# FABRICATION AND EVALUATION EXTRACTION UNIT FOR GINNING EGYPTIAN COTTON

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## ABSTRACT

*This research aims to develop and evaluate small prototype machine performance  during gin Egyptian cotton in laboratory. This machine helped technicians scholars to study  the effect of ginning experimental parameters  on fiber cotton quality properties. The independent variables in this study were: four rotation speeds were 0.79 m/s (60 r.p.m) ,1.18 m/s (90 r.p.m), 1.60 m/s(120 r.p.m) , and 2.36 m/s(180 r.p.m), three feeding rates were 30 kg/h, 45 kg/h and 60 kg/h and three values of clearance between two drums of 3 , 4 and 5 mm. Evaluation parameters were : gin stand productivity, lint turn out, seed wastage mass, gin lint losses and ginning efficiency. Also, energy requirement and total cost production were determined. On other hand, a comparative study between development prototype gin machine and the conventional McCarthy gin roller made to evaluate fiber properties. The test results for developed gin stand performance found that, a maximum of ginning efficiency, gin stand capacity, lint turn out percentage were 81.28 %. 32.8 kg, and 43.1 %, respectively . also, maximum of seeds wastage mass was 17.49 kg/h. while, minimum of gin lint losses percentage was 3.5% and minimum of energy requirement was 154.26 kW.h/Mg. On other hand, minimum of total operation cost was 231.40 L.E/Mg while, minimum of criterion function cost was 364.10 L.E/Mg. consequently, the new developed prototype machine was influenced by all of independent variables. Recently, a comparative study between the developed gin stand and the conventional McCarthy gin roller on the fiber quality properties found that the gin stand developed was consider the best for ginning Egyptian  seed cotton samples.*

**Key Words:** Developed machine, gin, seeds, fibers.

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# INTRODUCTION

Cotton is the most important fiber crop in the world as well as in Egypt. But this plant are exposed to many pests so, the country spend millions of pounds to increase the production by helping the technicians to control the pests .These pests can annihilate all crops if it is not controlled in other hand keep on good quality for fibers and seeds. **Anthony (1979)** determined the effects of individual processing machines and combinations on lint quality, and their electricity consumption of the 14 machine combinations investigated, the treatment that included, 2 tower driers, a cylinder cleaner, stick machine, impact cleaner, gin stand and 2 stages of lint cleaning produced highest classer's grade classification, the lowest trash content and lint turn out from both the high and low moisture content seed cotton samples. Treatments which included only the gin stand and one lint cleaner produced classer's grades among the highest and lint trash contents among the lowest. Lint turn outs for these treatments ranked in the intermediate range. About 55 - 60% of the total energy required by max. machine processing was consumed by the fans and separators. The lower moisture cotton consumed 20 - 40% more electric energy/kg of seed cotton processed. **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. **Hughs et al. (1983)** found that the total nonlint content of the cotton fiber, most quality factors measured for the cotton lint processed through the experimental gin-cleaner were generally as good if not better than the same quality factors for lint processed through standard cleaning equipment. **Anthony (1985)** discussed the different features of a ginning machine, the controls and the maintenance which, along with the humidity of the cotton, have an effect in limiting the deterioration of cottonseed and cotton fiber quality (percentage of short fiber and presence of foreign material and seed husk debris). Results

quoted are from tests at the cotton ginning laboratory. **Anthony(1989)** reported that processing cotton at the gin to minimize machinery usage and maximize monetary returns requires a thorough understanding of the performance characteristics of individual machines. A database involving multiple moisture, trash, machine and cotton levels was developed for all routine and laboratory fiber properties before and after various gin processes. Ranges of these variables are representative of the min. and max. levels normally found in spindle-harvested cotton. The database is suitable for multiple regression analyses and development of prediction equations based on the performance characteristics of individual and combinations of machines**. Rafiq - Chaudhry (1997)** found that about 85% of total cotton in the world is ginned on saw gins. Most countries have either large scale saw ginning or roller ginning, although small scale roller ginning does exist in some countries. Among the major cotton producing countries of the world, India and Turkey are the only countries where saw ginning and roller ginning are popular. Ginning is most expensive in Spain followed by Argentina, Zimbabwe, Australia and Colombia. Ginning is heavily subsidized in China (*mainland*). **Mangialardi and Anthony (2000)** found that, cotton (*Gossypium hirsutum L.*) fibers are cleaned at gins with saw-type lint cleaners to improve the market value, but the aggressive saws sometimes harm the quality of the fiber. The cleaning efficiency of one saw-type lint cleaner averaged 54%, and the efficiencies of seed cotton cleaners used as lint cleaners ranged from 9 to 16%. There was a significant improvement in the classers' leaf grade designations when lint was cleaned with each of the seed cotton-type cleaners. Staple lengths tended to be shorter after cleaning with saw-type cleaners. A modified non-saw cleaner appears practical and could help preserve fiber quality at cotton gins. **Patil et al. (2006 )** found that the foot operated gin and the Lilliput gin have a ginning output capacity of 0.311 and 2.111 kg lint/h, respectively. The 2.5% span length and uniformity ratio remained practically the same for

hand ginning, foot operated gin and the Lilliput gin. So, the foot operated gin is much more suitable for farmers because it is economical and auxiliary power is not required for its operation. The Lilliput gin is the most popular amongst the cotton breeders, traders and seed industries. **Whitelock et al.(2007)** stated that most gins use one or two cylinder cleaners and an air-type lint cleaner for lint cleaning. The trend in roller ginning today is toward aggressive seed-cotton cleaning and gentle lint cleaning to limit fiber damage. The aim of present study is to develop and evaluate simple prototype machine to gin Egyptian cotton in laboratory, to help technicians scholars to study  the effect of many treatments during operation  on fiber cotton quality  properties .

## MATERIALS AND METHODS

The gin stand prototype was designed to be used as a ginning system for mechanical harvested seed cotton .So , studying the effect of engineering parameters as rotation drum speeds, feed rates, clearance between two drums , inclination angle of drums with horizontal axis, to estimate the operation optimum conditions, also, to estimate energy requirements and operating cost essential to operation the last overall objective of this work was to test the gin stand developed and compare its performance with the conventional McCarthy  gin roller to investigate the machine effects of two different  gin stand on physical fiber properties.

