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ORGINAL RESEARCH ARTICLE

Evaluation of the Agronomic and Technological Performance of Three New Cotton Varieties in the Cotton Zone of Cameroon

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ABSTRACT

Climate change is putting significant pressure on agriculture. The main objective of this study is to identify among the three new cotton varieties that can effectively and sustainably replace the popularized variety IRMA Q302 in the cotton zone of Cameroon. It will be specifically to determine the vegetative behaviour and production characteristics of the new varieties compared to that of the IRMA Q302, compare the ginning of the varieties tested to that of the IRMA Q302. The results of the work show that the vegetative behaviour of the three (03) varieties tested is more excellent IRMA Q302, the production characteristics of IRMA A2262 and IRMA A2188 is higher than IRMA Q302. On ginning characteristics, the results show that the three new varieties have better ginning characteristics than IRMA Q302. In view of these results, have found that the three new varieties tested this involves better than the one popularized despite the significant pressure of climate change. The IRMA A2249 is more suitable in the ecological zone of the Far north and the IRMA A2262 is more suitable for the ecological zone of the North However, in view of the three selection criteria determined by SODECOTON the IRMA A2262 has the potential required to adapt throughout the cotton zone.

Keywords: *climate change, performance, assessments, Cameroon cotton zone and new varieties.*

INTRODUCTION

Climate change is one of the major concerns in the world today, not only because of its potential impacts on the environment, but also because of its negative effects on agricultural production and hence on food security. In sub-Saharan Africa, this concern is even more pronounced. Indeed, in this part of the world, agriculture plays a major social and economic role. It contributes to household food security, job and wealth creation and the maintenance of social peace [1]. A study of the evolution of climatic conditions since 1960 in sub-Saharan Africa shows a regional trend towards a significant increase in the duration of drought episodes [2]. Beyond the observation of a general decrease in rainfall, concomitant with an increase in the frequency of extreme events (floods and droughts) on the continent, the complexity of the climatic processes involved makes it difficult to characterized climate change at the local level [3].

Cotton cultivation is considered the main engine of the economy in semi-arid area. It is of direct interest to all farmers who, for the most of them, have become planters, and it provides a significant input to the commercial and even industrial circuits. In Cameroon, the cotton growing area is in the northern part where the climate (especially rainfall) is an important factor in agricultural production. However, the climatic instability that has been observed in recent years

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has had negative consequences on farms, leading to a disorganization of the agricultural calendar and significant fluctuations in production [4], [5].

Cotton producers who are victims of these hazards try to adapt by developing various strategies, including crop diversification and changing the sowing calendar [6]. They also resort to new varieties, known as selected varieties, adapted to these climatic hazards and to the use of agrochemical inputs to accompany production, thus constituting their only hope in this changing environment [7]. It was in this context that a joint research unit of the Agricultural Research Institute for Development (IRAD) / Cotton Development Company (SODECOTON) / International Centre for Agricultural Research for Development CIRAD) was set up with the objectives of varietal improvement, technological study of the fiber, monitoring of varieties and seed production [8]. Thus, over the years, several varieties well adapted to the ecosystem of the cotton area have been produced and made available to farmers, as well as agrochemical inputs [7]. The most popularized variety was IRMA Q302 because of its very high yield. However, the ecosystem of the cotton area has undergone many changes, so IRMA Q302 encountered many difficulties in completing its development cycle under good conditions, thus causing a drop in grain cotton production [9].

Faced with this environmental challenge, several new varieties have been created in order to adapt to the new ecological conditions. Of these newly created varieties, three (03) were pre-selected according to their capacity to adapt to the ecosystem of the cotton area. These are the varieties IRMA A2262, IRMA A2188 and IRMA A2249, which have completed their development cycles within the experimental system. The objective of this study is to identify the variety capable of effectively and sustainably replacing the IRMA Q302 variety.

MATERIALS AND METHODS

Study sites

Cameroon's cotton area is located in three administrative regions: the Far North, the North, and part of Adamawa, whose regional capitals are Maroua, Garoua, and Ngaoundéré respectively. It covers an area of about 5 million ha. More than 600.000 ha of cultivated land affected by SODECOTON's activities are spread over this area [10]. The study was conducted on four sites. They correspond respectively to the villages of Kodek and Makébi in the Far North region, Soukoundou and Sanguéré in the North region (Fig 1).

The sites in the northern region have a tropical Sudanese climate, defined by an average annual rainfall of 960 mm; the rainy season lasts 6 months, from May to October. The average annual temperature is 21.8°C [11]. The soils of the Soukoundou and Sanguéré sites are mostly tropical ferruginous. These soils are slightly acidic (pH 5.5 to 6) and have a low exchange capacity (less than 10 meq/100g). The organic matter content (0 to 20 cm) is generally less than 1%, their textures are generally sandy on the surface and clay tends to accumulate at depth, and the C/N ratio is between 14 and 17 [12]. They therefore have a rather low fertility. The vegetation consists of wooded savannah and forest galleries in places [13].
In the Far North, where the Kodek and Makébi sites are located, the climate is of the Sudano-Sahelian type. The rainy season lasts for five months from May to September, with many breaks in between. The average annual rainfall is 730 mm. The average annual temperature is 28.7°C [11]. The soils found in the Kodek and Makébi sites are mostly Vertisols. Their textures are silty-clay to silty-clay (20-40% clay). The organic matter content (0 to 20 cm) is less than 2% and the C/N ratio is 12 to 14. The pH is around 6 to 6.5 at the surface and at depth. The exchange capacity is 15 to 20 meq /100g (calcium largely dominant) [14]. The vegetation is mainly shrubby savannah [15].

Vegetal materials

In this study, the plant material consisted of four varieties (*Gossypium hirsutum*), namely IRMA Q302, IRMA A2249, which is currently being popularized, and two new varieties, IRMA A2188 and IRMA A2262. These varieties were bred in Cameroon, as indicated by their name IRMA. The pedigrees of the different cotton varieties evaluated are as follows :

- **IRMA Q302:** IRMA BLT-PF * IRMA I466 = M412-258 – N372-485 – P477-475 – Q302;
- **IRMA A2249:** Q295*L457 = V342-10-W602-3-Z1621-5-A2249;
- **IRMA A2262:** Q295*L457 = V342-10-W602-7-Z1625-3-A2262;
- **IRMA A2188:** L457*J133 = V327-20-W543-1-Z1482-3-A2188.

