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Study of the Technological Fibre Performance of the Y331 BLT, Gouassou Fus1 and Sicama Vir1 Cotton Varieties Popularised in Côte d'Ivoire

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Abstract

Cotton cultivation plays a major socio-economic role in the north and centre of Côte d'Ivoire, where it is the driving force behind the agricultural development of rural populations and contributes to the fight against poverty. In recent years, the crop has faced huge problems, including falling production and a deterioration in fibre quality. To remedy this, research has proposed cotton varieties of the species *Gossypium hirsutum*, which were popularised during the 2016-2020 period. This study was carried out to assess the fibre technological performance of these varieties in the growing areas. Its objective was to assess the technological characteristics of the fibre of varieties Y331 BLT, Gouassou Fus1 and Sicama Vir1 in the agro-ecological zones of cotton growing in Côte d'Ivoire. To do this, the varieties were grown at the observation posts in Séguéla, Korhogo and Nambingué, three localities that represent the southern, central and northern cotton-growing areas in Côte d'Ivoire, respectively. The seed cotton harvested on the experimental plots was ginned using a 10-saw gin. The fibres obtained were analysed on an HVI 1000/1000 integrated measurement chain. The results show that the technological characteristics of the fibre are likely to vary according to the variety grown or the locality of production. Fibre yields vary from 41.97% to 43.98% depending on the variety. However, the varieties compared in the different cotton-growing areas behave in much the same way in terms of the fibre's technological characteristics. Each variety can therefore be grown in these zones and produce fibre of good technological quality, provided that the recommended agronomic and post-harvest practices are followed. The greatest variations are due to the influence of agro-ecological conditions on fibre characteristics, which are highly dependent on the locality where the cotton is grown. The micronaire index

(4.24), length (29.43 mm) and tenacity (32.66 g/tex) are higher and better in Séguéla area, while the yellowness index is lower (8.32) and better in Nambingué zone. There could therefore be terroir cotton whose fibre could be marketed differently because of a particular good technological parameter. For example, fibres from the south of the cotton-growing zone could be more prized than those from other localities because of their better silk length, good tenacity and low yellowness index.

Keywords

Quality, Technological Characteristics, Fibre, Varieties, Côte d'Ivoire

1. Introduction

In Côte d'Ivoire, cotton is the main driver of development in the northern and central regions of the country (half the country), employing more than 200,000 farmers, most of them smallholders. It is grown on nearly 300,000 hectares, with an average seed cotton yield of 1,200 kg/ha [1]. Cotton production in Côte d'Ivoire accounts for 20% of ECOWAS cotton production [2]. As such, it is the main source of income and the leading job-generating activity in the north and centre of the country [3]. The cotton industry has encouraged the start of industrialisation in some regions through the creation of textile industries, spinning and weaving units, industrial clothing and hosiery units and others, including sewing and embroidery; jute yarn and bag making, traditional weavers, dyeing and art creation [4]. Unfortunately, in recent years, this crop has been confronted with enormous problems such as the production drop and the deterioration in fibre quality [5]. While agronomic efforts have helped to raise production levels, fibre quality remains a concern for the cotton industry in Côte d'Ivoire. Ensuring the quality of cotton, particularly marketed fibre, is a major concern for those involved in the sector. To address this, research has proposed cotton varieties of *Gossypium hirsutum* espacies, which were popularised during the period 2016-2020. Cotton quality depends on a variety of intrinsic and extrinsic factors linked to agro-climatic conditions and post-harvest treatments [6] [7]. To obtain good quality fibre, it is therefore important to understand the influence of these factors on the characteristics of the cotton in order to propose practices that will ensure good quality.

The general objective of this study is to assess the technological performance of cotton varieties popularised in Côte d'Ivoire from 2016 to 2020. Specifically, the aim was to:

- determine the fibre technological characteristics of the Gouassou Fus1, Sicama Vir1 and Y331 BLT cotton varieties popularised in Côte d'Ivoire;
- assess the impact of the production zone on the technological characteristics of the fibre of these popularised cotton varieties.

2. Materials and Methods

2.1. Plant Material

The plant material (Figure 1) used in this study consists of three (3) new cotton varieties from the *Gossypium hirsutum* species. These were varieties Y331 BLT, Gouassou Fus1 and Sicama Vir1, all selected at the Côte d'Ivoire National Agricultural Research Centre.

2.2. Work Equipment

2.2.1. Ginning Machine

An Eagle Continental ginner with 10 saws (Figure 1) was used to gin the seed cotton samples from the varietal trials. This machine is suitable for medium-staple cotton.

Figure 1. Eagle continental 10-saw gin.