**A - The gin stand developed:** A prototype reciprocating- knife gin having roller length of 70 cm was fabricated. The adjustment of moving parts of gin stand machine was set according to the conventional settings, which is usually followed with respect to each variety and grad. The power source of the machine is electricity (0.36 kW). The input power was controlled by a potentiometer to adjust the operating speed. The speeds of different moving parts of the gin stand were fixed and measured by a speedometer. The gin developed machine was fabricated and calibrated in private local workshops at Sofia village, El-Sharkeia

Governorate. Figure1 shows a schematic diagram of the developed gin stand **.**The main components of the developed gin machine were as follows**:**

**1- Rolls:** its were made from wood covering by natural leather. The gin stand developed was having two rolls used for separated cotton lint from seeds, as, cotton lint are attached in the direction of leather roller, stripping board strip the lint from the leather roller and empty seeds are thrown into grid, through which they pass into suitable receptacle. The dimensions of two rolls have length 700 mm, diameters 150 and 200 mm respectively and machine weight 65 kg

**2-.Moving knife and Stationary knife:** the knife serves three purposes

a) It direct (with the roller) seed cotton to the ginning point;

b) It removes seed away from the ginning point; and

c) It removes any seed cotton not able to ginned (carryover).

**3- Fly wheel :** Made from iron with diameter 380 mm. This diameter is kept on the balanced of machine.

## B - The conventional McCarthy gin roller

The fiber quality parameters of the developed machine were compared with conventional McCarthy gin roller (Figure 2), rotational speed (950 rpm) to evaluate the machine effects. It has the following component parts of

**a)** Parts for the separation of the fiber from the seed: these include fixed knife, moving knife and roller. These are called the main parts of gin stand.

**b)** Parts assistance to parts of the separation of the fiber from the seed : they include pusher board, seed grid and doffer.

**c)** Parts of transmission: these include crank shaft, employment pulley, idler pulley and the transfer of traffic pulleys.

**d)** Complementary parts like the fund fiber, in addition to the structure gin stand which consists of the thighs.

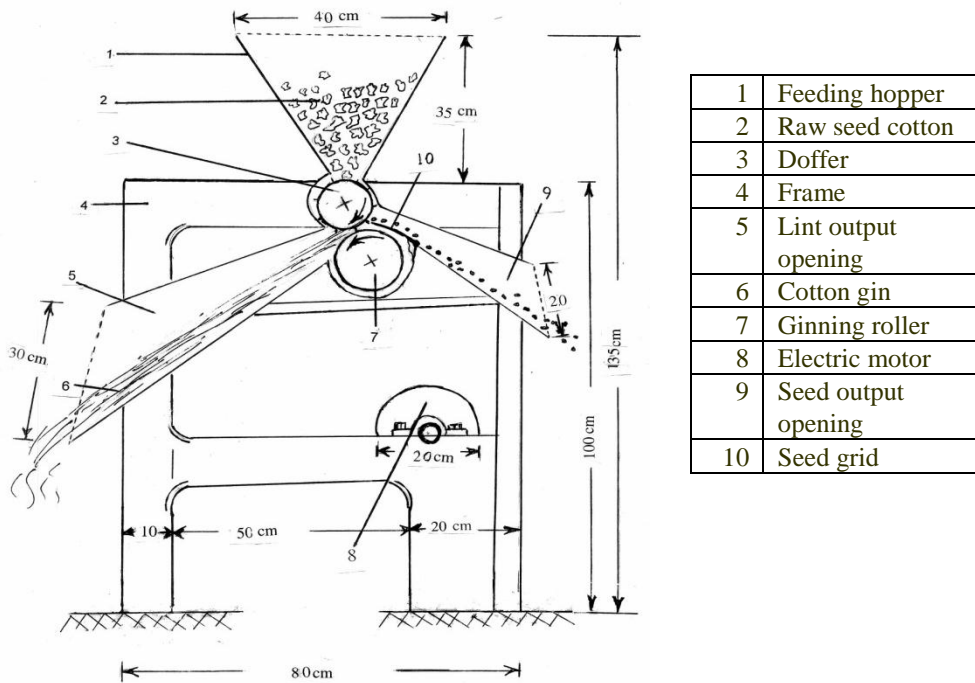| 1 | Feeding hopper |
|---|---|
| 2 | Raw seed cotton |
| 3 | Doffer |
| 4 | Frame |
| 5 | Lint output opening |
| 6 | Cotton gin |
| 7 | Ginning roller |
| 8 | Electric motor |
| 9 | Seed output opening |
| 10 | Seed grid |

**Fig. 1 : cross section of the developed gin stand machine.**
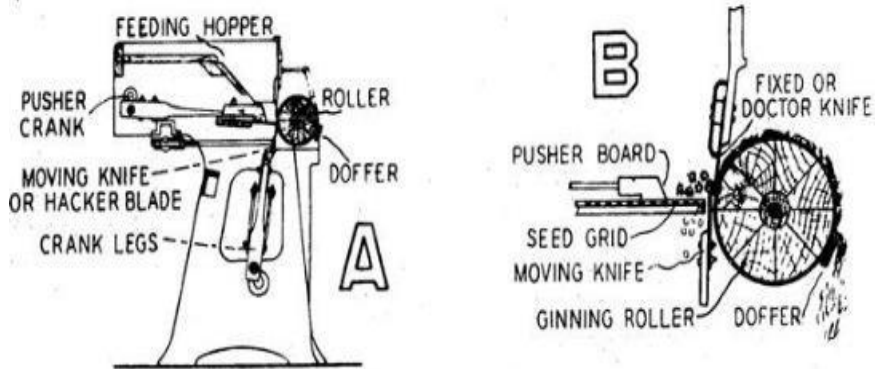


**Fig. 2: cross section of the conventional McCarthy gin roller (A) and the main parts of gin stand (B).**

**Treatments:**

Four rotation at speeds 0.79 m/s (60 r.p.m) ,1.18 m/s (90 r.p.m), 1.60 m/s(120 r.p.m), and 2.36 m/s(180 r.p.m). Three feeding rates 30 kg/h, 45 kg/h and 60 kg/h and three clearances between two drums 3, 4 and 5 mm were investigated. The measurements developed machine performance as follows:

**1- Machine productivity**

The machine productivity (Q) was calculated by using the following formula:

$$\text{Machine productivity, kg /h} = \frac{\text{Mass of input seed cotton, kg}}{\text{The time consummation for ginning, h.}} \quad ..(1)$$

**2- Ginning turn out**

It was determined by using the following formula:

$$\text{Ginning out turn , \%} = \frac{\text{Lint mass, kg}}{\text{Seed cotton mass, kg}} \quad ........(2)$$

**3- Gin lint losses**

It was determined by using the following formula:

$$\text{Gin lint losses, kg} = \frac{\text{Weight of seed cotton, kg} - (\text{lint productivity, kg + seed wastage mass, kg}}{} \quad ..(3)$$

**4- Ginning efficiency**

The percentage of ginning efficiency was determined by using the following formula:

$$\text{Ginning efficiency, \%} = \frac{\text{Seed cotton mass before ginning, kg} - \text{seed wastage mass, kg}}{\text{Seed cotton mass before ginning, kg}} \quad ...(4)$$

**5 - Energy requirement**

The required power was calculated according to the following formula (Gustafson, 1980):

$$\text{The consumed energy, (kW.h/ Mg)} = \frac{\text{Total power consumption (kW)}}{\text{Machine productivity (Mg / h).}} \quad ..(5)$$

Where:-

Total required power, kW = $\sqrt{2}$ I V Cos θ /1000 ..................( 6 )

I       = Electric current, ampere;
V       = Electric potential, voltage (220V);
cos θ  =  Power factor (being equal 0. 486)
$\sqrt{2}$   = Coefficient current two phases (being equal 1.4)

While the human energy was calculated as the following equation:

$$\text{Human energy} = \frac{\text{Manpower, kW}}{\text{Manual productivity, Mg / h}} \quad \ldots\ldots\ldots (7)$$

The manpower was computed by assuming that one normal labor supplies 0.0748 kW according to (Ezekiel, 1987) cited by (Matouk et al.1999)

## 6 - Operational cost of the unit

The total cost was determined by using the following equation (Awady,1978)

$$C = p/h(1/a + i + t/2 + r) + (Ec \times Ep) + m/144 \quad \text{---------------}( 8 )$$

|   |   |   |   |
|---|---|---|---|
| C | = Operation hourly cost , L.E/h. | p | = Price of machine , L.E. |
| h | = Yearly working hours, h/year | Ep | = Electricity price, (EL/kW.h) |
| Ec | = Electricity energy consumption ,(kW/h) | r | = Overheads and indirect cost ratio |
| a | = Life expectancy of the machine, h | m | = Monthly average wage ,L.E. |
| i | = Interest rate/year. | t | = Taxes ratio |
| 144 | = The estimated monthly working hours, h/mon | | |

Where:

**Also,** $Unit\ operating\ \cos t, LE/Mg = \dfrac{\Pr ototype\ \cos t\ (LE/h)}{\Pr oductivity\ (Mg/h)}$ …..…...( 9 )

Criterion function cost, LE/Mg = unit operating cost, LE/Mg + Losses cost, LE/Mg………………………………………………….( 10)

Losses cost, LE/Mg = value of lint wastage + fewness in cotton seed price according to reducing seed damaged………………………(11 )

## 7 - The fiber quality properties

The fiber properties were determined at fiber testing laboratory, CRI, ARC, Giza. As follows:

**A - Fiber length:** The digital fibrograph model 630 used to determine 2.5 and 5 % span fiber length according to May and Bridges, (1995).

**B - Uniformity ratio:** Determined by using the following formula: while it was had 2cm round holes diameter with saw drums concaves

$$\text{Uniformity ratio, \%} = \frac{\text{50\% span fiber length}}{\text{2.5\% span fiber length}} \times 100 \ldots\ldots\ldots\ldots(12)$$

Where, it was expressed on uniformity quantity between short and long fiber length.

**C -Lint Color:** HVI 9000 according to ASTM (D-1684-96) estimated lint color (reflectance Rd, % and yellowness +b)

**D - Fibers 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 give elongation reading and cotton strength can be determined by using the following formula:

$$\text{Strength for length unit, g/tex} = \frac{\text{cutting mass, kg}}{\text{mass of sample, mlg}} \times 1.5 \times 100 \quad \dots(13)$$

## RESULTS AND DISCUSSION

### A- Primordial Test :

Primary experiment was carried out during season 2009 at ginning seed cotton variety Giza 89 with using the conventional McCarthy gin roller, to determine the effect of some independent variables such as drum speed, feeding rate and clearance between drums on gin stand performance.Table1 show the average the conventional McCarthy gin roller processing data. This study proved that this machine is not suitable for low feed rates and therefore they do not fit the research tests urged it was designed for production only. Therefore there are been a urgent need of a model of ginning machines suitable for research experiments and for this reason has been the subject of machine design of the present study.

**Table1: Average the conventional McCarthy gin roller processing data.**

| Factor | Amount |
|---|---|
| Lint system ginning efficiency , % | 73.8 |
| Gin turn out , % | 28.6 |
| Lint loss , % | 4.6 |
| Ginning rate , kg / saw / h | 10.4 |

### B - Performance of development gin stand machine :

### 1- Gin stand productivity, kg/h :

Fig 3 show average gin processing for seed cotton variety Giza 89 usage development gin stand machine. Data illustrate that gin stand productivity was affected by drum speed, feeding rate and clearance

between drums. It's clear that gin stand productivity was increased by increasing all of drum speed, feeding rate and clearance between drums. whereas, at constant feed rate and clearance between drums at 30 kg/h and 3 mm and increase drum speed from 0.79 m/s to 2.36 m/s, gin stand productivity increased from 15.57 kg/h to 16.12 kg/h (+ 3.53%) . While, with increasing feeding rate from 30 kg/h to 60 kg/h at constancy drum speed and clearance between drums at 0.79 m/s and 3 mm respectively, gin stand productivity increased from  15.57 kg/h to 29.9 kg/h (+ 92%) . Also, at increasing clearance between drums from 3 mm to 5 mm at constant drum speed and feed rate at 30 kg/h and 0.79 m/s, gin stand productivity increased from 15.57 kg/h to 15.71 kg/h (+ 0.89 %). From previous results, feeding ate consider as very important factor affected on gin stand productivity. On the other hand, a maximum of gin stands productivity was 32.8 kg/h recorded at drum speed of 2.36 m/s, feeding rate of 60 kg/h and clearance between drums of 5mm.