***BLT-PF**= Bluk length tenacity - fiber percentage ; *= crossing between two different varieties ; IRMA= Research Institute of Maroua.*

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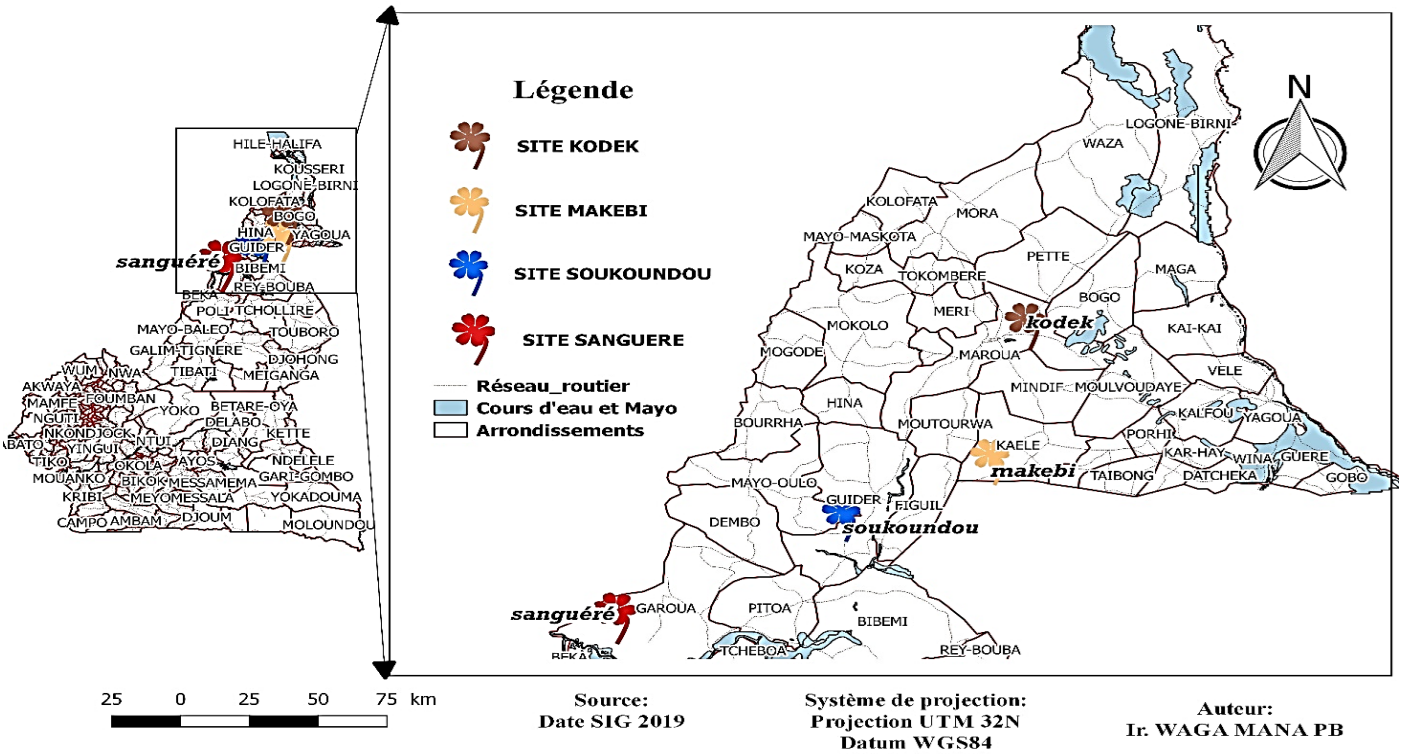

Figure 1: location of the study area

METHODS

Experimental device

The study was conducted in a Fisher block design with four (04) varieties and two (02) replications, or. an Elementary plot of eight (08) lines of 50 m. It is made up of 6 central lines or useful lines and 2 lateral lines. The spacing between lines is 80 cm and between the pockets it is 25 cm for the trials in the Far North, against 40 cm for the trials in the North. This difference in spacing between the plots is made to take into account the environmental conditions of each ecological area.

Data collection

Data collection was done in two main stages. The first stage consisted of collecting agronomic parameters, notably the density at harvest and the seed cotton yield per hectare. The second stage consisted of collecting ginning data, namely ginning speed, seed index and fiber yield at ginning, as well as technological parameters of the fiber (length fiber in mm (UHML), Strength of the fiber in g/Tex (Stren), Uniformity Index of the fiber in % (UI), Maturity (PM), Micronaire Index (MI), Reflectance of the fiber in % (Rd), Elongation of the fiber in % (Elong) and the Yellow Index of the fiber (+b)).

Data processing

The collected data were statistically analyzed with SAS software version 9.2. The SAS system is a set of software modules for the management and statistical processing of data. Within it there are a large number of comparison methods that differ not only in the contrasts they consider but also in the risk they control for. Among these methods are those of Bonferroni, Dunnett and Newman-Keuls.

In this study, the Newman-Keuls method or the Newman-Keuls test was chosen. This is one of the most widely used tests because it is more powerful than the Tukey test, among others. The purpose of this test is to classify all k means μ1, μ2, ..., μk into homogeneous subsets.

The Newman-Keuls procedure consists of performing Tukey tests on decreasing subsets of means. Thus, at each step, the critical value of the Tukey test is adjusted according to the number of means contained in the subset. In order not to obtain incompatible conclusions, once a subset of means is considered homogeneous, no further comparison is made between the means of the subset.

RESULTS

Agronomic behaviour

Density at harvest

In the northern ecological area

The analysis of the results shows that the varieties

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IRMA Q302 and IRMA A2262 have the same density at harvest of 77%. On the other hand, the two (02) other varieties tested, namely IRMA A2249 and IRMA A2188, have harvest densities of 81% and 76% respectively (Fig 2).

