

RELATION OF COTTONSEED FUZZ INDEX AND SOME FIBER CHARACTERISTICS TO FIBER - SEED ATTACHMENT FORCE IN EGYPTIAN COTTON VARIETIES

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Abstract

The present investigation was conducted to determine the relative importance and contribution of cottonseed fuzz index, micronaire reading and fiber stiffness to fiber-to- seed attachment force in Egyptian cottons. Eight commercial Egyptian cotton varieties were tested and the results were analyzed by using the path coefficient analysis. It was found that fuzz index, micronaire reading and their interactions, were the most important characteristics related to fiber - to - seed attachment force, while fiber stiffness did not show considerable relationship to fiber - to - seed attachment force.

INTRODUCTION

Evaluation of cotton fiber -to- seed attachment force has been tried by several specialists. Such force is important to both cotton ginner and producers, as cottons of lower attachment force are ginned easier, and produce ginned lint of better quality.

Iyengar (1954) reported that attachment force values were 0.26, 0.41, 0.76 and 0.98 grams per fiber for *G. barbadense*, *G. hirsutum*, *G. herbaceum*, and *G. arboreum*, respectively. Chapman (1969) found that Pima S-2 had lower fiber to seed attachment force and ginned about 33% faster than Pima S-1. Fransen *et al.* (1984) reported significant differences in force of attachment among different cotton varieties, and a low relationship between attachment index and pressley index. Verschraege and Kiekens (1985) found that differences in attachment force among varieties of *G. hirsutum* were statistically significant, and that high attachment force may correlate with lower ginning out-turn under identical ginning conditions. Awad (1989) noted that cotton fibers on fuzzy seeds had greater attachment force than fibers on naked seeds. Wahba and Eweida (1990) reported high and positive correlation coefficient between fiber-to-seed attachment force and fuzz index. Al-Tantawy *et al.* (1990) reported highly significant differences in fiber-to-seed attachment force between varieties. The attachment forces for the varieties under the study were 113.0, 102.0, 91.0, 90.7, 85.0, 77.3 and 75.7 (CN cm/mg) for the varieties Giza 70, Giza 76, Dendara, Giza 75, Giza 81, Giza 80 and Giza 77, respectively. They showed that fiber maturity followed by micronaire reading were the main factors contributing to attachment force. Al-Tantawy *et al.* (1992) found that the extra-long staple fine varieties Giza 45 and Giza 70 gave the highest attachment force while the long staple varieties Giza 80 and Dendara gave the lowest values, and Giza 75 variety was in between. Further studies concerning fiber-to-seed attachment were recommended.

Therefore, the present study was conducted to determine the relative importance of some factors related to fiber-to-seed attachment force and the relative contribution of each factor.

MATERIALS AND METHODS

Eight commercial Egyptian cotton varieties, Giza 45, Giza 76, Giza 77, Giza 75, Giza 80, Giza 81 and Dendara of grade good, season 1991, were tested. Fiber-to-seed attachment force was measured by the L.D.M. Cottonseed Attachment Tester, Shirley Development Ltd. described by Verschraege and Kiekens (1985), and reported in CN. cm/mg, where CN is the force unit equal 1/10 Newton. Thirty seeds of

each variety were combed and prepared for the test, one of the two wings of fibers on each seed was used for measuring the attachment force, while the other wing was pulled (ginned) very gently by hand and put directly between the jaws of the Stelometer instrument to determine tensile strength (g/tex) and elongation (percent) at 1/8" gauge according to ASTM, (D-1445 - 75). Fiber stiffness was calculated from the values of fiber strength (g/tex) and elongation (%) as follows:

$$\text{Stiffness (g/tex)} = \text{Fiber strength (g/tex)} / \text{Elongation\%}$$

Suitable samples of seed cotton were ginned gently by hand and the ginned fibers were used to determine micronaire reading by using Micronair instrument according to ASTM (D-1448 - 59), while the seeds were used to determine the fuzz index as the difference in seed weight per 100 seeds before and after delinting with 50% sulfuric acid for 5 minutes (this method was used by Awad, 1989). Fiber tests were performed according to procedures specified by ASTM (1979) under standard conditions of $70^{\circ}\text{F} \pm 2$ temperature and $65\% \pm 2$ relative humidity at the Cotton Fiber Laboratories, Cotton Research Institute, A. R. C. Simple correlation coefficients between fiber - to - seed attachment force and each of the three variables were calculated according to the procedure outlined by Little and Hills (1978). The path coefficient analysis first published by Wright (1921) and used by Dewey and Lu (1959) was followed to determine the contribution of each variable to fiber - to - seed attachment force.