2.2.2. Technical Equipment

The physical analyses of the fibre were carried out using HVI 1000/1000 Integrated Measurement Chain (IMC).

2.3. Methodology

2.3.1. Location of Experimental Sites

The trials were set up in the southern, central and northern zones of the cotton basin. These zones are the main cotton growing areas in Côte d'Ivoire. Each zone is represented by a locality housing an observation post (OP). The trials were set up at observation posts of Séguéla (southern zone), Korhogo (central zone) and Nambingué (northern zone) (Table 1).

Table 1. Location of test sites.

Locations (Observation Post)	South Zone	Central Zone	North Zone
Séguéla	X		
Korhogo		X	
Nambingué			X

2.3.2. Experimental Set-Up

Three selected varieties were planted at each experimental site. The experimental set-up used was a Fisher (scattered blocks) with three treatments represented by the varieties Y333 BLT, Gouassou Fus1 and Sicama Vir1. Randomisation was carried out with three (3) replicates per variety. Each variety (treatment) was represented by an elementary plot of 20 lines of 10 m where sowing was carried out with a spacing of 80 cm between lines and 30 cm between plants (**Figure 2**).

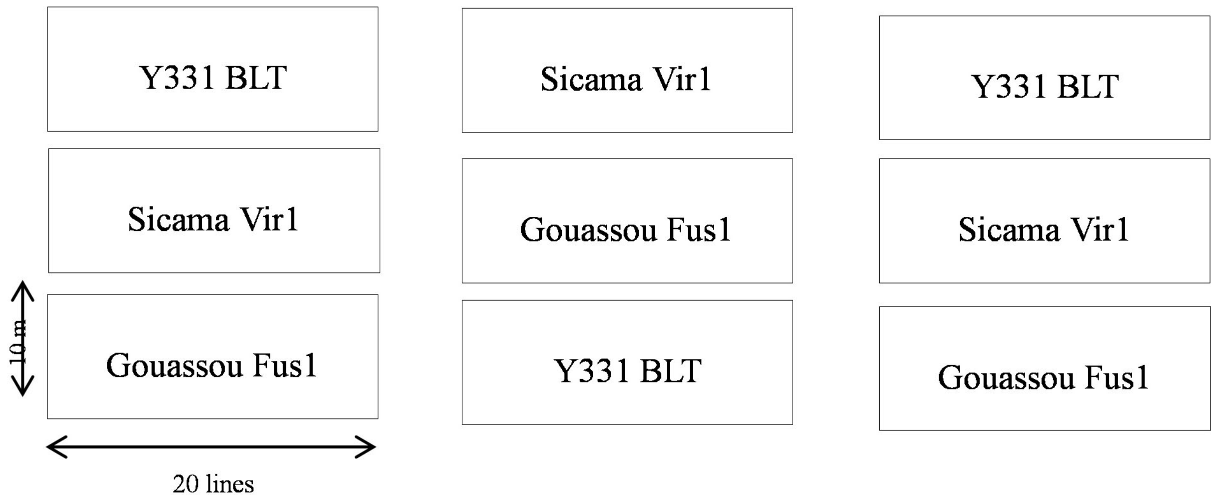

Figure 2. Experimental set-up at each site.

2.3.3. Establishment and Maintenance of Experimental Plots

Sowing on all the experimental sites took place in June. For the maintenance of all the plots, six (6) pesticide treatments were carried out at 15-day intervals from the 45th to the 115th day after emergence. NPK was applied at a rate of 200 kg/ha and urea was applied at a rate of 50 kg/ha. The plots were weeded regularly to keep them clean.

2.3.4. Harvesting and Sampling of Seed Cotton

The seed cotton was harvested manually after the total opening of the bolls at about 180 days (6 months) after sowing. Three (3) kg of seed cotton were taken us sample from each elementary plot. These seed cotton samples were ginned using a 10-saw gin. The fibres obtained were analyzed for quality.

2.3.5. Evaluation of the Technological Characteristics of the Fibre

The technological characteristics of the fibre were assessed using HVI 1000/1000, an integrated measurement chain (**Figure 3**). This fully automated device is used to determine the main parameters from a sample of around 100 g of fibre: micronaire index (Mic); maturity or percentage of mature fibre (Mat); fibre length (UHML: Upper Half Mean Length); fibre length uniformity (UI), short fibre index (SFI), tenacity (Str), elongation (Elg), reflectance (Rd) and yellowness index (+b).

