IRCT Institut de Recherches du Coton et des Textiles exotiques

Centre de Recherches
CIRAD de Montpellier

Montpellier, March 1992

STICKY COTTON

FROM PLANT TO YARN

For presentation to:

ITMF
International Committee on Cotton Testing Methods
Working group on honeydew
21th International Cotton Conference Bremen
March, 1992

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Photographs taken at the technology laboratory of the I.R.C.T./CIRAD by T. ERWIN and R. FRYDRYCH.

Photographs n° 4,5,6,7 and 10 were taken by the Entomological Division at the I.R.C.T./C.I.R.A.D.

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PRESENTATION

The I.T.M.F. report "Cotton Contamination Survey 1991" involving the participation of 201 companies based in 22 different countries, alerted the industry to the fact that 27 % of cases presented problems of stickiness compared with 21 % in 1989.

These figures indicate a marked deterioration in the situation in only 2 years. There is a considerable increase in stickiness except in Europe. The Sudan remains the country most affected, but the North American zone with 31,7 % positive cases, is now at the same level as Africa (without the Sudan) ie. 32,7 % positive cases (see figure 1). It should, however, be noted that this survey only determined the presence or absence of stickiness, rather than its intensity. Its conclusions should therefore be considered with care as cottons that are only slightly sticky do not systematically lead to problems during the spinning process.

In Europe, 17,3 % of cases were positive whereas the figure was 15,7 % in 1989, in Asia 21 % versus 13,3 %, and in South America 10,8 % versus 3,81 %. Stickiness is therefore an ever increasing, worldwide problem.

Many research projects have been initiated to examine cotton stickiness in spinning in order to better understand the phenomenon, detect stickiness and eliminate its cause.

The problem is very complex because the stickiness of cottons from different geographical origins may be due to a variety of factors, the effects of which are detailed in the specialized literature :

- various contaminants such as seed coat fragments, insecticide, oil, etc... (figures 2 and 3),
- physiological sugars,
- entomological sugars.

The latter are excreted by two homopters : the aphid *Aphis gossypii* and the aleurode *Bemisia tabaci*. These excretions (usually called honeydew) can be found throughout the different stages involved in the transformation of cotton fibers, i.e. from the plant to the yarn.

HONEYDEW ON THE PLANT

Aphids (figure 4) and aleurodes (figure 5) on the plant are essentially found underneath leaves and on leaf stalks. They excrete honeydew onto the leaves (figure 6) and onto the fibers of open bolls (figure 7). If climatic conditions are favorable, fungi start to develop on the honeydew to form fumagin (figure 8) which can also be found on non-sticky fibers, i.e. in the absence of honeydew (figure 9). If the quantity of sugary deposit on the leaves is substantial, droplets form at the leaf tips before falling onto the fibers (figure 10). These droplets, plus the honeydew directly excreted onto the fibres, combine to produce very high concentrations (figure 11 and 12). The ginning process disperses the honey dew droplets along the fiber (figure 13) and by reducing their size renders them difficult to detect with the naked eye.

HONEYDEW DETECTION ON THE FIBER

Several methods are employed to detect sticky cottons :

- simple, qualitative chemical tests (FEHLING-MASSAT, PERKINS etc.) assess reducing sugars,

- more complex chemical tests (thin layer chromatography, gas chromatography, etc.) are used to measure reducing and non-reducing sugars,

- the mechanical test involving the laboratory minicard is recognized by the I.T.M.F. as an international reference ; this test furnishes qualitative results ; the equipment is no longer in production,

- thermodetection using a thermodetector furnishes quantitative results ; this test is increasingly used by both the industry and laboratories as shown by the numerous machines currently in use worldwide (more than 53 machines in 1992, figure 14).

At the I.R.C.T. these different tests are used specifically for different studies. Complex chemical tests are imployed to identify and quantify the different sugars present in honeydew and the minicard used to analyze all types of stickiness (honeydew, crushed kernels, leaves). As the principal source of stickiness in spinning is currently due to cotton contamination by insect-derived honeydew, research workers at the I.R.C.T., technologists and entomologists have been using thermodetection for several years, even at production sites, in the application of ongoing research programs and for the large scale detection of contaminated cottons.

The study of cotton stickiness using the thermodetector has revealed the presence of different types of honeydew within the fiber that can be visualized after analysis by the thermodetector :

- very small size honeydew, figure 15
- honeydew group, figure 16,
- large honeydew, figure 17,
- small honeydew with fumagin, figure 18,
- large honeydew with fumagin, figure 19.

All these different forms of honeydew cause various degrees of disruption during spinning ; they induce increased irregularities in sliver and yarn, occasionally lead to yarn breakages, rotor clogging and machine shut downs.

Studies have been conducted in the technology laboratory to demonstrate the impact of cotton stickiness on yarn neppocity. Whereas USTER regularimeter determine the overall number of neps, a detailed analysis of the yarn has now been developed using the USTER GGP, IPI regulator to identify imperfections and classify them into various fragments (stem fragments), seed coat fragments, fiber neps, honeydew, figures 20, 21, 22, 23 (R. FRYDRYCH et J. GUTKNECHT, 1989, Cot. fib. trop.).

Results showed the influence of honeydew on the number of neps. Thirty cottons from 6 varieties grown in 5 regions of the same country were spun using ring spinning to produce 20 tex yarn. A detailed analysis of yarn imperfections (figure 24) showed that, for 4 of the sites, the number of seed coat fragments was very close to the total number of Uster neps. In this case, the number of fiber neps remained relatively constant. The number of total Uster neps at the fifth site was elevated and related to a very high number of fiber neps. A thermodetector test showed that these cottons had a very high stickiness potential.

This example let us to perform detailed regulator and thermodetection analyses on 70 cottons spun to produce 20 tex yarn. The range of cottons studied was from 140 to 1074 Uster neps and from 3 to 116 sticky points on the thermodetector. Figure 25 illustrates the strong relationship between the number of sticky points and Uster neps. An examination of figure 25 shows that it is of no practical use to take account of stickiness potential in cottons that are only slightly sticky, as they do not lead to any measurable disruption of the spinning process. As regards very sticky cottons (more than 32 sticky points), the impact on the number of fiber neps is very clear.

