

A Close Look at Seedcoat Fragments as Measured by AFISPro



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INTRODUCTION

Seed coat fragments (SCF) can cause spinning problems and fabric defects (dark specks), which ultimately cause financial losses to the cotton industry. SCF are parts of a seed coat that have been broken from the surface of either mature or immature seeds during mechanical processing. Seed coat neps are fragments of the cottonseed that still have some fibers attached (Figure 1b). They are counted mainly in ginning when the fibers are being separated from the seed.¹ The objective of this study was to evaluate measurements of SCF by AFISPro, the Advanced Fiber Information System, and compare AFISPro data to the dark specks measured on fabrics. The AFISPro fiber individualizer aeromechanically separates the sample into clean fiber, trash and dust components. These components are transported by air to the respective fiber and trash electro-optical sensors.² The trash sensor optically counts the number of trash and dust particles in a sample. The fiber sensor measures fibers and fibrous neps (Figure 1a) including seedcoat neps with fibers attached (Figure 1b).² SCN is the primary measurement we are interested in. Fibers will produce a rectangular waveform. Nep signals are much greater in magnitude and duration and have a spiked waveform. Seedcoat neps have a larger shadow that fibrous neps. Trash particles produce smaller spiked waveforms that are distinguishable from the nep waveforms in magnitude and duration. From these waveforms, data are acquired, analyzed and stored in the AFIS Pro computer.

MATERIALS AND METHODS

Experiments were conducted with cottons from the ATMI 2001 Variety Study along with two controls, a combed cotton and a polyester. The two controls along with five of the ATMI 2001 cottons were seeded with specific levels of seedcoat fragments (SCF) and trash. Treatments were as follows:

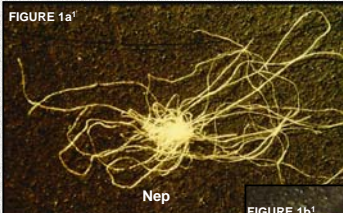
- 1) CLEANED FIBER ONLY;
- 2) 10 SCF, NO TRASH;
- 3) 10 TRASH PARTICLES, NO SCF;
- 4) 10 SCF AND 10 TRASH PARTICLES.

Samples were tested with five replications on AFISPro (Tables 1 & 2).

Experiments were conducted with cottons from the ATMI 2001 & 2002 Variety Studies. Cottons were hand cleaned, to remove trash and SCF from the fiber, to quantify the levels of SCF and trash before testing on AFISPro. Five 0.5 gram hand-cleaned fiber samples were then seeded with the removed SCF and trash and run on AFISPro. The matching bale fiber samples for each variety, without any cleaning were also run on AFISPro. The fabrics were processed from 100 lb lots to yarn and woven as a filling faced sateen fabric with a combed warp where approximately 85% of the experimental yarn is on the face of the fabric. The fabrics (from these fibers) are measured by Autorate an image analysis tool that detects SCF on fabrics. The fiber data was then related to the fabric data.

AFISPRO TERMS AND ABBREVIATIONS:

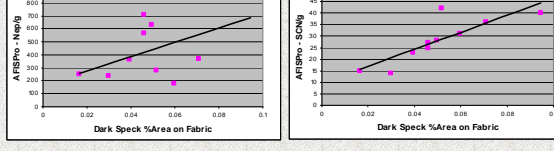
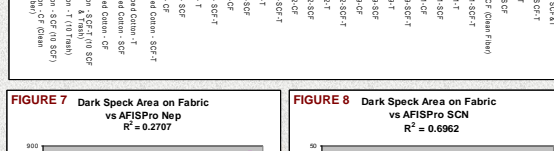
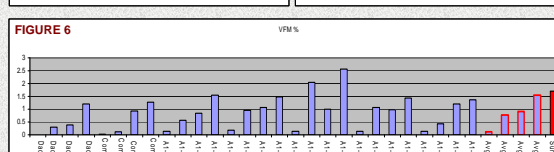
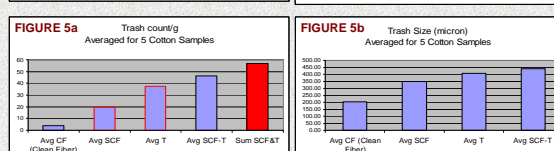
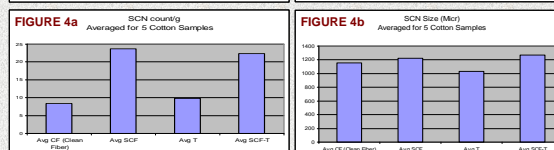
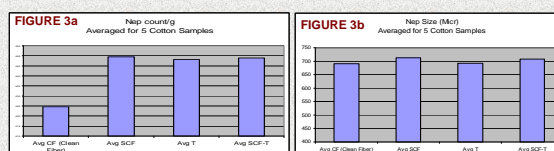
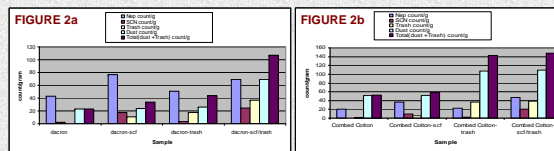
Nep = Total Neps/g of fiber tested including SCN, entanglements of several fibers
SCN = Seed Coat Neps/g of fiber tested - cast a larger shadow than fiber neps
Trash = Trash/g - larger impurities (500+ Microns) containing particles from the cotton plant and other plants (weeds) contaminating the cotton field. (leaf, bark, bract, and non-fibrous trash).
Dust = Dust/gram - smaller particles (20 - 500 Microns) from the plant and simply dirt from the cotton field that sticks with the plant during harvesting.
VFM = %Visible Foreign Matter (what you would see with a video trash meter, both dust and trash)



