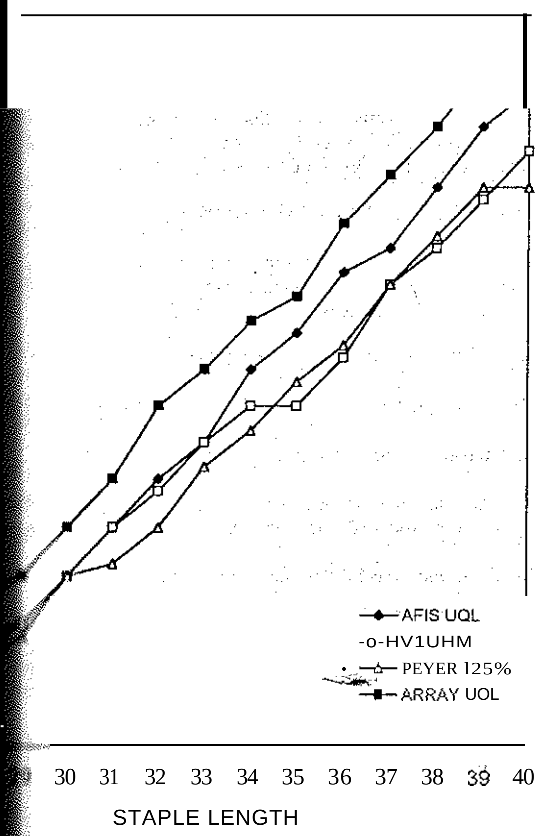


ngth versus Upper Length.

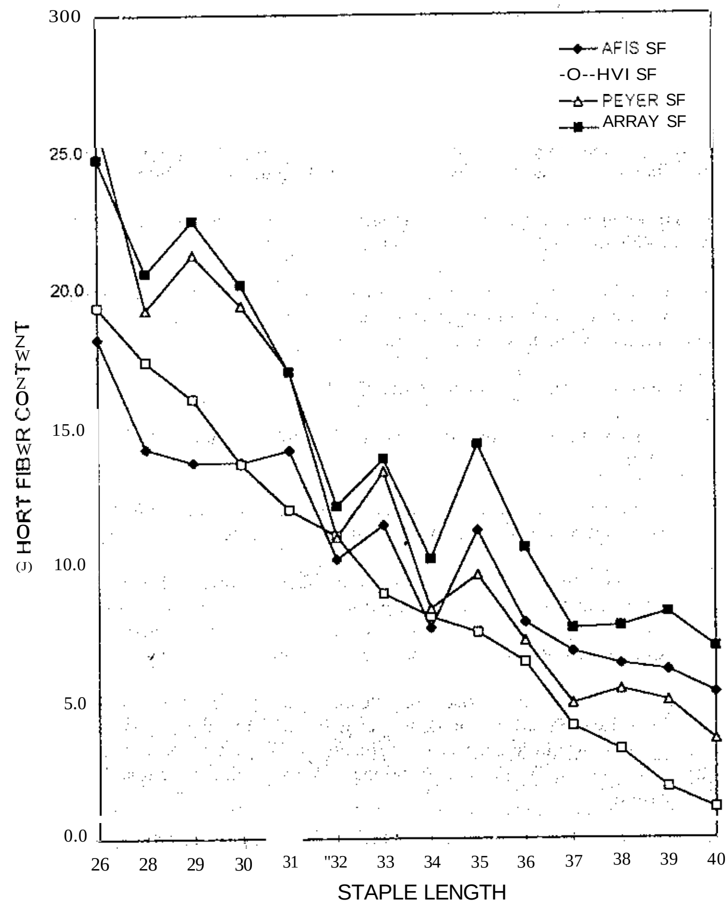
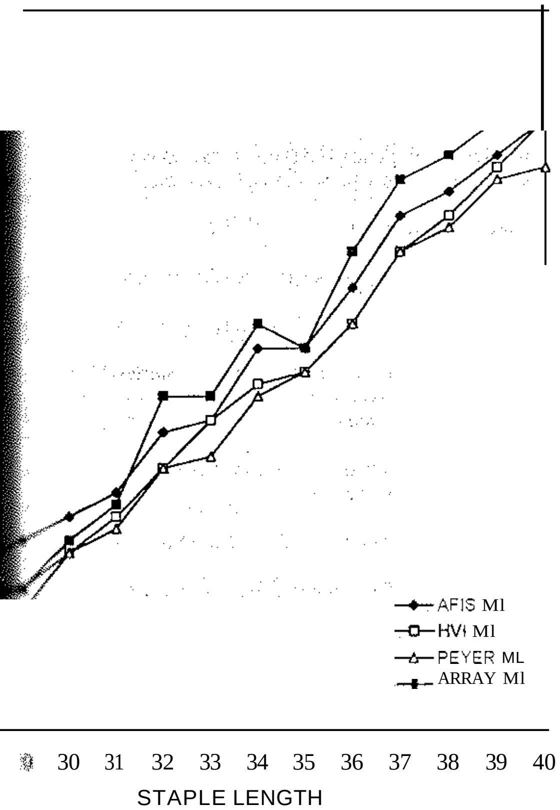


