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TEXTILE TECHNOLOGY

High-Speed Stickiness Detector Measurement: Effect of Temperature Settings and Relative Humidity

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INTERPRETIVE SUMMARY

Cottons contaminated with stickiness cause multiple problems in textile mills. The contaminants are essentially sticky deposits consisting of physiological and/or entomological sugars. During yarn manufacturing, all textile equipment is contaminated with these sugar deposits, affecting productivity and yarn quality.

We selected 150 cotton bales representing a wide range of stickiness and types of contamination from whiteflies, aphids, and physiological sugars. These samples came from three different growing regions: one known to have large whitefly populations and very few aphids (Area 1), one where both types of insects coexist (Area 2), and one where large populations of aphids exist and very few whiteflies (Area 3). In addition for Area 3, high physiological sugar contents could be obtained after the cotton plant had been exposed to freezing temperatures for several hours. This could also happen in Area 2, but is a rare event there. The bales were sampled, and then the samples were tested on the high-speed stickiness detector; the sugar contents were evaluated with high-performance liquid chromatography.

Previous work showed individual sugars present on contaminated cotton lint have different hygroscopic and thermal properties. Therefore, we investigated the effects of relative humidity, ambient laboratory conditions, and hot plate temperature settings on the high-speed stickiness detector readings.

The study showed significant effects of the relative humidity and the high-speed stickiness detector hot plate temperature settings on stickiness measurement. By testing at a lower relative humidity (55% ± 2% instead of 65% ± 2%), the high-speed stickiness detector readings were significantly lower: 23.2% (on the square root transformed data).

The samples were tested first on the high-speed stickiness detector at the recommended manufacturer's setting for the hot plate (53 °C). Next tests were performed at hot plate temperatures of 27 °C, 34 °C, 40 °C, and 67 °C. The high-speed stickiness detector readings on the contaminated cottons were 31.8% higher (for square root transformed data) when tests were performed at a high temperature (67 °C) than when done at 53 °C. There was no significant interaction between the growing area and temperature. However, at low temperatures (34 °C and 27 °C), significant interactions between the growing area and temperature were noted. For instance, at 27 °C, the high-speed stickiness detector readings were lower than the readings obtained at 53 °C: 46.4% for Area 1, 54% for Area 2, and 68.7% for Area 3 (all percentages calculated on square root transformed data). This suggests that the origin of the contamination (whiteflies or aphids) may affect the high-speed stickiness detector readings. Cottons significantly contaminated with whitefly honeydew appear sticky on the high-speed stickiness detector, regardless of the temperature setting, while cottons contaminated with aphid honeydew appear sticky at high temperature settings and slightly or non-sticky at low temperature settings.

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ABSTRACT

We selected 150 cotton (*Gossypium hirsutum* L.) bales representing a wide range of stickiness and types of contamination from whiteflies, aphids, and physiological sugars. These samples came from three different growing regions: one known to have large whitefly populations and very few aphids (Area 1), one where both types of insects coexist (Area 2), and one where large populations of aphids exist with very few whiteflies (Area 3). We investigated the effects of the relative humidity of ambient conditions and of the

temperature of the hot plate of the high-speed stickiness detector on cotton stickiness measurement. When we lowered the relative humidity (from 65% ± 2% to 55% ± 2%), the high-speed stickiness detector readings were significantly lower: 23.2% (on the square root transformed data). We also studied the effects of hot plate temperature settings of the high-speed stickiness detector; nearly all contaminated cottons that were sticky at 53°C were stickier at 67°C. We noticed no interaction between the growing area and temperature. However, at low temperature settings (34°C and 27°C), we noticed significant interactions between the growing area and temperature. For instance, at 27°C, the high-speed stickiness detector readings were lower than the readings obtained at 53°C: 46.4% for Area 1, 54% for Area 2, and 68.7% for Area 3. This suggests that the origin of the contamination (whiteflies or aphids) may affect the high-speed stickiness detector readings.

In spinning mills, cottons contaminated with stickiness are causing serious problems. The honeydew present on the cotton lint contaminates all the mechanical instruments used in transforming fiber to yarn: opening, carding, drawing, roving, and spinning operations. These contaminants are mainly sugar deposits produced either by the cotton plant itself (physiological sugars) or by feeding insects (entomological sugars), the latter being the most common source of contamination (Sisman and Schenek, 1984).

