DETERMINATION OF SOME COTTON PROPERTIES AFTER MECHANICAL CLEANING

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Abstract

The present study was conducted to investigate the role as determinants of the major mechanical constituents of cleaning Egyptian seed cotton (extra-long staple) Giza 86 cultivar was harvested by cotton picker during 2005 season at El-Karada farm, Kaferelsheikh governorate. The newly cleaning extractor was operated and tested with four saw drum speeds 7.06, 8.63, 10.20 and 12.56 m\s, four levels of feed rates 10, 12.5, 15 and 17.5 kg/min and four levels of moisture content for fiber 11.2, 9.8, 8.7 and 7.9 %, respectively, to determine its effects on some mechanical properties of cleaning seed cotton such as: seed cotton strength, g/tex, seed cotton elongation, %, seed cotton trash content, %, seed cotton wastage, %, and seed cotton cleaning output, kg/min.

Results showed that using the new local cleaning seed cotton extractor produced high values of seed cotton strength and seed cotton cleaning output. While, it producted low values of seed cotton elongation, seed cotton trash content and seed cotton wastage.

INTRODUCTION

Lint cleaners remove foreign matter and comb and blend the fiber. However, lint cleaners remove considerable quantities of good fiber and also damage the fiber due to their aggressive operating features. In most cases this removed fibrous material is cleaned, packaged and sold at a vastly reduced price as compared to lint. The amount of material removed by lint cleaners varies with harvesting practices, lint cleaner design and condition, and variety and quality of cotton being ginned when multiple stages of saw lint cleaner is used. Hence, determination of mechanical properties are very important in the process of economic development (Anthony, 2000). Barker and Baker (1986) found that fiber length decreased with increasing amounts of lint cleaning while fiber strength increased with a small amount. Mangialardi and Merdith (1990) found that fiber strength decreased consistently from 26.6 to22.9 g/tex from first harvest date to last harvest date treatments, overall last harvest date treatment producing the lowest strength of cotton. Elongation was also lowest for last harvest date treatments. The decrease in fiber strength between the first and the last harvest dates cotton treatment was statistically significant. Perter and Wahba (1999) found

that the short fiber content of ginned cotton is relatively correlated with fiber elongation and lint content, strength and uniformity. It is positively correlated with fiber micronaire. Anthony (1990) found that foreign matter ranged from 1.7 % to 4.6 % after cleaning through a standard gin cleaning sequence of cylinder cleaner, stick machine, extractor feeder and too lint cleaners**.** He added that HVI trash decreased from 5.6 to 4.8 and lint visible foreign matter decreased from 6.2 to 3.9 as the moisture content decrease from 7.5 to 4.1 %. Gillum et al. (2001) stated that lint loss in trash from the batt - Loss lint cleaner increased as the speed of the cleaning cylinder increased. Hossam el din (1978), Eweida et al. (1984) found that the feeding rate of seed cotton to gin-stand significantly affected capacity, ginning time and non-lint content.