Figure 3. Staple Length versus Short FiberContent.



ngth versus Mean Length.

SEED COAT FRAGMENT COUNTING AND SIZING IN CARD WEB

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'IUT
Montpellier, ,France
'CIRAD·CA
Maroua, Cameroon

Abstract

Amethod to differentiate cultivars depending on their SCF contents on yarn was developped in CIRAD CA using a GGP Uster Eveness Tester. Results indicate a high SCF heritability,but fabrication of yam is too costly to be used for breeding programs. 50, anew method, using image analysis, has been developpedforcounting andsizing up SCF on card web. SCF counts were made on card web and compared to those obtained by Uster Tester III on 20 tex, 27tex, 37 tex yams for 30 coUons. Number ofSCF on yarn can he predicted with R2 as great as 80%.

Introduction

A recent report by the ITMF (International Textile Manufacturers Federation) entitled "Cotton Contamination Survey - 1993" studies *"spinners' observatloTIS concerning the problem of contamination and foreign matter in cotton".* The results of the survey indicate that contamination by "seed coat fragments"'is significant. It must he stressed, however, that degrees of contamination are not dealt with in this survey, and that the survey was carried out on samples from origins which are not necessarily representative of production. Moreover, no subsequent validation control was carried out. Its results, therefore, serve merely as a a general pointer.

These results can be found in the table 1 according ta main geographic areas.

The "seed coat fragment" problem is on the increase because of changes that have occurred over the past few years:

* changes in ginning techniques: the number of devices for cleaning cotton seed and fiber has increased, as has their speed, making the process more aggressive,

* changes in spinning techniques: requiring batches of fiber that are ever more homogeneous and free of foreign matter,

These seed coat fragments make up a large part of yarn neppiness. Neppiness can be broken down into five categories and regrouped into fiber neps, seed coat fragments and miscellaneous fragments:

* three types of fiber neps can be identified:

- "shiny neps" are lumps of unripe fiber; they cause uneven dying of the c10th

- "process neps" are created duringthe various processing steps from seed cotton to yam (ginning, cleaning, carding, etc..)

- "sticky neps" are due to sugar on the fiber, the origin of which is either physiological or, more often, entomological (honeydew); this sugar is excreted by the aphid, *Aphis gossypii* and the white fly, *Bemisia tabaci.* Contamination from insect honeydew can result in severe production lasses.

* "seed coat fragments" arise from cleaning and ginning the seed cotton as these processestear off part of the seed coat, ta which the fibers remain attached. During spinning these seed coat fragments in the yarn cause breakages and deteriorate the yam'sappearance and increase production costs related to their elimination.

"' "other types ofneps" group plant debris such as leaves, stems, etc. and various impurities; their presence is most often linked to the quality of the harvest and the cleaning processes employed (seed cotton and fiber).

Incidence of SCF in total' yarn' neppiness and heritability

The presence of SCF in the fiber causes: numerous problems during spinning (J, D. Bargeron and T. H, Garner, 1988; G. J. Mangialardi Jr, 1988; L. Verschraege, 1989). Consequently, cottons known to contain large quantities ofSCF are Hable to heavy downgrading on the. market.

