J. Agric. Sci. Mansoura Univ., 34 (2): 1479 - 1494, 2009

UTILIZATION OF AN AUTOMATIC CONTROL SYSTEM FOR THRESHED MATERIALS UPON THRESHER SIEVES FOR REDUCING GRAIN SORGHUM LOSSES

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ABSTRACT

The objectives of the present study were to construct and evaluate an automatic control system to be used for minimizing grain sorghum loss in straw. Experiments were conducted at Sakha Agriculture Research Station during the summer season of 2005 using grain sorghum (hybrid 102). Experiments were carried out using locally manufactured threshing machine. A gate was used to control the time of staying the threshed materials upon cleaning sieves. The effect of cylinder speed, holding time and feed rate on threshing performance (total seed damage, total seed losses, cleaning efficiency and specific energy) were measured.

The construction and use of the automatic control system behind the cleaning sieves reduces grain losses in straw of about 78,80% compared with control treatment at cylinder speed of 26.18 m/s, feed rate of 5 kg/min and holding time 60 sec.

In the same manner the highest value of cleaning efficiency was 96.35% at the holding time of 20 sec, cylinder speed 17.42 m/s and feed rate of 5 kg/min for the modified threshing machine. However, the lowest value of specific energy was 10.21 kW.h/Mg at cylinder speed 17.42 m/s, feed rate of 10 kg/min and holding time of 60 sse.

The optimum operating conditions were holding time of 40 sec, cylinder speed of 23.61 m/s and feed rate of 7.5 kg/min for its good performance.

INTRODUCTION

Sorghum (sorghum bicolor L. Moench) is one of the important crops grown in arid and semi-arid regions. It is used for human and animal nutrition. In Egypt, sorghum is cultivated in an area of about 380 thousand feddans, which producing about 750 thousand metric tons, where the major planting area is in upper Egypt (USDA Yearbook, 2004).

In general, one pound of sorghum grain is approximately equal to one pound of corn in nutritive value for feeding diary cows of fattening lambs. It is equal to about 95% of the feed value of corn on a pound - for - pound basis for fattening beef cattle. On the other hand the important use is in the manufacture of starch, glucose, sirup, oil, gluten feeds and other products similar to those produced in the wet - milling of corn. Grain sorghum flour is used for adhesives (Martin and Jenkins, 1950). The entire plants of sorgo sometimes are chopped, dehydrated ground and pelleted for feed (Swanson, 1950).

Forage sorghum varieties are considerable importance as forage crops in the summer season in Egypt. Recently, the great need for green fodder to feed livestock has been increased vigorously in summer season (June to November), because the animals are essentially fed by poor quality roughage and concentrates. Great efforts have been made to increase the area occupied with forage sorghum crops as well as to develop methods and technology to fulfill the agricultural field operations and cut down on production costs. Cereal crops are too sensitive to harvesting operation due to the high percentages of grain losses affecting the total yield, so much care has to be taken to carry out the harvesting operation for minimum losses and cost.

Waelti *et al.* (1971) indicated that one way to reduce weather damage in harvesting grain sorghum is to harvest at an early stage of plant maturity with subsequent artificial drying of the grain. They added that cutter bar loss was about 2% and varied only a small amount. Reel loss increased from 2.3% at high to 5.2% later in the season from 2.5 to 0.8% and the grain damage increased from 2.9 to 3.5%. this was accomplished when pulley speed increased from 700 to 900 r.p.m.

Faibanks *et al.* (1979) studied the grain sorghum harvesting losses. They found that the cylinder speed of about 25.55 m/s threshed most of the grain from the head even at a high moisture content.

Huynh *et al.* (1982) stated that the seed separation from the stalks and passage of seed through the concave grate is a function of some variables such as crop feed rate, threshing speed, concave length and cylinder diameter and concave clearance. These variables are also related to the threshing losses and seed separation efficiency.

Kepner *et al.* (1982) stated that threshing effectiveness is related to: a) peripheral speed of the cylinder, b) the cylinder concave clearance, c) the number of rows of concave teeth used with a spike – tooth cylinder, d) the type of crop, e) the condition of the crop in terms of moisture content, maturity, etc. and f) the rate at which the material is fed into the machine.