Tarczynski et al. (1992) used the aphis-stylet technique to obtain pure phloem sap from cotton plants to show that the major sugar translocated is sucrose ($C_{12}H_{22}O_{11}$) (>90%). Therefore, the presence of sucrose in the cotton lint reveals that the plant was still growing when either (i) freezing temperatures occurred, killing the plant so quickly that the sucrose within the fiber lumen was not metabolized into cellulose, or (ii) harvest-aids had caused some bolls to open prematurely.

Cotton stickiness is more often caused by insect honeydew than by physiological sugars. The main honeydew-producing insects that infest cotton plants are the cotton whitefly, *Bemisia tabaci* (Gennadius), and the cotton aphid, *Aphis gossypii* (Glover). Whiteflies and aphids are both plant sap-sucking insects that feed by inserting their mouthparts and stylets into the leaf tissues. The insects digest the sap and eject it as a droplet of honeydew. The honeydew attaches itself to the leaves and the fibers of opened bolls. The ginning process scatters the honeydew, making it difficult to detect with the naked eye.

Hendrix et al. (1992) analyzed honeydew from *A. gossypii* and *B. tabaci* and found 38.3% melezitose ($C_{18}H_{32}O_{16}$) plus 1.1% trehalulose ($C_{12}H_{22}O_{11}$) in the aphid honeydew, and 16.8% melezitose plus 43.8% trehalulose in the whitefly honeydew. Other relative percentages may occur, depending on the environmental or feeding conditions.

In a previous work, Hequet and Abidi (2002) showed that sugars found in contaminated cotton with honeydew have different thermal and hygroscopic properties. Therefore, we decided to investigate the effects of the relative humidity of the laboratory ambient conditions and of the hot plate temperature settings of the high-speed stickiness detector on cotton stickiness measurements.

MATERIALS AND METHODS

Materials

We selected 150 commercial cotton bales representing a wide range of stickiness and types of contamination from whiteflies, aphids, and physiological sugars. Samples came from three different growing regions. Fifty bales came from Area 1, known to have large whitefly populations and very few aphids. Fifty bales came from Area 2, where both types of insects coexist. Fifty bales came from Area 3, where large populations of aphids and very few whiteflies exist. The bales were broken and two samples per bale were taken. The sugars present on the contaminated lint were identified and quantified using high-performance liquid chromatography (Dionex Corporation, Sunnyvale, CA). In addition, each sample was tested on the high-speed stickiness detector (CIRAD, Montpellier, France).

High-Performance Liquid Chromatography on Fiber Samples

For each sample, 1 g of cotton fibers was placed into a plastic bag, and 20 mL of 18.2-megohm water was added. A sample of the aqueous solution was taken from the bag with a 10-cm^3 syringe (Becto

Dickinson and Company, Franklin Lakes, NJ) to which a 0.2-μm filter (nylon membrane polypropylene housing) (National Scientific, Scottsdale, AZ) was attached. A 1.5-mL filtered sample was deposited into a 1.5-mL autosampler vial (C4013-15A, National Scientific, Scottsdale, AZ). Sugars were separated on columns (CarboPac PA1 anion-exchange guard column [Dionex Corporation, Sunnyvale, CA] and two CarboPac PA1 anion-exchange analytical columns [Dionex Corporation]) in series with a gradient eluent system. Eluent 1 was 200 m*M* NaOH, and Eluent 2 was 500 m*M* sodium acetate ($C_3H_3NaO_2 \cdot 3H_2O$) and 200 m*M* NaOH. Three replications were performed on each sample (two samples per bale × three replications = six tests per bale). The results were expressed in percentage of the fiber weight and in percentage of the total sugars.