A detailed analysis of the yarn showed that neps produced by stickiness are of different types, forms and sizes :

- neps formed by stickiness pulling up the fibers during the ring spinning process (figure 26),
- neps with a small honeydew accumulation (figure 27),
- neps with a large honeydew accumulation (figure 28 and 29).

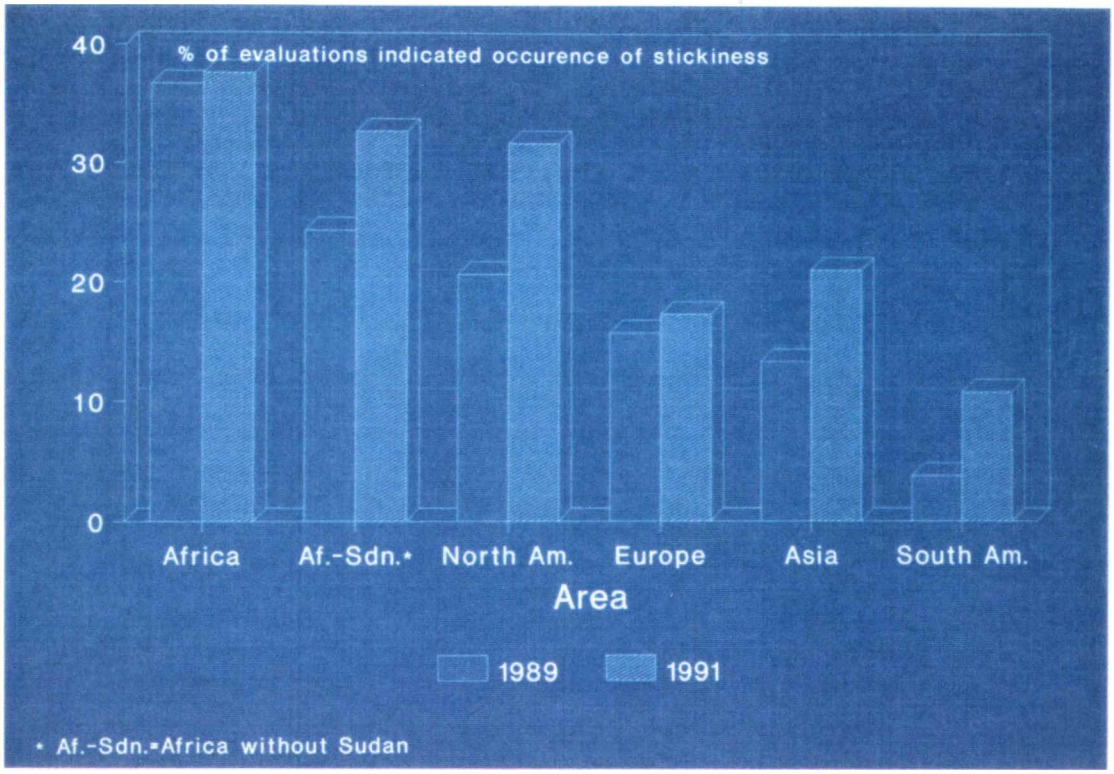

Figure 1: Developpement of stickiness from Cotton Contamination Survey ITMF

Figure 2: Crush kernel on card rolls (glanded variety with gossypol)

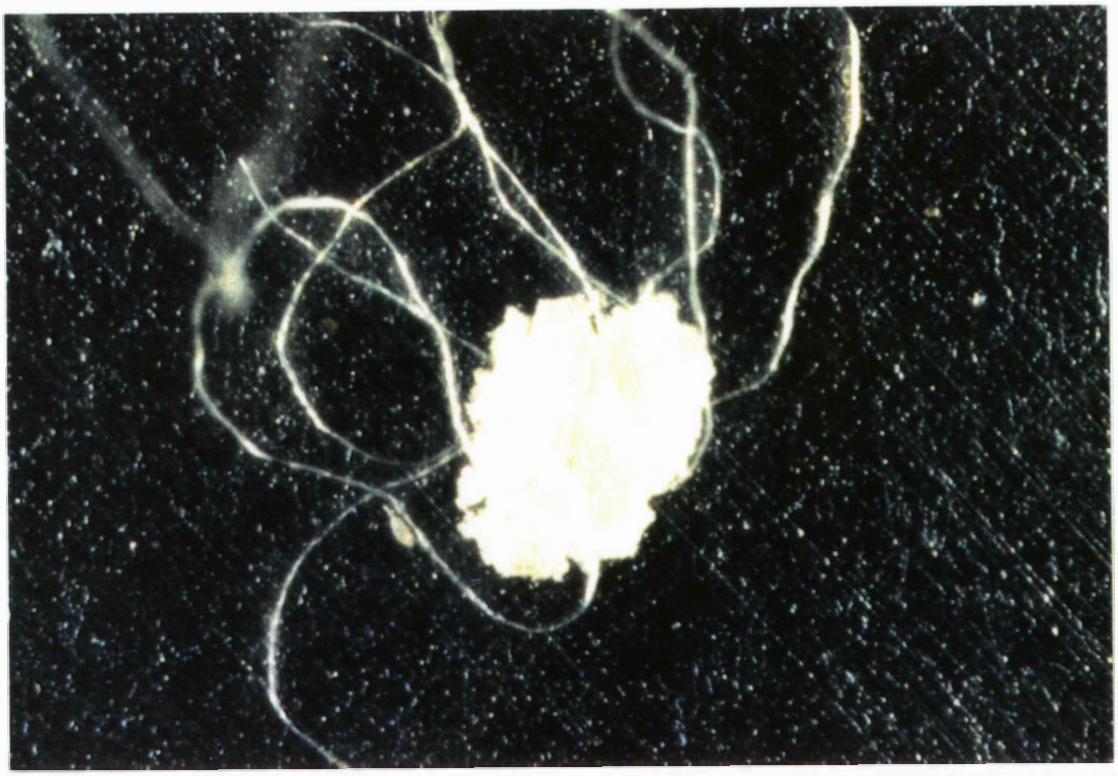

Figure 3: Crush kernel on card rolls (glandless variety without gossypol)