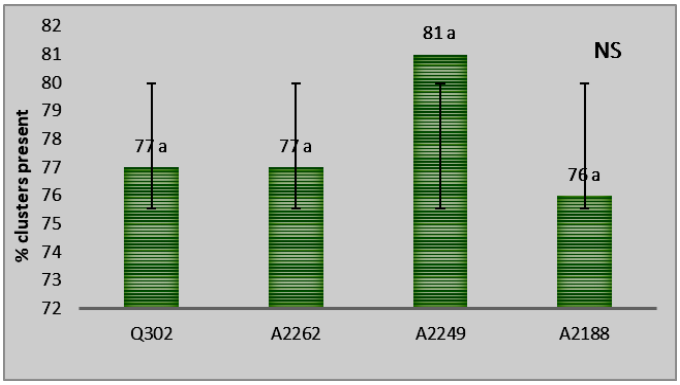

Figure 2: *Comparison of the three (03) new varieties tested with the popular one on the density at harvest in the northern ecological area*

The critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" has a value of 0.37. It is greater than 5%. This indicates that there is no significant difference in harvest densities between the three (03) new varieties tested and the popularized one in the two sites of the northern ecological zone (Table 1).

Table 1: Critical probability associated with the F-test of the interaction of the factors 'varieties' and 'locations' on harvest density in the Northern ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	245.70	245.70	49.50	0.004
« Block*Location »	2	12.00	6.00	0.48	0.64
« Location*Variety »	3	47.19	15.73	1.25	0.37 ns

ns : non-significant effect at 5 %

In the Far north ecological area

The results of the analysis show that the density at harvest of the variety IRMA Q302 and that of the tested variety IRMA A2188 are 88%, and therefore equivalent. On the other hand, the two (02) other varieties tested, IRMA A2262 and IRMA A2249, have harvest densities of 84% and 83% respectively (Fig 3). However, the critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" is 0.37. This probability is higher than 5%, demonstrating that the interaction of the factors "varieties" and This probability is higher than 5%, thus demonstrating that there is no significant difference in harvesting density between the three (03) new varieties tested and the popularized one, in the sites of the Far North ecological area (Table 2)

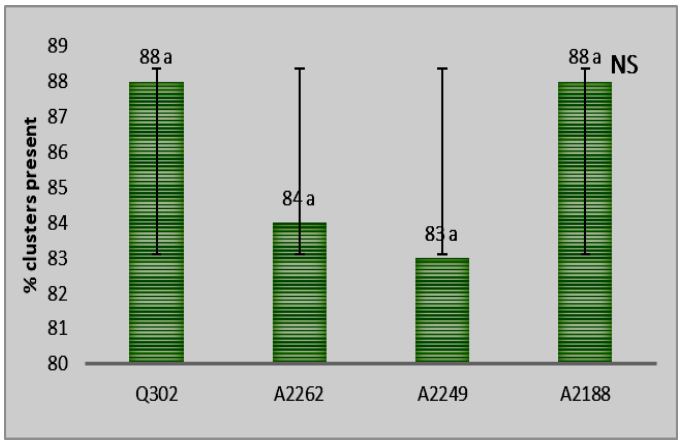

Figure 3: Comparison of the three (03) new varieties tested with the popularized one on density at harvest in the Far North ecological area

Table 2: Critical probability associated with the F-test of the interaction of 'variety' and 'location' factors on harvest density in the Far North area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	245.70	245.70	49.50	0.004
« Block*Location »	2	12.00	6.00	0.48	0.64
« Location*Variety »	3	47.19	15.73	1.25	0.37 ns

ns : non-significant effect at 5 %

Seed cotton yield in kg/ha

Case of the northern ecological area

According to the results of the analysis, the variety IRMA Q302 has a seed cotton yield of 1774kg/ha which is higher than that of the three (03) varieties tested. The three (03) new varieties tested, IRMA A2262, IRMA A2249 and IRMA A2188, have yields in seed cotton of 1741kg/ha, 1637kg/ha and 1765kg/ha respectively. (Fig 4).

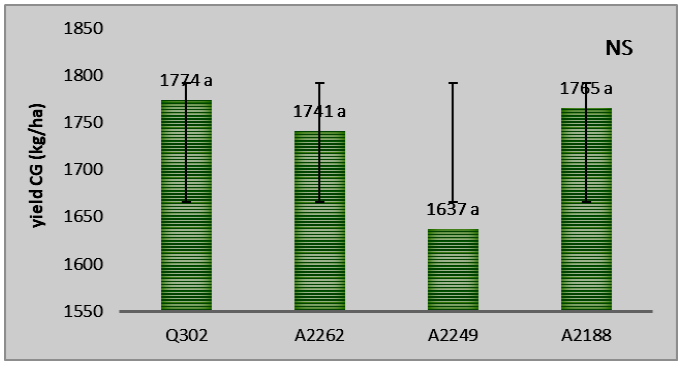

Figure 4: *Comparison of the three (03) new varieties tested with the popularized one on seed cotton yield in the northern ecological area*

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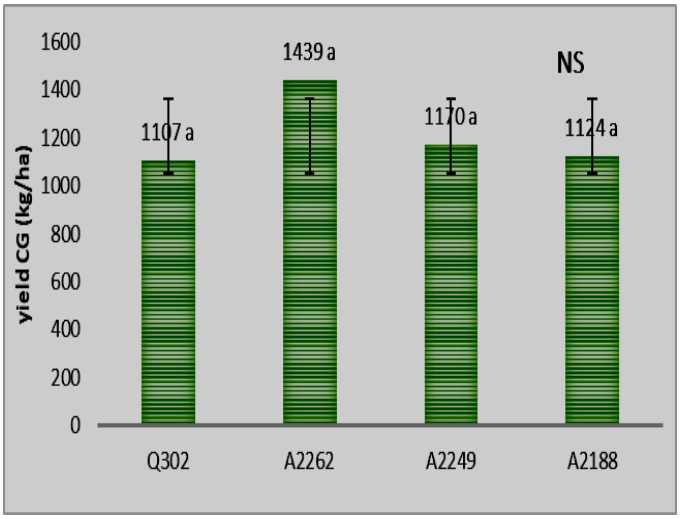

***Figure 5**: Comparison of the three (03) new varieties tested with the popularized one on seed cotton yield in the Far North ecological area*

The critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" is higher than 5%. This shows that there is no significant difference between the seed cotton yields of the three (03) new varieties tested and the one popularized, between the two experimental sites located in the northern ecological area (Table 3).