MATERIALS AND METHODS

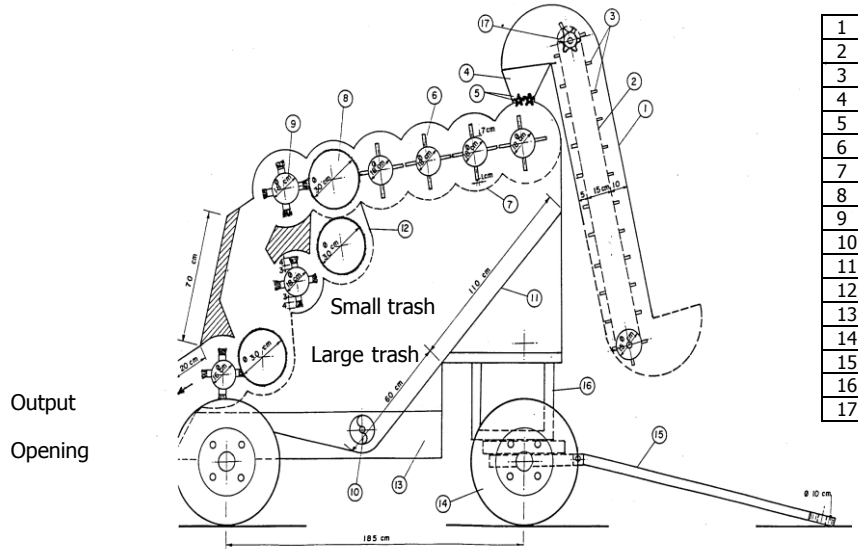
The present study aimed to test the new locally prototype pre-cleaning extractor suitable for cleaning Egyptian cotton varieties (extra-long staple) picked up mechanically. This prototype extractor was divided into three stages: the first stage contained the heaps loader, which is used to feed the machine with cotton bolls and seeds, and extracted the heavy impurities and green bolls. The second stage contained the impurity remover. The third stage contained waste conveyer for accumulated and remove small and large extracted impurities a side the machine. A photograph and engineering drawing of the main parts of the new locally prototype extractor shown in Fig. 1 and Fig. 2. This machine consists of machine frame, input opening, mechanical cotton heaps loader, feeder hopper, four impact drums, two saw drums, three doffing drums, reclaimer drum, trash auger, impurity removal concaves and output opening.

The extractor machine was operated and tested with four saw drum speeds 7.06, 8.63, 10.20 and 12.56 m/s, four levels of feed rates 10, 12.5, 15 and 17.5 kg/min and four levels of moisture content were used 11.2, 9.8, 8.7 and 7.9 %, respectively, to determine its effects on some mechanical properties such as: seed cotton strength, g/tex, seed cotton elongation, %, seed cotton trash content, %, seed cotton wastage, %, and seed cotton cleaning output, kg\min.

Laboratory tests

The cotton technology research laboratories were determined at CRI, ARC, and Giza. The fiber properties determined under standard conditions of 65 $\pm$ 2% relative humidity and 294 $\pm$ 1 k° temperature, as follows:

Fig. 1. The new local seed cotton extractor photography .



1	Mechanical loader.
2	Chain conveyer.
3	Strips.
4	Tank.
5	Feeder rollers.
6	Impact drum.
7	Concave.
8	Saw drum.
9	Doffing drum.
10	Trash auger.
11	Shielding.
12	Inclined surface.
13	Frame body.
14	Wheels.
15	Hitching point.
16	Revolving circle.
17	Gear.

Fig. 2. General arrangement and principal operation of the new seed cotton extractor.

1-Seed cotton strength and elongation: Measured by using stelometer instrument at fiber testing laboratory, CRI, ARC according to (ASTM, designated D-1445-75, 1984). Where, this instrument gives elongation reading and cotton strength can be determined by using the following formula:

$$SL = Wc \times \frac{1.5}{Ws} \times 100 \quad \text{.....(Anoun 1,1996)}$$

Where: SL = strength for length unit, g\tex,
Wc = cutting mass, kg,
Ws = mass of sample, mlg.

2-Seed cotton trash content: Determined by using fractionator instrument in the cotton ginning research division, CRI, ARC.It can determine percentage of trash content by using the following formula:

$$Tc = \frac{Wo - wt}{Wo} \times 100 \quad \text{.....(Anoun 2, 1992)}$$

Where: Tc= trash content in seed cotton, %,
Wo = mass of original sample, g,
Wt = mass of sample after treatment by instrument, g.

3-Seed cotton wastage, % : Trash content output were collected, weighed and re-separation into fiber and fiber foreign matter. The percentage of cotton wastage was calculated (based on the calculated cotton fiber in the sample to total weight of sample).

4-Seed cotton cleaning out put, kg/min : The time required for cleaning process was measured by using a stopwatch. From a measured weight of in put crop and the time required for cleaning the cotton yield output of the machine was determined.

