Nep Content in Relation to Cotton Fiber Quality Characteristics

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ABSTRACT

Textile Technology Research Centre conducted a two-year research programme to determine the nep content in baled cotton and the actual processes that contribute to their evolution and increase. Cotton samples were collected from every ginning industry participating before the gin stand, before the lint cleaners and from the final ginned product for testing for their nep and trash content with the Zellweger Uster AFIS instrument and for their fiber quality characteristics with an HVI . Measurements revealed that a considerable nep content in seed cotton is increased during the ginning process and the following cleaning stages. Quality measurements revealed that the higher the nep content in the final product, the lower the uniformity ratio and the higher the short fiber content.

Introduction

Fiber neps, which are classified as fiber impurities, are considered to be of great interest as a quality characteristic, not only for the baled cotton market but also for the spinning industry .In the American Standard Book (American Society for Testing Materials, 1978) a "fiber or mechanical nep" is defined as one or more fibers occurring in a tangled and unorganized mass and is distinct from fiber impurities including also seed or trash particles apart from fibers (Verschraege, 1990).

Seed cotton is thought to be relatively free of neps at the time of picking and that they are produced during cotton fiber processing. Mechanical harvesting, ginning and various cleaning stages of ginned lint intended to upgrade the final product, are responsible for nep formation, each contributing to a different extent. Fiber length and cotton maturity are considered important for the nepping potential of cotton while certain variety characteristics are related to the formation of seed-coat but not fiber neps (Verschraege, 1990). Neps may consist of mature fibers only, leading to yarn irregularities or neps with a high percentage of immature fibers that are responsible for "white specks" in dyed fabric (Smith, 1991; Zellweger Uster No. 2, 1995).

Until recently baled cotton market depended mainly on the cotton grade, but as problems in yarn and fabric industry become more urgent, cotton quality properties have become of major interest. The aim of this work of the Textile Technology Research Centre (K.E.Te.K) is to define, if possible, the extent of strain that cotton fibers are subjected to between harvesting and the final ginned product. With this knowledge, procedures can be tested to produce a competitive product of higher quality.

Materials and Methods

During the ginning periods 1996-97 and 1997-98, K.E.Te.K has conducted a research programme with the co-operation of the Hellenic Cotton Board and a considerable number of ginning industries in Greece. At weekly intervals throughout the ginning periods, three samples were collected each time from every industry and from certain stages of ginning process .The three stages, named "A", "B" and "C," were:

- A - before the gin stand (seed cotton sample)
- B - after the gin stand but before the lint cleaner(s)
- C - after the cotton condenser and prior to bale

The seed cotton samples were ginned in a conventional laboratory roller gin that has no effect on fiber quality. All samples from all weeks, areas and industries were tested with a Zellweger Uster HVI for technological properties and with the Zellweger Uster AFIS instrument for their nep, dust and trash content .The methods used for these measurements were ASTM D 5867 - 95 and ASTM D 5866 - 95, respectively (ASTM Standards, 1996).

The principles of the AFIS instrument operation (N and T module) used by K.E.Te.K have been described (Furter and Frey, 1990; Furter and Schneiter, 1993; Townes *et al.*, 1992; Zellweger Uster No. 38, 1991). Samples were tested for neps and total trash (Cnt/g) (Figure 1) and for dust and trash quantities separately. The total number of samples collected and tested from all over Greece during the two years was 1,498. Note, the three samples were taken simultaneously every week during ginning so cotton samples can not be fully related to each other since continuous quality changes are possible at each stage. Furthermore, the samples are not related to cotton produced in a specific area since cotton is moved and the varieties are unknown (seed cotton of different cultivars is mixed at the ginning industries). The micronaire value, although related to nep formation, is unreliable in this case.

For reasons of discretion, results are presented without any reference to the participating ginning industry.

Due to the extent of data, only a portion considered to represent the situation is presented.

Results

Results from all the ginning industries reveal a similarity in the nep situation.

All "A"samples have average 100 - 250 neps (Cnt/g) regardless of the place and the time of ginning. This could be attributed to both mechanical harvesting and cleaning stages before the ginning process, since the laboratory gin does not add neps .The difference between samples "A" and "B" can reach a total of 50-150 neps (Cnt/g), proving the importance of the ginning process in nep formation. Sample "C" shows an increase over both "A" and "B" samples, proving increase in neps due to lint cleaners and the cumulative effect of all procedures leading up to the production of the final baled cotton (Table 1).

The nep increase between samples " B " and " C " is accompanied by a reduction of up to half the Total Trash quantity, including both dust and trash quantities. Moreover, an improvement of the grade between these samples is obvious (Table 3).

Hand -picked cotton samples show that an initial number of 90 - 150 neps (Cnt/g) is present before ginning and that the increase in the following stages is always considerable (Table 2).

From the beginning to the end of the ginning period, for both years, results tend to repeat themselves as the nep content in "A" and "C" samples can be either very high or normal. In all cases a minimum of 270 neps (Cnt/g) is measured in the final product. This final baled cotton is not uniform since a range of 270 - 520 neps (Cnt/g) is possible.

The nep content increase between "B" and "C" samples is accompanied by a reduction of the Uniformity Ratio and a considerable increase of the Short Fiber Index (Table 3).

Discussion

Nep formation is a consequence of mechanical harvesting and the whole of the ginning process. Each step, from seed cotton to the final ginned lint, increases the number of neps, processes having a cumulative effect, sharing the same importance. The aim of the lint cleaner, to improve cotton grade, is almost reached in most cases but the negative impact on nep formation (Bel, *et al.*, 1991; Verschraege, 1990) is proved by these results. The ginning process is essential and can only be improved through careful machine maintenance with emphasis on the lint cleaners. Regardless of the number of lint cleaners, generally one for every gin stand in Greece, an increase of nep number takes place and is higher when the initial nep number is high.