Donnelle (1983) reported that the cylinder losses should be less than 2% and inversely related to the severity of threshing. However, damage to the grain limits the extent to which severe threshing may be employed. A compromise must be reached. The operator's manual of each combine indicated a range of cylinder speeds for specific crops: a) Wheat and small grains 30-36 m/s, b) Sorghums and soybeans 18-23 m/s, c) Corn 12-15 m/s and d) Peas or edible beans 8-15 m/s.

Hashish (1984) showed that cylinder speed and concave adjustment are all important for good threshing. Cylinder speed should be as low as possible and cylinder-concave clearance as high as possible for threshing without excessive cracking of grain. If the speed is too fast and the clearance too close " over threshing " results and kenrnels of grain will be cracked and the straw broken and shopped up. If the cylinder speed is too slow, or the clearance is too great, the grain may not be threshed well.

Yunus (1987) stated that the factors affecting grain losses at harvest and threshing of paddy are the methods, traveling speed, grain moisture content, speed of threshing drum and plant properties.

Helmy (1988) found that there was a good positive effect of feed rate on unit energy consumption. By increasing the wheat feed rate from 0.06 to 0.31 kg/s the unit energy increased from 0.57 to 1.03 kW.h/Mg and from 0.37 to 0.70 kW.h/Mg for an American threshing machine and from 0.63 to 1.15 kW.h/Mg and from 0.42 to 0.79 kW.h/Mg for a local threshing machine at

18.8, 13.5% and 13.6, 9.7% grain and straw moisture content, respectively using cylinder speed 20.52 m/s.

Kebede and Mishra (1990) studied the performance of a developed sorghum thresher. He found that the maximum threshing efficiency of 98.12% was obtained at the lowest feed rate of 6 kg/min, and cylinder concave clearance of 7 mm and cylinder speed of 500 r.p.m (12.6 m/s). Minimum threshing efficiency of 96.31% was found at lowest cylinder speed of 300 r.p.m (7.5 m/s), cylinder concave of 11 mm and feed rate of 10 kg/min. this is because at a higher speed the energy imported to the ear head and grain increase causing higher threshing efficiency. The reason for lower threshing efficiency at higher feed rate, cylinder concave clearance and at lower speed is because of the cautioning effect between the cylinder concave clearance and the low impact force at a low cylinder speed.

El-Shazely (1991) showed that at the same constant feed rate, grain moisture content of about 15.5% and 3 mm belt concave clearance, the unthreshed grain decreased.

Gummert (1991) showed that the feed rate is significantly affecting power requirement. The function of the investigated range is proximately linear and if feed rate is doubled, power requirements are 2.5 times higher.

Abdel Hameed (1994) noticed that threshing efficiency was increased by increasing the ylinder speed. The maximum threshing efficiency was obtained by using metal spike drum, hole concave type and 1.5 cm cylinder concave clearance.

Mohamed (1994) indicated that the relationship between the power consumed and feed rate was an increment proportional, with increasing feed rate, the power increased. He also reported that unthreshed grain losses were significantly affected by application power, where increasing power decreased unthreshed grain losses. The same author noticed that the power consumption during threshing operation was increased by increasing crop moisture content.

El-Behiry *et al.* (1997) found that the feeding rate increased linearly by increasing drum speed. Also feeding rate depends on the experience of the thresher labouer. The straw sizes decreased with increasing drum speed, while the grain losses increased. Also, the straw sizes decreased at low moisture content under all threshing machines.

Kabel (1998) carried out a comparison between some locally manufactured threshing machine. Type of the cylinder was spike tooth. He found that, threshing efficiency was increased as the cylinder speed increased when other variables were kept constant.

El-Haddad (2000) stated that the threshing efficiency for rice crop increased with increasing of drum speed and decreasing of feed rate. The maximum threshing efficiency was 99.76% at drum speed 21.25 m/s (1400 r.p.m), and feed rate 15 kg/min. he added that the maximum amount of visible grain damage was 0.90% at drum speed 21.25 m/s and feed rate of 15 kg/min.