Figure 4: Aphid (Aphis gossypii) on the underside of the leaves

Figure 5: Adult whitefly (Bemisia tabacii) on the underside of the leaves

Figure 6: Deposits of honeydew on cotton leaves

Figure 7: Drops of honeydew on cotton bolls

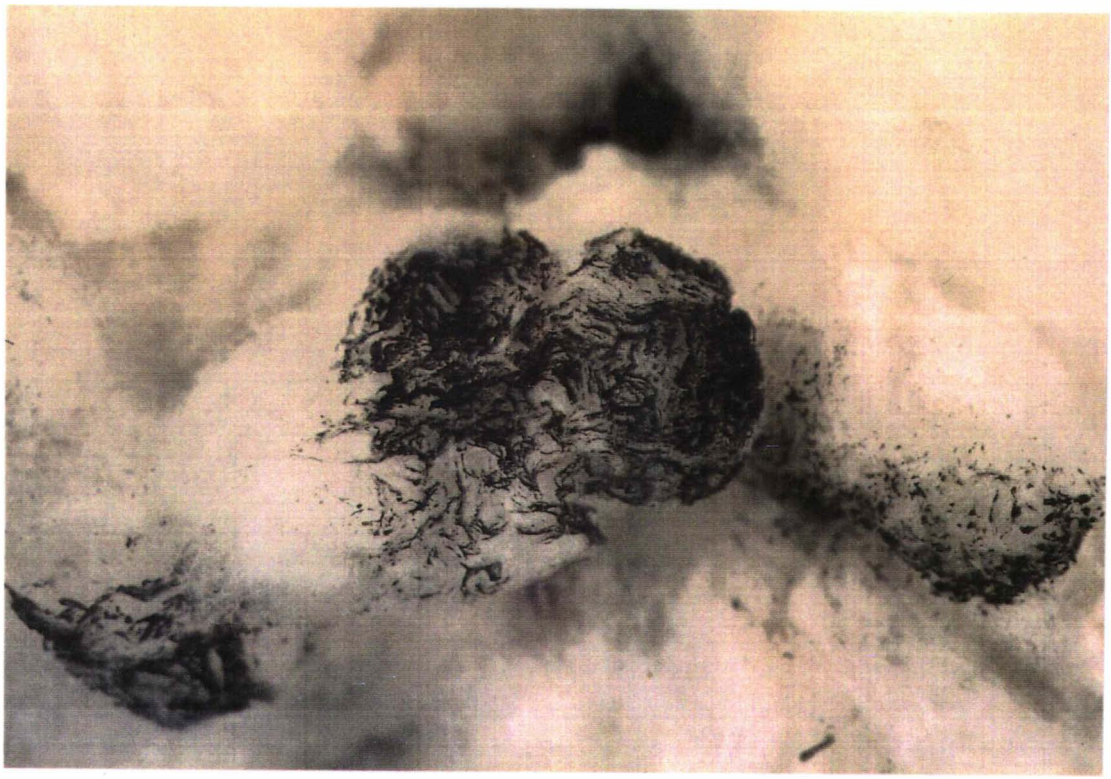

Figure 8: Heavy fumagin on lint contaminated by honeydew

Figure 9: Fumagin on lint without contamination by honeydew

Figure 10: Drop of honeydew falling off a leaf