Table 3: Critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" on seed cotton yield in the northern ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	3262539.06	3262539.06	77.68	0.0001
« Block*Location »	2	406363.62	203181.81	4.84	0.05
« Location*-Variety »	3	161808.68	53936.22	1.28	0.36 ns

ns : non-significant effect at 5 %

Case of the Far North ecological area

The analysis results in Figure 5 show that the popularised variety IRMA Q302 has a seed cotton yield of 1107kg/ha. In contrast, the seed cotton yields of the three (03) new varieties tested IRMA A2262, IRMA A2249 and IRMA A2188 are 1439kg/ha, 1170kg/ha and 1124kg/ha respectively. The three (03) new varieties tested have higher seed cotton yields than the popularized variety IRMA Q302 in the whole ecological area of the study. The tested variety IRMA A2262 has the highest seed cotton yield (1439 kg/ha). It stands out from the others in this part of the study area (Fig 5).

Furthermore, the critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" is 0.23. This value is greater than 5%. This means that there is no significant difference between the seedcotton yields of the three (03) new varieties tested and the one that was popularised (Table 4).

Table 4: Critical probability associated with the F-test of the interaction of the factors "varieties" and "locations" on RDTCG in the Far North ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	2061378.06	2061378.06	30.13	0.001
« Block*Location »	2	103771.62	51885.81	0.76	0.50
« Location*-Variety »	3	3863943.68	128981.22	1.89	0.23 ns

ns : non-significant effect at 5 %

Ginning and technological characteristics of the fiber

Ginning characteristics

Ginning speed (FSH)

In the northern ecological area

The results of the analysis show that the popularised variety IRMA Q302 has a ginning speed (FSH) of 4.7 kg/scie/hour. On the other hand, the three (03) new varieties tested, namely IRMA A2262, IRMA A2249 and IRMA A2188, have ginning speeds (FSH) of 5.5 kg/saws/hour, 5.7 kg/saws/hour and 4.5 kg/saws/hour respectively. However, two of the three (03) varieties tested, namely IRMA A2262 and IRMA A2249, have a higher ginning speed (FSH) than the popularised variety (Fig 6).

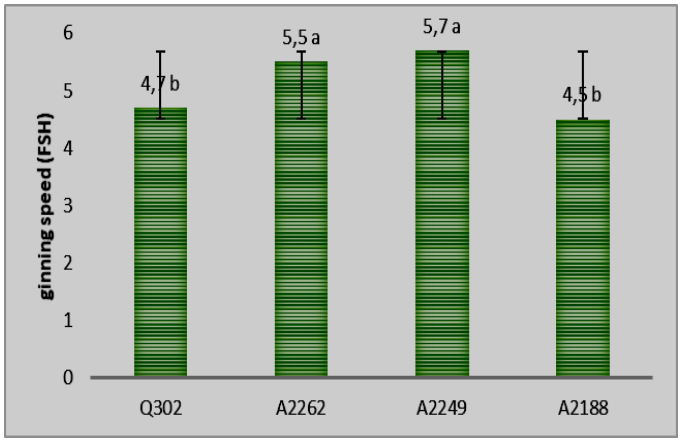

***Figure 6:** Comparison of ginning speeds (FSH) of the three (03) new varieties tested compared to the variety popularized in the northern ecological area*

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The critical probability associated with the F-test of the "varieties" factor is 0.001%. This value is less than 5%, which shows that there is a significant difference between the three (03) new varieties tested and the one that was popularised (Table 5).

Table 5: Critical probability associated with the F-test of the variety factor on ginning speed (FSH) in the Northern ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	4.00	4.00	29.33	0.0002
Variety	3	4.25	1.41	10.39	0.001**

***** : significant effect at 1%.***

Case of the Far North ecological area

The analysis results show that the two (02) new varieties tested IRMA A2262 and IRMA A2249 have the same ginning speed of 5.2 kg/saw/hour. The popularized variety IRMA Q302 and the new variety tested IRMA A2188 have ginning speeds of 4.2 kg/saw/hour and 4.7 kg/saw/hour respectively (Fig 7). The popularized variety IRMA Q302 has the lowest ginning speed value in the Far North ecological area. The critical probability associated with the F-test of the "varieties" factor is 0.05. This value is equal to 5%, which simply shows that the comparison of means by the Tukey test proves that there is no significant difference between the three (03) new varieties tested and the one popularized in the Far North ecological zone (Table 6).

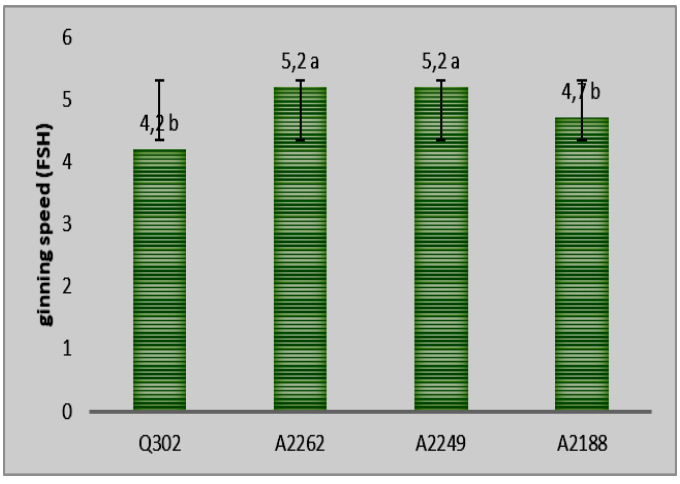

Figure 7: *Comparisons of ginning speeds (FSH) of the three (03) new varieties tested to the one popularized in the Far North ecological area*