RESULTS AND DISCUSSION

Characteristics of cotton varieties :

The results of fiber -to- seed attachment force, fuzz index, micronaire reading and fiber stiffness for the commercial Egyptian cotton varieties are presented in Table 1.

The results show that the highest value of attachment force was 109 CN. cm/mg for Giza 45 variety, while the lowest value was 81 CN. cm/ mg for Giza 81 variety. The other varieties ranged between the two values (Table 1). These results agree with those obtained by Al-Tantawy *et al.* (1992). However, varieties showed

definite trend of fiber - to - seed attachment force to each of fuzz index and fiber stiffness, where it was found that Extra - long staple varieties had the highest values of fiber - to - seed attachment force, fuzz index and fiber stiffness, while the long staple varieties had the lowest values of the same characteristics. In case of micronaire reading, the studied varieties did not show any definite trend.

Correlations between different cotton characteristics:

Simple correlation coefficients between fiber - to - seed attachment force and each of fuzz index, micronaire reading and fiber stiffness are presented in Table 2. It is apparent that fuzz index and fiber stiffness were positively and significantly correlated with fiber - to - seed attachment force, while micronaire reading showed negative and significant relation to fiber - to - seed attachment force. These results are similar to those found by lyengar (1954) who stated that *G. barbadense*, which normally has less fuzz on its seeds than *G. hirsutum*, had attachment force value of 0.26 compared to 0.41 grams per fiber for *G. hirsutum*. These results are in agreement with those obtained by Awad (1989) who reported that cotton fibers on fuzzy seeds had greater attachment force than fibers on naked ones, and with Wahba and Eweida (1990) who mentioned that fuzz index had high and positive correlation coefficient with fiber - to - seed attachment force.

Partitioning of simple correlation coefficients:

Simple correlation coefficients between fiber - to - seed attachment force and each of fuzz index, micronaire reading and fiber stiffness (individually analyzed into its components of direct and indirect effects, utilizing the path coefficient method) are given in Table 3.

1 - Fuzz index vs. fiber -to- seed attachment force:

Fuzz index proved to have a quite considerable positive direct influence upon fiber -to- seed attachment force.

Also, a moderate positive indirect effect for fuzz index through micronaire reading was found. On the other hand, indirect effect of fuzz index through fiber stiffness was negligible (Table 3). This may be explained by an increase in "fiber fuzz" total number per unit area of seed coat and thus increase in the resistance of fibers for pulling out from the seed coat as the amount of fuzz increases. However, to explain such relationship, further studies concerning fuzz and fiber density on the

Table 1. Fiber -to- seed attachment force, fuzz index, micronaire reading and fiber stiffness.

Cotton variety	Fiber-to-seed attachment force (CN cm / mg)	Fuzz index (g / 100 seeds)	Micronaire reading	Fiber stiffness (g / tex)
Giza 45	109	0.38	2.6	561
Giza 70	100	0.36	3.8	563
Giza 76	108	0.38	3.4	576
Giza 77	82	0.32	3.5	546
Giza 75	84	0.36	4.1	448
Giza 80	90	0.33	3.4	433
Giza 81	81	0.28	4.0	445
Dendara	98	0.32	3.5	420

Table 2. Simple correlation coefficients between different variables of all possible combinations.

variables	Fuzz index (g / 100 seed)	Micronaire reading	Fiber Stiffness (g / tex)
Fiber - to - seed attachment force (CN cm / mg)	0.7445 **	-0.6808**	0.5545 **
Fuzz index (g / 100 seeds)		-0.4525	0.6268 **
Micronaire reading			-0.4310

*, ** = Significant at 0.05 and 0.01 probability levels, respectively.

seed coat are required.

The positive direct effect of fuzz index on fiber -to- seed attachment force pointed out that the higher value of fuzz index resulted in higher fiber - to - seed attachment force.

2 - Micronaire reading vs. fiber -to- seed attachment force:

Micronaire reading, which is a combined measure of both fiber fineness and maturity, was found to have a pronounced negative direct effect upon fiber - to - seed attachment force. Also, a moderate negative indirect effect for micronaire reading through fuzz index, was found. Also the indirect effect of micronaire reading through fiber stiffness was very small (Table 3). The remarkable inverse direct effect of micronaire reading (fineness) on fiber - to - seed attachment force indicated that, with the other variables held constant, the decrease in micronaire reading increases fiber - to - seed attachment force. This result means that coarse fibers have less fiber - to - seed attachment force than fine ones and may be explained by various factors including the density of fibers on the seed coat and the way at which the fibers are attached to seed coat.