High-Speed Stickiness Detector

The high-speed stickiness detector is derived from the sticky cotton thermodetector (CIRAD, Montpellier, France), which was approved as a reference test by the International Textile Manufacturers Federation in 1994 (Frydrych and Hequet, 1998). The high-speed stickiness detector is an automated version of the sticky cotton thermodetector (Frydrych et al., 1994). First, a sample of cotton weighing between 3.0 and 3.5 g is opened using a rotor-type opener. The mass of opened fiber is then shaped into a rectangular, even pad of fibers. This pad is deposited by the system onto aluminum foil. Then the sample passes successively in front of four stations. Hot pressure is applied to the sample (53 °C, 30 s). This renders the honeydew sticky. The sticky points in contact with the aluminum are then fixed in place by means of pressure exerted at ambient air temperature. The loose cotton fibers are removed using a vacuum and a cleaning roll. The sticky spots still adhering to the aluminum foil are counted and sized by an image analyzer.

As shown previously (Hequet et al., 1997), the high-speed stickiness detector readings within a sample follow a Poisson-like distribution; therefore, a square root transformation is adequate to normalize data prior to statistical analysis. Consequently, all statistical analyses were performed on square root transformed data. Three replications were performed on each sample (two samples per bale × three replications = six tests per bale).

High-Speed Stickiness Detector Test at Two Different Relative Humidities

The effect of the relative humidity on the stickiness readings was determined under the following conditions: 55% ± 2% relative humidity, 23 °C ± 1 °C; and 65% ± 2% relative humidity, 21 °C ± 1 °C. The USDA-AMS (1993) recommends that samples be conditioned at least 48 h before testing. Thus, the high-speed stickiness detector instruments and samples were conditioned 96 h before testing to ensure that both the instruments and the cotton were in equilibrium with the laboratory conditions. The hot plate temperature of the high-speed stickiness detector was set at 53 °C (recommended manufacturer's setting).

High-Speed Stickiness Detector Test at Several Hot Plate Temperature Settings

Measurements were done at the recommended manufacturer's setting (53 °C) for the high-speed stickiness detector hot plate. Then tests were performed at hot plate temperatures of 27 °C, 34 °C, 40 °C, and 67 °C, under standard laboratory conditions (65% ± 2% relative humidity and 21 °C ± 1 °C). The manufacturer's choice of 53 °C for the hot plate temperature setting is not documented in the literature.

RESULTS AND DISCUSSION

Sucrose ($C_{12}H_{22}O_{11}$) is virtually the only sugar in the phloem sap of cotton (Hendrix et al., 1992). Insects produce trehalulose and melezitose by isomerization and polymerization of sucrose; neither of these sugars occurs in the cotton plant (Hendrix, 1999). Therefore, their presence on cotton lint demonstrates honeydew contamination.

Bales were selected on the basis of their insect sugar content. Table 1 shows results from high-performance liquid chromatography, expressed as a percentage of the fiber weight. Examination of this table reveals that all cottons were contaminated with insect honeydew to some degree. When expressed as

Table 1. Sugar contents, measured by high-performance liquid chromatography for the three growing areas, expressed as a percentage of the fiber weight.

		Sugar contents†								
Area		In	Treh	Gluc	Fruc	Trehal	Suc	Mel	Mal	Total
		% of fiber weight								
1	Average	0.035	0.018	0.043	0.059	0.103	0.000	0.052	0.018	0.328
	Minimum	0.011	0.006	0.010	0.009	0.003	0.000	0.000	0.000	0.064
	Maximum	0.068	0.046	0.107	0.146	0.358	0.003	0.160	0.074	0.940
2	Average	0.061	0.003	0.073	0.107	0.073	0.011	0.088	0.003	0.419
	Minimum	0.042	0.000	0.034	0.010	0.001	0.000	0.017	0.001	0.114
	Maximum	0.074	0.010	0.110	0.187	0.236	0.037	0.201	0.009	0.794
3	Average	0.035	0.011	0.055	0.067	0.000	0.024	0.026	0.006	0.225
	Minimum	0.018	0.002	0.020	0.010	0.000	0.001	0.002	0.001	0.074
	Maximum	0.053	0.029	0.147	0.215	0.002	0.088	0.079	0.017	0.462

† In, inositol; Treh, trehalose; Gluc, glucose; Fruc, fructose; Trehal, trehalulose; Suc, sucrose; Mel, melezitose; Mal, maltose; Total, total sugars.

Table 2. Sugar contents, measured by high-performance liquid chromatography for the three growing areas, expressed as a percentage of the total sugars.

