DEVELOPMENT OF THE THRESHING MACHINE FOR IMPROVING ITS PERFORMANCE UNDER EGYPTIAN CONDITIONS

E. A. El Saiedy* **G.R.Gamea**** **Adel M. El Ashker*****

ABSTRACT

To improve the performance of the locally manufactured threshing machines, a feeding system was developed to use with it. The aim of this work is to reduce both the threshing costs and the injuries to the laborers.

The main objectives of this study are:

1-Develop a feeding system for threshing machine.

2-Evaluat the performance of the threshing machines before modification at three moisture contents for wheat crop 17.2, 15.2 and 13.4 % and four drum speeds 700, 800, 900 and 1000 rpm (27.47, 31.4, 35.3 and 39.25 m/s) .

3-Test the threshing machines after modification under the same conditions at different angels of conveyor belt of 17.5, 20, 23 and 26 degree.

The experimental results showed that the performance of a threshing machine after modification is better than before modification. The value of the feeding rate after modification increased about 26% than before modification. It was of 2.28 ton/h compared to 1.68 ton/h before modification. Threshing efficiency of 99.50 %, cleaning efficiency of 99.70 %, unthreshed grain losses of 0.50 %, grain losses in straw of 0.30 %, grain damage of 0.65 %, cutting length of straw of 1.20 cm, total grain losses of 5.37 kg/ton were also recorded before modification. The operation cost was 22.8 LE / ton and the threshing cost was 36.4 LE / ton after the addition of the costs of lost grains at drum speed of 1000 rpm. These results were obtained at moisture content of 13.4 %, and conveyor belt angle of 20 degree.

***Lecturer. Dept of Ag. Eng., Fac. of Ag., Minoufiya Univ., Egypt.**
****Asso Prof.Dept of Ag. Eng., Fac. of Ag., Minoufiya Univ., Egypt.**
*****Assist Researcher, Ag. Eng. Res.Ins. Dokki, Giza, Egypt.**

On the other hand the results before modification threshing efficiency it was of 98.20 %, cleaning efficiency of 98.40 %, unthreshed grain losses 1.80 %, grain losses in straw of 1.00 %, grain damage of 2.10 %, cutting length of straw of 1.8 cm, total grain losses of 18.13 kg/ton were recorded. The operation cost was 33.33 LE/ton and threshing cost was 79.2 LE/ton after the addition of the costs of lost grains at drum speed of 1000 rpm and moisture content of 13.4 %. The specific energies were 11.3 and 8.1 kW.h/ton before and after modification at the same previous conditions.

INTRODUCTION

The cultivated area of wheat crop In Egypt at the year 2012 owing to Ministry of Agriculture was about 2.81 million Feddans. The Egyptian farmers usually use a local threshing machine to thresh their wheat. Many small workshops and manufactures produce threshing machines without any scientific guidance. Beside that, no feeding device was attached with the threshing machine, which makes feeding operation difficult and danger. For these reasons, it was necessary to develop a feeding device attached with the local manufactured threshing machine to increase its efficiency and to decrease total grain losses, energy, and total threshing cost. El - Mufti et al. (1989) reported that feeding crop without safety was one of the main reasons attributed to thresher injuries; they added also that the mechanical failures responsible for injuries were 17 %. Mohan and Patel (1992) stated that in India the mechanization of agricultural practices resulted in increased agricultural productivity but at the same time the incidence of traumatic injuries among agricultural workers seems to have increased also. Among these, threshing machines are responsible for a significant number of serious injuries. Abo El-Naga et al. (2004) reported that, increasing drum speed increased seed damage, while decreased both unthreshed seed and total seed losses. On the other hand, increasing feed rate decreased seed damage, while increased both unthreshed seed and total seed losses. It was showed also that increasing seed moisture content decreased seed damage, while unthreshed seed and consequently total seed losses increased. Khattab et al. (2007) developed a feeding device constructed and attached with a Turkish threshing machine and it was found that, Minimum total grain losses of 5.48 and

3.57 % before and after development were obtained at material-feed rate of 1100 kg/h, drum speed of 27 m/s and grain moisture content of 19 %. While both threshing and cleaning efficiencies of 97.74, 94.34 % and 98.35, 97.25 % were obtained before and after development at the same previous conditions. The minimum value of threshing cost of 35.53 and 30.46 L.E/ton before and after development was obtained at material feed rate of 1100 kg/h; drum speed of 27 m/s and grain moisture content of 19 %.The energy requirements of 18.26 and 18.92 kW.h/ton were obtained before and after development at the same previous conditions. Daghan et al. (2012) stated that, Technologies used to increase productivity in agriculture require the intense use of farming machines. In the literature, injuries due to farming machines including corn-picker, wheat thresher, grain auger, or hay baler have been reported. These accidents in agricultural enterprises result in income loss, production loss, material defects in devices, and high expenditures due to physical disabilities. He most commonly observed injury was the 5th degree injury and the most commonly affected fingers in this group were the third and fourth fingers while 14 of the patients had left upper extremity injury, 10 had right upper extremity injuries.

MATERIALS AND METHODS

(A) Materials

1. Threshing machine specifications:

The threshing machine used in this study was (CETINEL 120. Locally Manufacture). The specifications of the machine are shown in Table (1), fig. (1).

2. Developed machine:

(a) Conveyor's frame

The conveyor's frame was manufactured from two channels steel 10 x 10 x 0.5cm with length of 150 cm attached to the threshing machine by 2 bolts of 2.4 cm to change the angle of conveyor belt.

(b) Conveyor

The conveyor was made of special plastic and rubber 6 ply rating. The conveyer dimensions were 349 cm. length x 116 cm width x 0.5 cm thicknesses.