RESULTS AND DISCUSSION

1. Seed cotton strength, g/tex

Seed cotton strength, g/tex regard as extent standard for using seed cotton fiber in cotton industry Table 1 and Fig. 3 presented the effect of different variables on seed cotton strength .The results indicated that, seed cotton strength has a decreasing trend with increasing saw drum speed and with decreasing fiber moisture

content, while it had an increasing trend with increasing feed rate at all combinations of other variables. The maximum amount of seed cotton strength of 29.5 g/tex was recorded at using machine with saw drum speed of 7.06 m/s, feed rate 17.5 kg\min and fiber moisture content of 11.2%. The minimum seed cotton strength of 26.40 g/tex was recorded at using machine with saw drum speed of 12.56 m/s, feed rate of 10 kg/min and fiber moisture content of 7.9%.

It can be concluded that, fiber cotton produced from the new local extractor has a high amount of seed cotton strength, which may be due to decreasing impact and stress force affecting on seed cotton during extracting process.

Table 1. Average mechanical fiber properties

Fiber moisture content, %	**Feed rate, kg/min** / **Saw drum Speed, M/s**	Seed cotton strength, g\tex				Seed cotton elongation, %				Seed cotton trash content, %				Seed cotton wastage, %				Seed cotton cleaning output, kg\min.			
		10.0	12.5	15.0	17.5	10.0	12.5	15.0	17.5	10.0	12.5	15.0	17.5	10.0	12.5	15.0	17.5	10.0	12.5	15.0	17.5
11.2	7.06	28.8	29.0	29.3	29.5	6.9	6.5	6.3	5.9	2.40	2.82	3.22	3.61	0.49	0.46	0.43	0.40	8.99	11.30	13.62	15.98
	8.63	28.7	28.8	29.0	29.0	7.4	7.2	6.8	6.4	2.12	2.56	3.05	3.32	0.53	0.50	0.47	0.43	8.95	11.25	13.58	15.91
	10.20	28.5	28.6	28.7	28.7	7.9	7.5	7.2	6.8	1.81	2.00	2.40	2.90	0.58	0.53	0.51	0.47	8.90	11.18	13.48	15.82
	12.56	27.7	28.0	28.2	28.4	8.4	7.9	7.5	7.2	1.43	1.70	2.13	2.60	0.63	0.58	0.54	0.51	8.86	11.12	13.41	15.73
9.8	7.06	28.5	28.7	28.9	29.0	6.5	6.2	5.9	5.6	2.11	2.51	2.93	3.32	0.57	0.53	0.48	0.45	8.94	11.25	13.51	15.86
	8.63	28.1	28.3	28.5	28.8	7.1	6.9	6.4	6.1	1.70	2.10	2.61	3.03	0.62	0.57	0.53	0.50	8.88	11.19	13.43	15.72
	10.20	27.8	28.0	28.1	28.4	7.5	7.2	6.9	6.5	1.50	1.82	2.00	2.71	0.68	0.61	0.57	0.55	8.81	11.12	13.36	15.66
	12.56	27.2	27.6	27.9	28.2	7.8	7.4	7.3	6.9	1.22	1.41	1.72	2.20	0.74	0.67	0.63	0.61	8.77	11.03	13.27	15.57
8.7	7.06	28.0	28.2	28.4	28.4	6.2	5.8	5.4	5.0	1.80	2.20	2.61	2.91	0.64	0.61	0.57	0.53	8.85	11.13	13.42	15.77
	8.63	27.8	28.0	28.1	28.1	6.8	6.3	5.9	5.5	1.51	1.70	2.13	2.44	0.71	0.65	0.60	0.57	8.76	11.05	13.35	15.70
	10.20	27.4	27.8	28.0	28.0	7.3	6.9	6.5	6.1	1.33	1.50	1.82	2.15	0.83	0.78	0.72	0.68	8.68	10.96	13.29	15.59
	12.56	26.8	27.3	27.7	27.7	7.5	7.2	7.0	6.7	1.02	1.24	1.56	1.80	0.92	0.85	0.76	0.72	8.60	10.87	13.20	15.51
7.9	7.06	27.5	27.7	27.9	28.2	5.9	5.6	5.3	4.8	1.50	1.81	2.15	2.51	0.92	0.85	0.73	0.67	8.77	11.02	13.31	15.63
	8.63	27.3	27.5	27.7	28.0	6.5	6.0	5.6	5.1	1.22	1.52	1.82	2.10	1.04	0.98	0.91	0.83	8.69	10.93	13.25	15.54
	10.20	27.0	27.3	27.6	27.8	6.8	6.6	6.0	5.5	1.06	1.24	1.43	1.80	1.17	1.09	1.02	0.95	8.60	10.84	13.18	15.43
	12.56	26.4	27.0	27.4	27.6	7.2	6.9	6.5	6.1	0.70	1.02	1.31	1.53	1.35	1.20	1.13	1.05	8.55	10.73	13.09	15.36