		Sugar contents†							
Area		In	Treh	Gluc	Fruc	Trehal	Suc	Mel	Mal
		% of total sugar							
1	Average	13.7	6.3	16.9	20.6	23.7	0.3	14.2	4.2
	Minimum	6.4	3.1	8.2	12.7	2.8	0.0	0.0	0.3
	Maximum	21.0	14.7	33.6	35.1	41.7	1.5	36.7	10.7
2	Average	19.1	1.1	20.1	24.4	13.5	2.3	18.7	0.7
	Minimum	7.9	0.2	12.1	8.6	0.7	0.1	7.0	0.3
	Maximum	36.9	5.1	36.5	36.5	29.4	5.9	25.6	1.4
3	Average	17.6	5.8	25.4	28.2	0.2	8.9	11.4	2.6
	Minimum	8.4	0.9	13.8	13.1	0.0	1.4	2.4	0.3
	Maximum	33.3	16.3	37.3	46.5	1.7	23.8	28.3	6.9

† In, inositol; Treh, trehalose; Gluc, glucose; Fruc, fructose; Trehal, trehalulose; Suc, sucrose; Mel, melezitose; Mal, maltose.

a percentage of the total sugars (Table 2), the average trehalulose content for Area 1 was 67% higher than the melezitose content, revealing whitefly honeydew contamination. For Area 2, the average trehalulose content was 28% lower than the melezitose content, revealing a probable contamination by whitefly and aphid honeydew. For Area 3, the average trehalulose content represented <2% of the melezitose content, revealing aphid honeydew contamination.

Hequet and Abidi (2002) showed that the individual sugars present on sticky cotton have different hygroscopic properties. Among the sugars tested, trehalulose and fructose ($C_6H_{12}O_6$) have the highest hygroscopicity. After equilibrium is attained, the amount of adsorbed water at 65% relative humidity and at 21 °C corresponds to three molecules of H_2O adsorbed per molecule of trehalulose or fructose. This adsorption suggests a relationship between the water content of the raw material and stickiness and confirms the findings from previous work reporting that stickiness caused by honeydew depends on the relative humidity (Gutknecht et al., 1986; Frydrych et al., 1993). Consequently, we decided to test the samples at two different relative humidities. The lower level (55% ± 2%) was selected to represent common ring spinning conditions. The higher level (65% ± 2%) was selected to represent a standard textile laboratory atmosphere according to American Society for Testing and Materials (2001) standard practice D 1776. A linear relationship is shown between square-root transformed data collected at the manufacturer's recommended hot

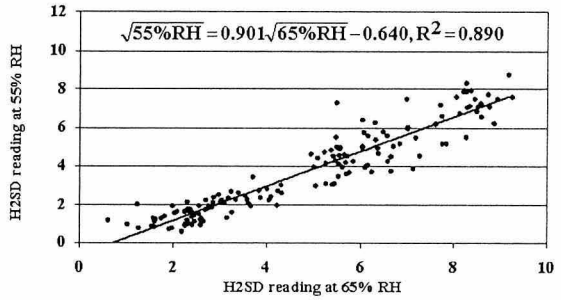

Fig. 1. Relationship between square-root-transformed readings from the high-speed stickiness detector (H2SD) at 65% ± 2% relative humidity (RH), 21°C ± 1°C and at 55% ± 2% RH, 23°C ± 1°C.

Table 3. Variance analysis on the square root transformed data: effect of growing area and relative humidity on high-speed stickiness detector readings (H2SD).

		df†	*F*†	Probability	H2SD‡
	Intercept	1	1093.26	0.0001	
	Area	2	6.20	0.0023	
	1				4.336 a§
	2				3.671 b
	3				4.774 a
	RH	1	18.85	0.0001	
	55%				3.701 b
	65%				4.820 a
Area	RH	2	0.11	0.8990	
1	55%				3.752
	65%				4.919
2	55%				3.193
	65%				4.148
3	55%				4.157
	65%				5.392
	Error	294			

† df, degrees of freedom; *F*, variance ratio.
‡ Square root transformed.
§ Readings not followed by the same letter are significantly different with a = 5% (according to the Newman-Keuls test).