The results from the "A" and "B" samples shows that the ginning process removes some of the short fibers but the lint cleaners increase the SFI (Griffin and Lalor, 1980) (Figure 2), mostly by fiber breakage (Verschraege, (1990) and reduce the uniformity ratio (Figure 3). Still the uniformity ratio of the ginned cotton is considerably better than that of the seed cotton sample, proving the necessity of this process even if the nep number is increased.

A combination of careful harvesting and ginning [good machine maintenance and appropriate cotton moisture (Bel *et al.*, 1991)] could lead to lower nep numbers before the lint cleaner. Partial cleaning of ginned cotton could be a compromise between upgrading cotton, improving uniformity and lowering nep content to improve its selling value .The major cleaning could take place at the spinning industry, according to the degree of cleanness needed (Bel *et al.*, 1991a). It seems important, though, to verify if the neps consist of mature or immature fibers, but not only based on micronaire value.

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Table 1. Neps , total trash and grade variation during four different weekly samplings from the same ginning industry.

	A			**B**			**C**		
	Neps Cnt / g	Total Trash Cnt / g	HVI CG	Neps Cnt / g	Total Trash Cnt / g	HVI CG	Neps Cnt / g	Total Trash Cnt / g	HVI CG
Week 1	206	2346	41-4	319	2325	41-4	473	975	21-4
Week 2	157	2041	41-3	256	1887	41-4	410	698	31-3
Week 3	204	1668	62-1	312	2114	61-3	593	811	51-3
Week 4	246	1912	41-4	346	1733	41-4	596	483	31-4

* A,B,C are the three different samples

Table 2. Neps , total trash variation and grade variation in samples from hand-picked cotton from different ginning industries.

	A			B			C		
	Neps Cnt / g	Total Trash Cnt / g	HVI CG	Neps Cnt / g	Total Trash Cnt / g	HVI CG	Neps Cnt / g	Total Trash Cnt / g	HVI CG
Plant 1	135	516	31-1	215	481	31-1	440	176	21-1
Plant 1	232	766	31-4	245	397	31-1	460	229	21-1
Plant 1	182	502	31-3	276	432	31-1	448	148	21-1
Plant 2	160	542	31-3	204	335	21-2	257	111	21-2
Plant 3	140	554	41-1	225	389	41-1	314	187	31-3
Plant 4	134	875	32-2	296	496	31-4	292	385	21-4
Plant 5	151	696	31-3	202	868	31-1	251	398	21-4

*Different ginning industries are mentioned by numbers for safety reasons

Table 3. HVI Length, uniformity ratio, short fiber index and grade variation in samples from the same ginning industry from weekly samplings.

B				C			
Length	Unf	SFI	CG	Length	Unf	SFI	CG
29,4	48,3	<3,5	41-1	28,3	46,6	6,6	31-2
28,8	47,4	5,2	41-2	28,2	46,8	6,6	31-2
28,2	47,3	6,1	41-2	28	45,7	8	41-1
28,3	46,8	6,4	41-2	28	45,6	8	41-2
29,1	48,7	3,6	51-4	28,3	46,5	6,7	42-1
29,3	46,6	5,2	41-4	27,8	45,7	8,1	42-1
27,9	44,9	8,7	52-2	27,6	43,4	10,6	52-1
28,7	48,2	4,6	41-3	28,1	46,3	7,3	31-3
28,9	47,5	4,9	42-1	28,8	46,3	6,2	32-2

- Each line represents a different sampling

Figure 1. Neps and total trash in weekly samplings during th ginning period 1997-98.

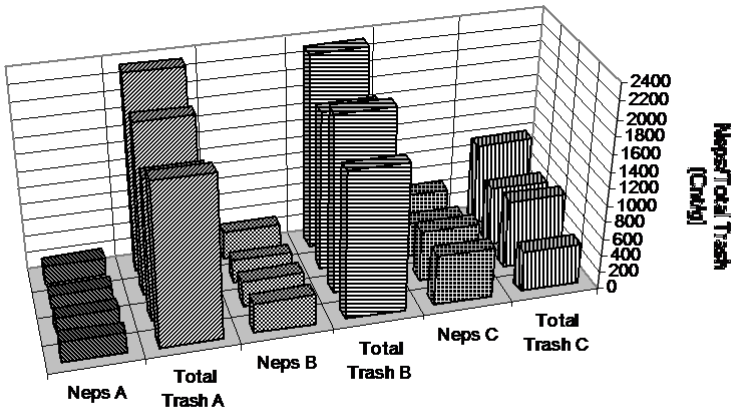

Figure 2. Short fiber variation as affected by lint cleaning in weekly samplings in a certain ginning industry.

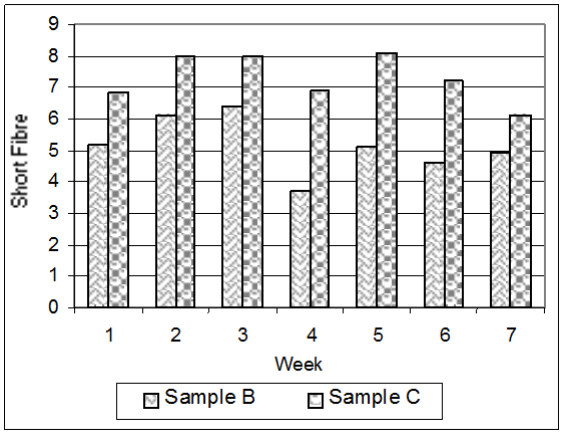

Figure 3. Uniformity ratio as affected by lint cleaning in four weekly samplings in a certain ginning industry.