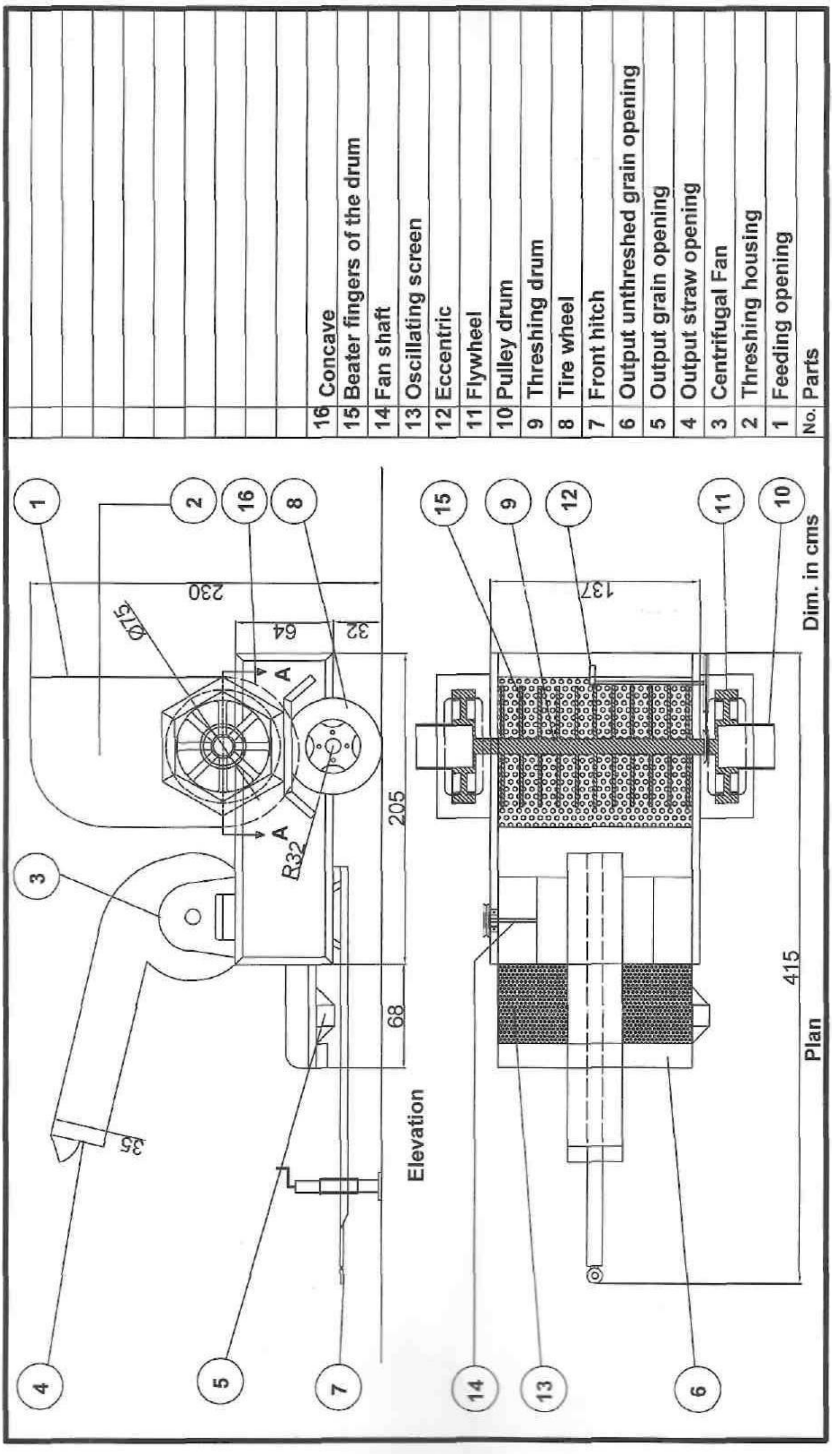


Fig. (1): Main components of threshing machine (Cetinel 120) before modification

Table (1): Specifications of threshing machine

Items	threshing machine (CETINEL-120)
Length, cm	320 without hitch, 415 with hitch
Width, cm	127
Height, cm	198
Weight, kg	1550
Source of power	Transmit from tractor through pulley and belt.
Threshing knives	Spike tooth
Length of the cylinder, cm	118
Diameter of the cylinder, cm	75
Cylinder knives	Total of 44 knives, 32.5 cm long, 10 and 6 bottom and top wide and 0.6 thick rites bolted to the central tube 10 diameters
Crop inlet, cm	1 2 0 x 45
Grain outlet, cm	10 x 10
Hole diameter for curved shaker	1.5

Both the ends of the conveyor were welded by leaser instrument using computer program. Also, seven supporting bars of rubber 1 cm width x 0.5 cm thickness x l16 cm length were fixed on the flat belt to control uniformity of the crop materials during the feeding process and decrease crop slipping. Fig (2) shows the conveyor and its components.

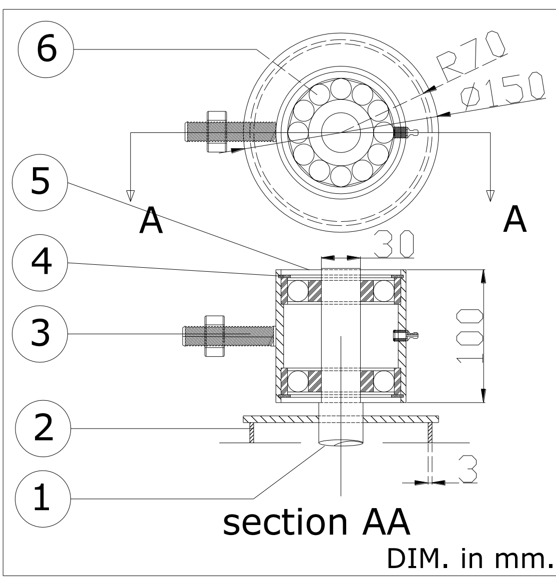
Fig (2): The conveyor belt.

(c) <u>Drive drum</u>

The idler drive was made of steel pipe with diameter of 7.5 cm, thickness of 0.4 cm and length of 116 cm. Two flanges with diameter of 10 cm were welded at both edges of the drum to prevent the conveyer to slip and two guides on both drum. An axle of 5 cm diameter and 150 cm length was fixed along the center of the drum and welded outer of the two flanges. The drive drum axle was rolled on two ball bearing housing and equipped with double ball bearing and greaser. The bearing housing equipped with threaded bolt to adjust the tension of the conveyer. The motion was transferred to the drive drum via a pulley of 14 cm diameter.

(d) <u>Driven drum</u>

The driven drum was made of steel pipe with diameter of 7.5 cm. thickness of 0.4 cm. and length of 116 cm. Two flanges with diameter of 10 cm were welded at both edges of the drum to prevent the conveyer to slip. An axle of diameter 5 cm and 140 cm length was fixed along the center of the drum and welded outer of the two flanges. The driven drum axle was rolled on two ball bearing hosing equipped with double ball bearing and greaser. Fig (3) shows a cross section in the drive drum bearing housing and conveyer tension.



No.	Main parts
6	Bearing
5	Bearing housing
4	Bearing lock
3	Belt tension
2	Drum
1	Drum shaft

Fig (3): Drive and driven drums bearing housing and conveyer tension.

(e) Balance of conveyor belt

In order to prevent deviation of the conveyor belt right or left during operation, 2 pulleys of 30 cm diameter welded from the end of each drum in both the drive and driven drum. 2 v belts of 1.7 cm width and 349 cm; lengths were fixed on inner surface of the conveyor belt so that the course of a pulley constantly lieutenants and don't not deviate from conveyor belt. The belts were welded by leaser instrument using computer program.

3. Transmission system

It was necessary to transmit motion to conveyor from the rote axle via a pulley of 14 cm diameter. It was fitted on it. The drive pulley transmits the motion to the driven axle of 40 cm diameter by a (V belt). Figs. 4, 5 and 6 shows the transmission system and main components after modification.

Fig. (4): Transmission system after modification.

4. Tractor:

A Nasr tractor of 60 hp was used for operating CETINEL-120 threshing machine. The tractor power was transmitted to the threshing machine through tractor pulley by using rubber belt.

5. Crop

The crop used in this study was wheat variety of Gemiza 9. The Grain straw ratio of this variety was (1: 1.7).

(B) Methods:

1 -Scope of variables

The experimental work were carried out mainly to determine the effects of conveyor belt speed, angle of conveyor belt on machine capacity, threshing efficiency, length of cut straw, grain losses damaged and fuel consumption. The following variables were investigated:

I-Drum speeds: four speeds were tested before and after the modification of the threshing machine. It was 700, 800, 900 and 1000 rpm, (27.47, 31.4, 35.3 and 39.25 m/s).

II- Angles of conveyor belt of were 17.5, 20, 23 and 26 degree.

III- The moisture content ratios of the crop were 17.2, 15.2 and 13.4 %.

2-Experimental procedure

2.1-Before the feeding process was conducted the following steps were done:

A- Adjusting the machine balance (horizontally - vertically) by a water balance for the modified and unmodified threshers.