To try to contend with the problem, teams of breeders and CIRAD coUon technicians began studying the phenomenon in the late 1980's (B. Bachelier, 1992).

First, it was necessary to find 'a way ta measurethe number of SCF in the yarn. Second, the heritability of the character then remained ta be detennined.

Measuring the number of SCF in the yarn

At present, ail quality control devicesmeasure aU neps in the yarn (fiber neps + shiny neps + sticky neps + SCF + plant debris); but although certain nèps seem ta result solely from thé environment (plant debris and sticky neps), others are probably controlled genetically to a greatextent (e.g. SCF). Yam neppiness-measuring instruments available today do not evaluatethis possible heredfty factor. For this reason, CIRAD-CA in Montpellier created a method whereby it was possible to measure neps in yam according ta their type (R. Frydrych and i; Gutknecht, 1989; R. Frydrych, 1992).

As a first step, aUSTER GGP-IPI regularimeter was used fitted with an "imperfector selector" (USTER News 1965). Each yaril·underwent the routine global testing{total neps) then a detailed analysis oflieps ta identify the different types of imperfection: SCF, Illiscellaneous neps such as honeydew, and' fiber neps.

The method is broken down inta two opérations:

The yam unrolls for a limited time at a speed of 2S mlmin, with the normal sensitivity settings chosen, e.g. -SO%, SO%, 200% for ring spinning. Theyarn is _retrieved'on a separate drum. Total neps are counted.

Secondly, the yam wound round the drum mounted· on the upper part of the regularimeteris introdliced into the "imperfectorselector", which stops it each time·it encounters an imperfectiori. Each is then examined carefully througha magnifying glassUnder intense Hghtplaced in front of the yam analyzer.The imperfections are counted by category: SCF, fiber neps, others.

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The method is broken down into two oper"ations:

The yarn unrolls for a limited time at a speed of 25 mlmin, with the nonnal sensitivity settings chosen, e.g. -50%, 50%, 200% for ring spinning. Theyarn is retrieved" on a separate drum. Total neps are counted.

Secondly, the yarn wound round the drum mounted, on the upper part of the regularimeter is introduced into the "imperfector selector", whichstôpsit each time it encounters an imperfection; Eachis then examined carefully througha magnifying glassunder intense Iightplaced in' front of the yam analyzer. The imperfections are counted by category: SCF, fiber neps, others.

The results obtained by regularimetry on 94 non-sticky cOUons, spun in 20 tex and originating in several African and South American countries, confirmed the correlation between SCF and total USTER neps.

A statistical analysis revealed that the number of SCF in non-sticky cottons can he estimated fairly precisely by an equation which includes thick places and tOtal neps, counted by the USTER (fig. 1) (r = 0.984):

SCF = -0.14 * THICK + 0.96 * NEPS + 14

In the case of sticky coUons, the stickiness potential measured by the thennodetector must be added to the equation. The equation developed after analysis of 70 coUons is (fig. 2) (r - 0.956)

SCF = -0.17' THICK + 0.92' NEPS'- 1.98' SCT + 62

The technique has now been adapted and can be used on UT3.

Evaluation of yarn SCF heritabiIity

A preliminary trial using 5 varieties was performed at 6 different locations. The seed coUon produced was ginned and the fiber spun by ring spinning 20 tex.

Total variance was broken down ioto varietal, location and residual variance. Heritability was estimated using the ratio:

Varietal variance! (varieta1 variance + location variance + residual variance)

Heritability thus estimated was 73.2%.

At the same time, anothertrial in another country was performed using 6 varieties at 6 different locations. Estimated heritability was 76.1 %.

It can he reasonably asserted, therefore, that the heritability of SCF in 20 tex ring spinning yam is about 70%. This high level of heritability is compatible with CIRAD's aim of setting up a genetic irnprovemem program dealing with neppiness.

However, although the present technique for counting SCF in yam is autolllated, it is unable ta meet the requirements of a strategy of varietal improvcment designed ta reduce neppiness, since thousands of yam analyses woul(be necessary. As the cost of a microspinning trial followed by quality control of the yam is very high, this method would be incompatible with the usual blli get at a breeder's disposaI.