Fig. 3.

2. Seed cotton elongation, %

Table 1 and Fig. 4 indiceted that, seed cotton elongation increased with increasing saw drum speed, while it decreased with increasing feed rate and with decreasing moisture content. The maximum seed cotton elongation of 8.4% was recorded when using the new local extractor with saw drum speed of 12.56 m/s, feed rate level of 10 kg/min and fiber moisture content of 11.2%. The minimum seed cotton elongation of 4.8% recorded when using saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 7.9%. Previous results indicated that, the new local extractor produces a law amount of seed cotton elongation, because seed cotton fiber may be exposed to little impact inside machine.

3. Seed cotton trash content, %

Table 1 and Fig. 5 showed that, trash content has a decreasing trend with increasing saw drum speed and with decreasing moisture content, while it has an increasing trend with increasing feed rate at all combinations of other variables. The maximum trash content of 3.61% was recorded when using the new local extractor with saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 11.2% .The minimum trash content of 0.7% was recorded with saw drum speed of 12.56 m/s, feed rate of 10 kg/min and fiber moisture content of 7.9%. It can be concluded that, the new local extractor has accounted a law amount of trash content after extracting, which may be due to high machine parts efficiencies for the extracting process.

4. Seed cotton wastage, %

Seed cotton wastage increased as the saw drum speed increased and with decreasing moisture content, while it was decreasing with increasing feed rate at constant other variables as given in Table 1 and Fig. 6. The maximum seed cotton wastage of 1.35 % was recorded at operated new local extractor with saw drum of 12.56 m/s, feed rate of 10 kg/min and fiber moisture content of 7.9 %, while the minimum value of 0.4% was recorded when using the new local extractor with saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 11.2 %, respectively. It can be concluded that, the newly local extractor produces a small amount of seed cotton wastage, this could be due to the reclaimed drum performance of this machine had high capability.

5-Seed cotton cleaning output, kg/min

Table 1 showed that, seed cotton cleaning output decreased with increasing saw drum speed with decreasing moisture content, while it was increasing with increasing feed rate. The maximum amount of cleaning output was 15.98 kg/min at saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content 11.2 %, respectively.

FIG .4

FIG.5

FIG.6

CONCLUSION

The aim of the present study is to test a local extractor machine for seed cotton pre-cleaning mechanically harvested. Then, evaluating the performance included the study of the effect of moisture content, feed rate and saw drum speed to determine some mechanical quality parameters. Results led to the following conclusion:

1-The new local extractor produced cleaning cotton having high amount of strength at all operation levels. The maximum seed cotton strength of 29.5 g/tex was recorded when using machine with saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 11.2 %.

2- Results showed that, the new local extractor produced cleaning seed cotton having law amount of elongation, %. The minimum seed cotton elongation of 4.8% recorded at using saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 7.9 %.

3- The new local extractor extracted most of trash content from seed cotton because of high machine parts efficiency for the extracting process .The maximum trash content of 3.61 % recorded when using designed machine with saw drum speed of 7.06 m/s, feed rate of 17.5 kg/min and fiber moisture content of 11.2 %.

4- The new local extractor had law levels of seed cotton wastage, %, because of the high efficiency of the reclaimer drum.

