COTTON CHARACTERISTICS AS AFFECTED BY CLEANING MACHINERY AND TYPE OF GIN-STAND

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Abstract

The present study was conducted to determine the extent of possible damage and adverse effects on fiber and yarn qualities characteristics of Egyptian cottons as subjected to mechanical manipulation by means of gins, seed cotton cleaners and lint cleaners. The four Egyptian cotton varieties Giza 70, Giza 88 (extra long staple varieties), Giza 80 and Giza 89 (long staple varieties) were used as a material for this study. The seed cotton grade used was the same for each variety, i.e. Good- ¼. The stick machine and inclined cleaner was used to clean seed cotton prior to ginning while the Mill-type lint opener cleaner was employed to clean cotton lint subsequent to ginning. (The Rotary Knife gin-stand and the McCarthy gin stand were used in this investigation). The findings of the present study indicated that when seed cotton cleaning and lint cleaning were practiced in combination., the least amount of trash content was attained by both gin-stands. However, the reciprocating knife gin stand appeared to act better with the cleaning machineries than the Rotary Knife gin regarding the degree of cleanliness of cotton attained.

Further., fiber strength., elongation., length [2.5% S.L.] and length uniformity showed the highest decrease in their values when seed cotton cleaning and lint cleaning were applied in combination. To the contrary, micronaire reading tended to increase whenever the cotton was processed by cleaning machineries. With respect to yarn quality properties, the results obtained revealed that the highest values of yarn strength were achieved when seed cotton cleaning and lint cleaning were conducted in combination. This trend was the same for the 2 gin-stand types used in the study. By contrast, a general tendency of decrease in either the thick places or the thin places and hence an improvement in yarn evenness could be noticed in the 2 gin-stands when cleaning both seed cotton and lint cotton were applied together. However nep count showed insignificant differences due to ginning and cleaning treatments.

INTRODUCTION

Cleaning and Ginning cotton play an important role in affecting cotton quality. Chapman *et al.* (1968) studied the effect of some cleaning treatments and found that cotton grades were affected considerably by the combined cleaning treatments of seed cotton and lint which produced higher grades than the treatment of only seed cotton cleaning. Non – lint content followed the same pattern where, the non-lint content decreased as the seed cotton or lint was cleaned. Fiber length and length

distribution of the ginned lint were somewhat affected by the cleaning treatments, while most of the differences were insignificant. Youssef *et al.* (1976) did not find any significant differences in the micronaire reading, fiber span length (2.5%) and yarn strength, due to using the rotary knife gin stand and the McCarthy gin stand in ginning the seed cotton of Giza 70 and Giza 69 varieties. Mahgoub (1981) using the reciprocating gin stand revealed higher values of fiber span lengths (2.5% and 12.5% S.L), length uniformity and lower values of floating fiber index in Giza 68 and Giza 67 varieties as compared to the rotary knife gin stand. He added that the effects of rotary knife gin and reciprocating knife gin on fiber bundle tensile properties and micronaire reading of the two varieties were not significant. Moreover, the cotton ginned by using the reciprocating knife gin produced yarn of higher strength and better appearance grade as compared to the rotary knife gin. Zaied (1981) showed that the cleaning treatments of seed cotton gave greater benefits with the cotton of higher foreign-matter content than with the lower one and with the short staple cotton than with the long staple one. Baker and Griffin (1984) mentioned that ginning and lint cleaning could adversely affect fiber length and length distribution, especially when the fiber moisture content was very low. Since fiber tensile strength was proportional to fiber moisture content fiber breakage increased as moisture content decreased and hence fiber length also decreased. Youssef *et al.* (1992) reported that no significant differences in fiber, yarn and seed qualities were found, due to ginning the seed cotton by the rotary knife gin or the McCarthy one.

Hugus and Bragg (1992) reported that short fiber content increased by about 4.4% as a result of using bad roller gin-stand. EL-shafei (1995) reported that the gin stand type showed highly significant effect on 2.5% fiber span length and short fiber content. Cotton ginned by using the reciprocating knife gin stand showed slightly higher values of 2.5% S.L. and uniformity ratio and a decrease in short fiber content comparing with the rotary knife gin stand. The two ginning types showed nearly the same values of micronaire reading. Hussein (1999) reported that the rotary knife gin stand gave higher 2.5% fiber span length, than the reciprocating knife one whether the ginned cotton was a long staple or an extra-long staple.