Badway (2002) reported that the highest threshing efficiency was 97.17% at the optimum performance of deseeding machine. By increasing drum speeds from 9.28 to 15.33 m/s the machine capacity increased from 1800 to 2400 kg/h.

The main objective of the present work is to study the feasibility of using locally manufactured threshing machine for threshing grain sorghum. The cleaning unit is modified and tested through the following main points: a) utilization of an automatic control system to minimize grain sorghum losses upon the sieves. b) studying some operational factors affecting the threshing and cleaning efficiency. c) estimating the energy requirement for the proposed threshing machine.

MATERIALS AND METHODS

Filed experiments were carried out at Sakha Agriculture Research station during the summer season 2005 by using locally threshing machine which was developed to be suitable for threshing and cleaning grain sorghum (hybrid 102) as shown in Fig 1. The development include adding an electronic control system at the end of the cleaning sieve to control the staying period of threshed materials on sieves. The threshing machine has been evaluated and tested under different operating conditions. The specifications of threshing machine are indicated in Table 1.

Table 1: The specifications of threshing machine

Items	Threshing machine
Length, cm	200
Width, cm	120
Height, cm	175
Mass, kg	475
Source of power, hp	Self operated Diesel engine, 10 hp
Cylinder type	Spike tooth
Cylinder length, cm	110
Cylinder diameter, cm	60
Concave length, cm	80
Through out length, cm	20
Sieve type	Flat perforated sheet screen
Sieve length, cm	100
Sieve width, cm	120
Hole diameter, mm	15
Eccentric stroke of the screen, cm	2-3

1. Experimental treatments:

a) Four different cylinder speeds: 17.42, 20.12, 23.61 and 26.18 m/s. b) Four various holding times: continuous cleaning (without using the electronic system), opened after 20, 40 and 60 second. C) Three different levels of feeding rates 5, 7.5 and 10 kg/min.

2. Electronic control system:

The main function of the electronic control system is to control the holding time required to open the gate behind the cleaning sieve. Consequently minimizing seed loss in straw. Figure 2 shows a sketchmatic diagram for the automatic control system.

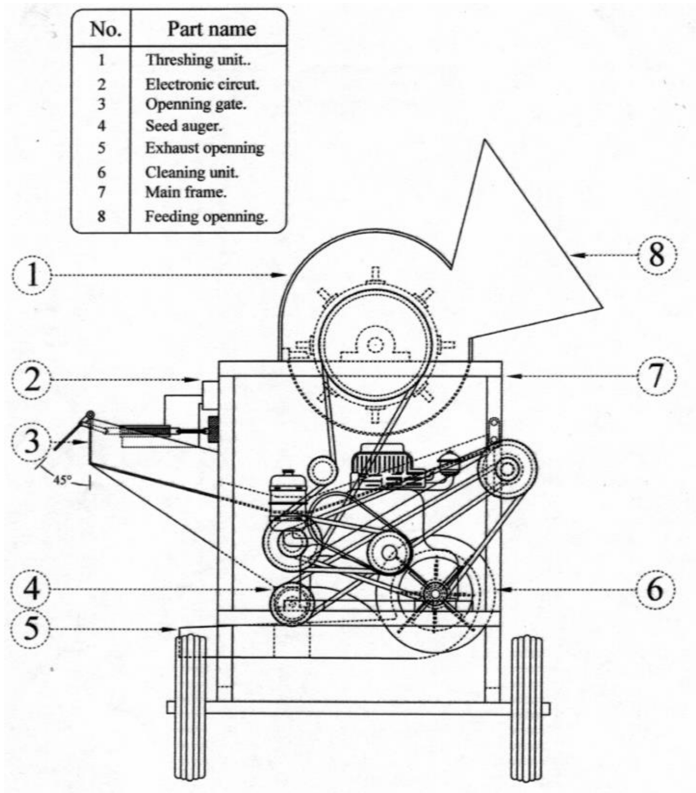

Fig. 1: Sketchmatic diagram of threshing machine after modification.

a. **Electric circuit for determining the opening time:**

This circuit consists of transformer 12V and bridge to pass the current in one way, capacitor in addition to the integrated circuit (LM555), as well as three different resistances as shown in Fig. (2). The opening or closing gate times were calculated according to the following equations:

$T_1 = 0.693 (R_1 + R_{2a}) C$ --- (1)

$T_2 = 0.693 (R_{2b}) C$ --- (2)

Where:

T_1 = opening time, sec.