Figure 11: Honeydew on lint: looks like burnt sugar

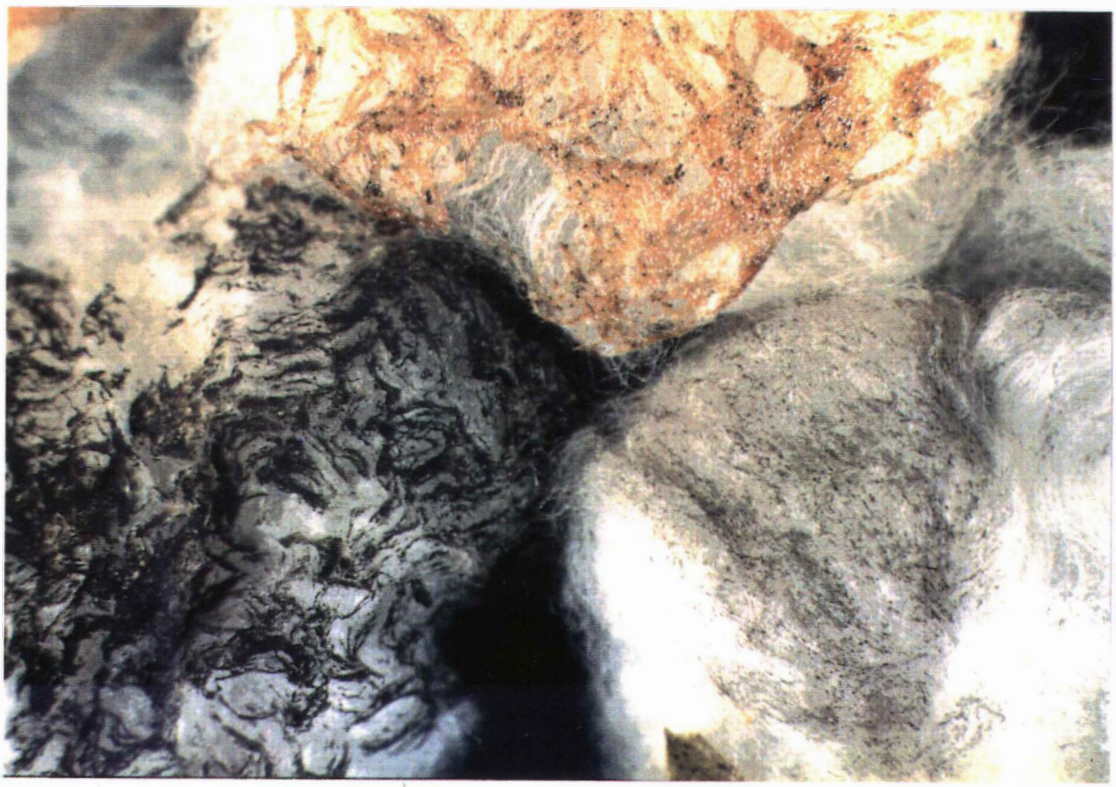

Figure 12: Different types of contamination

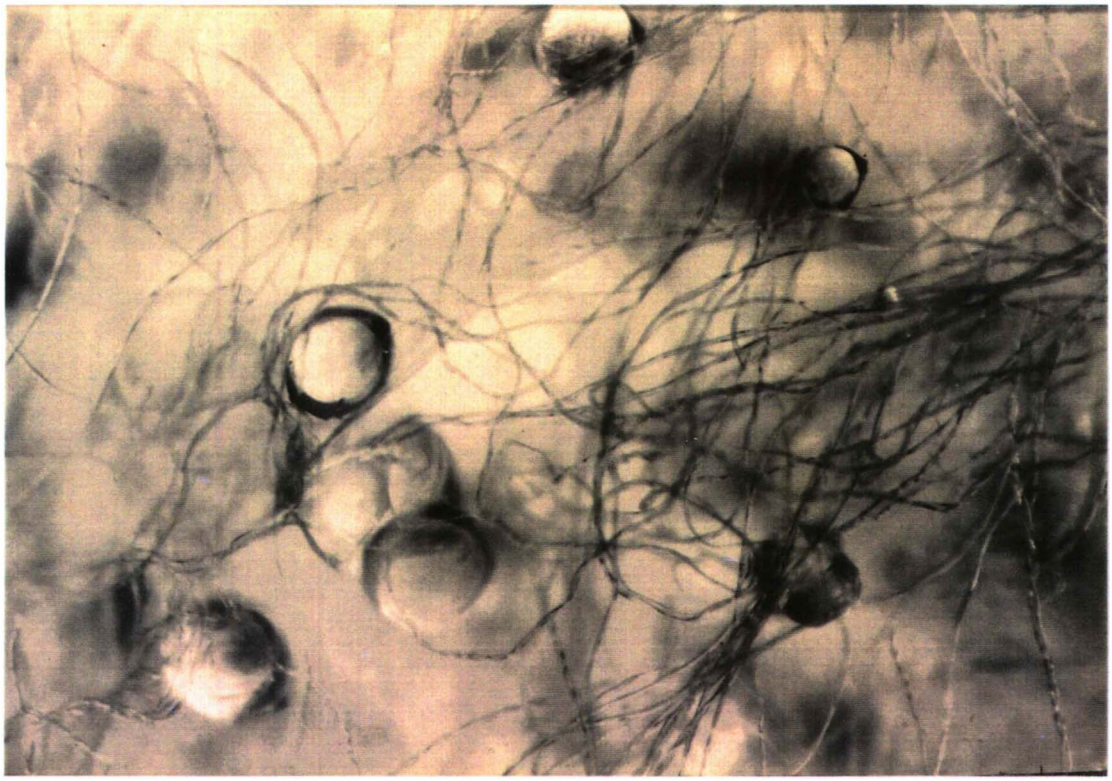

Figure 13 : Droplets scatter in the lint

Country	Number of SCT
Italy	11
France	9
Switzerland	8
Germany	3
Portugal	1
United Kingdom	1
Netherland	2
Czechoslovakia	1
Turkey	1
China	1
U.S.A.	1
Madagascar	5
Ivory Coast	1
Chad	2
Mali	2
Togo	2
Cameroun	1
Sénégal	1
Total	53