Setting up a quick method to count SCF on yarn

Ta solve this problem, CIRAD decided ta evaluate the number of SCF in a card web and to study the relation between this parameter and yarn neppiness due ta SCF.

MateriaIs and methods

Two samples (500 g and 40 g) were taken from thirty coUons ofvarious origins.

Bach cotton underwent the following processing and analyses:

* Spinning trials were performed on a Shirley·Platt microspinning machine comprising a coUon opener, a card, adrawing frame and a ring spinning frame using two drawing areas.

- 500 g offihers were used in these tests to obtain about 13 kmofyam of 20 tex, 27 tex or 37 tex.

·500 g offiber were divided into 5 parts, each weighing 100 g.

- Each 100 g sample was opened and mixed on our laboratoryopener. The webwas wound onto a drum 1.55 cm in circumference. Five webs were obtaiIied for each cotton.

- Each web was folded in the middle and inserted into the card feed roller. The stationary fiats were cleaned twice during each test. The cotton web produced was wound around a drum identical to that used on the opener. Five webs were obtainedfor each cotton.

-The first drawing, with a value of 10.5, converted the web into a sliver. The sliver, which was 15.60m.long, was collectedin a cano In aH, 5 slivers were obtained to he used for the second drawing.

- The second drawing was used to homogenize and retine the sliver by doubling at 5. The 5 cans were placed at the back of the drawing frame

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The second drawing, with a value of 10.5, resulted in a sliver 170 m. long which was collected in a can, then dividedinto 10 cans. Each can contained 15.60 m. of sliver. The 10 cans were placed at the back of the drawing frame for the third drawing.

The third drawing homogenized and refined the sliver by doubling at 10. To make 20 tex and 27 tex yam, the drawing used is 10.5; then the sliver used to feed the 4 spindles of the ring spinning is about 2200 tex. To make 37 tex yam, the drawing used is about 8.5; then the sliver used to feed the 4 spind1es is 3000 tex.

For each spindle, a length of sliver was collected in a can and p1aced at the back of the ring spinning frame.

Ring spinning was composed of two drawings; the back draught was fixed at about 6.5, the front draught fluetuated depending on the incoming tex. Four spindles were used. For eaeh tex, the length of sliver used was divided to oblain:

1500 m. of yarn for the regularimetry test (first replication). The length was wound onto four cops;

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Temperature and hygromelric conditions in the course of the study were 22°C and 50% relative humidity during spinning.

Each yarn was analyzed on USTER devices as follows:

- Regularimetry: perfonned on a USTER UT3 regularimeter. The seuings chosen were as follows: speed Sam/min., thin (-50%), thick (+50%), neps (200%).

These settings were used for bath regularimeter tests, i.e. nonnal test and detailed analysis.

- Normal test: Iwo replications were made, each replication using 250m. of yam per cap ,x 4 cops to obtain 1000 m. The mean was calculated.

- Dctailed analysis: performedusing a method developed at CIRAD to identify the different neps observed. Each imperfection was examined in detail using a magnifying glass and intense lighting. The yam was stopped for a given period oftime (20 seconds); then loosened ta obtairlstabilization for 5 seconds befote reading. Imperfections were classified, as seed coat fmgmems,fiber neps (entatlgledfibers and sticky neps)"fragments such as leaves. Percentages obtained for each type of imperfection were adjusted ta total neps on 1000 m to obtain Ihe number of neps per type of impelfection on 1000m.

Counling of impurities on card web.

Our rapid counting method for estimating cotton SCF comprises:

- a minicard
- equipillent for image acquisition;
  . a support for the card web
  . a light source
  - a video camera
  - a PC 486 computer with video card
  - software created especially for the purpose.

The 40 g fiber sample is put through the fol1owing steps:

- The sample is opened by hand to obtain a web of about 26 cm x 21 cm.

- The web is foIded iri four, and is carded with a smooth aluminium plaque in place offlat.

- The fiber web thus obtained is woundround a drum.

- The web is thendivided into three equal parlsthatare placedoneon top of the other and are carded a second lime, this time with a nonnai card flat.

_Once a regular web has been obtainéd, 4 layers of the web are wound around a drum.