T_2 = closing time, sec.

C = capacitor, μ Farad

R_1, R_{2a} and R_{2b} = resistances, kΩ.

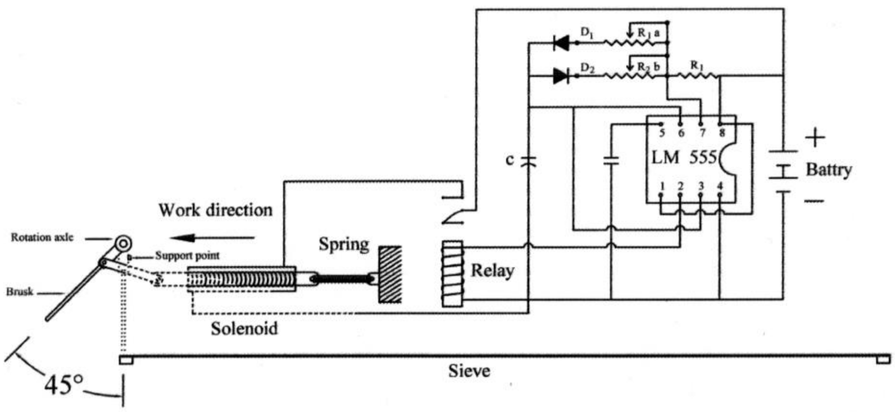

Fig. 2: Electronic circuit to control the opening gate.

b. Solenoid valve:

The current passes from LM555 to relay and subsequently into the solenoid valve. The solenoid consists of free iron rod surrounded by coil. When the electricity passes in the coil, the magnetic field are generated which otherwise pushed the iron rod at the same time the moved arm tends to open gate.

c. controlling gate:

It consists of a metal plate with 120 cm length and 20 cm width attached from the upper with rotating axle which connected with iron rod of the solenoid.

3. Physical properties of grain sorghum:

Figure 3 and Table 2 illustrate some physical properties of the grain sorghum (hybrid 102). These physical properties considered the most important properties in threshing and cleaning operation.

Table 2: Some physical properties of the grain sorghum hybrid 102

No. of sample	Plant length, cm	Mass of 1000 seed, gm	Mass of straw in sample, gm	Mass of grain in sample, gm	Grain/straw ratio
1	114	31.16	239	96	1 : 2.49
2	119	31.00	245	105	1 : 2.33
3	116	29.35	236	103	1 : 2. 29
4	110	31.92	267	110	1 : 2.43
5	123	32.19	275	114	1 : 2.41
6	115	33.10	262	99	1 : 2.65
7	90	32.50	250	98	1 : 2.55
8	120	29.75	265	102	1 : 2.60
9	126	30.67	249	108	1 : 2.31
10	125	32.83	257	113	1 : 2.27
Total	**1168**	**314.47**	**2545**	**1048**	**10 : 24.33**
Mean	**116.8**	**31.45**	**254.5**	**104.8**	**1 : 2.43**

Fig. 3: Heads of hybrid grain sorghum.