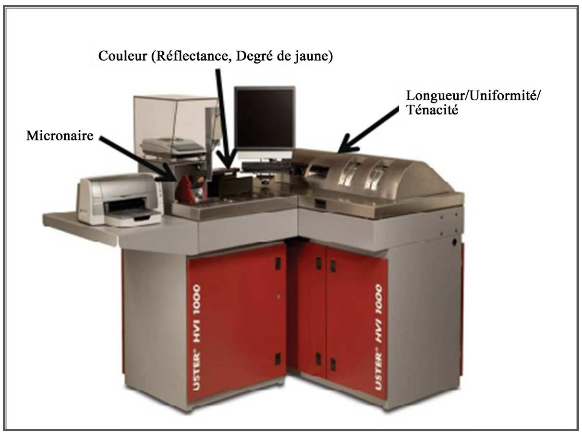

Figure 3. Integrated measurement chain (Uster model: HVI 1000/1000).

2.3.6. Statistical Analysis

The data collected from the quality tests carried out on cotton fibres were processed using Excel 2016 software. After a homogeneity test, the data were subjected to an analysis of variance (ANOVA) using STATISTICA version 7.1 software. In the event of a significant difference between the means, the Duncan test was used to compare these means at the 5% threshold.

3. Results

3.1. Fibre Yield Comparative Study

Table 2 shows the fibre yield of the varieties in the production localities. The varieties tested gave statistically identical values in most localities except Korhogo, where a significant difference was observed ($P < 0.05$). In Korhogo, the fibre yield of Sicama Vir1 (43.40%) and Y331 BLT (43.36%) was higher than the one of Gouassou Fus1 (41.97%). Fibre yield also varied statistically from one locality to another. The highest average values for this parameter were obtained in Nambingué (43.59%) and Séguéla (43.53%). The value of Korhogo (42.91%) was low.

Table 2. Fibre yield (%) of varieties in production areas.

	Measured Parameters			
Varieties	Korhogo	Nambingué	Séguéla	Quality Standards
Gouassou Fus1	41.97^{a}	43.11^{a}	42.98^{a}	43% ≤ Fibre yield ≤ 47%
Sicama Vir1	43.40^{b}	43.71^{a}	44.18^{a}	
Y331 BLT	43.36^{b}	43.94^{a}	43.42^{a}	
Average Values	42.91^{ab}	43.59^{a}	43.53^{a}	
CV (%)	0.87	0.76	1.54	
P Locality			0.00	
P Variety	0.04	0.44	0.69	
Significance	*	Ns	Ns	

In each locality, the means of the varieties assigned different alphabetical letters are significantly different at the a = 5% threshold according to Duncan's test. On the line of mean values per locality, the values assigned the same alphabetical letter are not significantly different. CV: coefficients of variation, P: probability, NS: not significant; (*): significant.

3.2. Comparative Study of the Fiber Characteristics of Varieties in Each Locality

Analysis of the technological parameters of the fiber of the three cotton varieties compared in the three production localities showed that the variables measured vary according to the varieties in each locality.

In Séguéla, no significant difference was observed between varieties for micronaire index (Mic), maturity (Mat), length uniformity (UI), short fibre index (SFI), tenacity (Str) and colorimetry (Rd and +b). Only fiber length (UHML) and elongation (Elg) differed significantly between varieties, with higher values for Y331 BLT (Table 3).

Table 3. Fibre characteristics of varieties in Séguéla locality.

	Measured Parameters								
Varieties	Mic	Mat (%)	UHML (mm)	UI (%)	SFI (%)	Str (g/tex)	Elg (%)	Rd (%)	+b
Gouassou Fus1	4.05[a]	0.86[a]	29.09[a]	83.13[a]	5.82[a]	31.10[a]	4.57[a]	78.60[a]	8.54[a]
Sicama Vir1	4.43[a]	0.87[a]	29.15[a]	82.73[a]	5.87[a]	33.59[a]	4.43[a]	78.64[a]	8.59[a]
Y331 BLT	4.24[a]	0.86[a]	30.05[b]	83.93[a]	5.27[a]	33.30[a]	5.40[b]	78.07[a]	9.02[a]
Average Values	4.24	0.87	29.43	83.26	5.65	32.66	4,80	78.44	8.71
CV (%)	8.25	1.14	1.93	1.32	7.25	4.99	10.83	1.35	8.49
P Locality					0.00				
P Variety	0.48	0.38	0.03	0.45	0.13	0.11	0.01	0.81	0.74
Significance	NS	NS	*	NS	NS	NS	*	NS	NS

For each parameter, the means of the varieties assigned different alphabetical letters are significantly different at the a = 5% threshold according to Duncan's test. CV: coefficients of variation, P: probability, NS: not significant; (*): significant.