MATERIALS AND METHODS

In the present investigation, seed cotton of four varieties, i.e., Giza70, Giza88, Giza 80 and Giza 89 each of Good -¼ grade from 2001 season were cleaned by the stick machine and inclined cleaner before feeding them to the rotary knife gin stand and to the McCarthy one. Also, the ginned lint was cleaned by the Mill-type lint opener cleaner in order to study their effects on the properties of fiber and yarn. Thus, four

treatments (combinations) obtained as follows:

00 Uncleaned seed cotton combined with uncleaned lint

01 Uncleaned seed cotton combined with cleaned lint

10 Cleaned seed cotton combined with uncleaned lint

11 Cleaned seed cotton combined with cleaned lint

Three replications each of 90 kilograms of seed cotton were ginned by the rotary knife gin stand and the McCarthy one after fixing their moving parts according to the variety and the grade of cotton.

Representative samples of ginned lint were drawn, at random to measure fiber and yarn properties at the cotton research institute, Agric. Res. Center. Fiber and yarn properties were tested under controlled atmospheric condition of (70 ± 2°F) temperature and (65 ± 2 %) relative humidity.

The following measurements were conducted:

1. Micronaire reading was determined according to ASTM. D-1448-59, 1984.
2. Fiber strength at 1/8 inch gauge length (g/tex) and fiber elongation (%) were measured on the Stelometer according to ASTM .D-1445-75, 1984.
3. Fiber length parameters were measured by using the "Digital Fibro graph" according to ASTM, D-1447- 83, 1984.
4. Trash content was determined on the microdust and trash analyzer [MDTA3] (ASTM, D, 2812- 95 [02]).

Ring spun carded 60 count yarns using 3.6 twist factor were produced by the standard 60 grams micro-spinning technique used in the spinning research, section. Those yarns were tested for yarn strength (L.P) using the Good Brand lea tester according to ASTM, D-1578-67. Yarn evenness was measured by the Uster evenness tester according to ASTM, D,1425 - 60, 1984.

Data were statistically analyzed according to the procedures out-lined by Snedecor and Cochran (1981), The significance of the differences between means were tested following the least significant difference (L.S.D.) procedure.

RESULTS AND DISCUSSION

1- Effect of gin stand type and cleaning machinery on trash content:

From the data recorded in table 1, it is quite evident that there was a consistent pattern of decrease in trash content when either seed cotton cleaning prior to ginning or lint cleaning subsequent to ginning was applied. However the least amount of trash was attained when both seed cotton cleaning and lint cleaning were practiced combined. This pattern was true in all the 4 cotton varieties involved in this study.

Further, it is rather interesting to note that, on average., the seed cotton and lint

cotton cleaners proved to be more effective in reducing trash content when used with the McCarthy gin stand than when used with the Rotary Knife gin stand. This finding implies that the reciprocating knife system of the McCarthy gin would act better in combination with the cleaning machineries regarding the degree of cleanliness attained than when they were used with the Rotary knife gin. The significant decrease in trash content due to the use of cleaning processes could be ascribed to the fact that seed cotton cleaner would remove a sensible amount of heavy trash while lint cleaner would remove additional amount of fine trash. This conclusion agrees with that of Chapman *et al.* (1968) who pointed out that seed cotton cleaning combined with lint cleaning resulted in the lowest non – lint content.

2 - Effect of gin stand type and cleaning machinery on fiber quality characteristics:

On average, the values of fiber strength, elongation, length (2.5% S.L) and length uniformity tended to decrease due to cleaning of either seed cotton or lint cotton (Table 1). However the highest decrease in these characters was realized when seed cotton cleaning and lint cleaning were applied in combination. This trend was similar for both the Rotary Knife gin and the McCarthy one.