4. Measurements:

During the performance test of the developed threshing machine, the following items were measured.

a. Unthreshed grain loss:

Unthreshed grain loss was calculated according to the following formula:

$$\text{Unthreshed grain, \%} = \left(\frac{\text{Mass of unthreshed grain, kg}}{\text{Total yield, kg}}\right) \times 100 \quad \text{------------- (3)}$$

b. Grain losses in straw:

To determine the percent of grain in straw, the working samples of straw were taken by randomized method. This test was done by separating the grain in straw by hand from 250 g working samples. The separated grains were weighed and the total weight of the seed in straw calculated. The percentage of the grain in straw was evaluated as a ratio of total weight.

$$\text{Grain loss in straw,\%} = \frac{\text{Mass of grain loss in straw,kg}}{\text{Total yield, kg}} \times 100 \quad \text{---------------- (4)}$$

c. Visible grain damage:

Visible grain damage was determined at different drum speeds, feed rates and grain moisture content for randomized samples 50 g was done by separating the visible grain damage by hand. Percentage of the grain damaged was determined.

d. Invisible grain damage:

A germination test was made to determine the invisible grain damage. The samples of this test were taken from a portion of the working sample that remained after separating grain damage. The germination test was carried out in three Petri dishes for each treatment in each Petri dish 50 grain were placed on a filter paper, covered with water and incubated at 20º C for 24 h. The germinated grains were counted in each dish and expressed as a percentage of the original number of grains. The average of three replications was taken as the percentage of the germinated grains for the treatments.

e. Cleaning efficiency:

Cleaning efficiency was estimated according to the following formula:

$$\text{Cleaning efficiency, \%} = \left[\frac{\text{Mass of cleand grain in sample}}{\text{Total grain sample}}\right] \times 100 \text{ ------- (4)}$$

f. Consumed power:

Consumed energy was calculated by accurately measuring the decrease in fuel level in fuel tank immediately after carrying out each treatment. The following formula was used to determine consumed power (Barger *et al.* 1963).

$$E_r(\text{kW}) = \left[F_c \times \frac{1}{3600}\right] \times P_f \times \text{L.C.V} \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36} \text{ ---- (5)}$$

Where:

FC = Fuel consumption rate, l/h;

P_f = Density of the fuel, kg/l (for solar fuel = 850 kg/l;

L.C.V = Lower calorific value of fuel kcal/kg;

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

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

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

g. Specific energy requirements (kW.h/Mg):

It was calculated by dividing the consumed power (kW) by the machine productivity (Mg/h).

RESULTS AND DISCUSSION

1-Unthreshed grain losses, %

Figure 4 shows the effect of feeding rate, holding time and cylinder speed on unthreshed grain loss. It can be mentioned that, the increase of feed rate tends to increase the unthreshed grain loss at all holding times and cylinder speeds. It is evident that, increasing the feed rate from 5 to 10 kg/min caused a corresponding increase in the unthreshed grain loss by about 36.94% at holding time 20 sec and drum speed of 17.42 m/s. the other holding times and cylinder speeds had the same above mentioned trend.

On the other hand, increasing cylinder speeds from 17.42 to 26.18 m/s tends to decrease the unthreshed grain loss for all opening times, and feeding rates. Results also showed that, cylinder speed of 17.42, 20.12, 23.61 and 26.18 m/s gave the following unthreshed grain loss: 1.41, 1.19, 1.01 and 0.82% at holding time 60 sec and feeding rate 5 kg/min.

Dealing with the effect of holding time the results showed that the holding time had no effect on unthreshed grain losses.

2. Grain loss in straw, %:

Figure 5 shows the effect of feeding rate, holding time and cylinder speed on grain loss in straw. Increasing the feeding rate from 5 to 10 kg/min during threshing operation of grain sorghum leads to increase grain loss in straw for all cylinder speeds however, it was decreased by increasing the holding time. The results illustrated that, increasing the feeding rate from 5 to 10 kg/min caused a corresponding increase in grain loss in straw of about 180% at cylinder speed 17.42 m/s and holding time 60 sec.

The data also showed that, the increase of holding time from 20 to 60 sec noticeable reduction in grain loss in straw was observed at all cylinder speeds and feeding rates. This decrease may be attributed to gaving the grain chanse to fall through the sieve and prevent grain scattering with the chaff.

In the same manner, increasing cylinder speeds from 17.42 to 26.18 m/s tends to increase grain loss in straw by 84.00% at feeding rate 5 kg/min and holding time 60 sec. The other feeding rates and holding time gave the same mentioned above trend. This trend may be due to the increase of the amount of chaff upon sieve (over load) as a result of over threshing.

