).

With respect to seed cotton yield, based on the overall performance at six different irrigated areas, VBCHB 1527 gave the highest of 2.64 ton/ha, followed by VBCHB 1203 (2.35 ton/ha) and VBCHB 1526 (2.25 ton/ha) as shown on Table 2. Accordingly, VBCHB 1527, VBCHB 1203 and VBCHB 1526 had respectively, 40.37%, 24.85% and 19.55% seed cotton yield advantage over the highest yielding check variety (Deltapine 90). The lowest of 1.88 ton/ha and 1.85 ton/ha seed cotton yield belongs to local check varieties Deltapine 90 and YD-211, respectively. Furthermore, the results of the test entries at six irrigated locations revealed that the entries performed best at Weyto compared to other locations. Similarly, the introduced hybrid varieties; VBCHB 1527, VBCHB 1203 and VBCHB 1526 each gave the highest yield of 4.86, 4.49 and 4.29 ton/ha, respectively. However, at Werer location VBCHB 1527 and VBCHB 1203 hybrid were exceeded by the standard check variety (YD-211), which gave a seed cotton yield of 1.09 ton/ha. At Gewane the new test entries, VBCHB 1527, VBCHB 1526 and VBCHB 1203, each gave a seed cotton yield of 3.15 ton/ha, 3.08 ton/ha and 2.87 ton/ha, respectively. Here, the highest yielding entry exceeded the best check variety i.e., Deltapine 90 by about 0.29 ton/ha.

The lint yield performance obtained from this experiment at six irrigated locations indicate the existence of a little differences among the hybrids tested under various production farms of certain agro-ecologies of the country (Table 3). Among hybrids only VBCHB 1526 scored better mean lint yield than the best standard check varieties (Deltapine 90) with about 6.44% lint yield advantage.

Table 1. *Average plant height (m) of hybrid cotton varieties.*

S. No	Variety name	Locations						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	1.27	1.82	1.63	1.69	2.18	1.86	1.74
2	VBCHB 1203	0.98	1.66	1.11	1.74	2.29	1.91	1.61
3	VBCHB 1526	1.17	1.58	1.21	1.53	1.6	1.42	1.42
4	YD-211	1.21	1.32	1.01	1.13	1.46	1.41	1.25
5	Deltapine 90	0.63	0.89	0.57	0.71	1.6	1.11	0.92

Table 2. *Seed cotton yield (ton/ha) performance of hybrid cotton varieties.*

S. No	Variety name	Locations						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	0.97	2.74	1.37	3.15	2.76	4.86	2.64
2	VBCHB 1203	0.97	2.13	0.80	2.87	2.85	4.49	2.35
3	VBCHB 1526	1.37	2.27	0.72	3.08	1.77	4.29	2.25
4	YD-211	1.09	2.14	0.54	2.59	1.55	3.20	1.85
5	Deltapine 90	0.86	1.81	0.40	2.86	1.81	3.55	1.88

Table 3. *Lint yield (ton/ha) performance of hybrid cotton varieties.*

S. No	Variety name	Locations						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	0.26	0.75	0.37	0.78	0.89	1.34	0.73
2	VBCHB 1203	0.31	0.69	0.25	0.87	0.94	1.30	0.73
3	VBCHB 1526	0.47	0.86	0.26	0.98	0.64	1.50	0.78
4	YD-211	0.37	0.74	0.18	0.82	0.58	1.09	0.63
5	Deltapine 90	0.34	0.72	0.15	1.08	0.72	1.41	0.74

3.2. Fiber Quality Performance

Results of the fiber quality analysis of the cotton varieties from six test locations are indicated in Tables 4-6. The micronaire value obtained from VBCHB 1526 at each testing locations except at Shellie is at the premium range (in range of 3.5 to 4.2). Likewise the micronaire value of VBCHB 1203 is at premium range except at Shellie and Weyto locations. Regarding VBCHB 1527 hybrid cotton, its micronaire value is low and the standard check variety (YD-211) exhibited a better micronaire value.

The fiber length data of each tested hybrids and standard check varieties have been presented in Table 5. The results revealed the high fiber length at overall location belongs to the newly introduced hybrid cotton varieties namely, VBCHB 1527 and VBCHB 1203 each with 36.48 mm and 34.35 mm, respectively. The other introduced variety gave 31.49 mm, which is less by about 2.37 mm from the top performing standard check variety (YD-211). Furthermore, across most locations, VBCHB 1527 showed the highest fiber length ranged from 35.59 mm to 38.51 mm. Comparably, VBCHB 1203 also gave fiber length ranging from 32.71 mm to 35.5 mm.

The overall fiber strength performance of the hybrid varieties indicated VBCHB 1527 exhibited the highest of 36.57 g/tex (Table 6). Likewise, except at Weyto VBCHB 1527 showed fiber strength advantage over the best performed standard check (YD-21) variety. The other two hybrid varieties outperformed by YD-211 (standard check) which showed fiber strength of 35.97 g/tex at overall locations. Similarly, except at Weyto YD-211 showed better fiber strength than VBCHB 1203 and VBCHB 1526.

Table 4. *Micronaire value of hybrid cotton varieties.*

S. No	Variety name	Locations						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	2.83	3.07	2.92	2.97	2.89	2.8	2.91
2	VBCHB 1203	3.55	3.87	3.8	3.62	3.14	3.28	3.54
3	VBCHB 1526	3.66	4.01	4	3.6	2.78	3.67	3.62
4	YD-211	3.73	3.8	3.58	3.55	3.02	3.19	3.48
5	Deltapine 90	5.35	5.31	5.22	5.24	3.63	4.47	4.87

Table 5. *Fiber length (mm) performance of hybrid cotton varieties.*

S. No	Variety name	Location						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	35.85	36.45	38.51	36.33	35.59	36.14	36.48
2	VBCHB 1203	32.71	32.67	35.72	35.41	34.09	35.5	34.35
3	VBCHB 1526	32.25	27.66	33.76	30.82	32.25	32.17	31.49

S. No	Variety name	Location						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
4	YD-211	32.92	32.68	35.34	35.93	31.96	34.31	33.86
5	Deltapine 90	25.94	26.57	29.15	26.77	27.14	28.68	27.38

Table 6. *Fiber strength (g/tex) performance of hybrid cotton varieties.*

S. No	Variety name	Locations						Overall location
		Werer	Melkasedi	Amibara	Gewane	Shellie	Weyto	
1	VBCHB 1527	37.5	36.3	36.4	40.4	33.5	35.3	36.57
2	VBCHB 1203	34.7	34.8	35.6	36.1	32.8	38.5	35.42
3	VBCHB 1526	32.3	27.6	33.7	34.3	34.3	32	32.37
4	YD-211	36.9	35.7	36.4	37.8	32.8	36.2	35.97
5	Deltapine 90	24.8	25	28.9	25.7	25.3	27.5	26.20

4. Conclusion

The results of the test entries at six irrigated locations revealed that the seed cotton yield performance of introduced hybrid cotton varieties at Weyto compared to other locations was high. At overall locations all the introduced hybrid gave a high seed cotton yield than the best performed variety and exhibited comparable lint yield to the best performed variety. Furthermore, fiber quality result showed that VBCHB 1527 and VBCHB 1203 possess better fiber strength and length. Overall, among the tested hybrid cotton varieties VBCHB 1527 and VBCHB 1203 exceeded all the standard check varieties almost in every aspect of the important characteristics considered in this study and hence could possibly better varieties for quality cotton fiber production.

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