A possible explanation for the highest decrease in fiber strength and elongation that occurred due to the combined treatment of seed cotton and lint cotton cleaning was that the successive mechanical manipulations by means of seed cotton cleaner, gin and lint cleaner that adversely affected the tensile properties of the fibers. In fact, the stresses and the dynamic forces to which the cotton fibers were subjected during these mechanical treatments would likely deteriorate fiber quality characteristics. In such a case, a significant downward trend in fiber strength and elongation would be expected. Also the reduction in fiber length and length uniformity could be possibly ascribed to that, during the mechanical manipulation by the cleaners, a sensible proportion of fibers would be subjected to breakage and as such fiber length would be expectedly reduced, while length irregularity would be correspondingly increased. These results are in accordance with Baker and Griffin (1984) results, while they disagree with Mahgoub (1981) results. Unlike the aforementioned findings of fiber quality properties., the micronaire reading, which basically denotes fiber maturity within a variety tended to increase whenever the cotton was processed by either the seed cotton cleaner or the lint cleaner (Table 1). Nevertheless, the increase in micronaire reading due to cotton cleaning practiced with both gin- stand types used in this study., is in fact attributed to the removal of a proportion of the dead locks during seed cotton cleaning and subsequent ginning process. Further., additional amount of immature fibers in the resultant lint would be removed during lint cleaning.

Accordingly micronaire reading of cleaned cotton would be expectedly increased. This finding was the same regardless of the gin-stand type used. However, this result is in agreement with Youssef *et al.* (1972) results who indicated that cleaning of both seed cotton and ginned lint increased micronaire reading.

When a comparison was held between the 2 gin-stand types used in this study, it appeared that generally there were no significant differences between the Rotary Knife gin and the McCarthy gin with regard to their effects on fiber strength, elongation, micronaire reading and length uniformity. Yet, length of the fibers produced by McCarthy gin was significantly higher than that of the cotton ginned by the Rotary Knife gin stand (Table 1). 3- Effect of gin stand type and cleaning machinery on yarn quality characteristics:

Table 2 displays the data of yarn strength, nep count, number of imperfections (thick and thin places) and unevenness (c.v.%) for yarns spun from cotton subjected to different treatments (combinations). Including gin stand types, seed cotton cleaning and lint cleaning However, it was evident that on average an increase in yarn strength was achieved when both lint cleaning alone and the combination of seed cotton cleaning and lint cleaning were practiced. The latter treatment gave the highest values of yarn strength and this trend was the same in the 2 gin-stand types. By contrast, the use of seed cotton cleaning alone resulted in a reduction in yarn strength in both gins involved in the study. On the other hand no significant differences in nep count were detected due to ginning and cleaning treatments. Conversely, a general tendency of decrease in either the thick places or the thin places and hence an improvement in yarn evenness could be noticed in both gin – stand types used, when cleaning machineries were employed. The increase in yarn strength due to the combined use of the seed cotton cleaner alongside the lint cleaner could be ascribed to the reduction that took place in the number of imperfections, i.e. the number of thick and thin places, (Table 2). However, it is widely acknowledged that the upgrading of yarn evenness would have a positive impact on yarn strength, since thin places in particular are regarded as weak places along yarn length. Generally, the comparison between the 2 gin-stand types employed in this study revealed that on average no significant differences were found between the 2 gins with respect to their effects on nep count, number of thick places and yarn unevenness. In contrast, the McCarthy gin-stand induced significantly higher number of thin places and produced yarns of better strength (Table 2) than the rotary gin stand.

Table 1. Trash content and fiber qualities as effected with gin-stand type, seed cotton cleaning and lint cleaning processes for four cotton varieties.