Table 6: Critical probability associated with the F-test of the variety factor on ginning speed (FSH) in the Far North ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	0.00	0.00	0.00	1.00
Variety	3	2.75	0.91	3.36	0.05 ns

ns : non-significant effect at 5 %

Seed Index (SI)

Case of the Northern Ecological area

From the results of the analysis, it appears that the variety IRMA Q302, which has been extended, has a Seed Index (SI) of 8.4g. The three (03) new varieties tested IRMA A2262, IRMA A2249 and IRMA A2188 have Seed Indexes of 8.5g, 8.1g and 8.6g respectively (Fig 7)

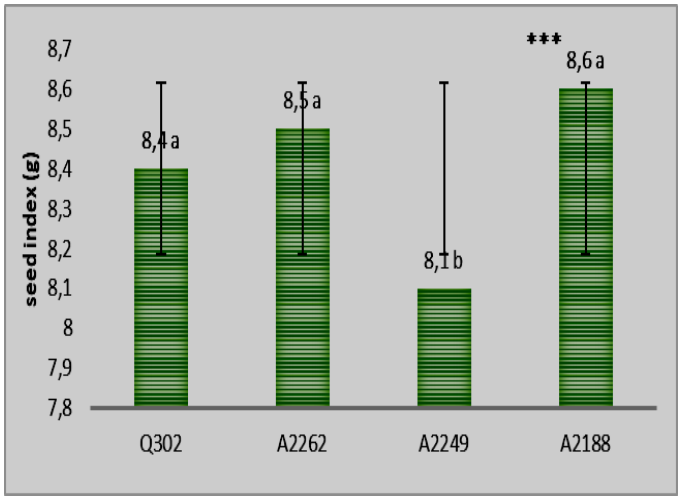

Figure 8: Comparison of the seed index of the new varieties tested with the one popularized in the northern ecological area

Furthermore, the critical probability associated with the F-test of the "variety" factor is 0.007. This value is greater than 5%. This simply means that the comparison of means by Tukey's test attests that there is no significant difference between the seed indexes of the three (03) new varieties tested and the one popularized in the northern ecological area (Table 7).

Table 7: Critical probability associated with the F-test of the Seed Index variety factor for the three (03) new varieties tested and for the one extended in the northern area

Source	DDL	SS	Root mean	F-value	Pr > F

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Continued..

Location	1	0.005	0.005	0.18	0.676
Variety	3	0.621	0.207	6.77	0.007 ***

****** : highly significant at 0.1%.***

Case of the Far North ecological area

Results of analysis show that the variety IRMA A2262 has the highest Seed Index (8.5g). This is followed by the variety IRMA Q302 (8.3g) and finally the varieties IRMA A2249 and IRMA A2188 with a Seed India of 8.1g (fig 9)

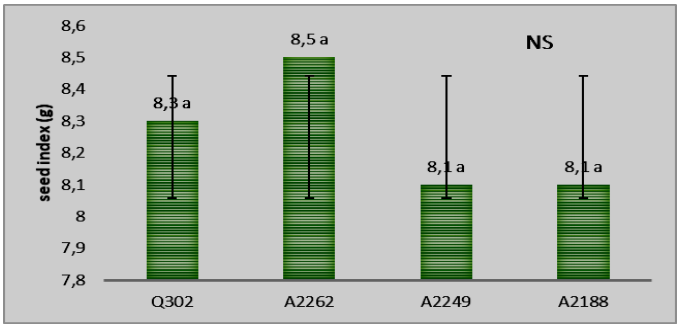

Figure 9 : Comparison of the seed index of the new varieties tested with that popularized in the Far North ecological area

The critical probability associated with the F-test of the "varieties" factor is 0.61. This value is higher than 5%, which simply shows that the comparison of means by Tukey's test proves that there is no significant difference between the Seed Index of the three (03) new varieties tested and the one popularized in the Far North ecological zone (Table 8).

Table 8 : Critical probability associated with the F-test of the Seed Index variety factor in the Far North of the three (03) new varieties tested and the popularized one

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	0.03	0.03	0.13	0.72
Variety	3	0.43	0.14	0.63	0.61 ns

ns : non-significant effect at 5 %

Fiber yield at ginning

Case of the northern ecological area

The popularized variety IRMA Q302 has a net fiber yield at ginning (%NGF) of 41.8%. On the other hand, the three (03) new varieties tested, namely IRMA A2262, IRMA A2249 and IRMA A2188 have respectively a net fiber yield (% RFN) of 43.5%, 44.6% and 42.8%. It is noted that the three (03) new varieties tested have a higher net fiber yield at ginning (%NGF) than the popularized variety. Moreover, the variety IRMA A2249 is the one that stands out from the other two (02) (fig 10).

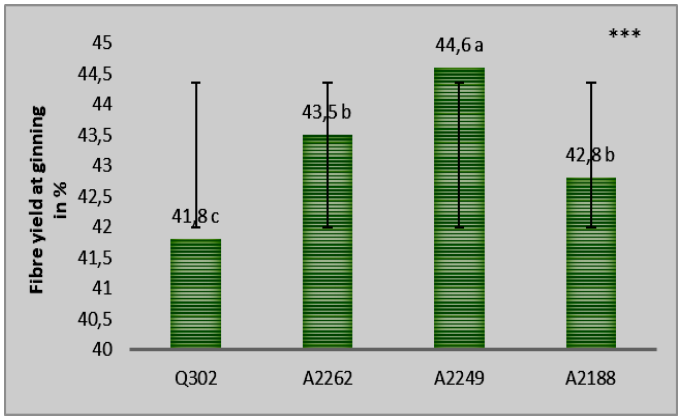

***Figure 10** : Comparison of net fibre yield at ginning (%NGF) of the new varieties tested compared to the one popularised in the northern ecological area*

The critical probability associated with the F-test of the "variety" factor is less than 5%; the comparison of means by Tukey's test proves that there is a very highly significant difference between the ginning fiber yields (%GRFN) of the three (03) new varieties tested and the one popularized in the northern ecological zone (Table 9).