B- Adjusting the shaker angle for the machines.

C- Crop sample of 200 kg was weight to do the experiments (bundle of 3 kg approximately).

2.2-The angle of the conveyor was adjusted by means of bolts.

2.3-The belt which transmits the motion between the tractor and the machine was also adjusted.

2.4–The threshing machine speed was adjusted by measured of digital tachometer.

2.5–The speeds of the belt, shaker and the cleaning fan also were measured.

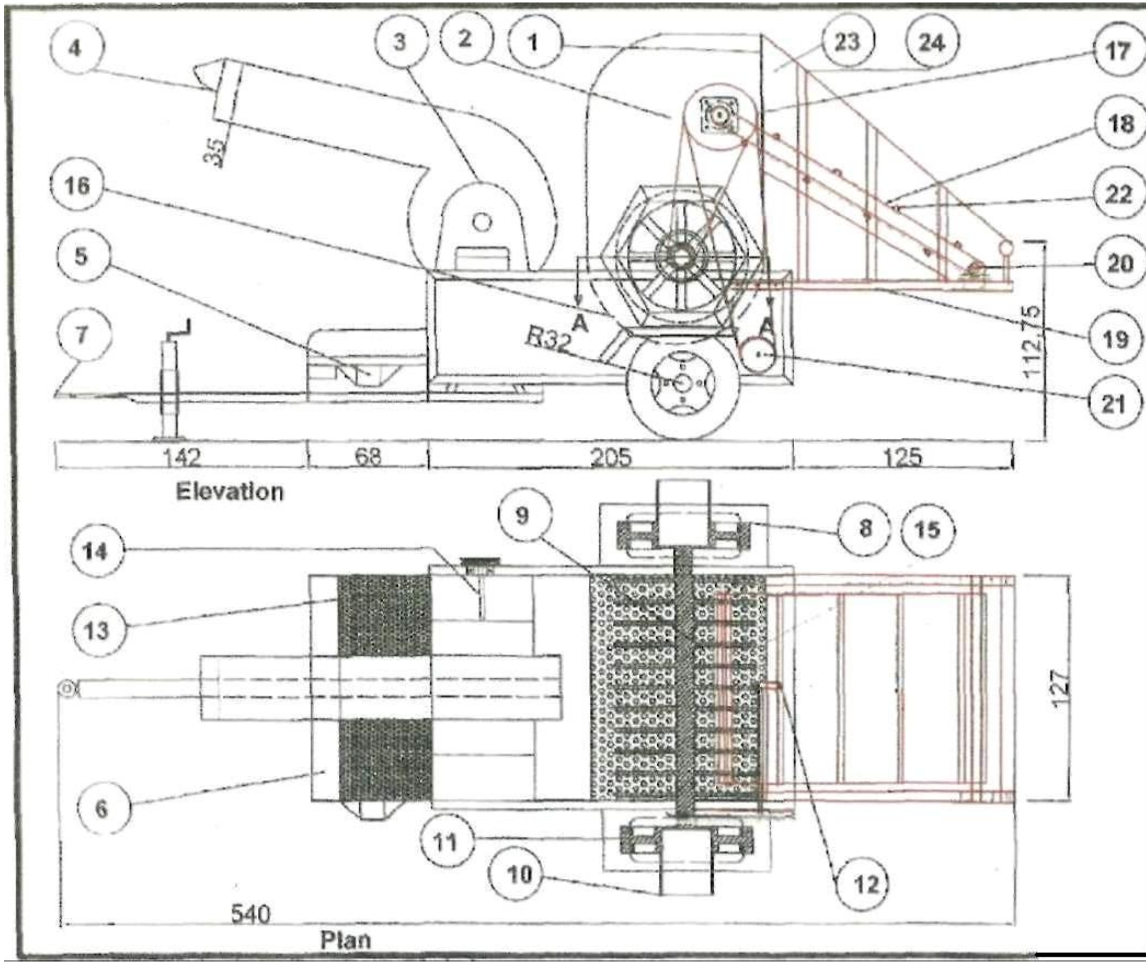
2.6–The feeding process was done according to the previous operating conditions and controlling the following parameters.

A- Feeding rate from the feed opening to the threshing drum.

B- The threshing efficiency of the threshing drum.

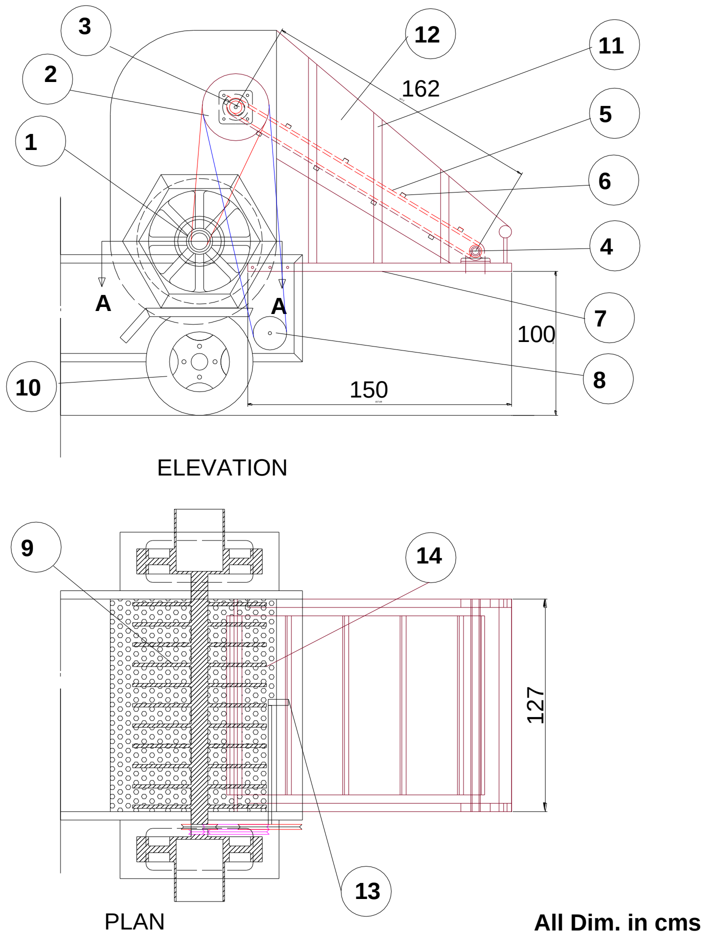
2.7– Measuring the threshing time of each sample.

2.8- Each experiment was repeated three times. The following parameter was measured.



No.	Parts
24	Frame side supporter
23	Conveyor protection side
22	Supporter on conveyor
21	Shaker intake pulley
20	Conveyor drum
19	Conveyor frame
18	Conveyor
17	Conveyor intake pulley
16	Concave
15	Beater fingers of the drum
14	Fan shaft
13	Oscillating screen
12	Eccentric
11	Flywheel
10	In take pulley drum
9	Threshing drum
8	Tire wheel
7	Front hitch
6	Output unthreshed grain opening
5	Output grain opening
4	Output straw opening
3	Centrifugal Fan
2	Threshing housing
1	Feeding opening

Fig. (5) Main components of threshing machine (cetinel 120) after modification.