**2- lint turn out ,% :**

From Fig. 4 results indicates that, increasing drum speed and clearance between drums led to increase lint turn out , while increasing feeding rate led to decease lint turn out . Whereas, at used constant feeding rate and clearance between drums at 30 kg/h and 3mm with increasing drum speed from 0.79 m/s to 2.36 m/s , lint turn out increased from 38.8 % to 41.4 % (+6.7%) . On the contrary, at used feeding rate and drum speed of 30 kg/h and 0.79 m/s, lint turn out increased from 38.8 % to 40.3 % (+3.86%) . While, at used drum speed of 0.79m/s and clearance between drums of 3 mm and by increasing feeding rate from 30 kg/h to 60 kg/h , lint turn out decreased from 39.4% to 38.3% (- 2.8%) . The maximum value of lint turn out was 43.1% recorded at drum speed of 2.36 m/s, feeding rate of 30 kg/h and clearance between drums of 5 mm.

**3- Seed wastage mass , kg :**

Fig.5 indicated that, seed wastage mass tend to decrease with increasing all of drum speed and clearance between drums. While, it was increase with increasing feeding rate. On the whole results recorded a maximum amount of seed wastage mass was 17.49 kg at using feeding rate of 60 kg/h, drum speed of 0.79 m/s and clearance between drums of 3 mm . It's clear that, at using feeding rate of 30 kg/h , clearance between drums of 3 mm and increase drum speed from 0.79 m/s to 2.36 m/s, seed wastage mass decrease from 8.21 kg
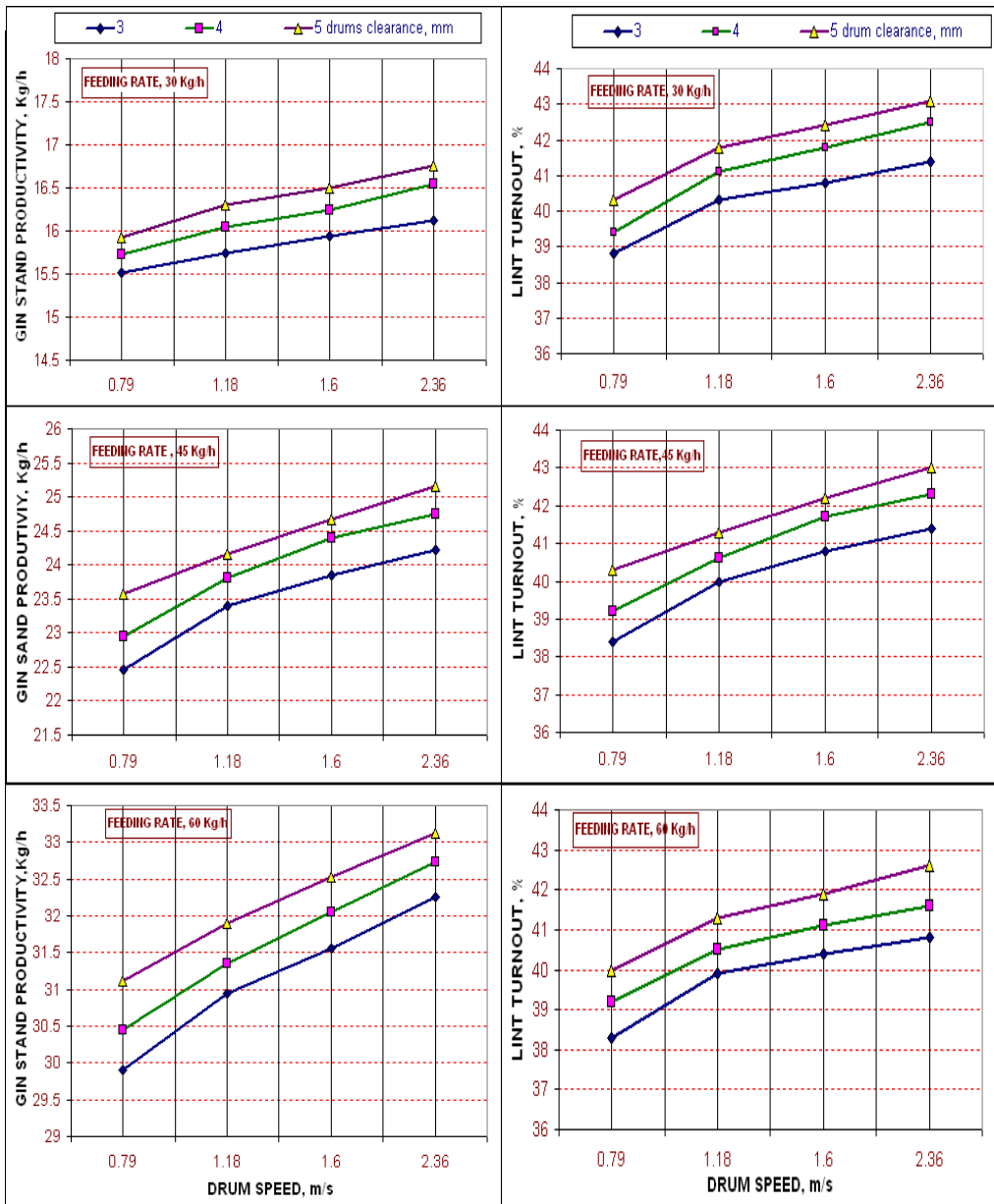
Fig 3 : Effect of drum speed , feed rate and clearance between two drums on **gin stand productivity** , kg/h .

Fig 4 : Effect of drum speed , feed rate and clearance between two drums on **lint turn out**, %.

to 7.81 kg (- 4.87%). Also, at using drum speed of 0.79 m/s, clearance between drums of 3 mm and increasing feeding rate from 30 kg/h to 60 kg/h. seed wastage mass increase from 8.21 kg to 17.49 kg (+113%) seed wastage mass decrease too from 8.21 kg to 7.76 kg (- 5.48%) at using feeding rate of 30 kg /h, drum speed of 0.79 m/s and increase clearance between drums from 3 mm to 5 mm.