plate temperature (53°C) for the high-speed stickiness detector performed at 55% ± 2% relative humidity and 23°C ± 1°C and at 65% ± 2% relative humidity and 21°C ± 1°C (Fig. 1). The square root transformed high-speed stickiness detector readings at 55% ± 2% relative humidity were, on average, 23.2% lower (Table 3). No significant interaction between the growing area and the relative humidity was noticed, suggesting that the moisture adsorption equilibrium of the sugars involved in the stickiness

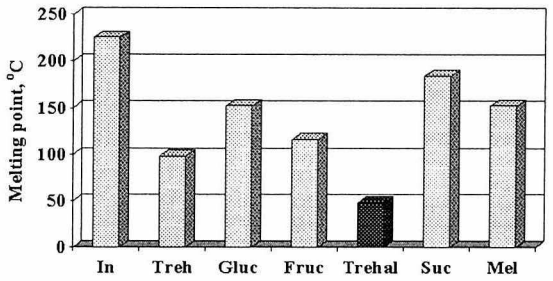

Fig. 2. Melting points of selected sugars. In = inositol, Treh = trehalose, Gluc = glucose, Fruc = fructose, Trehal = trehalulose, Suc = sucrose, Mel = melezitose.

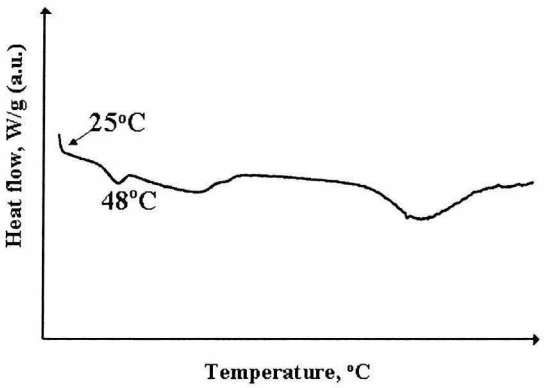

Fig. 3. Differential scanning calorimetry profile of trehalulose (heat rate is 5°C min^{-1} between 25°C and 250°C).

phenomenon is lower at 55% relative humidity than at 65%. Consequently, all of the stickiness readings were lower, but the relative ranking of the three areas was unchanged.

Hequet and Abidi (2002) showed that sugars present on honeydew-contaminated lint have different thermal properties. Figure 2 shows the melting points of inositol ($C_6H_{12}O_6$), trehalose ($C_{12}H_{22}O_{11}$), glucose ($C_6H_{12}O_6$), fructose, trehalulose, sucrose, and melezitose. Trehalulose has the lowest melting point (48°C). Therefore, when testing cotton for stickiness at 53°C (recommended manufacturer's setting for the high-speed stickiness detector), trehalulose, which is mainly present in whitefly honeydew, should melt while the other types of sugars should remain unchanged. Trehalulose begins to melt around 25°C, as shown on the differential scanning calorimetry profile (Fig. 3). Therefore, we can hypothesize that the honeydew droplets having a high percentage of trehalulose would be sticky at any temperature above 25°C, and that the lower the

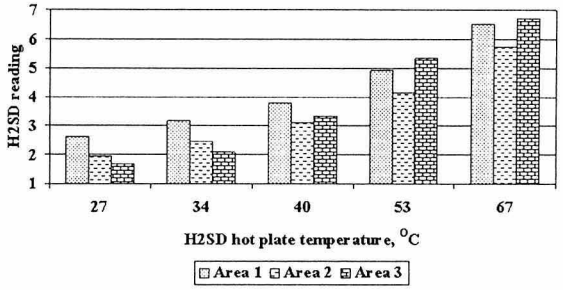

Fig. 4. Effect of hot plate temperature of high-speed stickiness detector (H2SD) on square-root-transformed readings.

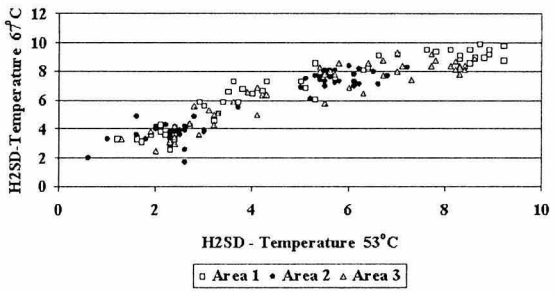

Fig. 5. Square-root-transformed readings from the high-speed stickiness detector (H2SD) at 67 vs. 53°C.