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file.

To obtain high quality images, the f
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with auniform white background.

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objects. The area of an abject is ove
effect produced by the anti-reflectio
For this reason, sulface areas will b

The size distribution of the impuri
area classifications, from 1 to 30 pi

Temperature and hygromelric candi
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Resuus

Number of impurities

A statistical analysis of the number
Fisherwith 30 varietiesand 4 rep
observed by Trashcam in relation t
Intra-cotton variance distribution is
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test was significant at 1 in 1000.
Figure 3 shows tha! the range of co

Surface area of impurities

Impurities were distributed into 6
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- Once a regular web ,has been obtained, 4 layers of the web are wound around a drum.

- A second drum is then introduced in order ta wind another four layers of web. The operation is carried out twice to obtain 4 webs of fiber, each made up of 41ayers of card web.

- The first web is placed on the examination plate (30 cm x 22 cm) and 3 video images are taken. Each image is processed by the software and the result (number of objects andsize distribution) is stored in an ASCII file.

To obtain high quality images, the fiber web is pressed against the examination plate. The side of thepressing instrument in contact with the fiber web is covered with a unifonn white background.

The software reads the image !ine by Hne and impurities are revealed by localized contrasts. Contiguous lines are then analyzed to describe the contours of the objects. The area of an object is overestimated because of the slight magnifying effect produced by the anti-reflection plate onto which the fiber web is pressed. For this reason, surface areas will be described in pixelsrather than in mm^2.

The size distributioq of the impurities is established according to 30 surface area classifications, from 1 to 30 pixels.

Temperature and hygrometric conditions in the, course of the stlldy were 22°C an,d 65% relative humidity during resistance and regularimetry testing.

ResuUs and discussion

Number of impurities

A statistical analysis of the number of impurities was carried out according to Fisherwith 30 varieties.and 4 repetitions.We corrected the number of SCF observed by Trashcam in relation to the weight of the web analyzed (0.5 g). Intra-cotton variance distribution is not normal. A square root transformation of the number of impurities observed per 500 g offiber stabilized the variances. The coefficient of variation for the transfonned trial data was 8.3%, and the F test was significant at 1 in 1000.
Figure 3 shows that the range of coUons chosen was very wide.

Surface area of impurities

Impuritiés were distributed into 6 classes foreach cotton. The 30 classes of imperfections observed were reclassified into 6 classes of surface area.

Distribution homogeneity of the surface areas for the 30 cottons was tested using Pearson's Chi^2 test. The Chi^2 of 238.2 for 145 degrees of freedom was highly significant. This revealed that the mean distributionobserved for the 30 cottons (fig. 4)was not representative of ail cases observed. Figures 5; 6 and 7 show the different possible types of distribution, These variations in distribution fonns depending on the coUon may be related to several causes (non-exhaustive list):

- type ofharvest (manual or mechanical) leading to variations in the amount of plant fragmentsin the fiber.

- type and number of seed cotton c1eaners in the ginning miÜ

- type and number oflint c1eaners in the ginning mill

- variety

A precise study would he necessary to detennine the impact of these different factors on the number and size of the abjects revealed by image analysis,

Subsequently, research was conducted on the type of object which could represent SCFon 20,27 and 37 tex yam in.ring spinning:

- objects smaller than 15 pixels are too small to be of significance on the yam.

- übjects larger than orequal t020 pixels are not generally SCF; they are often plant debris or are not categorized as neps by the UT3,

It was therefore decided to study the relation between objects between 15 and 19 pixels and the number of SCF on the yam.

Relation between SCF on the fiber web and SCF on the yarn

Figures 8, 9 and 10 show the relationship between the number of SeF on the card web and the number of SCF on the yam.

The correlation coefficient between the card web and 20 tex yam is 0.916.

The correlation coefficient between the card web and 27 tex yam is 0.912.

The correlation coefficient between the card web and37 tex yam is 0.888.

Conclusion

The correlation between the number of SCF on the card web and the number of SCF on ring spinningyam is satisfactory throughout. The process is currently being computerized to obtain direct reading of the card web as it unravels. This method can be used in varietal improvement. However, investigations must continue to establish the impact of types of ginning processes on the number of SCF and their size distribution.