**4- Energy requirement , kW.h/Mg :**
Data presented in Fig. 6 show the effect of drum speed, feed rate and clearance between drums on energy requirements. It's observed that, increasing drum speed from 0.79 m/s to 2.36 m/s tends to increase energy requirements. While, increasing feed rate from 30 kg/h to 60 kg/h or increasing clearance between drums from 3 mm to 5 mm led to decrease energy requirements. As it was to allow the passage of the samples easily without making contact with a large capacity, less the rate of energy required. A minimum energy requirements was 154.26 kW.h/Mg recorded at using drum speed of 0.79 m/s , feed rate of 60 kg/h and clearance between drums of 5 mm.

**5- Ginning efficiency and gin lint losses percentage**
Ginning efficiency and gin lint losses percentage as related to the drum speed , feeding rate and clearance between drums are shown in Fig. 7. It's clear that, increasing drum speed , feed rate and clearance between drums led to decrease ginning efficiency at all experimental points. Also , increasing drum speed and clearance between drums led to increasing gin lint losses percentage while, increasing feeding rate led to decrease gin lint losses percentage. And through the intersection curves of ginning efficiency and estimate the proportion of lint losses can determine the optimum conditions for operating the machine, which then will be suitable efficiency with less ginning percentage or an acceptable degree of lint losses. And through the signing of curves graphically possible to identify optimum conditions for operating the machine manufacturer when drum speed and feeding rate and clearance between the drums. Accordingly the optimum operating conditions for the gin stand developed was recorded at drum speed of 0.79 m/s, feed rate of 45 kg/h and clearance between drums of 3 mm. Where it was produced high value of ginning efficiency equal 80.69% and low value of gin lint losses percentage equal 5.19%, respectively.
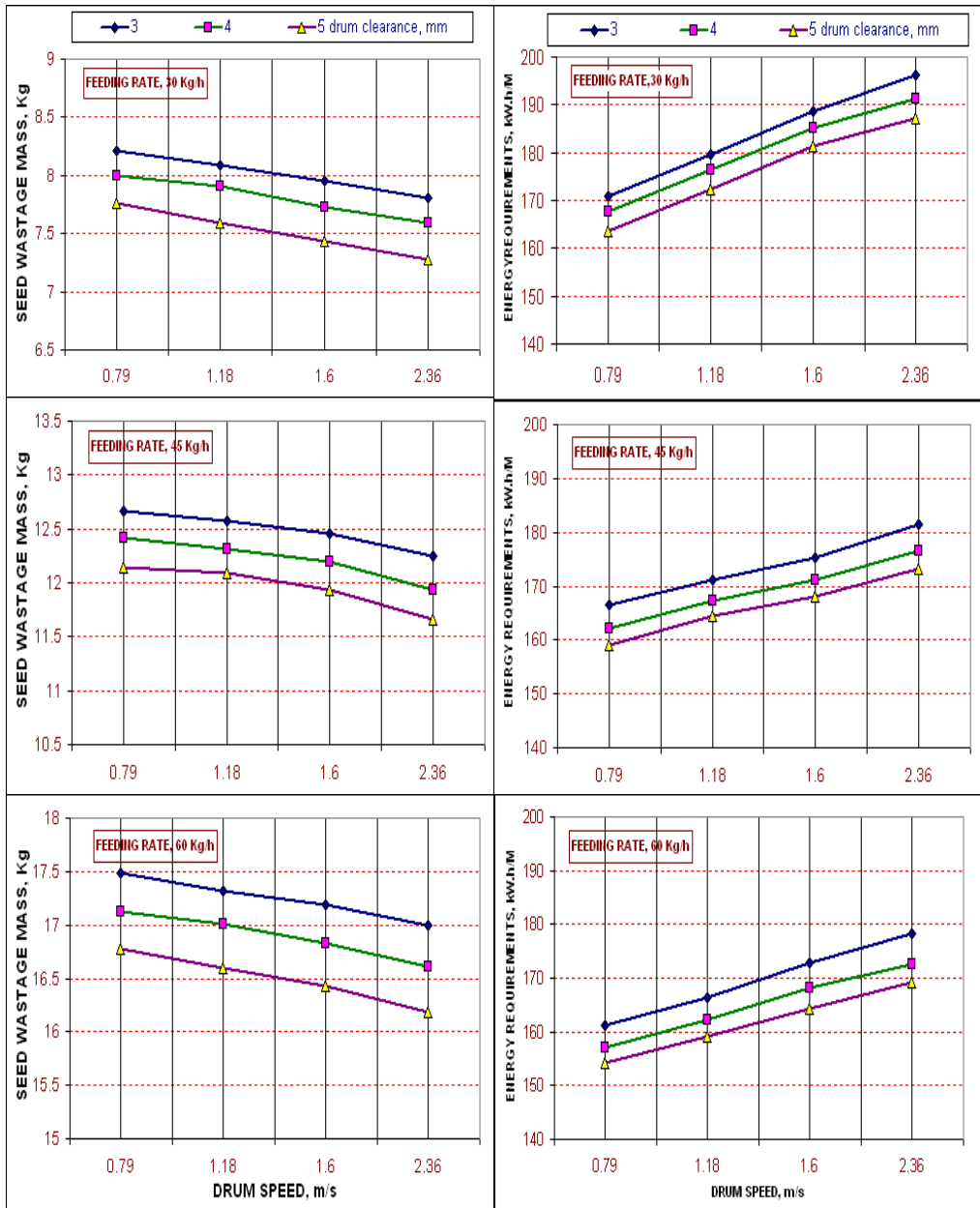
Fig 5: Effect of drum speed , feed rate and clearance between two drums on **seed wastage mass** , kg .