Figure 14: Sticky Cotton Thermodetector Worlwide intallations

Figure 15: Small sticky spot with attached fibers

Figure 16: Group of two sticky spots burnt sugar type with attached fibers

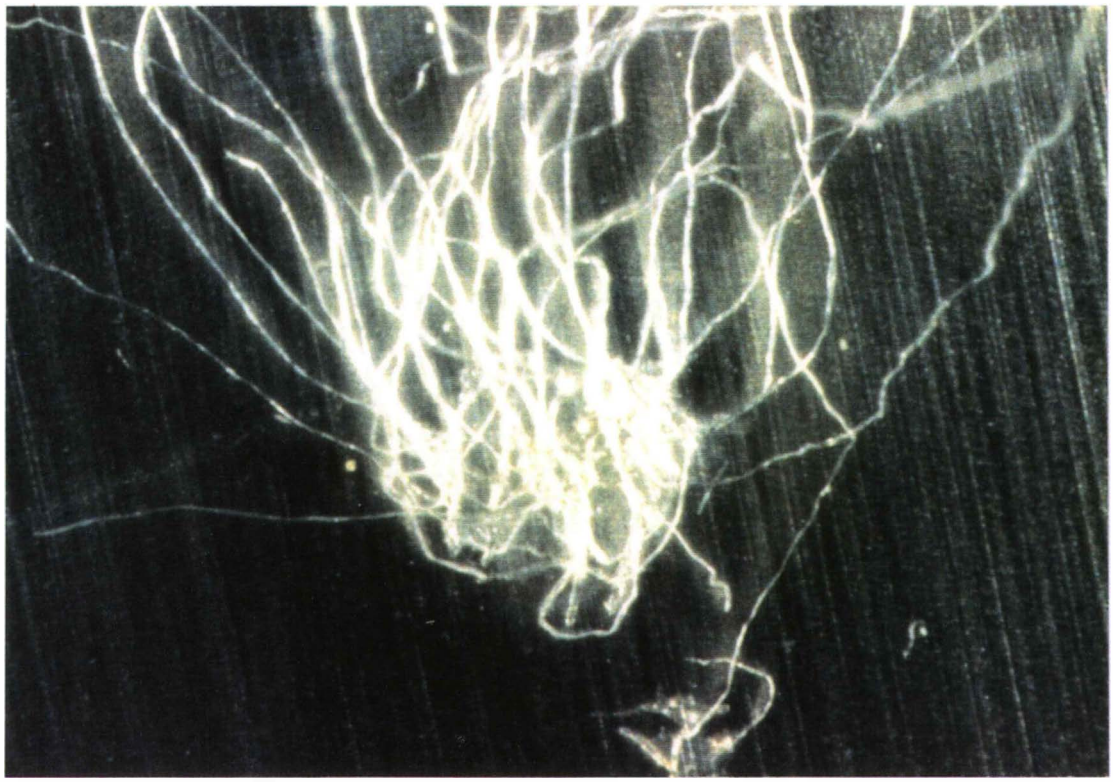

Figure 17: Sticky spot transparent type with attached fibers

Figure 18: Small sticky spot contaminated with fumagin

Figure 19: Big sticky spot contaminated with fumagin