3. Total grain losses, %:

Figure 6 shows the effect of feed rate, holding time and cylinder speed on total grain loss. It is conceivable that, increasing the cylinder speed from 17.42 to 26.18 m/s tends to decrease the total grain losses by 10.58% at feed rate of 10 kg/min and holding time 60 sec. The other feed rates and holding times had the same mentioned trend.

On the other hand, increasing the holding time from 20 to 60 sec tends to decrease the total grain losses due to the increase of grain ability to fall through sieve which otherwise minimize or prevent grain scattering with chaff. Increasing the holding time from 20 to 60 sec leads to decrease the total grain losses by 18.50% at cylinder speed 17.42 m/s and feed rate 5 kg/min.

It can be found that the mean values of total grain losses reached to 1.63, 2.24 and 2.93% at feed rates of 5, 7.5 and 10 kg/min with cylinder speed 17.42 m/s and holding time 60 sec. The other holding times and cylinder speeds had the same mentioned above trend.

4. Cleaning efficiency, %:

Figure 7 shows the effect of feed rate, holding time and cylinder speed on cleaning efficiency. Results indicated that, the feeding rate had a great effect on cleaning efficiency. Whereas, the increase in feeding rate from 5 to 10 kg/min leads to decrease the cleaning efficiency by 5.30% at cylinder speed 17.42 m/s and holding time 60 sec. In the same manner the increase in holding time from 20 to 60 sec decreases the cleaning efficiency by 2.01% at feed rate of 5 kg/min, cylinder speed of 17.42 m/s. The other feeding rates had the same mentioned above trend. This attributed to increase of staying period of grain and chaff which subsequently fall trash with grain.

F4-5

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5. Grain damage (visible and invisible), %:

It must be denoted that, there is no effect of holding time on grain damage Figure 8 shows the effect of feed rate and cylinder speed on total grain damage (visible and invisible). Increasing the feed rate from 5 to 10 kg/min tends to decrease the visible and invisible grain damage by 58 and 54% respectively at cylinder speed of 26.18 m/s. This is due to the dense layers of material passing between cylinder and concave bars at high feed rates which provide more protection and reducing the repeated impact by cylinder bars.

Results also, indicated that the increase of cylinder speed leads to increase the visible and invisible grain damage at all feed rates. The obtained values of visible and invisible grain damage were found to be (0.8, 0.86, 0.93 and 1.00%) and (1.01, 1.09, 1.16 and 1.23%) respectively at feed rate of 5 kg/min and cylinder speeds of 17.42, 20.12, 23.61 and 26.18 m/s respectively. That is considered due to increasing the momentum changes. The impact forces increase by acceleration resulting in visible and invisible grain damage.

8. Specific energy, kW.h/Mg:

Figure 9 shows the effect of feeding rate, holding time and cylinder speed on specific energy. It can be stated that the increase of in both holding time and feeding rate tend to decrease the specific energy as a result of increasing the machine productivity. On the other hand the increase of cylinder speed tends to increase the specific energy. These due to the increase of fuel consumption rate.

The power consumption increased substantially as the cylinder speed and feed rates increased. It is clear that, the increase of cylinder speed from 17.42 to 26.18 m/s tends to increase the specific energy by 9.33% at feed rate 5 kg/min.

Hence, the increase of feed rate from 5 to 10 kg/min leads to decrease the specific energy by 41.19% at speed 17.42 m/s. this reduction in specific energy may be due to the increase of machine productivity by increasing the feed rate.