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Table 1. Seed Coat Fragment contamination (from Cotton Contamination Survey - 1993 - ITMF).

Geographie area	Positives answers	Number of answers
South America	32.0	129
North America	34.0	446
Africa	38.5	385
Europa	39.7	225
Asia	49.0	390
World	36.2	1575

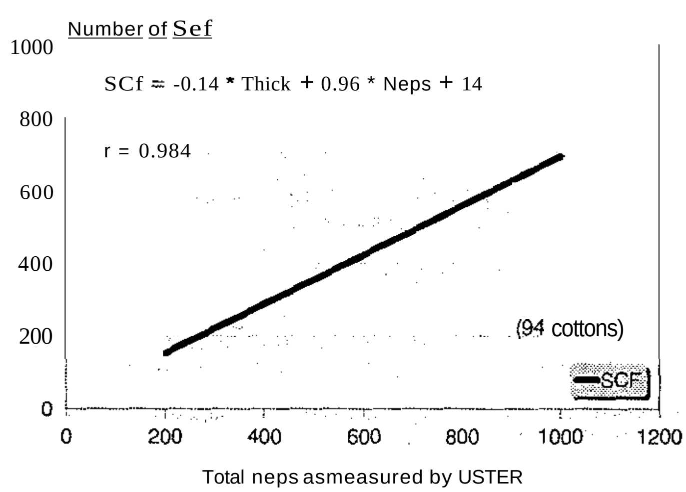

Figure 1. Relation between SCF and total USTER neps on a range of non-sticky coUons.

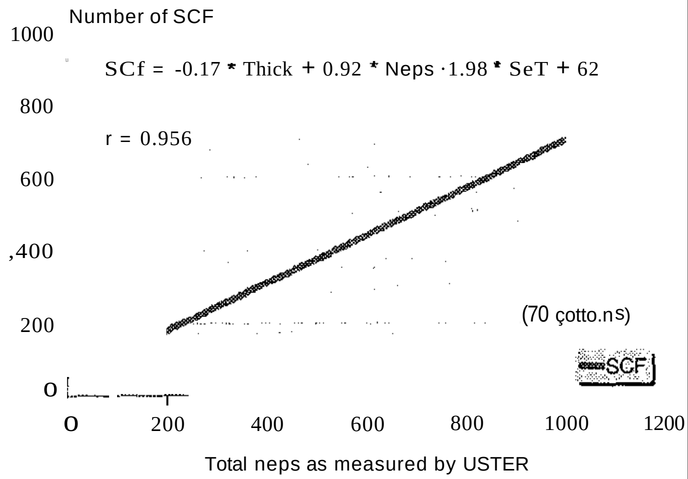

Figure 2. Relation between SCF and total USTER neps on a range ofsticky cotton

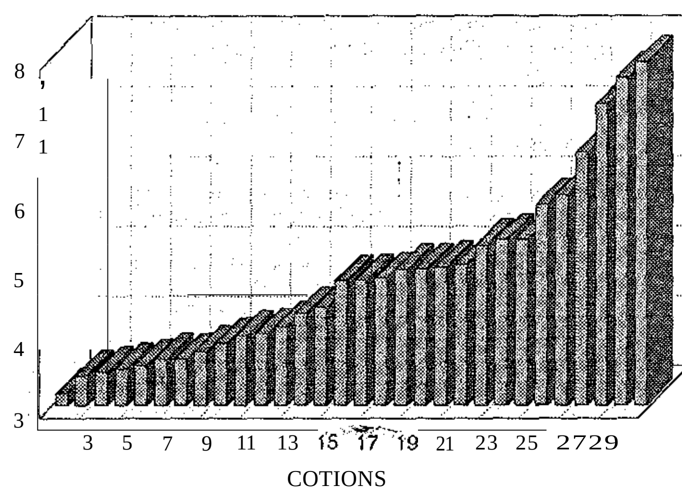

Figure 3. Trashcam count for 30 coUons: square root of the mean's for 0. grams of fibres.