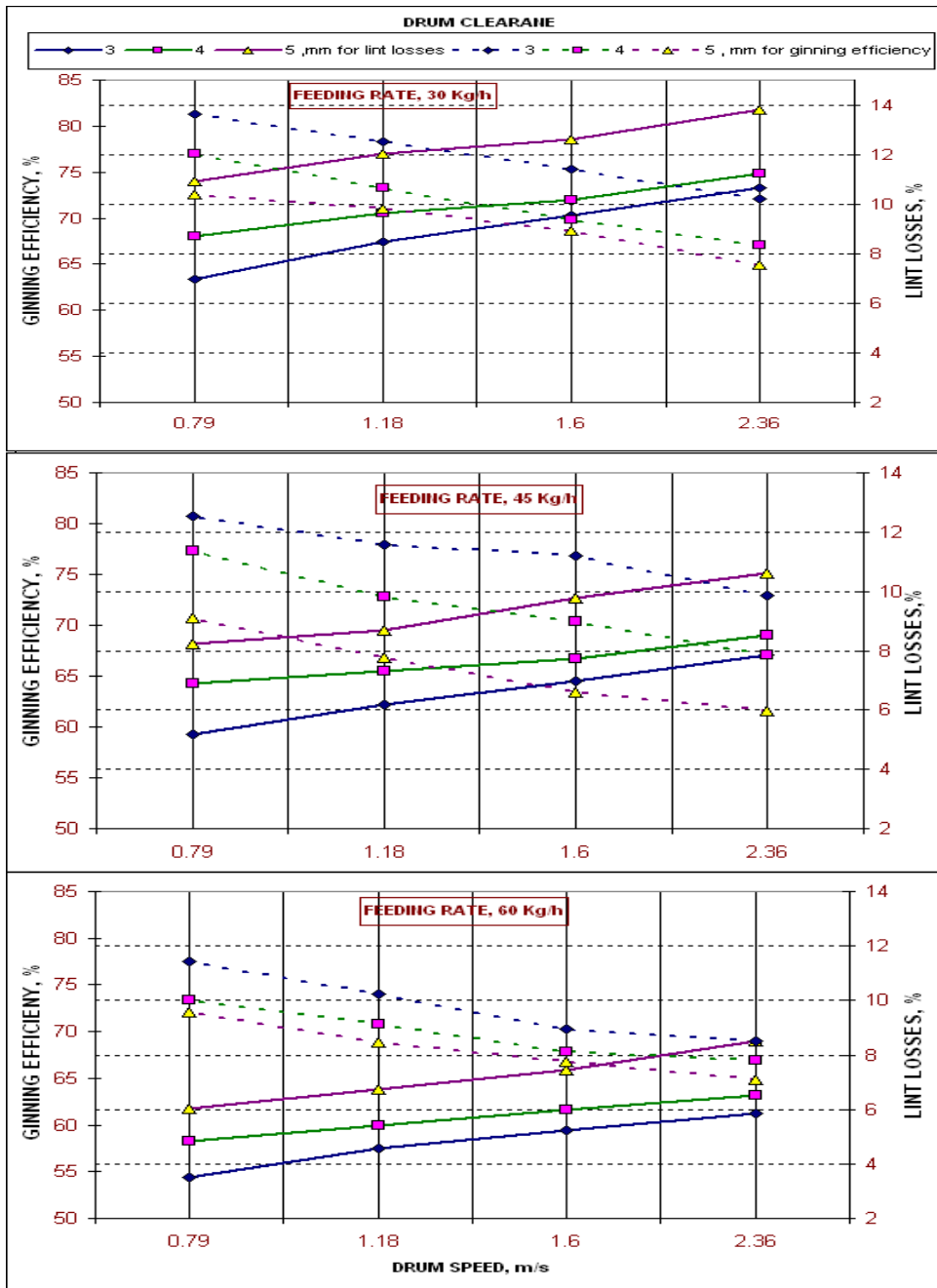Fig 6: Effect of drum speed, feed rate and clearance between two drums on **energy requirements** , kW.h/ Mg.

Fig.7: The relation between drum speed and both of **ginning efficiency** and **gin lint losses ,%** at different feed rates and drum clearances.

## 6- Total production cost and criterion function determination :

Table 2 illustrates the effect of drum speed on total production cost and criterion function cost at different levels of feeding rate and clearance between two drums. whereas, the total production cost was decreased with increasing drum speed, increasing feeding rate and with increasing clearance between two drums. Vice versa, criterion function was increased at the same previous conditions. On the other hand, criterion function cost was estimated by total cost of all of the operating costs and machine costs in the lint losses and machine costs in the seed damaged. In addition to, a minimum total cost production was 231.40 L.E/Mg recorded at drum speed of 2.36 m/s, feeding rate of 60 kg/h and clearance between two drums of 5 mm. while, a minimum criterion function cost was 364.10 LE/Mg recorded at drum speed of 0.79 m/s, feeding rate of 60 kg/h and clearance between two drums of  3 mm respectively.

**Table 2 : Total production cost and criterion function cost for the gin stand developed**

| Feed rate, Kg/h | Clearance between drums, mm Drum speed ,m/s | Total production cost, L.E/Mg | | | Criterion Function Cost, LE/Mg | | |
|---|---|---|---|---|---|---|---|
| | | 3mm | 4mm | 5mm | 3mm | 4mm | 5mm |
| 30 | 0.79 | 388.74 | 384.06 | 379.5 | 599.12 | 660.84 | 722.42 |
| | 1.18 | 378.57 | 371.5 | 365.5 | 657.75 | 671.80 | 757.80 |
| | 1.60 | 374.10 | 367.2 | 361.36 | 683.55 | 688.27 | 776.21 |
| | 2.36 | 369.76 | 360.6 | 355.70 | 699.46 | 722.97 | 818.57 |
| 45 | 0.79 | 318.64 | 311.76 | 303.40 | 466.97 | 482.53 | 554.40 |
| | 1.18 | 305.77 | 300.60 | 285.20 | 511.82 | 509.11 | 555.00 |
| | 1.60 | 300.00 | 293.30 | 251.98 | 520.77 | 523.20 | 562.28 |
| | 2.36 | 295.50 | 289.00 | 234.40 | 538.83 | 543.90 | 577.63 |
| 60 | 0.79 | 265.80 | 261.00 | 251.90 | 364.10 | 399.56 | 433.76 |
| | 1.18 | 255.20 | 251.18 | 246.50 | 398.62 | 404.99 | 451.68 |
| | 1.60 | 251.90 | 248.00 | 243.50 | 419.50 | 414.78 | 466.95 |
| | 2.36 | 246.50 | 242.30 | 231.40 | 417.66 | 437.45 | 494.80 |

**C- Effect of Gin Machine Type on The fiber quality parameters:**

Table3 illustrates the properties for fiber quality which produced by the gin stand developed and the conventional McCarthy gin roller at optimum operation condition. Results show that, developed gin stand was give good outcome compared with the conventional McCarthy gin roller. Where it was recorded high value of span fiber length2.5% (mm), span fiber length50% (mm), uniformity ratio (%), fiber reflectance (%) and fiber strength (g/tex) . While, the conventional McCarthy gin roller was recorded high value of fiber yellowness (unit) and fiber elongation (%).