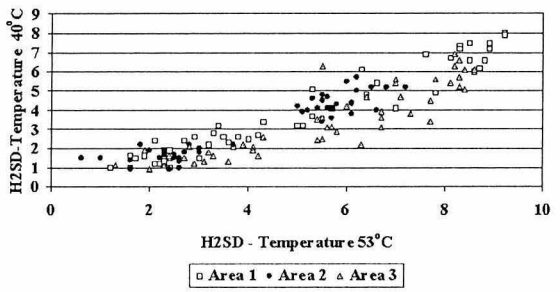

Fig. 6. Square-root-transformed readings from the high-speed stickiness detector (H2SD) at 40 vs. 53°C.

trehalulose percentage in those droplets, the lower the "sticky potential." To confirm this hypothesis, the high-speed stickiness detector hot plate temperature was modified to perform the stickiness measurement at different temperature settings. The following hot plate temperatures were chosen: 27 °C, 34 °C, 40 °C, 53 °C, and 67 °C. All of the tests were performed in standard laboratory conditions at 65% ± 2% relative humidity and 21 °C ± 1 °C.

Figure 4 shows an increase in the high-speed stickiness detector readings with increasing hot plate temperatures for the three areas tested. A significant

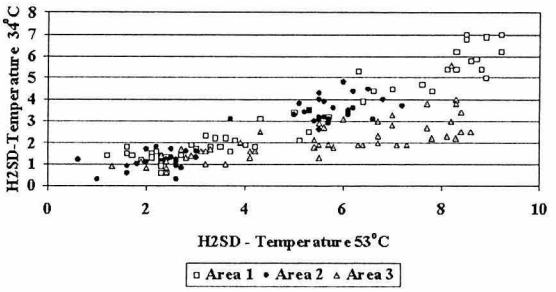

Fig. 7. Square-root-transformed readings from the high-speed stickiness detector (H2SD) at 34 vs. 53°C .

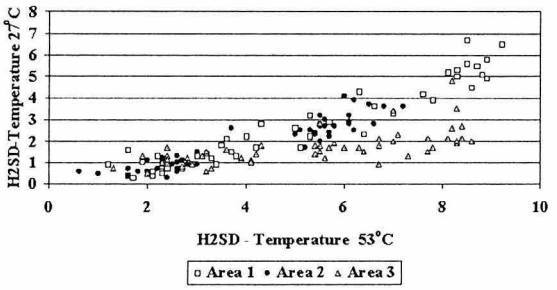

Fig. 8. Square-root-transformed readings from the high-speed stickiness detector (H2SD) at 27 vs. 53°C.

interaction between these two parameters is apparent.

To elucidate this interaction, we decided to plot the high-speed stickiness detector readings at each temperature against the readings at the manufacturer's recommended temperature of 53 °C.

Figures 5 to 8 show the relationship between the high-speed stickiness detector readings (square root transformed) performed at 53 °C and the readings performed at 67 °C, 40 °C, 34 °C, and 27 °C for Area 1, Area 2, and Area 3.

High Speed Stickiness Detector Readings at Various Hot Plate Temperature Settings

Hot Plate Temperature Setting at 67 °C

The three growing areas seemed to follow the same trend; the relationships were not linear, revealing a probable saturation phenomenon (Fig. 5). The image analysis software does not seem to be able to separate two merging sticky spots. When the number of sticky spots on the aluminum foil is large, the probability for two sticky spots to merge is high, making the image analysis software unable to count

Table 4. Variance analysis on the square root transformed data: effect of hot plate temperature setting (67°C) on high-speed stickiness detector readings (H2SD).

		df†	*F*†	Probability	H2SD‡
	Intercept	1	1898.67	0.0001	
	Area	2	6.33	0.0020	
	1				5.735 a§
	2				4.950 b
	3				6.031 a
	Temperature	1	35.86	0.0001	
	53°C				4.814 b
	67°C				6.345 a
Area	Temperature	2	0.09	0.9161	
1	53°C				4.923
	67°C				6.547
2	53°C				4.155
	67°C				5.745
3	53°C				5.340
	67°C				6.723
	Error	294			

† df, degrees of freedom; *F*, variance ratio.
‡ Square root transformed.
§ Readings not followed by the same letter are significantly different with a = 5% (according to the Newman-Keuls test).