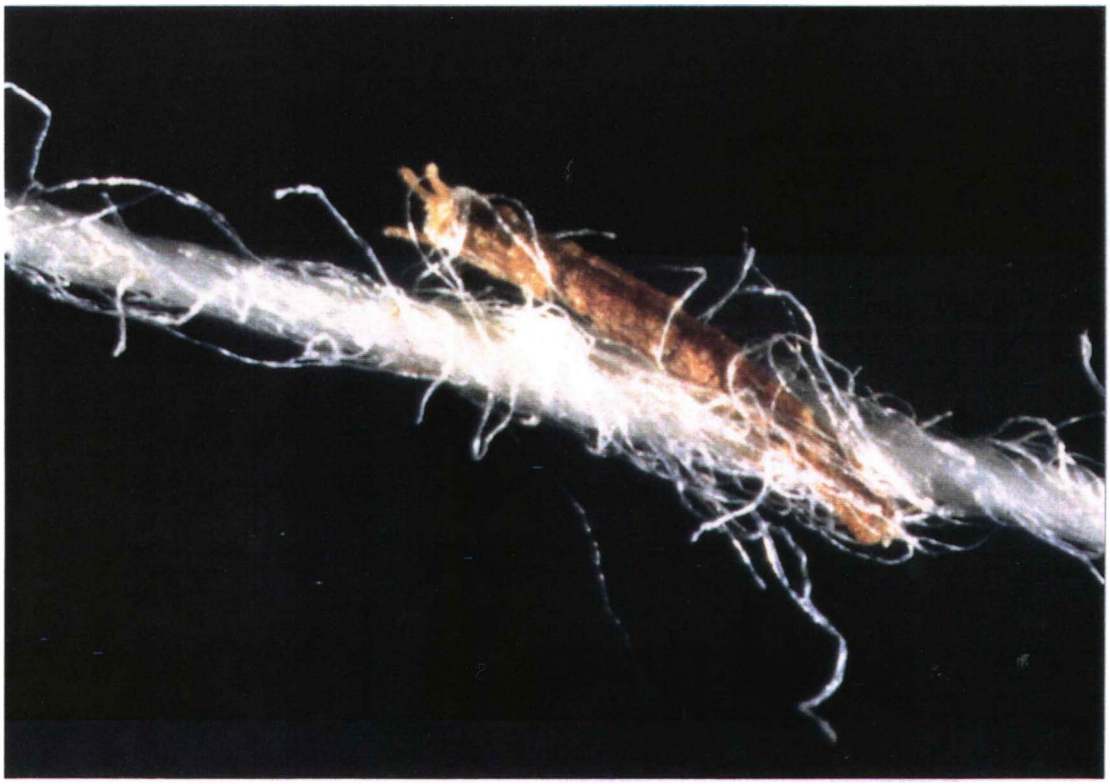

Figure 20: Yarn imperfection: vegetal fragment

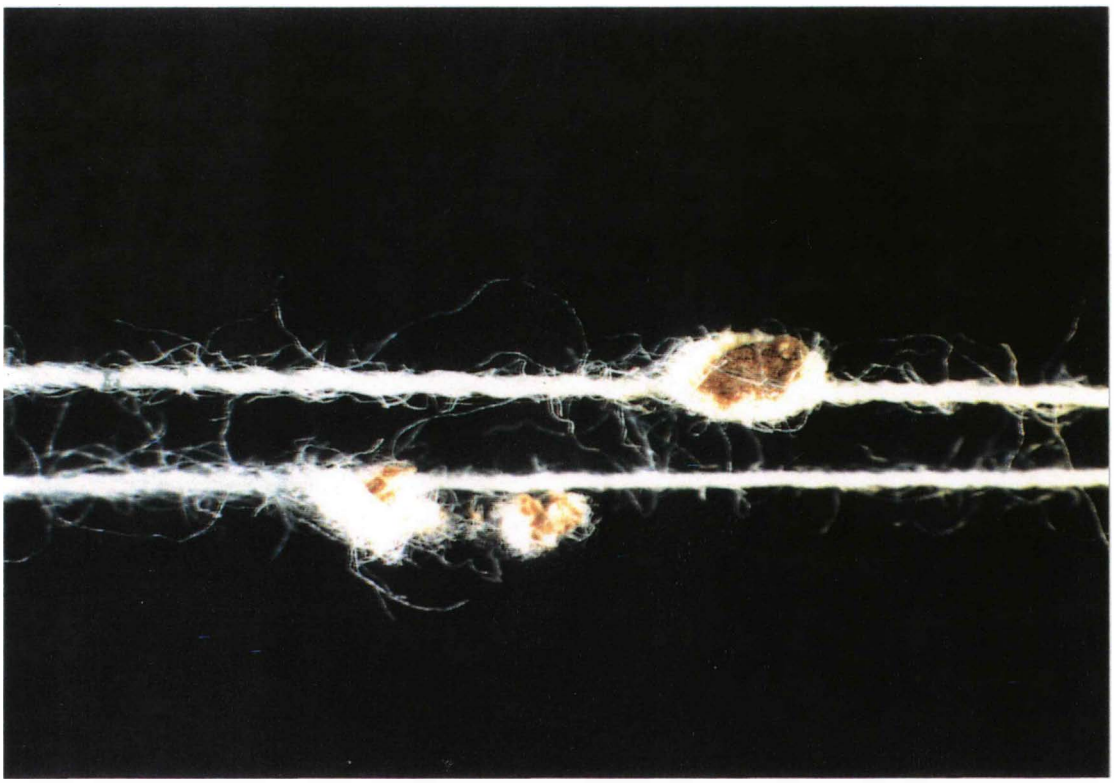

Figure 21: Yarn imperfection:
seed coat fragment

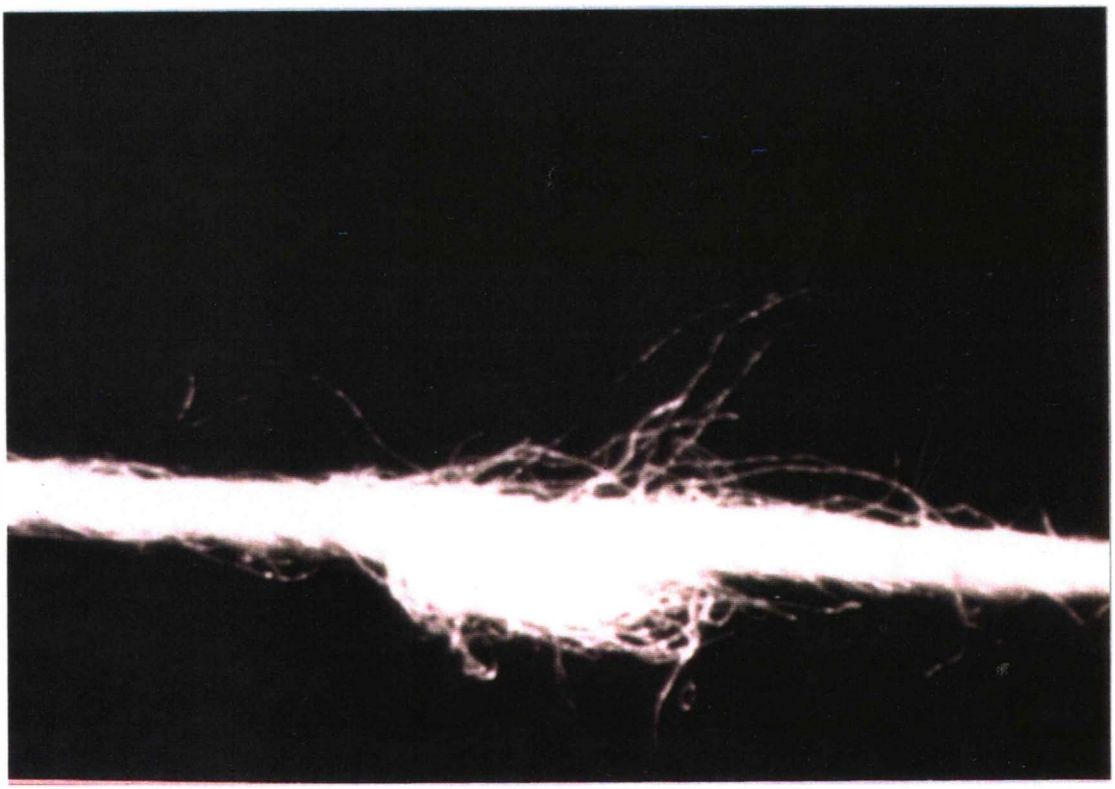

Figure 22: Yarn imperfection:
real fiber neps

Figure 23: Yarn imperfection: sticky neps

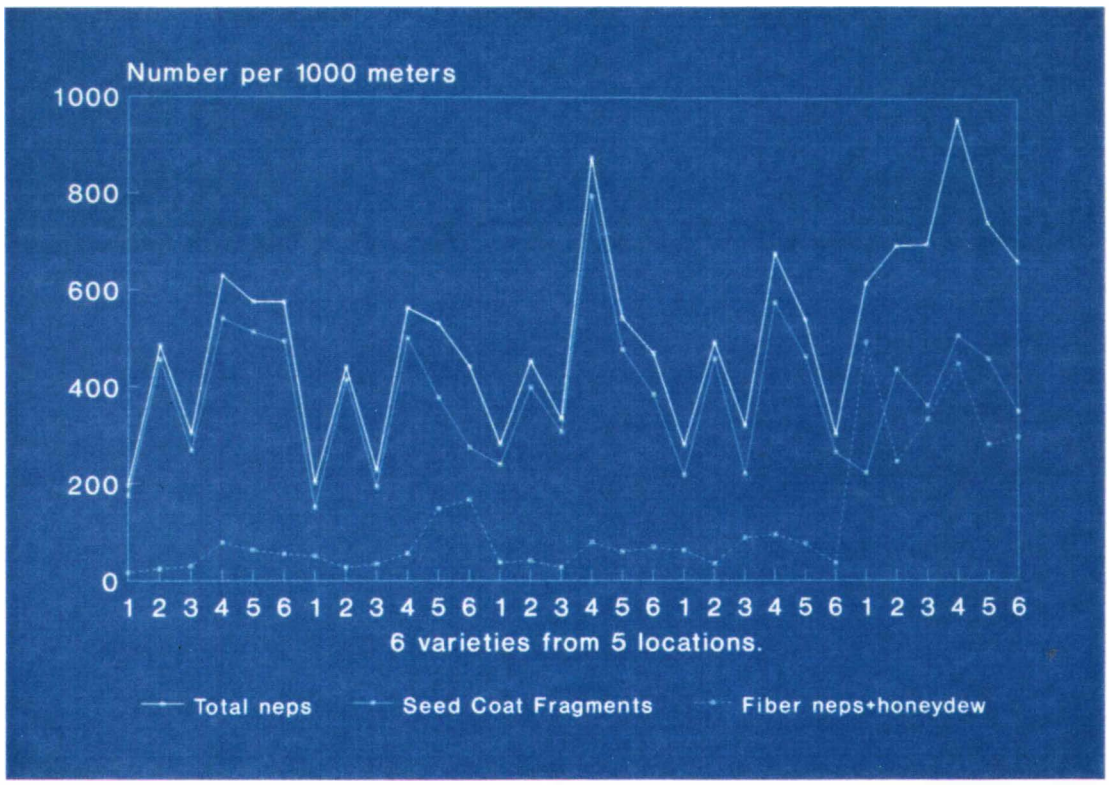

Figure 24: Effect of stickiness on yarn neps content (USTER)