No.	Part name	No. off	No.	Part name	No. off
1	Feeding shaft	1	8	Shaker intake pulley	1
2	Conveyor intake pulley	1	9	Threshing drum	1
3	Idler shaft	1	10	Wheel	1
4	Idle shaft	1	11	Frame side supporter	1
5	Conveyor	1	12	Conveyor protection side	1
6	Supporter on conveyor	7	13	Eccentric	1
7	Conveyor frame	1	14	Beater fingers of the drum	44

Fig. (6): Elevation and plan of the developed feed device in a CETINEL threshing machine

A- Feeding rate kg/min.

B- Grain losses in straw

C- Unthreshed grain losses %

D- Grain damage %.

E- Cleaning efficiency %

F- Fuel consumption lit/h.

G- Length of cut straw cm.

2.9-All the previous processed were done with the modified and the unmodified machine after changing the threshing drum speed to 700, 800, 900, and 1000 r.p.m. and changing the conveyor angle to 17°, 20°,23°, and 26°

2.10-One labor was used for the feeding process for the modified machine and two labors were used with the unmodified machine.

Measurements and calculation

1. Moisture content.

Plant samples were oven dried at 70° C for 72 h by using hot air oven. The samples were weighed before and after drying and the moisture content was determined by using the equation of **AOAC (1990)**

$$M.C., \% = \frac{S_B - S_A}{S_A} \times 100 \quad \text{(dry base)}\ldots \quad (1)$$

Where:

S_B=Sample weight before drying (g)

S_A = Sample weight after drying (g)

2. Determination of un-threshed grain losses

The un-threshed heads were collected, weighed and re-threshed. The percentage of grain losses was calculated (based on the calculated input weight of grain into the threshing unit).

3. Visible grain damage

Randomized samples of 100-g was collected to determine visible grain damage. It was calculated as follows:-

$$DGL, \% = \frac{D_G}{T_G} \times 100 \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where:-

D_G = Weight of grain damaged in sample

T_G = Total grain sample (Desta and Mishra, 1990)

4. Grain losses in straw

Grain losses in straw percentage were calculated as follows:-

$$SGL, (\%) = \frac{S_G}{T_G} \times 100 \quad \ldots\ldots \quad (3)$$

Where:-

S_G = Weight of grain losses in straw in sample

T_G = Total grain sample (Desta and Mishra, 1990)

5. <u>The length of cut straw</u>

The length of cut straw was measured also. Three randomized samples were taken from the output straw for measuring the length of cut straw. Each sample contains about 100 g. The mean of the cut straw length was calculated.

6. <u>Determination of threshing efficiency</u>

Machine threshing efficiency was estimated according to the following formula:

$$\text{Threshing efficiency, } (\%) = (100 - \frac{\text{Unthreshed grain in sample, g}}{\text{Total grain sample, g}} \text{x} 100) \quad (4)$$

(Desta and Mishra, 1990)

7. <u>Determination of cleaning efficiency</u>

$$\text{Cleaning efficiency, } (\%) = \frac{W}{W_o} \times 100 \quad \ldots\ldots \quad (5)$$

Where:-

W =Weight of grains from the main output opening after cleaning, kg.

Wo =Weight of grains and small chaff from the main output opening, kg.

8. <u>Determination of fuel consumption</u>:

Fuel consumption per unit time is determined by measuring the volume of the consumed fuel during threshing time as follows:

The fuel tank refilled completely before and after the test, the difference between the two volumes is the fuel consumed.

9. <u>Power requirements</u>

The following formula was used to estimate the engine power according to **Hunt (1983)**.

$$E.P = F.C \times \frac{1}{3600} \times \rho_f \times L.C.V \times 427 \times \eta_m \times \eta_{th} \times \frac{1}{75} \times \frac{1}{1.36} \quad KW \quad . \quad (6)$$

Where:

E.P =Power consumption requirements during the threshing operation (k.W).

Fc = Fuel consumption L/h.

ρ_f = Density of fuel, kg/L (for solar = 0.85).

L.C.V = Lower calorific value of fuel (k.cal/kg) average L.C.V of solar is 11000 k.cal/kg).

η_{th} = Thermal efficiency of the engine, (considered to be about 35 % for diesel engine).

427 = Thermo-mechanical equivalent, kg.m/kcal.

η_m = Mechanical efficiency of the engine, (considered to be 80 percentage for diesel engine).

11. Specific energy

Specific energy could be determined using the following equation **Hunt (1983**).

$$\text{Specific energy} = \frac{\text{Power requirements}}{\text{Machine productivity}} \left(\frac{\mathbf{KW}}{\mathbf{ton/h}}\right) \ldots \qquad (7)$$

12. Economic evaluation

The total cost of threshing operating was estimated using the following equation, **(Awady et al. 1982)**

Threshing cost, (L.E/ton) = Operating cost + Grain losses cost ……. (8)

Operating cost was determined using the following equation:-

$$\text{Operating cost} = \frac{\text{Machine cost (L.E / h)}}{\text{Feed rate (ton / h)}}, \text{(L.E/ton)} \ldots\ldots\ldots\ldots \quad (9)$$

Machine cost could be determined using the following equation **(Awady 1978)**

$$\mathbf{C = \frac{P}{h}\left[\frac{1}{a} + \frac{i}{2} + t + r\right] + (0.9 \quad W.S.F) + \frac{m}{144}} \quad (10)$$

Where:-

C =	Hourly cost, L.E/h	p =	Price of machine, L.E.
h =	Yearly working hours, h/year.	a =	Life expectancy of the machine, h
i =	Interest rate/year.	F =	Foul price, L.E/l.
t =	Taxes, over heads ratio.	r =	Repairs and maintenance ratio.
m =	Monthly average wage, L.E.	0.9 =	Factor accounting for lubrications.
w =	Engine power, hp.	S =	Specific fuel consumption, l/hp.h.
144 =	Reasonable estimation of monthly working hours.		

RESULTS AND DISCUSSION

A. Machine performance.

Results obtained showed that the drum speed of 1000 rpm and crop moisture content of 13.4 % are considered the optimum values during threshing operation before and after machine modification. Results recorded the minimum value of the total grain losses, minimum length of cut straw and maximum feeding rate (kg/min). The maximum threshing and cleaning efficiencies were also recorded. Decreasing drum speed and increasing crop moisture content more than the optimum values mentioned above, lead to increase total grain losses significantly under all experimental conditions. Thus is due to increasing un-threshed grains, as a result of non-uniform conditions during threshing operation.

1. **Feeding rate:**

Fig. (7) Shows that increasing the drum speed increase the feeding rate. Also, the feeding rate increased as a result of decreasing crop moisture content for thresher before and after machine modification under all experimental feeding rate conditions. At drum speeds of 700, 800, 900 and 1000 rpm, and crop moisture content of 13.4 % the feeding rates were 18.5, 22, 25 and 28 kg/min respectively using the threshing machine before modification. It was 23, 28, 33 and 38 kg/min respectively using the developed machine. The conveyor belt angle was 20 degree.