Table 9 : Critical probability associated with the F-test of the variety factor of the percentage of net fiber at ginning (%NFG) of the three (03) new varieties tested and the one popularized in the Northern ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	2.80	2.80	9.07	0.118
Variety	3	16.47	5.49	17.76	0.0002***

****** : highly significant at 0.1%.***

Case of the Far North ecological area

According to the test results, the popularized variety IRMA Q302 has a net fiber yield at ginning (%NGF) of 41.2%. In addition, the three (03) varieties tested, namely IRMA A2262, IRMA A2249 and IRMA A2188 have a net fiber yield at ginning (%NGF) of 43.9%, 44.2% and 42.5% respectively. The three (03) new varieties tested have a higher net fiber yield at ginning (%NGF) than the popularized variety (Fig 11). The critical probability associated with the

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F-test of the "varieties" factor is less than 5%, which clearly demonstrates that the comparison of means by Tukey's test proves that there is a very highly significant difference between the three (03) new varieties tested and the popularized variety on the net fiber yield at ginning (%NGF) in the Far North ecological area (table 10).

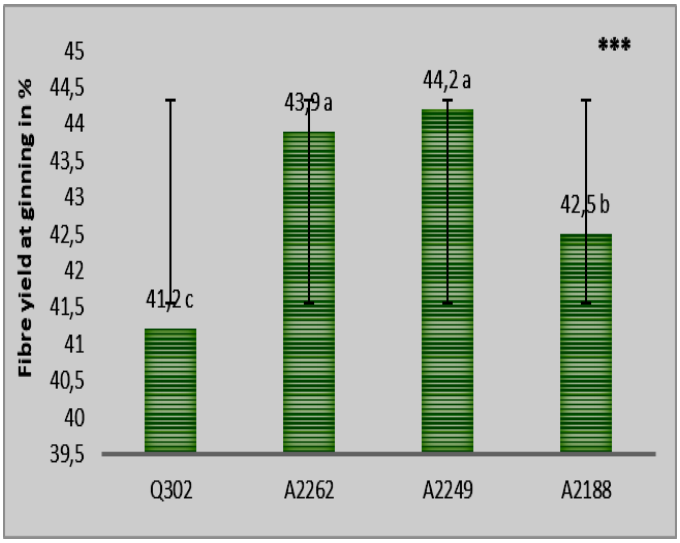

Figure 11 : Comparison of the net fiber yield at ginning (%NGF) of the new varieties tested compared to the one popularized in the Far North ecological area

Table 10 : Critical probability associated with the F-test of the variety factor of percentage net fiber at ginning (%NGF) in the Far North ecological area

Source	DDL	SS	Root mean	F-value	Pr > F
Location	1	1.05	1.05	7.10	0.02
Variety	3	23.21	7.73	52.33	<0.0001***

****: highly significant at 0.1%***

DISCUSSION

Agronomic behaviour

Density at harvest

According to the results of the analysis of the comparisons made between the three (03) varieties tested and the one popularized on their density at harvest, it is observed that there is no significant difference between the four varieties tested in the two ecological area (North and Far North). This non-significant difference is due to the fact that the density at harvest depends more or less on the variety, but also on the irregularity of rainfall observed during the sowing period in the study area. However, in the northern ecological area, IRMA A2249 was found to have the highest density at harvest. On the other hand, in the Far North ecological area, IRMA Q302 and IRMA A2188, which have equal values, have the highest density at harvest. This difference could be explained in part by the fact that in the Far North, the distance between bunches is 25 cm, as opposed to 40 cm in the Northern ecological area. In addition, it should be noted that when the density at harvest is high, plants compete for growth and development elements. Indeed, according to [17], high densities lead to increased competition for water and nutrient resources and even for light interception.

According to [16], the architecture and phenology of a cotton plant are more sensitive to density effects. High densities increase competition for soil resources, light and space occupation. Similarly, [19] show that high densities improve earliness of production by fixing a higher percentage of bolls on the first fruiting branch positions and at the bottom of the plant. The very high densities of the narrow row cotton system accelerate the end of flowering as measured by Node Above White Flower (NAWF = 5) [17]. In the same sense, [18] show that low densities lengthen the growth cycle of cotton plants.

Thus, it is possible to state that the density character at harvest is a function of the spacing between bunches and the rainfall levels and not of the variety.

Seed cotton yield (RDTCG)

The results of the analysis of the comparison of the three (03) new varieties and the one popularized concerning seed cotton yield showed that there was no significant difference for the "variety" factor between the tested varieties and IRMA Q302 in the two ecological zones. In addition, there was also a non-significant difference for the interaction of the factors "variety" and "location" despite the different environments. This non-significant difference noted in the whole study area for the first "variety" factor demonstrates that the varieties tested and IRMA Q302 belong to the same indeterminate growth type and the small genetic distance between them. For the interaction of the factors "variety" and "location" it is possible that they do not differ in terms of drought resistance and more broadly in hardiness. This result shows that seed cotton yield is a purely genetic trait that also depends on environmental conditions.

The work of [20] confirms our results by clearly

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establishing that yield is a function of factors that influence some components. These components include plant density, which is in turn influenced by sowing distances, emergence, which in turn is influenced by environmental conditions and weeding. The other components are variety related but are also strongly influenced by the environment and pest pressure. According to [21], cotton cultivation requires a lot of sunshine, water for at least 120 days to ensure growth, and dry weather at the end of the cycle to facilitate boll dehiscence and prevent fiber rot. In the same vein, the work of [22] clearly illustrates that the late arrival of the rains and the early cessation of the rains cause poor germination of the cotton plants, which, according to the producers, requires.

However, it was observed that in the Northern ecological zone, the popularized variety had a higher seed cotton yield than the three (03) new varieties tested. On the other hand, in the Far North ecological zone, the three new varieties had a higher seed cotton yield than the one that was popularized. This difference could be explained in part by the fact that in the Far North zone the climate is harsher with low average annual rainfall and high average annual temperatures compared to the North zone. According to [19], the different biotic and abiotic factors of the environment affect growth, development and production parameters. The water factor (precipitation) thus interacts with the other limiting factors of production. According to [23], there are similarities between the effects of high temperature and drought on plants and it is often difficult to separate the discrete effects of these two environmental factors.

In sum, for this trait, IRMA Q302 is more adapted to the Northern area than to the Far North area. Contrary to the new varieties that perform better in the Far North.