Treatment Combinations		Trash content (%)					Fiber strength (g./tex)					Fiber elongation (%)					Micronaire values					Fiber span length (2.5 %) (mm)					Fiber length uniformity (%)				
		G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean
Rotary	00	4.82	4.95	5.64	5.32	5.18	34.46	34.28	28.84	29.60	31.80	7.57	6.63	7.56	6.88	7.16	3.5	3.5	3.8	3.9	3.7	33.19	33.18	30.27	30.60	31.81	49.38	48.72	48.90	48.78	48.95
	01	4.53	4.22	5.55	4.65	4.74	34.12	34.00	28.01	29.28	31.35	6.89	6.46	7.48	6.66	6.87	3.6	3.6	4.0	4.1	3.8	33.07	32.90	30.10	30.38	31.61	49.07	48.07	48.48	48.52	48.54
	10	4.09	3.94	3.67	4.39	4.02	33.28	33.52	27.62	28.91	30.83	6.49	6.20	7.34	6.64	6.67	3.9	3.8	4.3	4.4	4.1	32.91	32.38	30.07	30.12	31.37	48.47	47.56	48.43	48.17	48.16
	11	3.81	3.87	3.32	4.06	3.77	33.03	33.14	27.10	27.90	30.29	6.01	5.58	7.10	6.27	6.24	3.9	3.8	4.3	4.5	4.1	32.51	32.24	30.01	29.59	31.09	48.13	47.50	47.47	47.89	47.75
General mean		4.31	4.25	4.55	4.61	4.43	33.72	33.74	27	8.92	31.07	6.74	6.22	7.37	6.61	6.74	3.7	3.7	4.1	4.2	3.9	32.92	32.68	30.11	30.17	31.47	48.76	47.96	48.32	48.34	48.35
L.S.D	5 %			0.38					0.51					0.31					0.35					0.59					0.81		
	1 %			0.51					0.92					0.41					0.69					0.79					1.08		
McCarthy	00	2.63	3.19	4.77	4.22	3.70	35.31	34.84	29.12	29.45	32.18	7.66	6.97	7.90	7.63	7.54	3.6	3.6	3.9	4.0	3.8	34.68	33.77	30.93	31.98	32.84	50.67	49.44	49.82	49.75	49.92
	01	2.43	2.98	4.41	3.45	3.32	35.20	34.56	28.53	28.97	31.82	6.96	6.95	7.69	6.96	7.14	3.8	3.8	4.2	4.2	4.0	34.55	33.53	30.84	30.95	32.47	49.53	49.33	49.50	49.50	49.47
	10	2.10	2.63	3.42	3.43	2.90	35.07	34.16	28.06	28.84	31.53	6.55	6.52	7.61	6.35	6.76	4.1	3.8	4.4	4.5	4.2	34.08	33.17	30.12	30.38	31.94	49.33	48.87	49.00	49.03	49.06
	11	2.09	2.22	3.32	3.14	2.69	34.40	33.21	26.75	27.72	30.52	6.05	6.10	7.18	6.28	6.40	4.1	4.0	4.5	4.5	4.3	33.53	33.10	30.12	30.35	31.78	48.42	48.00	48.08	48.03	48.13
General Mean		2.31	2.76	3.98	3.56	3.15	35.00	34.19	28.12	28.75	31.51	6.81	6.64	7.60	6.81	6.96	3.9	3.8	4.3	4.3	4.1	34.21	33.39	30.50	30.92	32.26	49.49	48.91	49.10	49.08	49.15
L.S.D.	5%			0.38					0.51					0.31					0.35					0.59					0.81		
	1%			0.51					0.92					0.41					0.69					0.79					1.08		

* N.S. : Not Significant.
00 uncleaned seed cotton + uncleaned lint.
01 uncleaned seed cotton + cleaned lint.
10 cleaned seed cotton + uncleaned lint.
11 cleaned seed cotton + cleaned lint.

Table 2. Yarn quality as effected by gin-stand type, seed cotton cleaning and lint cleaning processes for four cotton varieties.