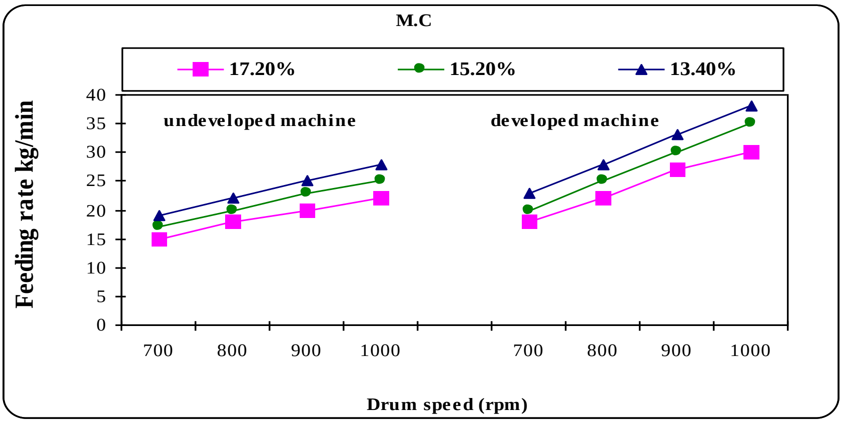


Fig. (7): Effect of drum speed on feeding rate at different moisture contents by using the thresher before and after modification.

Using the machine after modification increased the feeding rate comparing with the machine before development due to the uniform distribution of wheat materials along the feeding device, which guide wheat to the threshing chamber uniformity resulting in improve threshing operation.

2. Un- threshed grain losses:

Data presented in Fig. (8) Shows that increasing drum speed decreased un-threshered grain. Also there is a direct correlation between un-threshed grain and crop moisture content. Decreasing crop moisture content decreased un-threshed grain for thresher before and after modification under all experimental conditions. At drum speeds of 700, 800, 900 and 1000 rpm, and crop moisture content of 13.4 % the obtained unthreshed grain were 3.8, 2.9, 2.2 and 1.8 % respectively before modification. It was 1.4, 0.9, 0.7and 0.5 % respectively after modification at conveyor belt angle (20 degree) under the same previous conditions. Using the machine after modification decreased the unthreshed grain from 1.8 % to 0.5 % comparing with the machine before modification due to the uniform distribution of wheat materials along the developed feeding device, which enable plants to enter the threshing chamber from the panicles direction. Also the decrease in the percentage of unthreshed grains by increasing drum speed are attributed to the high stripping and impacting forces applied to the wheat plants, that tends to improve the threshing operation and decrease unthreshed grains.

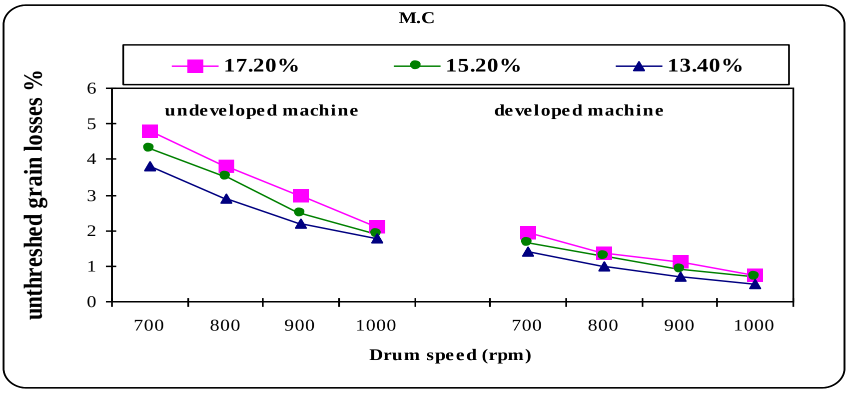


Fig. (8): Effect of drum speed on unthreshed grain losses at different moisture contents by using the thresher before and after modification.

3. Grain losses in straw:

Data presented in fig. (9) Shows that increasing drum speed increased grain losses in straw. Also increasing crop moisture content increased grain losses in straw for thresher before and after modification under all experimental conditions. At drum speeds of 700, 800, 900 and 1000 rpm, and crop moisture content of 13.4 % the obtained grain losses in straw grain were 0.4, 0.7, 0.8 and 1.0 % respectively using the threshing machine before modification and 0.12, 0.15, 0.25 and 0.30 % respectively using the developed machine at conveyor belt angle (20 degree) under the same previous conditions. Using the machine after modification decreased the grain losses in straw from 1.0 % to 0.30 % comparing with the machine before modification due to the uniform distribution of wheat materials along the developed feeding device.

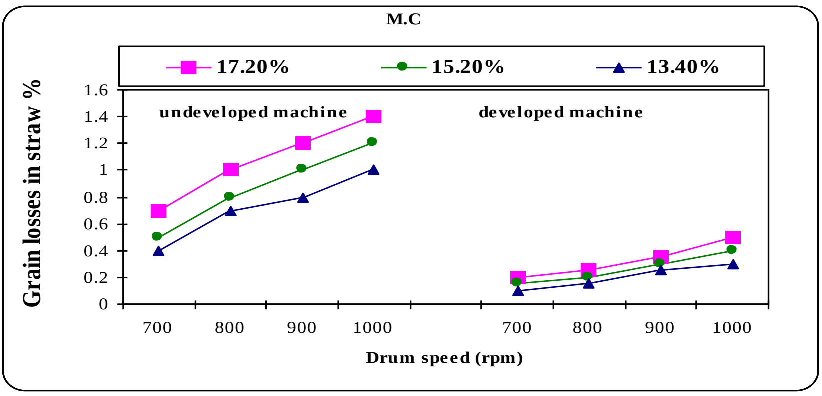


Fig. (9): Effect of drum speed on grain losses in straw at different moisture contents by using the thresher before and after modification.

4. Visible grain damage:

Fig. (10) Shows that increasing drum speed increased visible grain damage. Also decreasing crop moisture content increased visible grain damage for thresher before and after modification under all experimental conditions. At drum speeds of 700, 800, 900 and 1000 rpm, and crop moisture content of 13.4 % the obtained visible grain damage were 1.4, 1.7, 2.0 and 2.1% respectively using the threshing machine before development and 0.40, 0.45, 0.55 and 0.65 % respectively using the developed machine at conveyor belt angle (20 degree) under the same previous conditions. The obtained data using the machine after modification decreased visible grain damage from 2.1% to 0.65 % comparing with the machine before modification. The uniform distribution of wheat along the developed feeding led to the decrease in visible grain damage.

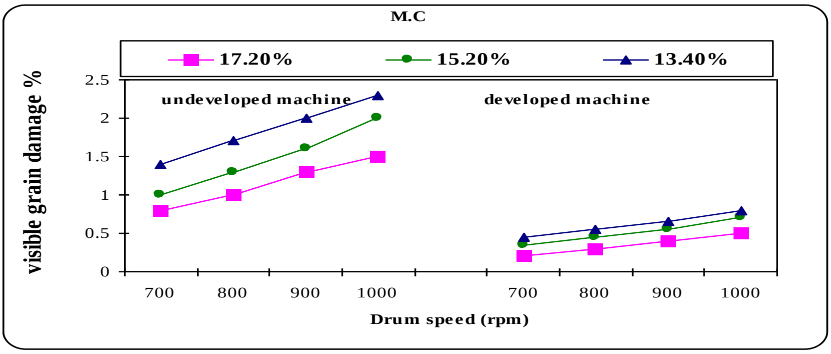


Fig. (10): Effect of drum speed on visible grain damage at different moisture contents by using the thresher before and after modification.

5. Cutting length of straw:

Data presented in Fig. (11) Shows that there is a indirect correlation between the thresher drum speed and the cutting length of straw. Increasing drum speed decreased the cutting length of straw. On the other hand decreasing moisture content decreased the cutting length of straw for thresher before and after modification under all experimental conditions. At drum speeds of 700, 800, 900 and 1000 rpm, and crop moisture content of 13.4 % the obtained cutting length of straw was 2.3, 2.1, 2.0 and 1.8 cm respectively using the threshing machine before modification and 1.7, 1.6, 1.4 and 1.2 cm respectively using the modification machine at conveyor belt angle (20 degree) under the same previous conditions.