Ginning characteristics

Ginning speed

The results of the analysis of the comparison of the ginning speeds of IRMA Q302 and the three new varieties tested show a significant difference between the varieties tested and IRMA Q302 in the Northern ecological zone. However, in the Far North ecological zone there was no significant difference. This could be explained by the quality of the seed cotton harvested, the conditions of harvesting and storage of this seed cotton which are not the same in the two zones. It should also be noted that the ginning speed parameter also depends on the gin and the variety itself. According to [21] certain elements, namely: the variety of cotton, the deterioration in the field and the water content are elements that influence more or less strongly the attachment of the fiber to the grain. This force is generally about 55% of the breaking load, which suggests that the fiber could be detached from the seed without breaking.

According to [24], the gin, whether saw or roller, draws the fiber from the seed and is at the heart of the ginning process. The capacity of the system, the quality and potential performance of the cotton fiber in the spinning process depend on the operating conditions and settings of the gin. Gins must be properly adjusted, maintained and operated within the allowable load. According to [25], the short fiber content increases if the ginning rate exceeds the manufacturer's recommendations. The short fiber content also increases in the speed of the saws is increased. Increasing the ginning rate also increases imperfections in the yarns, and can cause damage to the seeds, especially when they are dry [26]. A high ginning rate and low seed moisture content can damage the seeds in the gin by 2% to 8% [26].
Ultimately, IRMA A2262 and IRMA A2249 are the two new varieties out of the three that have a higher ginning speed than IRMA Q302 and IRMA A2188. This is true for the whole study area.

Seed Index (SI)

The comparison made between IRMA Q302 and the three new varieties tested for this characteristic shows a very highly significant difference between the seed indexes of the three (03) new varieties tested and the one popularized in the Northern ecological zone. However, in the Far North ecological zone there is no significant difference. This could be explained by the fact that the Seed Index trait is mainly determined by the genotype and, to a lesser extent, influenced by environmental conditions [26]. Indeed, the Seed Index represents the size of a seed and this trait is good when the seed reaches a good maturity. According to [27], seeds produced by stressed cotton plants are smaller and less heavy. According to [28], the effects of the environment of this trait are difficult to study because of the presence on the same plant at the same time of bolls and fiber at different stages of ripening. Moreover, the work of [27] shows that it

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is also important to note that severe drought during the maturation phase of the seeds will affect their germination capacity.

Thus, it can be stated that only IRMA A2262 performs well in both ecological zones for this trait and that IRMA Q302 still maintains its trait throughout the study area.

Fiber yield at ginning

The comparison of fiber yields at ginning (%NGF) of the three (03) new varieties tested and the popularized one, shows that there is a very highly significant difference between them in all ecological zones. This significant difference observed across the study area could be explained by the fact that the %NGF trait is a purely genetic trait. However, it can be influenced by environmental conditions and the ginning process. According to [29], the ginning process can significantly affect fiber length and uniformity. The two operations related to ginning that affect quality the most are the regulation of water content during ginning and cleaning (its intensity).
[30] point out that it is temperature rather than water factors that affect boll and fiber development, as the fiber development operations have different optimum temperatures.
In sum, for this characteristic, the new varieties tested performed well throughout the study area. In addition, IRMA A2249 is the most adaptable in all the sites in the study area.

CONCLUSION

In this study, the aim was to identify which of the three new varieties could effectively and sustainably replace the popularized variety. Two experimental fields were set up in the North and Far North ecological zones respectively. Several data were collected: agronomic parameters, including density at harvest and seed cotton yield per hectare; and ginning parameters such as ginning speed, seed index and fiber yield at ginning.

From the analyses, it appears that IRMA A2249 and IRMA A2262 behave well for the density character at harvest in the Far North zone. On the other hand, in the Northern ecological zone, only IRMA A2249 performed negatively. For seed cotton yield per hectare, IRMA Q302 is better adapted to the northern zone. Contrary to the new ones which behave better in the Far North than in the North. As regards ginning characteristics, IRMA A2262 and IRMA A2249 are the two new varieties out of the three that have a higher ginning speed than IRMA Q302. Finally, concerning the seed index, only IRMA A2262 performed well in the two ecological zones; IRMA Q302 always maintained its character in the entire study area. The new varieties tested performed well throughout the study area in terms of fiber yield at ginning. Nevertheless, IRMA A2249 was the most adaptable in all the sites of the study area.

Finally, the variety IRMA A2262 is the one able to replace effectively and durably IRMA Q302 in the northern ecological zone. While IRMA A2249 is the most suitable variety to replace IRMA Q302 in the Far North ecological zone.

REFERENCES

[1.] Chotte, J.L., Kosuth, P., Les Dossiers d'Agropolis International, Extrait du dossier Changement climatique : impacts et adaptations, 20, pp. 68-85, 2015.

[2.] Nicholson, S., On the question of the "recovery" of the rains in the West African Sahel. J. Arid Environ., 63(3), pp. 615-641, 2005.

[3.] Sylla, M.B., Diallo, I., Sal, J.S., West African monsoon in state-of-the-science regional climate models. In : Climate Variability - Regional and Thematic Patterns. Rijeka, Croatia: InTech, 2013.

[4.] Gerardeaux E., Sultan Benjamin, Palai, O., Guiziou, C., Oettli P., Naudin K., Positive effect of climate change on cotton in 2050 by CO2 enrichment and conservation agriculture in Cameroon. Agronomy for Sustainable Development, 33 (3), pp. 485-495, 2013. ISSN 1774-0746.

[5.] Abdoulaye, A.A., Hofs. et Mergeai, G., Relever les défis environnementaux pour les filières cotonnières d'Afrique de l'ouest et du centre, Biotechnol. Agron. Soc.Environ. 2006, pp. 351 359.

[6.] Faure, G., « Valorisation agricole des milieux de savanes en Afrique de l'Ouest : des résultats contrastés », Les Cahiers d'Outre-Mer, 229, pp. 5-24, 2005.