Treatment Combinations		Yarn strength (L.P.)					Nep count per 120 yards					Thick places per 120 Yards					Thin Places Per 120 Yards					Yarn unevenness (C.V. %)				
		G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean	G. 70	G. 88	G. 80	G. 89	Mean
Rotary	00	2531	2668	1633	2188	2255	196	248	176	188	202	235	250	166	161	203	152	137	134	103	132	25.44	26.62	26.16	24.04	25.57
	01	2614	2698	1740	2216	2317	170	219	156	178	181	213	218	147	142	180	105	103	104	79	98	24.07	24.85	23.55	23.69	24.04
	10	2570	2615	1618	2186	2247	182	244	179	175	195	227	250	161	160	200	136	138	121	96	123	24.85	25.85	26.05	23.79	25.14
	11	2688	2719	1754	2214	2344	184	223	153	165	181	221	219	153	137	183	122	116	101	66	101	24.26	25.62	24.87	22.77	24.38
General Mean		2601	2675	1686	2201	2291	183	234	166	177	190	224	234	157	150	192	129	124	115	86	114	24.66	25.74	25.16	32.57	24.78
5% L.S.D 1%				59					N.S.					15					13					0.91		
				78					N.S.					19					17					1.21		
McCarthy	00	2734	2766	1901	2218	2405	264	218	199	176	214	274	255	199	163	223	168	153	147	142	153	27.68	25.11	26.35	23.91	25.76
	01	2772	2782	1901	2293	2437	250	160	179	153	186	223	191	155	148	179	136	105	115	139	124	25.27	24.73	24.42	22.89	24.33
	10	2668	2657	1821	2218	2341	281	223	188	170	216	262	262	180	165	217	169	160	132	155	154	27.09	26.23	26.42	23.96	25.93
	11	2733	2752	1981	2297	2441	233	155	161	149	175	235	184	173	147	185	135	82	111	127	114	25.86	23.61	25.15	22.09	24.18
General Mean		2727	2739	1901	2257	2406	257	189	182	162	198	249	223	177	156	201	152	125	126	141	139	26.48	24.92	25.59	23.21	25.05
5% L.S.D 1%				59					N.S.					15					13					0.91		
				78					N.S.					19					17					1.21		

* N.S.: Not Significant.
00 uncleaned seed cotton + uncleaned lint.
01 uncleaned seed cotton + cleaned lint.
10 cleaned seed cotton + uncleaned lint.
11 cleaned seed cotton + cleaned lint.

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تأثير تنظيف القطن و نوع الحلاجة على صفات القطن المحلوج

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أجريت هذه الدراسة لتقدير مدى الأضرار المحتملة التي يمكن أن تتعرض لها صفات جودة تيلة وخيوط غزل الأقطان المصرية عند تعرضها للمعاملات الميكانيكية الناتجة عن حلاجة القطن واستخدام منظفات القطن الزهر(قبل الحلج) ومنظفات القطن الشعر (بعد الحلج). وقد استخدم في هذه الدراسة أربعة أصناف من القطن المصري هي جيزة ٧٠ و جيزة ٨٨ (أقطان فائقة الطول) وجيزة ٨٠ وجيزة ٨٩ (أقطان طويلة التيلة) وكانت رتبة القطن الزهر التي استخدمت موحدة لجميع هذه الأصناف (جود – ¼) واستخدم أيضا طرازان من الحلاجات وهما الحلاجة ذات السكينة الدوارة Rotary kinfe والحلاجة ذات السكين الترددية McCarthy. وقد أشارت نتائج هذه الدراسة إلى أن استخدام منظف القطن الزهر ومنظف القطن الشعر معا أسفر عن اقل محتوى للشوائب في القطن الناتج(بعد الحلج) وان بدا أن الحلاجة ذات السكينة الترددية أنتجت قطنا أكثر نظافة من الحلاجة ذات السكينة الدوارة. إضافة إلى ذلك فان استخدام منظفي الزهر والشعر معا أدى إلى الحصول على أقل القيم لمتانة التيلة واستطالتها وطول التيلة وانتظام الطول وعلى العكس من ذلك فقد أديا إلى زيادة قيم قراءة الميكرونير التي تعبر أساسا عن نضج تيلة القطن في داخل الصنف الواحد وبالنسبة لصفات جودة خيوط الغزل فقد أشارت النتائج إلى أن استخدام منظفي القطن الزهر والشعر معا ترتب عليه الحصول على أعلى متانة لخيوط الغزل بصرف النظر عن نوع الحلاجة المستخدمة. وأيضا فقد أعطت هذه المعاملة انخفاضا في عدد المناطق السميكة والمناطق الرفيعة في خيوط الغزل وترتب على هذا الأمر تحسن في درجة انتظام الخيوط. أما عدد العقد في خيوط الغزل فلم تختلف اختلافا معنويا نتيجة معاملات الحلج والتنظيف التي استخدمت في الدراسة.