In Korhogo (Table 4), the varieties tested were statistically identical for most fibre's technological parameters, except elongation for what, a significant difference was observed (p = 0.00). In Korhogo, the fibre elongation of varieties Y331 BLT (6.68%) and Gouassou Fus1 (5.56%) was statistically higher than that of Sicama Vir1 (4.71%).

Table 4. Fibre characteristics varieties in Korhogo locality.

	Measured Parameters								
Varieties	Mic	Mat (%)	UHML (mm)	UI (%)	SFI (%)	Str (g/tex)	Elg (%)	Rd (%)	+b
Gouassou Fus1	3.82[a]	0.85[a]	27.51[a]	81.67[a]	7.24[a]	27.60[a]	5.56[a]	77.53[a]	9.19[a]
Sicama Vir1	3.52[a]	0.85[a]	27.67[a]	83.35[a]	6.21[a]	28.28[a]	4.71[b]	78.29[a]	8.85[a]
Y331 BLT	3.49[a]	0.84[a]	28.44[a]	82.32[a]	6.41[a]	29.71[a]	6.08[a]	78.32[a]	9.75[a]
Average Values	3.61	0.85	27.87	82.45	6.62	28.53	5.45	78.05	9.26
CV (%)	5.81	0.7	2.69	1.41	9.51	4.20	11.74	1.22	6.26
P Locality					0.00				
P Variety	0.09	0.06	0.30	0.22	0.08	0.06	0.00	0.58	0.15
Significance	NS	NS	NS	NS	NS	NS	**	NS	NS

For each parameter, the means of the varieties assigned different alphabetical letters are significantly different at the a = 5% threshold according to Duncan's test. CV: coefficients of variation, P: probability, NS: not significant; (*): significant.

In Nambingué, the analysis revealed that the varieties compared were statistically identical for each of technological parameters of the fibre (**Table 5**).

Table 5. Fibre characteristics of varieties in Nambingué locality.

	Measured Parameters								
Variety	**Mic**	**Mat (%)**	**UHML (mm)**	**UI (%)**	**SFI (%)**	**Str (g/tex)**	**Elg (%)**	**Rd (%)**	**+b**
Gouassou Fus1	3.17[a]	0.83[a]	28.01[a]	81.17[a]	6.88[a]	29.56[a]	5.99[a]	76.20[a]	8.22[a]
Sicama Vir1	3.44[a]	0.84[a]	28.56[a]	82.43[a]	6.52[a]	29.91[a]	5.27[a]	77.17[a]	8.53[a]
Y331 BLT	3.13[a]	0.83[a]	28.91[a]	82.33[a]	7.13[a]	30.47[a]	5.62[a]	75.80[a]	8.19[a]
Average Values	3.25	0.84	28.49	81.98	6.84	29.98	5.63	76.39	8.32
CV (%)	8.00	0.83	1.79	1.58	8.62	6.17	8.52	1.75	6.00
P Locality					0.00				
P Variety	0.30	0.12	0.06	0.47	0.52	0.86	0.19	0.49	0.71
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS

For each parameter, the means of the varieties assigned different alphabetical letters are significantly different at the a = 5% threshold according to Duncan's test. CV: coefficients of variation, P: probability, NS: not significant; (*): significant.

3.3. Comparison of Fibre Technological Parameters of Varieties in All Localities

Table 6 shows the average values for the technological parameters of the fibre by variety. The varieties tested showed statistically identical micronaire index, length uniformity, short fiber content, elongation and reflectance. The Sicama Vir1 variety had a higher fibre maturity (0.85%) than the other two varieties (0.84%). In terms of silk length, the Y331 BLT variety is the best (28.81 mm compared with 28.15 and 28.01 mm respectively for Sicama Vir1 and Gouassou Fus1). Tenacity was higher for Y331 BLT (30.19) and Sicama Vir1 (30.08) than for Gouassou Fus1 (28.83). The fibres of the Gouassou Fus1 variety have a lower yellowness index (9.52) than those of Sicama vir1 (9.88) and Y331 BLT (10.01).

Table 6. Varietal average values of technological parameters.