Table 5. Variance analysis on the square root transformed data: effect of hot plate temperature setting (40°C) on high-speed stickiness detector readings (H2SD).

		df†	*F*†	Probability	H2SD‡
	Intercept	1	1161.11	0.0001	
	Area	2	3.98	0.0196	
	1				4.363 a§
	2				3.627 b
	3				4.342 a
	Temperature	1	33.19	0.0001	
	40°C				3.417 b
	53°C				4.814 a
Area	Temperature	2	1.59	0.2052	
1	53°C				4.923
	40°C				3.803
2	53°C				4.155
	40°C				3.099
3	53°C				5.340
	40°C				3.345
	Error	294			

† df, degrees of freedom; *F*, variance ratio.
‡ Square root transformed.
§ Readings not followed by the same letter are significantly different with a = 5% (according to the Newman-Keuls test).

accurately above 60 sticky spots. Of course this number needs to be adjusted depending on the size of the sticky spots. The statistical analysis (Table 4) did not show a significant interaction between temperature setting and growing area. At 67°C, the readings averaged 31.8% higher than at 53°C on the square root transformed data.

Hot Plate Temperature Setting at 40°C

For the three growing areas, the relationship between the readings taken at hot plate temperatures of 40°C and 53°C was linear (Fig. 6). The statistical analysis (Table 5) did not show a significant interaction between temperature setting and growing area. The high-speed stickiness detector readings at 40°C averaged 29% lower than the readings obtained at 53°C.

Hot Plate Temperature Setting at 34°C

The relationship between the readings taken at hot plate temperatures of 53°C and 34°C was also linear (Fig. 7), with Area 3 reacting differently as reflected by a highly significant interaction between temperature and growing area (Table 6). The high-speed stickiness detector readings at 34°C, on average, were lower than the readings obtained at 53°C: 35.8% lower for Area 1 (mainly contaminated by whiteflies), 40.9% lower for Area 2 (mixed whitefly and aphid contaminations), and 60.7% lower for Area 3 (mainly contaminated by aphids).

Hot Plate Temperature Setting at 27°C

The relationship between the readings taken at hot plate temperatures of 53°C and 27°C was also linear (Fig. 8), with Area 3 reacting differently as reflected by a highly significant interaction between temperature and growing area (Table 7). The high-speed stickiness detector readings at 27°C, on average, were lower than the readings obtained at 53°C: 46.4% lower for Area 1, 54% lower for Area 2, and 68.7% lower for Area 3. This result supports our hypothesis that trehalulose is sticky even at low temperatures, while melezitose is not.

Figure 9 summarizes the high-speed stickiness detector readings taken at hot plate temperatures of

Table 6. Variance analysis on the square root transformed data: effect of hot plate temperature setting (34°C) on high-speed stickiness detector readings (H2SD).

		df†	*F*†	Probability	H2SD‡
Intercept		1	1108.53	0.0001	
Area		2	3.66	0.0268	
1					4.042 a§
2					3.305 b
2					3.718 ab
Temperature		1	101.73	0.0001	
34°C					2.569 b
53°C					4.814 a
Area	Temperature	2	5.24	0.0058	
1	53°C				4.923 a
	34°C				3.161 c
2	53°C				4.155 b
	34°C				2.456 cd
3	53°C				5.340 a
	34°C				2.096 d
Error		294			

† df, degrees of freedom; *F*, variance ratio.
‡ Square root transformed.
§ Readings not followed by the same letter are significantly different with a = 5% (according to the Newman-Keuls test).