Fibers Tested on AFISPro

Run Number for AFISPro	Investigator Code	Base line samples A1-1, 9, 12, 19, 21; CC & P
Run 1	A1-1-CF	clean fiber (cotton) only (5 reps)
Run 2	A1-1-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 3	A1-1-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 4	A1-1-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 5	A1-9-CF	clean fiber (cotton) only (5 reps)
Run 6	A1-9-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 7	A1-9-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 8	A1-9-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 9	A1-12-CF	clean fiber (cotton) only (5 reps)
Run 10	A1-12-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 11	A1-12-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 12	A1-12-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 13	A1-19-CF	clean fiber (cotton) only (5 reps)
Run 14	A1-19-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 15	A1-19-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 16	A1-19-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 17	A1-21-CF	clean fiber (cotton) only (5 reps)
Run 18	A1-21-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 19	A1-21-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 20	A1-21-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 21	cc-CF	clean fiber (cotton) only (5 reps)
Run 22	cc-SCF	clean cotton seeded with 10 Seedcoat fragments (5 reps)
Run 23	cc-T	clean cotton seeded with 10 Trash particles (5 reps)
Run 24	cc-SCF-T	clean cotton seeded with 10 SCF & 10 Trash (5 reps)
Run 25	P-CF	clean fiber (polyester) only (5 reps)
Run 26	P-SCF	clean polyester seeded with 10 Seedcoat fragments (5 reps)
Run 27	P-T	clean polyester seeded with 10 Trash particles (5 reps)
Run 28	P-SCF-T	clean polyester seeded with 10 SCF & 10 Trash (5 reps)

Sample	AFISPro Data									
	Nep count/g	SCN count/g	Trash count/g	Dust count/g	Total (dust+Trash) count/g	VFM %	Nep Size (Micr)	SCN Size (Micr)	Trash Size (Micr)	Trash Count/g
Dacron - CF (Clean Fiber)	43	2	0	23	23	0	631	1475	117	
Dacron - SCF (10 SCF)	77	18	11	24	34	0.29	737	1308	447	
Dacron - T (10 Trash)	51	4	18	26	44	0.38	646	1085	566	
Dacron SCF-T (10 SCF & 10 Trash)	70	25	37	70	107	1.20	890	1365	559	
Combed Cotton (CC)-CF	20.2	0	1	52	53	0.03	620	0	163	
CC - SCF	36	9.2	5	52	58	0.11	792	1512	234	
CC - T	22.8	2	36	107	143	0.94	661	767	462	
CC - SCF-T	47.6	20.4	39	109	148	1.28	811	1115	473	
A1-1-CF	884	9.2	9	95	104	0.14	733	1103	239	
A1-1-SCF	943	27.2	18	148	166	0.57	735	1233	304	
A1-1-T	942	16.4	40	184	224	0.85	726	903	348	
A1-1-SCF-T	962	29.6	53	196	250	1.54	740	1244	413	
A1-9-CF	394	13.6	6	146	152	0.19	678	1085	210	
A1-9-SCF	423.2	31.6	26	192	217	0.96	710	1226	323	
A1-9-T	417.6	9.2	34	196	230	1.06	695	1034	361	
A1-9-SCF-T	392	19.2	44	236	279	1.47	700	1262	365	
A1-12-CF	364.4	10	4	116	120	0.13	704	1098	216	
A1-12-SCF	368.6	15.2	38	192	231	2.04	699	1044	437	
A1-12-T	385.2	9.6	41	204	245	1.01	700	1110	349	
A1-12-SCF-T	390.8	19.2	58	216	274	2.57	698	1263	466	
A1-19-CF	306.6	2.8	6	91	98	0.13	667	1172	227	
A1-19-SCF	339.6	24.2	26	180	206	1.06	728	1396	333	
A1-19-T	335.6	7.6	36	117	153	0.97	692	1205	439	
A1-19-SCF-T	333.6	22.8	52	150	202	1.44	708	1294	460	
A1-21-CF	174.4	6	2	40	42	0.13	674	1333	265	
A1-21-SCF	173.2	20	11	66	76	0.44	695	1224	349	
A1-21-T	159.6	6	58	297	355	1.21	648	904	335	
A1-21-SCF-T	166	21.2	40	225	265	1.37	691	1279	353	
Avg CF	312	6	4	80	85	0.11	672.43	1038.00	205.29	
Avg SCF	337	21	19	122	141	0.78	728.00	1277.57	346.71	
Avg T	331	8	38	162	199	0.92	681.14	1001.14	408.57	
Avg SCF-T	337	22	46	172	218	1.55	748.31	1260.31	441.23	
Sum SCF & T	668	28	57	284	340	1.70	1409	2279	755	