Range of stickiness	Range of stickiness
Slight+moderate+high 1 to 116 sticky spots	Slight+moderate 1 to 29 sticky spots
Neps = 1.25*SCF +22	Neps = 1.12*SCF +28
R2 = 80.6%	R2 = 91.9%
Neps = 1.11*SCF +2.64*Stick +7	Neps = 1.11*SCF +2.19*Stick +12
R2 = 92.5%	R2 = 92.9%

Fiber neps = 2.79*stickiness + 32 R2 = 66.0%

Figure 25 : Effect of stickiness on yarn neps content

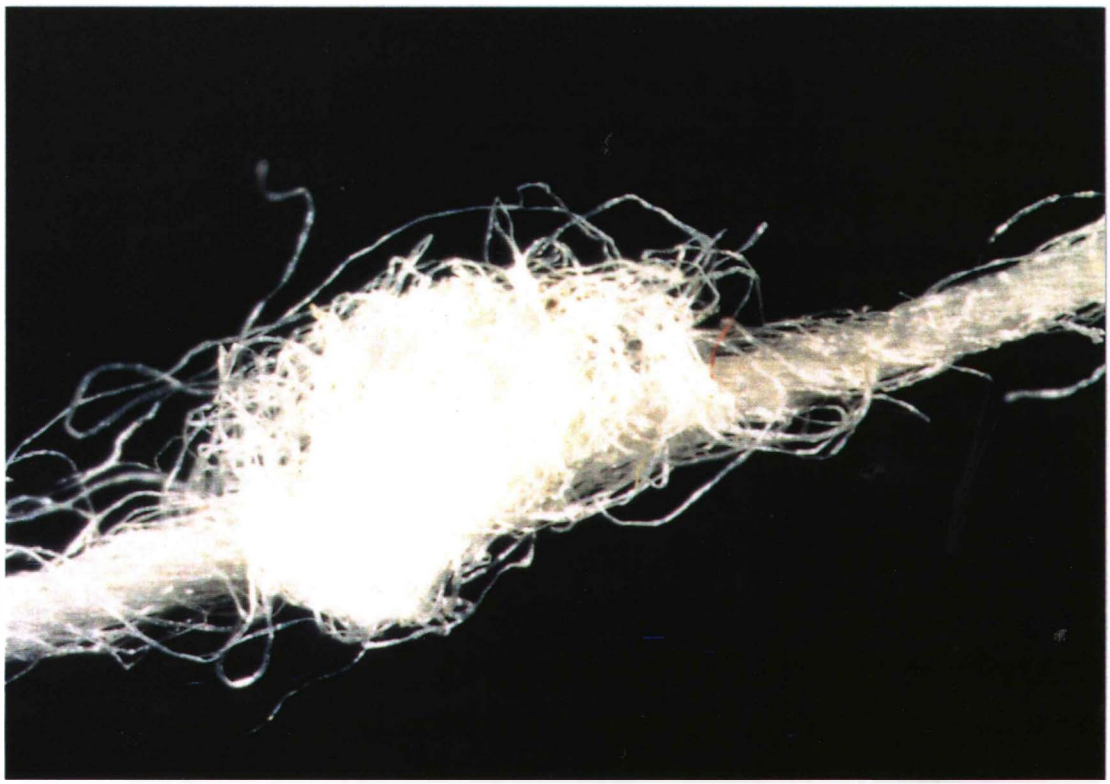

Figure 26 : Yarn neps produced by troubles during the ring spinning process

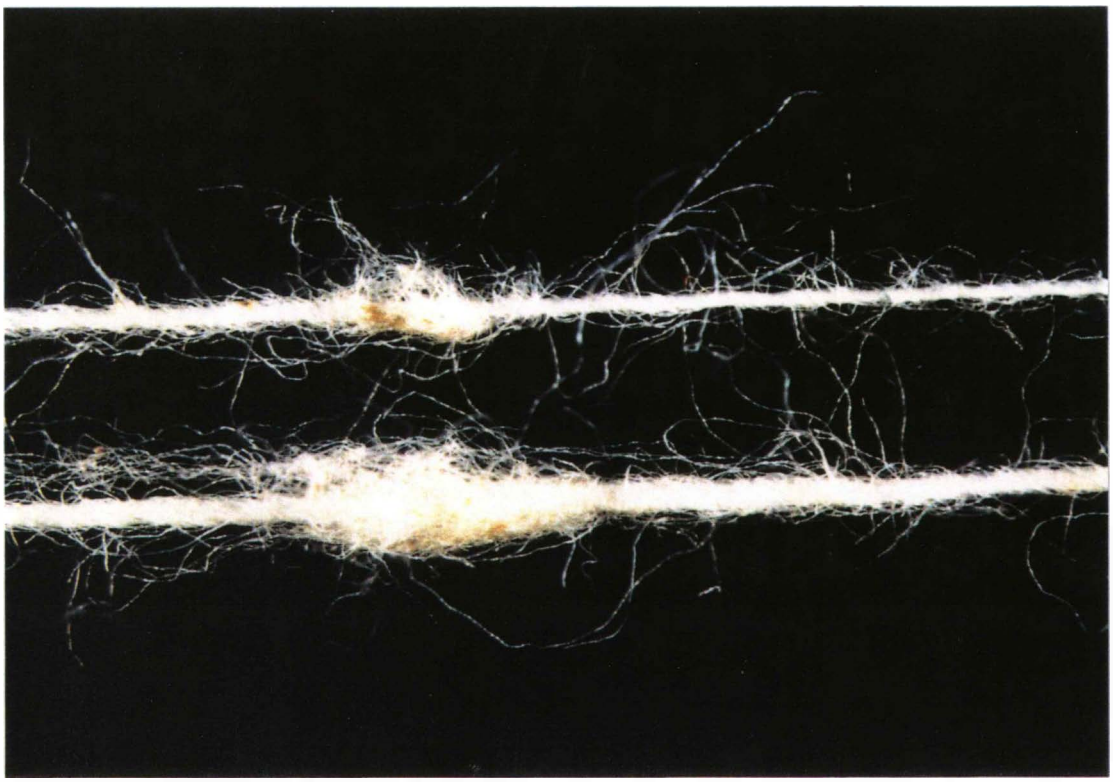

Figure 27: Yarn neps with small sticky spots

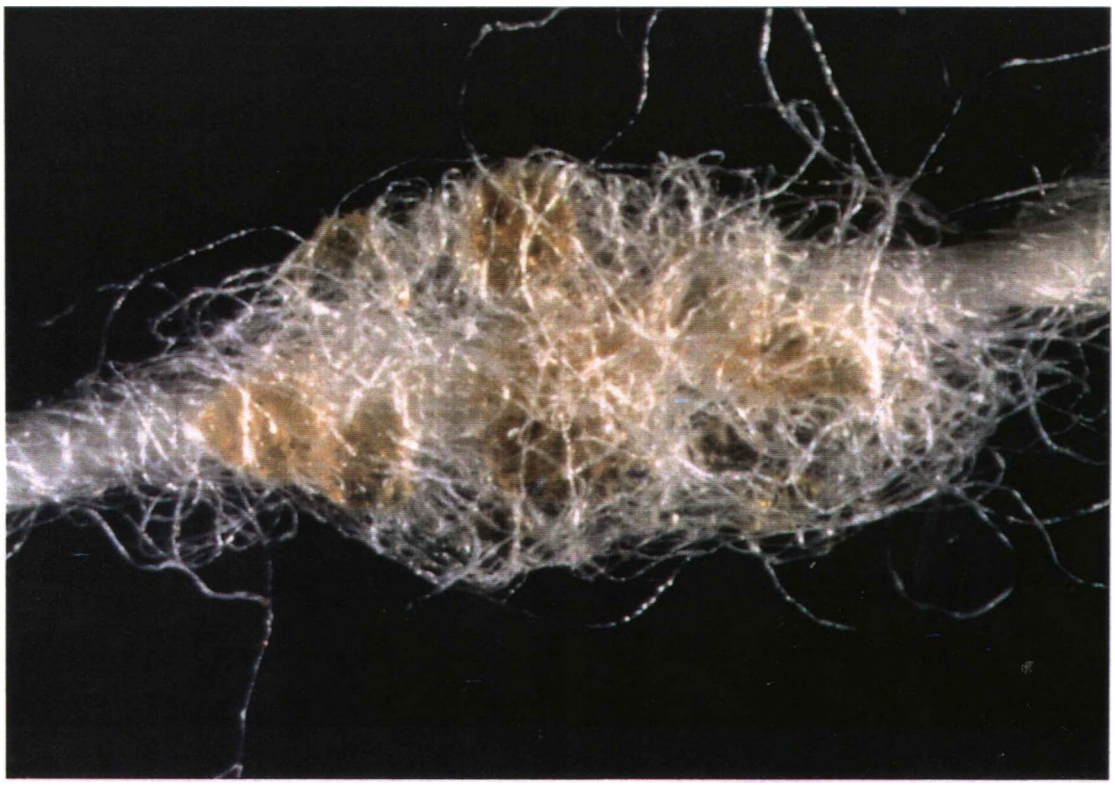

Figure 28: Yarn neps with big sticky spots

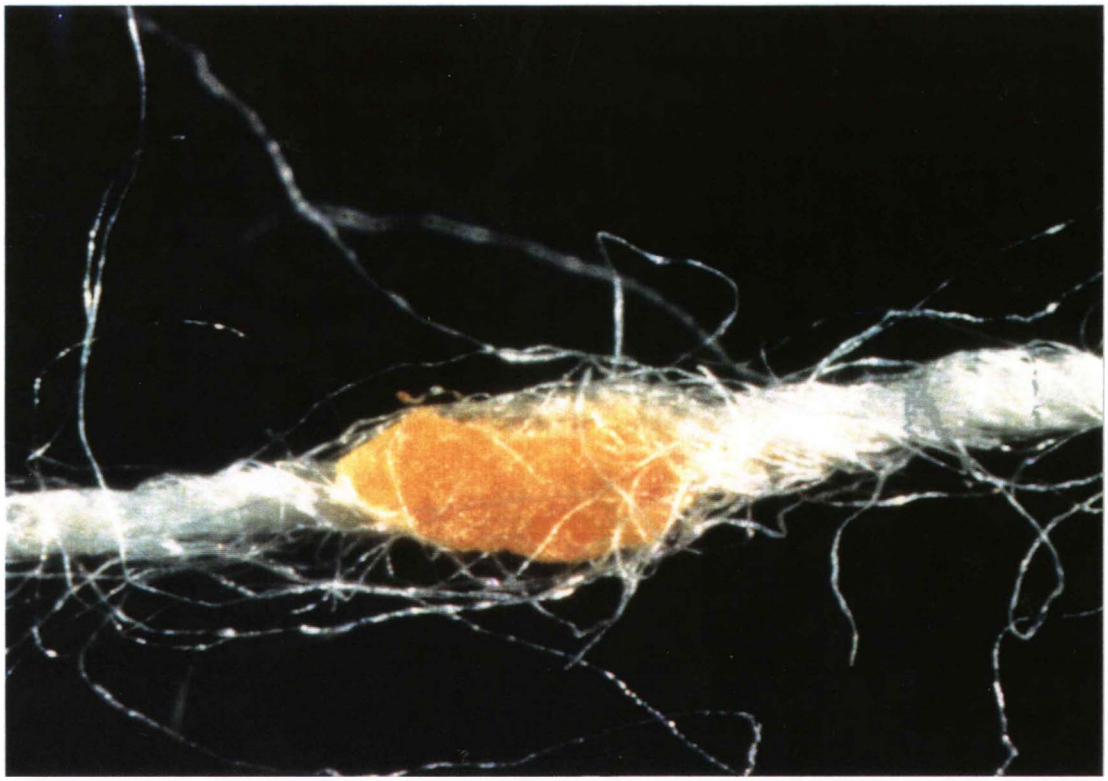

Figure 29: Yarn neps with big cristaline sticky spot