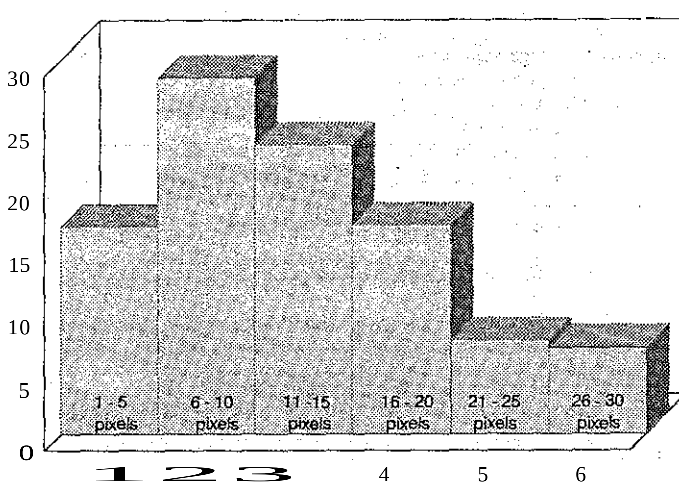

Figure 4. Average;d Trashcam count distribution for 30 coUons.

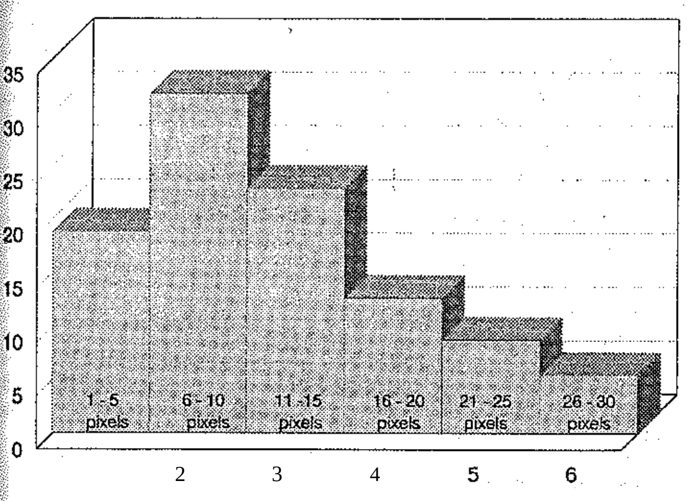

Figure 5. An example of trashcam count distribution.

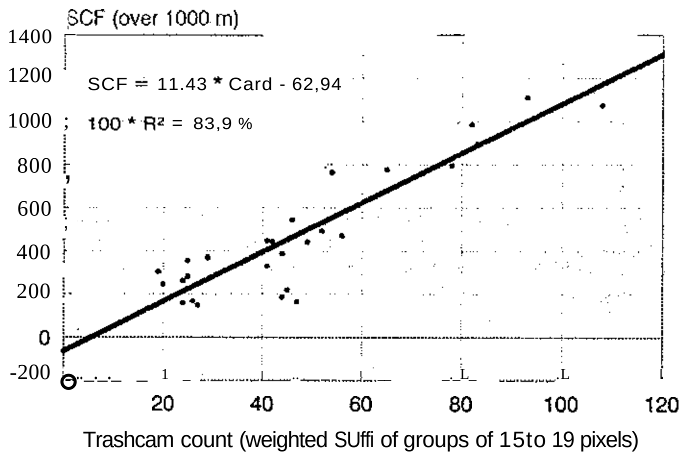

Figure 8. Seed Coat Fragments on 20 tex yam' vs Trashcam count on the web (5 grams web).

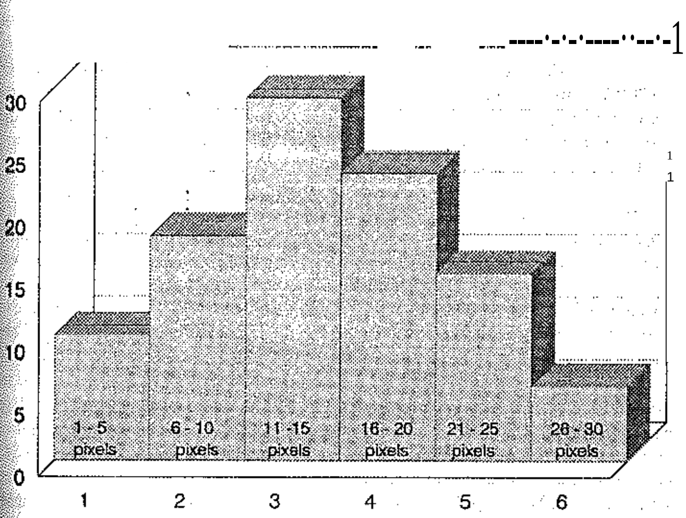

Figure 6. An example of trashcam count distribution.