**Table 3: The fiber quality parameters at optimum operation conditions.**

| Ginning stand machines / Fiber quality parameters | The gin stand developed | McCarthy gin roller |
|---|---|---|
| Span fiber length 2.5%,mm | 31.1 | 30.8 |
| Span fiber length 50%,mm | 14.8 | 14.1 |
| Uniformity ratio,% | 47.6 | 45.8 |
| Fiber reflectance ,% | 68.0 | 66.4 |
| Fiber yellowness, unit | 6.1 | 6.5 |
| Fiber strength ,g/tex | 29.1 | 28.0 |
| Fiber elongation ,% | 6.9 | 7.3 |

So, the gin stand developed was consider the best for ginning Egyptian seed cotton samples.

## CONCLUSION

The research can be concluded that :

1- At determination the developed gin stand capacity, it was agreed directly relation with increasing drum speed, feed rate and clearance between drums. Also, the maximum capacity was 32.8 kg/h recorded at using drum speed of 2.36 m/s, feed rate of 60 kg/h and clearance between drums of 5 mm.

2-Lint turn out percentage was agreed directly relation with increasing

drum speed and increasing clearance between drums, maximum lint turn out was 43.1% recorded at using drum speed of 2.36 m/s, feed rate of 30 kg/h and clearance between drums of 5 mm.

3- Seeds wastage mass was had directly relation with all independent variables. Also, the maximum seeds wastage mass was 17.49 kg recorded at using drum speed of 0.79 m/s, feed rate of 60 kg/h and clearance between drums of 5 mm. On other hand, gin lint losses percentage was had directly relation with drum speed and clearance between drums while, it was had reversely relation with feed rate . Whereas, the minimum value was 3.5% recorded at using drum speed of 0.79 m/s, feed rate of 60 kg/h and clearance of 3 mm.

4- Developed gin stand machine was had maximum ginning efficiency equal 81.28% at using drum speed of 0.79 m/s, feed rate of 30 kg/h and clearance of  3 mm.

5- Minimum value of energy requirements was 154.26 kW.h /Mg at using drum speed of 0.79 m/s, feed rate of 60 kg/h and clearance of 5 mm.

6-Minimum value of total  production cost was 231.40 L.E/Mg recorded at using drum speed of 2.36 m/s, feed rate of 60 kg/h and clearance of 5 mm . While, minimum of criterion function cost 364.10 LE/Mg was recorded at using drum speed of o.79 m/s, feed rate of 60 kg/h and clearance of 3mm

7- A comparison study between effects of the gin stand developed and McCarthy  gin roller on fiber quality parameters, it illustrate that, the gin stand developed was consider the best for ginning Egyptian seed cotton samples.

## REFERENCES

**ASTM,Standards(1982).** Designatians:64,(884-96)ASTM, Philadelphia ,Pa, USA..

**ASTM, Standards (1984).** Designations: 1445 – 75. American society for testing and materials. Standards of textile testing and materials .The society, philadelaphia, USA.

**Awady,M.N.1978.** Tractors and farm machine, in Arabic, text. Col. Ag., Ain Shams Univ.; 164-167.

**Anthony, W.S.1979.** Energy-quality considerations in modeling cotton ginning systems. Trans. of The ASAE. 22(3): 644-648.

**Anthony, W.S.1985.** Effect of gin stands on cotton fiber and seed Cotton. Gin and Oil Mill Press.; 86(16): 14-18.

**Anthony, W.S.1989.** Performance characteristics of cotton ginning machinery . American Society of Agricultural Engineers.; Paper (89-1010): 26 pp.

**Eweida, M.A.; G.A.Morshedi; M.A, Risk and S.S.Marzook (1984).** Effect of the rotary knife gin –stand adjustment and cleaning the cotton lint on ginning efficiency in some Egyptian and upland cotton varieties. Agric.res.rev. 62(6): 301 –311.

**Ezeike, M.S. 1987.** Energy requirements for cotton gin machinery. Applied Engineering in Agriculture. 12(3): 455-473.

**Gustafson, R.J. 1980.** Fundamentals of Electricity for Agriculture. The AVI publishing company, Inc. Westport, Connecticut.

**Hossam el-din, A.E. (1978)** Ginning efficiency as affected by cotton characteristics and some other major factors. Ph.D thesis. Fac. of Agric. Al –azhar Univ.

**Hughs, S.E.; M.N. Gillum and W.F. Lalor.1983** Fiber quality from a combination gin-lint cleaner. American Society of Agricultural Engineers. Paper No. ( 83-3533): 15 pp.

**Matouk A. M. ; Y. M. El-Hadidi and H. El-Mashad.1999.** Energy accounting and management in some food plants. Misr Journal of Agric. Eng. 16 (1) : 157-175.

**Mangialardi, G.J. and W.S. Anthony 2000**. Engineering and ginning: feasibility of applying seed cotton cleaning principles to lint cleaning. Journal of Cotton Science. 4(3): 183-192.

**May, O.L.and B.C. Bridges, Tr. (1995).** Breeding cottons for conventional and late planted production systems. Crop Sci. 35: 132-136.

**Patil, P.G.;S.K. Shukla and V.G. Arude 2006**. Design development and performance evaluation of portable cotton ginning machines. AMA, 37(1): 30-34.