[7.] Cao, J., Long, L.Z., Shan, D.S., Wei Deng, Z., Short-season cotton (Gossypium hirsutum) may be a suitable response to late planting in sub-Saharan regions. Field Crops Res., pp. 9-20, 2011.

[8.] SDRADDT., Premier Draft du schéma directeur

http://dx.doi.org/10.5281/zenodo.7715249

régional d'aménagement et de développement du territoire révisé. Région de l'Extrême-Nord, 96p, 2010.

[9.] Balarabe, O., Naudin, K., Aboubakary., Dourwe G., Les SCV: mis au point et leurs performances. Projet ESA-SDCC, Nord-Cameroun. http://agroecologie.cirad.fr., 54 p, 2007.

[10.] Devèze, J.C., Le coton, moteur du développement et facteur de stabilité du Cameroun du Nord ? », Afrique contemporaine, vol 1, N° 217, pp 107-120, 2006.

[11.] Tchiadeu, G., Wokam, C.H., À propos des dates de démarrage de la saison des pluies entre les 2˚-6˚ de latitude Nord Cameroun. In Revue de Géographie du Cameroun. Vol. XVII, n˚2, XVII n˚2, pp 16-21, 2006.

[12.] Azinwi P. T. Petrological, physic-chemical and mechanical study of the Benue watershed vertisols (Nord Cameroon) : spatial analysis and agricultural potential evaluation. Th. Doc. Ph.D. Fac. Sc. Univ. Yaoundé I, 183 p, 2012.

[13.] Ministère de l'Environnement et de la Protection de la Nature (MINEP), Plan d'action national de lutte contre la désertification (PAN/LCD), Cameroun, MINEP/PNUD, 221 p, 2006.

[14.] Basga, S.D., Tsozué, D., Temga, J.P., Balna, J., Nguetnkam, J.P., Land use impact on clay dispersion/flocculation in irrigated and flooded vertisols from Northern Cameroon. International Soil and Water Conservation Research, 6(3) : 237-244, 2018.

[15.] Mvondo Awono, J-P., Plan Directeur de Recherche pour la Plaine d'Inondation du Logone, Cameroun (2004-2014), CEDC, Maroua, Cameroun, CML - Université de Leiden, Pays-Bas et UICN, Gland, Suisse, 2003.

[16.] Turner, N C., Crop water deficits, a decade of progress ADV AGRON. 39, pp. 5-51, 1986.

[17.] Ball, R.A., 0osterhuis, D.M., Mauromoustakos, Growth dynamics of cotton plants during water deficit stress. AGRONOM. JOURNAL 86(5), pp. 788-735, 1994.

[18.] Mugishawimana, J., Impact de la pluviométrie des dix dernières années sur la mise en place des cultures mécanisées en zone cotonnière Ouest du Burkina Faso : cas du coton et du maïs. Mémoire d'Ingénieur en Agronomie, Institut du Développement Rural, Université Polytechnique de Bobo, 85p, 2000.

[19.] Hennou, L., Zouzou, M., Annerose, D., Macauley, H. R., Nwalozie, M.C., Réponses physiologiques et morphologiques au déficit hydrique de quatre variétés de cotonnier (Gossypium hirsutum L.), Rev. CAMES-Série A, Vol. 01, pp. 87-98, 1999.

[20.] Lançon, J., L'amélioration du cotonnier au CIRAD. In "Traitement statistique des essais de sélection. Actes du séminaire de biométrie et génétique quantitative, 12-14 septembre 1994". CIRAD. Montpellier, France, pp. 275-293, 1994.

[21.] Barrios, S., Ouattara, B., Strobl, E., "The impact of climatic change on agricultural production: Is it different for Africa?", Food Policy, vol 33, N° 4, pp. 287-298, 2008.

[22.] Sekloka, E., Lancon, J., Goze, E., Hau, B., Lewicki-Dhainaut, S., Thomas, G., Breeding new cotton varieties to fit the diversity of cropping conditions in Africa: effect of plant architecture, earliness and effective flowering time on late-planted cotton productivity. Exp. Agric., 44(2), pp. 197-207, 2008.

[23.] Saranga, Y., Menz, M., Jiang, C.X., Wright, R. J., Yakir, D., Paterson, A. H., Genomic Dissection of Genotype x Environment Interactions Conferring Adaptation of Cotton to Arid Conditions. Genome Research 11(12), pp. 1988-1995, 2001.

[24.] Rasheed, A., Malik, W., Khan, A.A., Murtaza, N., Qayyum, A. et Noor, E., Genetic evaluation of fiber yield and components of yield in fifteen cotton (Gossypium hirsutum L.) genotypes. Int. J. Agric. Biol., 11, pp. 581-85, 2009.

[25.] Pilette, M., La technique de l'égrenage du coton. Ed. COTONCO in Programme coton du CIRAD-CA, 287-291, 1959.

[26.] Chanselme, J.L., Kinré, H., Guide COTIMES de fonctionnement des usines d'égrenage et Guide COTIMES de maintenance des usines d'égrenage. Atelier régional de formation dans le cadre du Programme qualité de l'UEMOA, Elaboration, préservation et caractérisation de la qualité des fibres de coton, UE/UEMOA/ ONUDI, 13 au 18 mai, Parakou – Bénin, 2005.

[27.] Guinn, G., Dunlap, J.R., Brummett, D.L., Influence of water deficits on the abscisic acid and indol-3-acetic acid contents of cotton flower buds and flowers. PLANT PHYSIOLOGY, 93(3), 1117-1120, 1990.

[28.] Jackson, S.H., Relationship between normalized

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leaf water potential and crop water stress index values for Acala cotton. AGRICULTURAL WATER MANAGEMENT 20(2), pp. 109-118, 1991.

[29.] Davidonis, G.H., Johnson, A.S., Campbell, C.H., Landivar, J.A., Fiber property variability in green lint cotton at the seed and boll level. Proceedings of the Beltwide Cotton Conference 1: 592-593, 2000.

[30.] Sequeira R.A, EL-ZIK, K.M., Fruiting sites and water stress effects on cotton: T yield and fiber quality. Proceedings of the Beltwide Cotton Conference, pp. 564-565, 1991.

http://dx.doi.org/10.5281/zenodo.7715249