3 - Fiber stiffness vs. fiber -to- seed attachment force:

Fiber stiffness was found to have minor effect on fiber - to - seed attachment force (Table 3). On the other hand, a moderate positive effect was recorded indirectly by fiber stiffness on fiber - to - seed attachment force through fuzz index and micronaire reading.

Contribution to variation in fiber -to- seed attachment force:

The coefficient of determinations and contribution percentage of all variables and their interactions are presented in Table 4. It is shown that fuzz index exerted the greatest influence both directly or indirectly upon fiber -to- seed attachment force followed by micronaire reading which exerted a moderate effect. On the other hand, fiber stiffness revealed the lowest effect on fiber -to- seed attachment force, compared with the other two factors.

From Table 4, it could be shown that the three factors contributing to fiber-to-seed attachment force and their interactions were responsible for 70.39% of the total variation in fiber -to- seed attachment force. The residual effects may be caused by other components not included in the present study, amounted to 29.61%. The

Table 3. Partitioning of simple correlation coefficients between fiber -to- seed attachment force and each of fuzz index, micronaire reading and fiber stiffness.

Components	Values
1 - Fuzz index vs. fiber-to-seed attachment force :	
Direct effect (Py_1)	0.5262
Indirect via micronaire reading	0.1922
Indirect via fiber stiffness	0.0261
Total (ry_1)	0.7445
2 - Micronaire reading vs. fiber-to-seed attachment force:	
Direct effect (Py_2)	-0.4248
Indirect via fuzz index	-0.2381
Indirect via fiber stiffness	-0.0179
Total (ry_2)	-0.6808
3 - Fiber stiffness vs. fiber - to seed attachment force:	
Direct effect (Py_3)	0.0416
Indirect via fuzz index	0.3298
Indirect via fiber stiffness	0.1831
Total (ry_3)	0.5545

Table 4. Components contributing to variation in fiber -to- seed attachment force.

Source of variation	C. D.	%
Fuzz index	0.2769	27.69
Micronaire reading	0.1804	18.04
Fiber stiffness	0.0017	0.17
Fuzz index X Micronaire reading	0.2023	20.23
Fuzz index X Fiber stiffness	0.0274	2.74
Micronaire reading X Fiber stiffness	0.0152	1.52
Residual	0.2961	29.61
Total	1.0000	100.00

C.D. = Coefficient of determination.

% = Contribution percentage.

main sources of the variation in fiber -to- seed attachment force were the direct effect of fuzz index, ranking first in this respect, followed by the joint effect of fuzz index with micronaire reading and the direct effect of micronaire reading. The other components showed slight contributions to the variation in fiber -to- seed attachment force. These results are in accordance with those results obtained by Al-Tantawy *et al.* (1991) who stated that micronaire reading was one of the main contributing factors, to attachment force.

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علاقة زغب بذرة القطن وبعض صفات التيلة بقوة تماسك الشعر بالبذرة

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أجريت هذه الدراسة لتقدير الأهمية النسبية لكل من كمية الزغب على البذور وقراءة الميكرونير (النعومة) وصلابة التيلة ومدى مساهمة كل منهم فى قوة تماسك الشعر بالبذرة .

تم اختيار أصناف القطن المصرية التجارية وهى :

جيزة ٤٥ ، جيزة ٧٠ ، جيزة ٧٦ ، جيزة ٧٧ ، جيزة ٧٥ ، جيزة ٨٠ ، جيزة ٨١ ، دندرة . وجميعهم من رتبة جود محصول ١٩٩١ .

وتم تقدير قراءة الميكرونير بواسطة جهاز الميكرونير كما تم حساب صلابة التيلة بعد تقدير متانة التيلة واستطالتها باستخدام جهاز الاستيلوميتر، كما تم تقدير معامل الزغب باستخدام حمض الكبريتيك لإزالة الزغب وتقدير نسبة الزغب بالوزن وذلك لجميع الأصناف تحت الدراسة.

كما تم تحليل النتائج بطريقة معامل المرور Path coefficient بعد حساب معامل الارتباط البسيط لجميع العوامل تحت الدراسة . وقد أوضحت النتائج أن كمية الزغب على البذرة وقراءة الميكرونير والتفاعل بينة فى أكثر العوامل أهمية فى التأثير على قوة تماسك الشعر بالبذرة . بينما كان لصفة صلابة التيلة تأثيراً ضئيلاً.