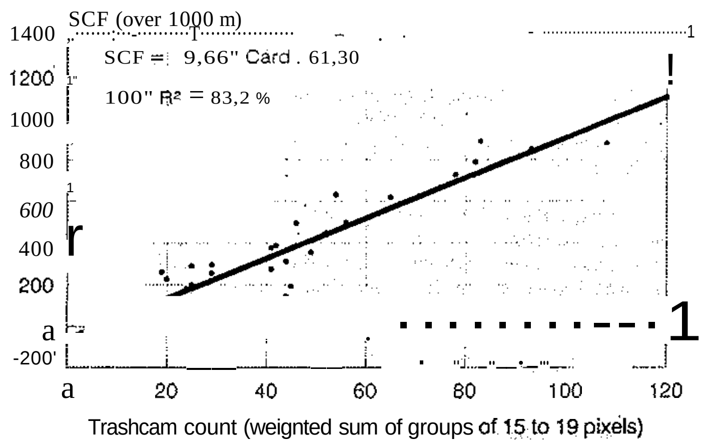

Figure 9. Seed Coat Fragments on 27 tex yaro vs Trashcam count on the web (5 gram, web).

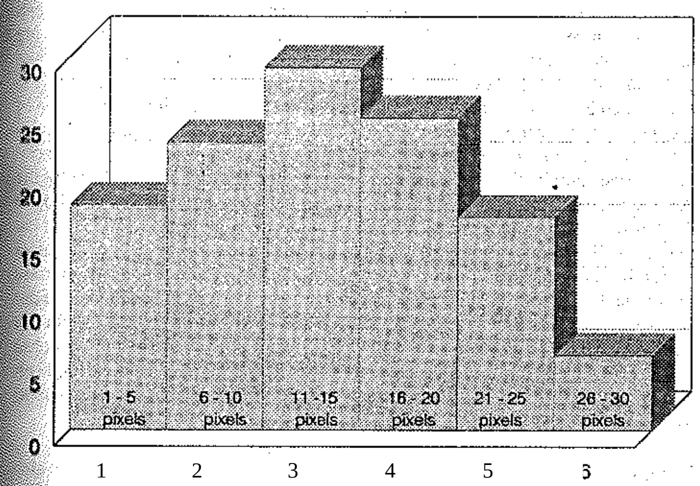

Figure 7. An example of trashcam colint distribution.

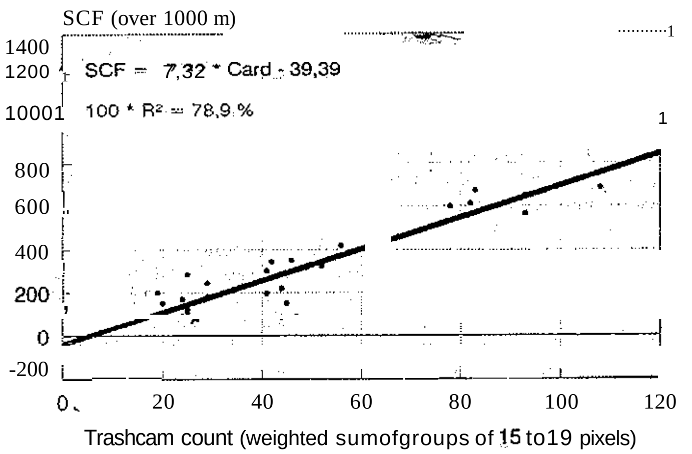

Figure 10. Seed Coat Fragments on 37 tex yam vs Trashcam count on the web (5 grams web).