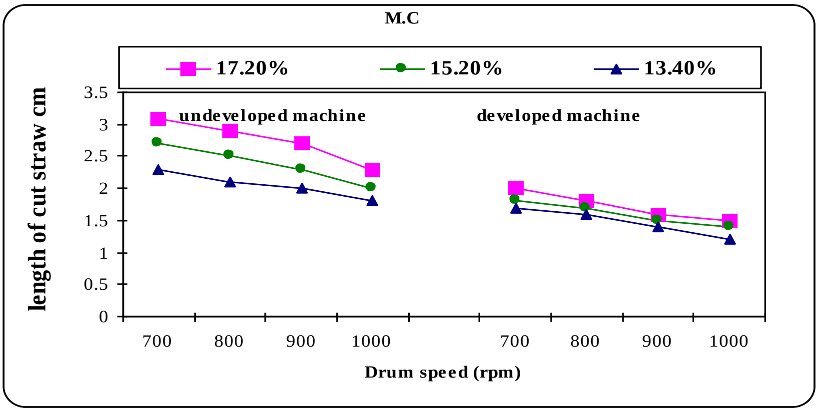


Fig. (11): Effect of drum speed on length of cut straw at different moisture contents by using the thresher before and after modification

This decrease in the cutting length of straw was due to the uniform distribution of wheat materials along the developed feeding device.

6. Threshing and cleaning efficiencies:

Threshing efficiency is a function of the un-threshed grain losses. It decreased as increasing grain moisture content. On the other hand it increased as increasing drum speed. While the cleaning efficiency expresses the amount of clean grains with minimum straw, stone and foreign materials thorough the threshing operation. The cleaning efficiency decreased as the grain moisture content increased. It increased as increasing drum speed. Fig. (12,13) show also that, the developed machine increased the percentage of threshing and cleaning efficiencies comparing with the machine before modification under all experimental conditions due to the uniform distribution of wheat along the developed feeding device. That guide wheat to the chamber of thrashing in a uniform way resulting in low percentage of un-threshed grains and improve threshing operation. Increasing drum speed from 700 t0 1000 rpm and decreasing crop moisture content from 17.2 to 13.4 % increased the percentage of threshing and cleaning efficiencies from 95.8, 95.3 % to 98.2, 98.4 % respectively using the threshing machine before modification and from 98.1, 98.6 % to 99.5, 99.7 % respectively using the threshing machine after modification at conveyor belt angle (20 degree) due to the uniform distribution of wheat materials along the shaker under the same previous conditions.

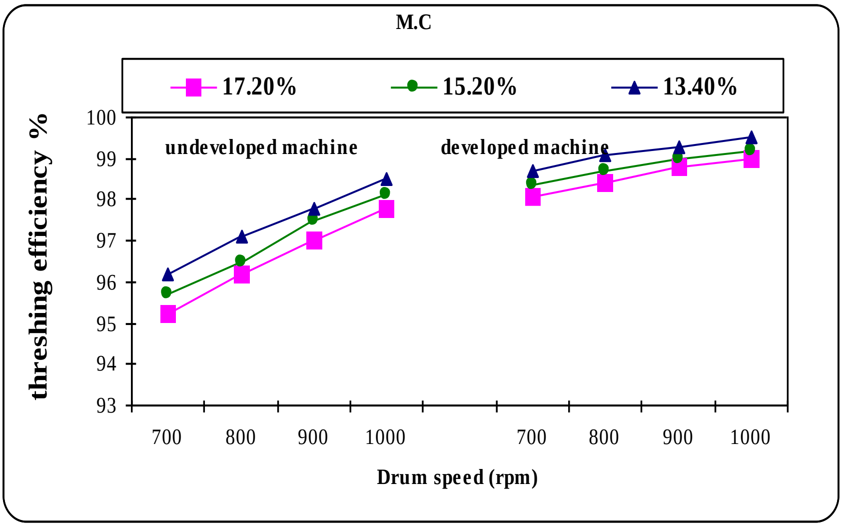


Fig. (12): Effect of drum speed on threshing efficiency at different moisture contents by using the thresher before and after modification.

The obtained data show also that the developed machine increased the percentage of threshing and cleaning efficiencies comparing with the machine before modification because of the uniform distribution of wheat materials along the threshing chamber which enable the threshing drum to knock wheat materials more times that tends to improve threshing process and increase threshing and cleaning efficiencies.

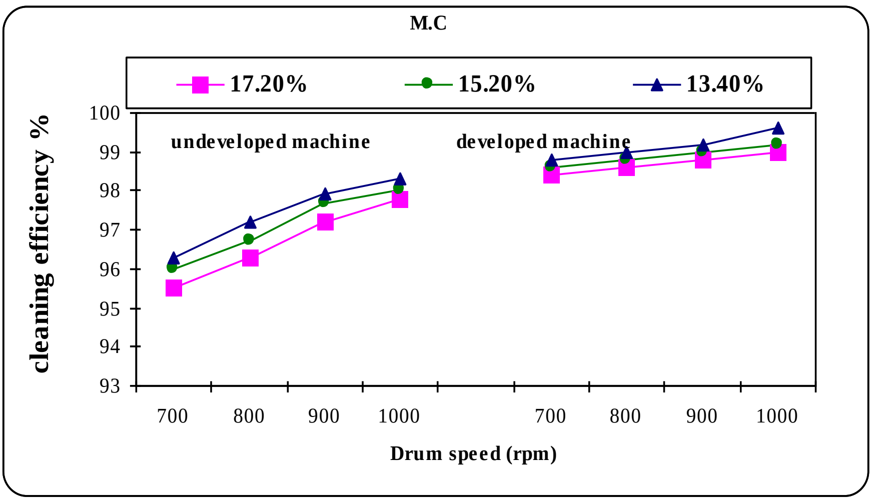


Fig. (13): Effect of drum speed on cleaning efficiency at different moisture contents by using the thresher before and after modification

7. Fuel consumption (lit/h) and energy requirements:

The energy requirements and fuel consumption are a measure for all parameters affecting the threshing operation. It increased as increasing the material feed rate due to increasing threshing drum speed and grain moisture content. Results obtained in fig. (14,15) show that increasing material feed rate increased rate of fuel consumption and the percentage of energy requirements under all experimental conditions. The increase in the percentage of energy requirements by increasing material feed rate is attributed to the excessive wheat in the threshing chamber, that increase the load on the threshing drum caused more fuel consumed. Results presented in fig. (15) Show that increasing drum speed increased the energy requirements under all experimental conditions. Increasing drum speed from 700 to 1000 rpm increased the percentage of energy requirements from 13.9 to 18.96 kW using the threshing machine before modification. This speed increased from 13.9 to 18.65 kW using the modification machine at conveyor belt angle (20 degree) under the same previous conditions. The increase in the percentage of energy requirements by increasing drum speed is attributed to the high stripping and impacting forces applied during threshing operation, that tend to consume more fuel and increase energy requirements. Results also show that the modification machine decreased the percentage of energy requirements comparing with the machine before modification due to increased fuel consumption with the machine before modification.