DISCUSSION

When fiber is processed through AFISPro an aggressive fiber individualizer sorts the fiber and trash. The trash and SCF may be broken into smaller particles. Only trash without fiber is measured by the trash sensor (Fig5). Particles with fiber attached (SCF or trash entangled with fiber) are measured by the lint sensor as SCN (Fig4) or fiber neps (Fig3). Nep count is total nep count (both fiber neps and SCN). From this data it appears that only the large SCF are counted as SCN, the smaller SCF are counted as fiber neps. The SCF were broken into smaller SCF and counted as fiber neps.

Nep levels did not show a significant change when the 10 trash elements were added, but there was a significant increase when 10 SCF or 10 SCF and 10 trash elements were added (Figs. 2 & 3). Nep size (Fig 3b) increased when seedcoat fragments were added which may indicate that some of the seedcoat fragments were incorporated into some neps. As expected the addition of SCFs did increase the AFISPro SCN levels (Fig. 4), trash did not significantly affect SCN.

CONCLUSIONS

In the first study cottons were seeded with a specific count of SCF and/or trash. Overall the addition of SCFs affected the levels of SCN and Neps, where the addition of trash mainly affected the Trash, Dust and VFM with a slight addition to the SCN and Neps, most likely larger trash particles which tangled with fibers. The opener in the AFISPro is aggressive and breaks the SCFs. The larger particles which cast a large shadow are counted as SCN and the smaller broken SCF tangled with fibers are seen as neps and a few with minimal fiber may become trash particles, some of the seedcoat alone will break off and become trash or dust. There was very little dust, so the majority of the seedcoat particles without fiber were counted as trash. VFM (Fig 6) increased slightly. When Trash is processed through the opener it breaks into smaller trash particles and dust. A small portion of the trash particles tangled with fiber to form Neps, and very few of those are large enough to be counted as SCFs. SCNs are 1.6 times larger than the Neps in this study (Fig 3b & 4b). Smaller SCF are counted as Neps.

Seeded samples had similar results to the Standard samples for AFISPro which leads to the conclusion that AFISPro is consistent in its measurements. The Hand Counted SCF (Figure 9) is larger than SCN count. This is probably because AFIS counts many SCF as Neps only and not as SCNs because they are too small to meet the criteria, (only neps with a large shadow are counted as SCF). VFM and Trash were unrelated to the dark specks in the fabric which would mean that these dark specks are SCF, not trash particles. SCF (Fig. 8) and Neps (Fig. 7) combined (Fig. 10) were able to predict the dark specks in the fabric with an R² of 0.7752 and results in the following equation: % Area dark on Fabric = 0.001689 * SCN + 0.000028 * Nep - 0.0095

REFERENCES

1. Schlieht, A. and Peters, G. USTER AFIS PRO, The fiber process control System, Application Handbook, V2.1, May, 2005.
2. USTER AFIS PRO, Seed breeders conference, Cotton Inc., July 19, 2005.