Table 7. Variance analysis on the square root transformed data: effect of hot plate temperature setting (27°C) on high-speed stickiness detector readings (H2SD).

		df†	*F*†	Probability	H2SD‡
Intercept		1	1008.96	0.0001	
Area		2	3.97	0.0199	
1					3.780 a§
2					3.036 b
3					3.507 ab
Temperature		1	158.69	0.0001	
27°C					2.075 b
53°C					4.814 a
Area	Temperature	2	4.71	0.0097	
1	53°C				4.923 a
	27°C				2.636 c
2	53°C				4.155 b
	27°C				1.918 cd
3	53°C				5.340 a
	27°C				1.675 d
Error		294			

† df, degrees of freedom; *F*, variance ratio.
‡ Square root transformed.
§ Readings not followed by the same letter are significantly different with a = 5% (according to the Newman-Keuls test).

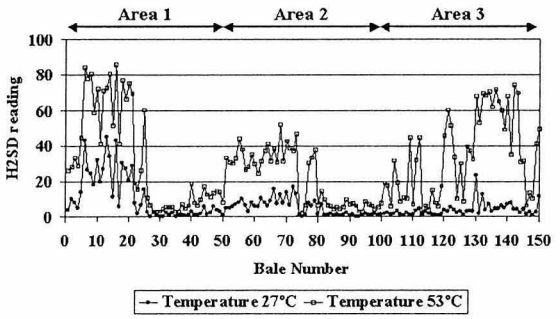

Fig. 9. Readings from the high-speed stickiness detector (H2SD) for 150 bales compared at 27 and 53°C.

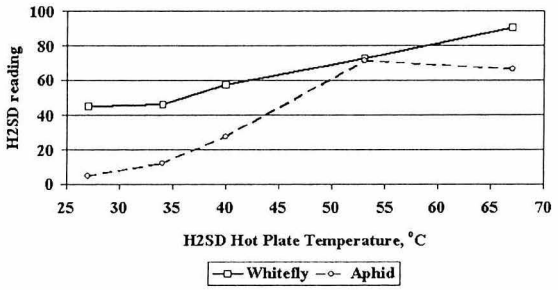

Fig. 10. Effects of the type of honeydew contamination on high-speed stickiness detector (H2SD) readings.

27°C and 53°C for the three growing areas. This figure shows that for Area 1, all of the cottons that tested sticky at 53°C were also sticky at 27°C. For Area 2, most of the cottons that tested sticky at 53°C were slightly sticky at 27°C. However, for Area 3, nearly all the cottons that tested sticky at 53°C were not sticky at 27°C. These results demonstrate clearly an effect of the hot plate temperature of the high-speed stickiness detector on the stickiness readings. They also confirm, as hypothesized earlier, that different behaviors of the honeydew deposits depend upon the origin of the contamination (whitefly or aphid).

Figure 10 shows the high-speed stickiness detector readings for two types of cotton contaminated with whiteflies and aphid honeydew. The two cottons had nearly the same number of sticky spots at 53C (72.8 and 71.7 spots, respectively). However, when the hot plate temperature was lowered from 53C to 27C, the two cottons reacted differently. The cotton

contaminated with whitefly honeydew remained sticky at the lower temperature, whereas the cotton contaminated with aphid honeydew was not sticky at that temperature.

CONCLUSIONS

The results demonstrate the significant effects of the relative humidity on stickiness measurement. When the tests were performed at a lower relative humidity (55% ± 2% instead of 65% ± 2%), the high-speed stickiness detector readings were significantly lower at 23.2%.

The high-speed stickiness detector readings on the contaminated cottons were higher when tests were performed at a high temperature (67°C) than at 53°C, with no significant interaction between the growing area and temperature. However, at 27°C, we noticed significant interactions between the growing area and temperature. The high-speed stickiness detector readings at this temperature were lower: 46.4% lower for Area 1, 54% lower for Area 2, and 68.7% lower for Area 3 - suggesting that the origin of the contamination (whiteflies or aphids) may affect the high-speed stickiness detector readings. Therefore, the question of the most appropriate hot plate temperature setting for the high-speed stickiness detector arises. To answer this question we conducted spinning trials of sticky cottons from different origins representing both whitefly and aphid honeydew contamination. Then we related both productivity and yarn quality parameters to the high-speed stickiness detector readings performed at different hot plate temperature settings. The results of this work will be published in the near future.

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