	Measured Parameters								
Varieties	**Mic**	**Mat (%)**	**UHML (mm)**	**UI (%)**	**SFI (%)**	**Str (g/tex)**	**Elg (%)**	**Rd (%)**	**+b**
Gouassou Fus1	3.42[a]	0.84[a]	28.15[a]	81.93[a]	6.70[a]	28.83[a]	5.32[b]	75.79[a]	9.52[a]
Sicama Vir1	3.52[a]	0.85[b]	28.01[a]	81.93[a]	6.76[a]	30.08[b]	4.79[a]	76.03[a]	9.88[ab]
Y331 BLT	3.36[a]	0.84[a]	28.81[b]	82.26[a]	6.64[a]	30.19[b]	5.30[b]	75.81[a]	10.01[b]
Averages	3.43	0.84	28.32	82.04	6.70	29.70	5.14	75.88	9.80
CV (%)	17.20	1.19	3.28	2.26	17.16	7.74	11.28	6.23	20.71

In the same column, the mean values assigned to the same alphabetical letter are not significantly different at the a = 5% threshold according to the Duncan test. CV: coefficients of variation.

3.4. Influence of Locality on Fibre Technological Parameters

The mean values for the fibre technological parameters of the varieties (**Table 7**) varied according to production locality. However, the average values for most of the technological parameters tested, such as micronaire index, maturity, fiber length, length uniformity, short fiber index and tenacity, were better in Séguéla locality. Korhogo and Nambingué recorded the best fibre elongation. The yellow index of the fiber in Nambingué was higher.

Table 7. Average values of fibre technological parameters by locality.

Localities	Mic	Mat (%)	UHML (mm)	UI (%)	SFI (%)	Str (g/tex)	Elg (%)	Rd (%)	+b
Korhogo	3.61^{c}	0.85^{c}	27.87^{ab}	82.45^{bc}	6.62^{b}	28.53^{ab}	5.45^{c}	78.05^{c}	9.26^{b}
Nambingué	3.25^{b}	0.84^{b}	28.49^{c}	81.98^{b}	6.84^{b}	29.98^{b}	5.63^{c}	76.39^{b}	8.32^{a}
Séguéla	4.24^{d}	0.87^{d}	29.43^{d}	83.26^{c}	5.65^{a}	32.66^{c}	4.80^{ab}	78.44^{cd}	8.71^{ab}

Within the same column, the mean values assigned to the same alphabetical letter are not significantly different at the a = 5% threshold according to the Duncan test.

4. Discussion

The aim of this study was to evaluate the fibre technological performance of three cotton varieties from the species *G. hirsutum* L., popularised in Côte d'Ivoire. The results of the fibre average after ginning of the three varieties compared in the three production areas showed that for each production locality, the three varieties tested presented statistically similar values. This can be explained by the fact that fibre yield depends on many other parameters such as impurities level in the seed cotton [8]. This shows that the varieties perform essentially the same wherever they are grown. Concerning the fibre technological characteristics, the comparative analysis of the three varieties tested showed that, for the same variety, the technological parameters can change when moving from one growing environment to another. The technological characteristics of the fibre can also depend on the variety [9]. That is what [10] showed in their study. On the other hand, fibre parameters are influenced by the environment. In this case, variations can be attributed to various factors including agro-climatic conditions. Indeed, in rainfall conditions such as late rains, the characteristics of the fibre can change [11] [12]. In addition, these differences may be due to the level of pest infestations in the growing area [13]. Certain sucking pests such as whiteflies (*Bemisia tabaci*) and aphids (*Aphis gossypii*) degrade fibre quality when the cotton is harvested late [14]. Compliance with good agricultural practices regarding fertilization, pesticide treatments and seed cotton harvesting are recommended to producers so that they can optimize the potential of the varieties tested.

5. Conclusions

This study, which consisted of evaluating the technological performances of fibre from cotton varieties popularized in Côte d'Ivoire, revealed that the technological characteristics of cotton fibre are likely to vary according to the variety grown or the locality of production. However, within the same locality, there are rarely differences in the technological characteristics of the varieties tested. In fact, the varieties compared in the different cotton-growing areas behave in much the same way. Each variety can therefore be grown in these zones and produce cotton of good technological quality, provided that the recommended agronomic and post-harvest practices are followed. The greatest variations of fiber quality are due to the influence of agro-ecological conditions on the characteristics of the cotton fibre. The value of seed and fibre quality parameters depends very much on the locality where the cotton is grown. There could therefore be terroir cotton whose fibre could be marketed differently because of its particular good technological parameters. Fibre from Séguéla, for example, could be more prized than those from other localities because of its better silk length and tenacity.

This study was limited because it was carried out at three observation posts. Given the size of the Côte d'Ivoire cotton-growing basin, it would be advisable to extend the study to more localities in order to gain a better understanding of the influence of agro-ecological conditions on the technological characteristics of the fibre.

Moreover, this work is only one aspect of the vast field of research into cotton quality. Finally, the technological performance of each variety should be evaluated in the main agro-ecological zones of the Côte d'Ivoire cotton-growing areas before it is popularization.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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