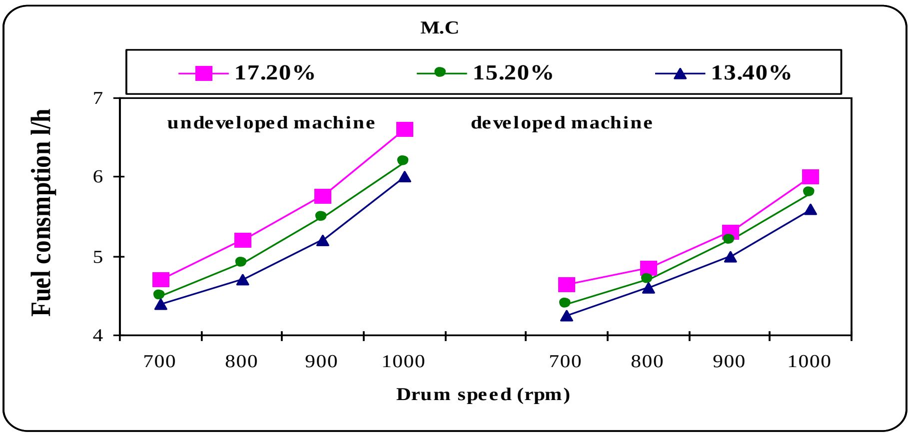


Fig. (14): Effect of drum speed on fuel consumption at different moisture content by using the thresher before and after modification.

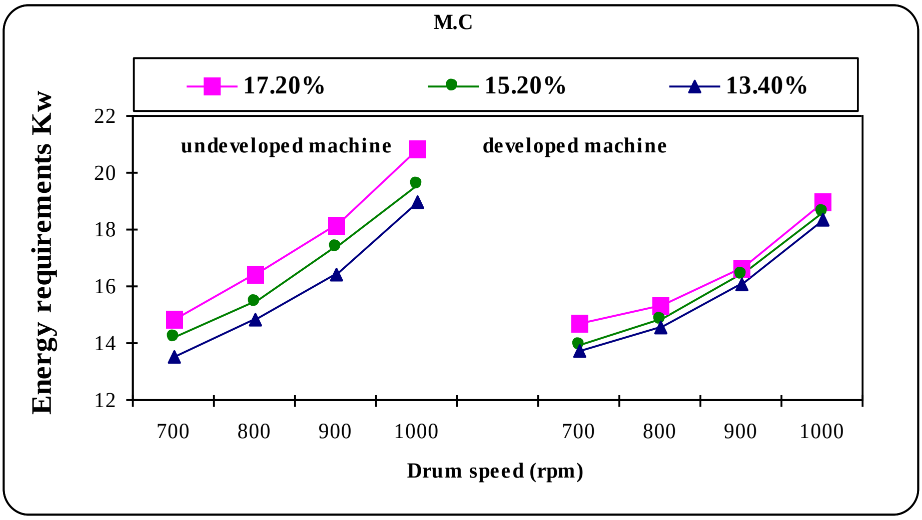


Fig. (15): Effect of drum speed on energy requirements at different moisture contents by using the thresher before and after modification.

B. Threshing cost LE/ton:

One of the most important factors that judge the success of the machine modification is the total threshing costs. It was also calculated. Assuming that the purchase price (P), anticipated length of time owned (a) and yearly working hours (h) for different equipment are as presented in table (1):

Equipment	P (LE)	a (year)	h (h/year)
-Tractor NASR 60 hp	100000	10	1000
-Original thresher	20000	10	500
-Developed thresher	22000	10	500

* According to equation (10)   Assuming that:

- Rate of interest = 15 %
- Mean of fuel consumption for original thresher and developed thresher at high productivity = 6 lit/h approximately
- Price per liter fuel = 1.1 LE
- Wage of laborer = 5 LE/h
- Number of labors = 2 labors for original thresher and
  1 laborer for developed thresher

Table (2) indicated that, the minimum value of the losses cost was 45.87 LE/ton for undeveloped thresher at 1000 rpm and 13.4 % moisture content while the minimum value of the losses cost was 13.58 LE/ton for developed thresher at 1000 rpm and 13.4 % moisture content.

Table (3) indicated that threshing cost for the developed machine was 36.4 LE/ton compared to 79.2 LE/ton for undeveloped machine that was due to higher losses of grains and lowest feeding rate for undeveloped machine. Cost determinations were obtained as the total cost per unit of operating time (LE/h) and threshing cost (LE/ton) as indicated in table (3).

Table (2) Losses cost for undeveloped thresher and developed thresher

Machine	Un-thereshed grain losses %	Grain losses in straw %	Visible grain damage %	Total grain losses %	Weight of total grain losses Kg/ton	Losses cost LE/ton
Undeveloped thresher	1.8	1.0	2.1	4.9	18.13	45.87*
Developed thresher	0.5	0.3	0.65	1.45	5.37	13.58*

* Price per kilogram grain (2012) = 2.53 LE/kg

Table (3): Criterion function cost for two threshing machines.

machine	Operating cost l.E/h	Feeding rate Ton/h	Criterion function cost LE/ton	Total* grain losses Kg/ton	Losses cost LE/ton	Threshing cost LE/ton
Undeveloped thresher	21	1.680	12.5	18.13	45.87	58.37
Tractor	35	-	20.83	-	-	20.83
Total	56	-	33.33	18.13	45.87	79.2
Develop-ed thresher	17	2.280	7.47	5.37	13.58	21.05
Tractor	35	-	15.35	-	-	15.35
Total	52	-	22.81	5.37	13.58	36.4

* Total grain losses = Un-threshed grain losses + grain losses in straw + visible grain damage

REFERENCES

Abo El-Naga, M.H.M., M.K.Afify and S.E.Badr (2004) "Utilization of Local wheat thresher machine for threshing mungbean" Misr J. Ag. Eng. 21 (2): 423-436.

AOAC (1990) "Association official Analytical chemists".15th edn. Wash. Dc, U.S.A.

Daghan, I; T.Hakan and Y. Canbaz (2012) "Upper extremity injuries due to threshing machine" Turkish Journal of trauma 2012; 18 (1):55-60.

Desta, K. and T.N. Mishra (1990) "Development and performance Evaluation of a Sorghum thresher" AMA, 21 (3): 33-37**.**

El-Awady, M. N.(1978). Tractor and farm machinery. Text book, Faculty of Agriculture, Ain- Shams University, Cairo, Egypt. PP: 164-167

El-Awady, M. N; E. Y. Ghoniem and A. I. Hashim (1982)"A critical comparison between wheat combine harvester under Egyptian condition". R. S. No.1920 Ain Shams Univ. Col.Agr. Pp. 1-12

El-Mufti, I; S. I. Ahmad and A. Majid (1989) "Farm accidents in Pakistan"Agric Mech. Asia Africa Latin America 20, 73-75.

Hunt, D. (1983)"Farm power and machinery management."(eight-edition) pp.135 - 137.

Khattab A. M.; M. M. EL-Sharabasy and M. M. Mahmoud (2007) "Development of feeding device in a Turkishing machine" Misr. J.Agric. Eng., 235-257.

Mohan, D. and R. Patel (1992) "Design of safer agricultural equipment" application of ergonomics and epidemiology. Int. J. Ind.Ergonom. 10,301-309.