5- Seed cotton cleaning output, kg/min, increased with increasing feed rate of the machine.

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تقدير بعض صفات القطن الزهر الميكانيكية عند التنظيف آليا

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تعتبر أصناف القطن المصرية من أجود أصناف القطن العالمية لما تتميز به من خواص غزلية مرغوبة و صفات تيلة جيدة من حيث المتانة و الاستطالة و هذه الصفات يفضلها الغزالين. لذلك فانه من الأهمية بمكان أن نهتم باستخدام الطرق و الأساليب الميكانيكية في الإنتاج من إعداد مرقد البذرة إلى ما بعد عملية الجني. و لكن بنظرة سريعة إلى مستوى الخدمة الآلية لمحصول القطن نجد إنها تفتقر إلى أساليب الجني الآلي، حيث يعتمد المزارع المصري على الجني اليدوي، وذلك خوفا من عدم نظافة القطن الناتج من الجني الآلي و تدنى رتبته وصفات جودته و بالتالي انخفاض سعر تداوله.لذلك فقد كان الهدف الرئيسي من هذا البحث هو تصنيع آلة محلية صغيرة لتنظيف القطن الزهر المجني آلياً ودراسة تأثير هذه الآلة على صفات جودة التيلة الميكانيكية، و ذلك كمرحلة تنظيف ابتدائية حتى يتم قبول هذه الأقطان لدى المحالج المصرية.

وقد تم دراسة تأثير العوامل الآتية:

١- سرعة الدرفيل المنشاري وقد استخدم أربع سرعات ٧.٠٦، ٨.٦٣، ١٠.٢٠، ١٢.٥٦ م/ث.
٢- معدلات التلقيم للآلة وقد استخدم أربعة معدلات تلقيم ١٠، ١٢.٥، ١٥.٠، ١٧.٥كج/د.
٣- المحتوى الرطوبى لألياف القطن الزهر حيث تم إجراء التجارب عند أربعة محتويات رطوبة ١١.٢، ٩.٨، ٨.٧، ٧.٩٪. وقد تم دراسة هذه المتغيرات على كل من:

١- المتانة. ٢- الاستطالة.
٣- نسبة الشوائب بالقطن الزهر بعد التنظيف. ٤- نسبة فقد القطن مع الشوائب.
٥- إنتاجية الآلة.

قد أمكن التوصل للنتائج الآتية:

١- الآلة المصنعة كانت تحافظ على مستوى متانة الألياف ولم تؤثر عليها بدرجة كبيرة و كانت أعلى قيمة للمتانة تم الحصول عليها هي ٢٩.٥ ج / تكس وذلك بتشغيل الآلة عند سرعة درفيل منشاري ٧.٠٦ م/ث ومعدل تلقيم ١٧.٥ كج / د ومحتوى رطوبى للألياف ١١.٢ ٪.
٢- الأجهادات المؤثرة على الألياف داخل الآلة المصنعة محليا نتيجة لتعرضها للأجزاء الدوارة كانت تسبب استطالة بسيطة في الألياف مما يؤكد صغر هذه الأجهادات المؤثرة داخل الآلة.
٣- الأقطان الناتجة من الآلة بعد التنظيف كانت تحتوى نسب بسيطة من الشوائب حيث أن الآلة كانت ذات قدرة كبيرة على فصل معظم الشوائب المختلطة بالقطن الزهر.
نسبة الفقد للقطن الخارج مع الشوائب المفصولة كانت بسيطة جدا و ذلك لارتفاع كفاءة درفيل الاستعادة داخل الآلة في إعادة تجميع الأقطان الساقطة مع الشوائب وأعادتها إلى داخل الآلة.
٤- إنتاجية الآلة كانت تزداد بزيادة معدل التلقيم و قد كانت أعلى إنتاجية للآلة هي ١٥.٩٨كج / د وذلك عند تشغيل الآلة عند سرعة درفيل منشاري ٧.٠٦م / ث ومعدل تلقيم للآلة ١٧.٥كج / د ومحتوى رطوبى للألياف ١١.٢٪ .