**Rafiq-Chaudhry, M. 1997.** Harvesting and ginning of cotton in the world. Proceedings Beltwide Cotton Conferences, New Orleans, LA, USA, Volume 2 : 1617-1619.

**Whitelock, D.P; C.B. Armijo; G.R.Gamble and S.E. Hughs 2007.** Survey of seed-cotton and lint cleaning equipment in U.S. roller gins. USDA - ARS Southwestern Cotton Ginning Research Lab, 300 E College  Journal of Cotton Science. 11(3): 128-140.

## الملخص العربى

# تطوير نموذج أولى لحلاجة بسيطة تناسب القطن المصري.

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محصول القطن من المحاصيل الهامة التي ظلت مؤثرة على الاقتصاد القومي المصري لفترة طويلة نظرا للميزة النسبية للأصناف المصرية لما تتمتع بة من صفات غزلية جيدة مرغوبة لدى الحلاجين و الغزالين على مستوى العالم. و نظرا لتعرض الأقطان لكثير من المعاملات داخل الحقل قد تؤثر على صفات الجودة لالياف . فإننا عند تداول هذة الأقطان في الأسواق نكون في حاجة ملحة إلى سرعة تقدير هذة الصفات حتى يمكن تقدير أسعار تداولة بدقة. و يهدف هذا البحث إلى تطوير نظام ميكانيكي معملي بسيط يستخدم لحلج عينات القطن الزهر حتى يسهل استخدام هذة العينات داخل أجهزة تقدير صفات جودة الألياف.و لتنفيذ البحث تم تصنيع آلة حليج بسيطة تتركب من إطار معدني مثبت علية زوج من الدرافيل الدوارة (شوبك حلج) ، حدافة ، و مصدر إدارة عبارة عن موتور كهربي ٠,٣٦كيلو وات.و قد تم تقدير أداء هذة الآلة تحت ظروف التشغيل المختلفة ثم تم مقارنة صفات ألياف القطن المحلوج بها مع صفات ألياف القطن المحلوج بحلاجة متداولة بالأسواق (حلاجة مكارثى ) وذلك لتقدير تأثير كل حلاجة على الألياف الناتجة .

**العوامل تحت الدراسة** :

١ـ سرعة دوران الـدرفيل (الشوبك ): وقد تـم استخدام أربعـة سـرعات لـلدرفيل كانـت٧٩,٠، ١,١٨، ١,٦٠، ٢.٣٦ م/ث .

٢ـ معدل التلقيم : و قد تم استخدام ثلاثة معدلات تلقيم كانت ٣٠ ، ٤٥ ، ٦٠ كجم / س .

٣ـ الخلوص بين درافيل الشوبك : و قد تم استخدام ثلاثة خلوصات كانت ٣ ، ٤ ، ٥ مم .

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- و قد تم تقييم أداء الحلاجة المطورة من خلال دراسة **مؤشرات الكفاءة** التالية :

١- إنتاجية الحلاجة ، كجم / س .  ٢- صافى الحليج ، % .

٣- وزن البذور الناتجة من الحلج ، كجم .  ٤- كفاءة الحليج ، % .

٥- التكاليف الكلية للعملية ، جنية / ميجا  ٦- الطاقـــة اللازمـــة للحليج ، ك.وات .س
جرام .  /ميجا جرام .

٧- الدالة المعيارية ، جنية / ميجا جرام .  ٨- نسبة الألياف المفقودة أثناء الحلج ، % .

و أيضا تم تقدير صفات جودة ألياف القطن التالية لكلتا الحلاجتين :

١- طول التيلة عند نسبة توزيع ٢٫٥ %،مم  ٢- طول التيلة عند نسبة توزيع ٥٠%، مم

٣- معدل الانتظام ، % .  ٤- نسبة انعكاس اللون ، % .

٥- درجة اصفرار اللون ، درجة .  ٦- متانة التيلة ، جم / تكس .

٧- نسبة استطالة التيلة ، % .

**النتائج :**

١- الحلاجـة المطورة كانت تناسب حلج عينـات القطن الزهر الصغيرة بكفاءة عاليـة مقارنـة
بالحلاجات الكبيرة الحجم نظرا لصغر حجمها مع إمكانية تصنيع نماذج كبيرة منها .

٢- السـعة الإنتاجيـة للحلاجـة المطورة بلغت أعلى قيمـة لهـا٨٧٫٦ كجم عند استخدام سـرعة
شوبك ٢.٣٦ م /ث و معدل تلقيم ٦٠ كجم /س و خلوص ٥ مم.

٣- صـافى الحليج كن يتناسب طرديا مـع سـرعة الشـوبك و الخلوص بين الاسطوانات بينما
يتناسب عكسيا مع معدل التلقيم . و قد كانت على قيمة لة١٫٤٣% عند سرعة شوبك ٢.٣٦
م /ث و معدل تلقيم ٣٠ كجم /س و خلوص ٥ مم.

٤- وزن البذور الناتجة من الحلج كانت تتناسب طرديا مـع جميـع المتغيرات تحت الدراسـة و
كانت أقصى قيمة لهـا٢١١٫٤ كجم عند سرعة شوبك ٢.٣٦ م /ث و معدل تلقيم ٦٠ كجم
/س و خلوص ٥ مم.

٥- نسبة الألياف المفقودة أثناء الحلج كانت تزداد مـع زيـادة سـرعة الشـوبك و زيـادة الخلوص
بينما تقل مع زيادة معدل التلقيم

٦- أعلى كفاءة حلج كانت٨١٫٢٨% عند سـرعة شوبك٠٫٧٩ م /ث و معدل تلقيم ٣٠ كجم /س
و خلوص ٣ مم.بينما كانت اقل طاقـة لازمـة٢٦٫١٥٤ ك.وات .س /ميجا جرام .عند نفس
السرعة مع معدل تلقيم ٦٠ كجم /س و خلوص ٥ مم .

٧- اقل تكاليف كلية كانت٢٣١٫٤٠ جنية / ميجا جرام بينما اقل دالة معيارية كانت٣٦٤٫١٠
جنية / ميجا جرام .

٨- بمقارنـة صفات جودة الألياف وجد أن الآلـة المطورة كانت تحـافظ علـى الصفات بدرجـة
أعلى من حلاجة مكارثى التقليدية.