- المجلة الزراعيه - وزارة الزراعه المصريه ٢٠١٢

الملخص العربي

تطوير آلة الدراس والتذريه لتحسين أدائها تحت الظروف الزراعية المصرية

د.ايهاب عبد العزيزالصعيدي* د. جمال رشاد جامع عادل محمد الاشقر*****

يعتبر القمح من اهم محاصيل الحبوب الغذائيه التى يعتمد عليها الشعب المصرى فى غذائه وعلى الرغم من زراعة نحو ٢,٨١ مليون فدان وزيادة انتاجية الفدان من حبوب القمح (المجله الزراعيه – وزارة الزراعه المصريه ٢٠١٢) الا انه ما زالت هناك فجوة كبيره بين الانتاج والاستهلاك. وحيث ان عملية الدراس من العمليات الزراعيه التى ينتج عنها فواقد كبيره من الحبوب بالاضافة الي المخاطر التى يتعرض لها العمال اثناء عملية تلقيم المحصول للاله

***مدرس- قسم الهندسة الزراعية- كلية الزراعة- جامعة المنوفية –مصر.**

**** أستاذ مساعد - قسم الهندسة الزراعية- كلية الزراعة- جامعة المنوفية –مصر.**

*****باحث مساعد-معهد بحوث الهندسة الزراعية –مركز البحوث الزراعية-الدقي- مصر.**

حيث توجد كثير من الاصابات التى تعرض لها العديد من العاملين فى هذا المجال ونظرا للفواقد العاليه من الحبوب ولخطورة هذه العمليه على حياة ومستقبل العمال نظرا لقرب درفيل الدراس من العامل الذى يقوم بتلقيم المحصول وكذلك الاهتزازات الناتجه من الاله وتعرض العامل للاتربه الناتجه من عملية الدراس فقد تم تصنيع جهاز تلقيم و تثبيته بالاله بحيث ياخذ حركته من درفيل الدراس مباشرة ويصبح هذا الجهاز جزء اساسى من الة الدراس وذلك بغرض تحسين اداء الاله علاوة على تقليل المخاطر التى تواجه العمال . وتم تصنيع هذا الجهازمن شاسيه عبارة عن عدد ٢كمره على شكل حرف (U) طول كل منها ١٥٠ سم وعرض ١٠ سم وسمك ٠,٥ سم يتم تثبيتهما اسفل فتحة التغذيه عن طريق عدد ٢مسمار مقاس ٢,٤ سم و طول ١٠ سم يتم من خلالهما تغيير زاوية السير الناقل الذى يعمل على درفيلين بطول ١١٦ سم وقطر ٧,٥ سم وسمك ٠,٣ سم ويتم تثبيتهم عن طريق زوج من كراسى المحور من الجانبين لكل درفيل ويتم تثبيت الدرفيل القائد امام فتحة التغذيه اما الدرفيل المنقاد فيتم تثبيته على نهايتى الكمرتين عن طريق زوج من كراسى المحور من الجانبين و يتم شد و ارتخاء السير الناقل عن طريق ٢ شداد يقوما بتحريك الدرفيل المنقاد للامام وللخلف . و السير الناقل يتم تركيبه على الدرفيلين بطول ١٦٢ سم (وهى المسافه بين محورى الدرفيلين) وعرض السير ١١٦ سم وسمك ٠,٥سم مصنوع من الكاوتش والمطاط وتم لحام طرفيه بالليزرعن طريق ورشه متخصصه باستخدام برنامج كمبيوتر. وتم تثبيت عوارض على السير بعرض السير(١١٦سم) و ارتفاع ١ سم و عرض ٢ سم على مسافات ٥٠ سم لعدم انزلاق المحصول اثناء التلقيم . وتنقل الحركه الى جهاز التلقيم من طاره قطرها ١٤ سم مثبته على عمود الدرفيل الى طاره قطرها ٤٠ سم مركبه على محور الدرفيل القائد للسير الناقل للمحصول و بالتالى تتغير سرعة السير الناقل مع تغيير سرعة درفيل الدراس . وتم تصنيع هذا الجهاز و تثبيته باله الدراس (سيتينيل ١٢٠) المصنعه محليا. و قد اجريت التجربه فى احد المزارع بقرية ميت خلف – محافظة المنوفية حيث تم تجريب الاله لدراس محصول القمح صنف (جميزه ٩) قبل و بعد التطوير وذلك على اربع سرعات للدرفيل هى. ٧٠٠و٨٠٠و٩٠٠و١٠٠٠ لفه/دقيقه اى (٢٧,٤٧و٣١,٤و٣٥,٣و ٣٩,٢٥م/ث) وثلاث نسب لرطوبة المحصول هى ١٣,٤ و ١٥,٢ و ١٧,٢ % بالاضافه الى اربع زوايا للسير الناقل للاله المعدله هى ١٧,٥و ٢٠و ٢٣و ٢٦ درجه .

اظهرت النتائج التجريبيه ان اداء اله الدراس بعد التعديل كان افضل من اداء الاله قبل التعديل وذلك يرجع الي زيادة كفاءة العامل الذي يقوم بالتلقيم والتوزيع الجيد للمحصول علي درفيل الدراس وتوريع ناتج الدراس علي الهزاز حيث اظهرت النتائج ان :- اقصى معدل تلقيم ٢,٢٨ طن / ساعه بزيادة قدرها ٦٠٠ كجم/ساعة عن الاله قبل التعديل واقصى كفاءة دراس بعد التعديل ٩٩,٥٠ % و اقصى كفاءة تنظيف٩٩,٧٠ % و اقل فاقد للحبوب الغير مدروسه ٠,٥٠% و اقل فاقد للحبوب في القش بلغ ٠,٣٠ % و ان اقل نسبة كسر للحبوب ٠,٦٥ % و اقل طول لقطع

القش بلغ ١,٢ سم وان اقل كميه للفواقد الكليه من الحبوب بلغت ٥,٣٧ كجم / طن و اقل تكاليف للتشغيل٢٢,٨١جنيه / طن و تكلفة عملية الدراس بعد اضافة تكاليف فواقد الحبوب الكليه بلغت ٣٦,٤ جنيه / طن وذلك عند سرعة ١٠٠٠ لفه/ دقيقه لدرفيل الدراس ومحتوى رطوبى للمحصول ١٣,٤ % وزاوية السير الناقل ٢٠ درجه . ولكن قبل التعديل كان اقصى معدل تلقيم ١,٦٨ طن / ساعه و اقصى كفاءة دراس قبل التعديل ٩٨,٢ % و اقصى كفاءة تنظيف٩٨,٤ % و اقل فاقد للحبوب الغير مدروسه ١,٨٠% و اقل فاقد للحبوب في القش بلغ ١,٠٠ % و ان اقل نسبة لكسر للحبوب ٢,١٠ % و اقل طول لقطع القش بلغ ١,٨ سم وان اقل كميه للفواقد الكليه من الحبوب بلغت ١٨,١٣ كجم / طن و اقل تكاليف للتشغيل٣٣,٣٣ جنيه / طن و تكلفة عملية الدراس بعد اضافة تكاليف فواقد الحبوب الكليه بلغ٧٩,٢ جنيه / طن وذلك عند سرعة ١٠٠٠ لفه/ دقيقه لدرفيل الدراس ومحتوى رطوبى ١٣,٤ % . وكانت الطاقة المستهلكة في عملية الدراس ١١,٣ و ٨,١ كيلووات.س/طن قبل وبعد التعديل عند نفس السرعة والرطوبة السابقة.