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CONCLUSIONS

The present study concluded the main following points:

1. The developed threshing machine had a good performance in threshing and cleaning efficiency compared with the threshing grain sorghum in original machine (without using the automatic control system).
2. It is obvious that, adding the automatic control system minimizes the grain losses in straw by 78.80% at cylinder speed 26.18 m/s, feed rate 5 kg/min and holding time 60 sec compared with control treatment.
3. The total grain losses decreases by 49.85% when using the automatic control system with the holding time of 60 sec, feeding rate 5 kg/min and cylinder speed 17.42 m/sec
4. The results showed that, the holding time of separating the material upon the sieve had no effect on the total seed damage where, they were increased by increasing cylinder speed and the lowest value was 0.57% at cylinder speed 17.42 m/s and feed rate of 10 kg/min.
5. Results also concluded that, the lowest value of specific energy was 10.21 kW.h/Mg at cylinder speed 17.42 m/s and feed rate 10 kg/min.
6. It is clear that, the highest value of cleaning efficiency was reached 96.35% with holding time 20 sec, cylinder speed 17.42 m/s and feed rate 5 kg/min by using automatic control system.
7. It can be concluded that, the optimum operating conditions were holding time of 40 sec, cylinder speed of 23.61 m/s and feed rate of 7.5 kg/min.

REFERENCES

Abdel Hameed, E.A. (1994). Studying concave drum factors and operation of a locally manufactured thresher and their effect on threshing efficiency. M.Sc. Thesis, Agric. Eng. Dept., Fac. of Agric., Ain Shams Univ.

Badway, M.E. (2002). Modification and evaluation of paddy rice thresher to suit flax deseeding. Misr J. Ag. Eng., 19(4): 881-900.

Barger H.; J.L. Edohl, W.M. Carletor and E.G. Mchibben (1963). Tractor and their power units. 2nd ed, Wiley Sons Inc., New York, U.S.A.

Donnelle (1983). Performance test of thresher. RNAM test codes and procedure. Farm machinery: 230-233.

Duncan, D.B. (1955). Multiple range and multiple F. test. Biometrics, 11: 1-42.

El-Behiry, A.A.; M.I. ward and A.M. El-Sherbieny (1997). Performance evaluation of some wheat thresher machines under different conditions. Misr J. Ag. Eng., 14(4): 149-160.

El-Haddad, W.Z. (2000). A simplified design and performance study of threshing and winnowing machine suitable for sample holdings. M.Sc Thesis, Agric. Mech., Fac. of Agric., Kafr El-Sheik, Tanta Univ.

El-Shazely, A.M. (1991). Development of simple rice thresher machine for small farms. M. Sc. Thesis. Ag. Eng. Dept., Faculty of Ag., Ain Shams Univ.

Faribanks, G.E.; W.H. Johnson; M.D. Shrock and S. Nath (1979). Grain sorghum harvesting loss study. Trans. of the ASAE, 22 (2): 246-250.
Gummert, M. (1991). IRRI thresher performance special international Rice Res. Inst. Nov. 26: 1-20.
Hashish, A.I. (1984). Rice combine harvesting parameters. J. Ag. Res. Tanta Univ., 10(43): 736-749.
Helmy, M.A (1988). Threshing parameters affecting the performance of local and foreign wheat threshing machines. Misr J. Ag. Eng., 5(4): 329-343.
Huynh, V.M.; T. Powell and J.N. Siddal (1982). Threshing separating process A-mathematical model. Trans. of ASAE, 25(1): 62-73.
Kabel, A.E. (1998). Comparative study on some locally manufactured threshing machines. M.Sc. Thesis, Agric. Mech. Dept., Fac. of Agric., Kafr El-Sheikh, Tanta Univ.
Kebedo , D. and T.N. Mishra (1990). Development and performance evaluation of a sorghum thresher. Ag. Mech. in Asia, Africa and latin America, 21(3): 33-37.
Kepner, R.A.; R. Bainer and E.I. Barger (1982). Principles of farm machinery. Third edition. Wiley and Sons Inc., N.Y.
Martin, J.H. and M.T. Jenkins (1950). "New uses for waxy – cereal starches" in crops in peace and war, USDA Yearbook: 159-162.
Mohamed, A.H. (1994). Optimization of power rice for locally manufactured machine. M.Sc. Thesis, Agric. Eng., Fac. of Agric., Ain Shams Univ.
Snedecor, G.W. and W.G. Conchran (1980). Statistical method 7th Ed. Iowa State Univ. Press. Ames. Iowa, USA.
Swanson, A.F. (1950). "Making pellets of forage sorghum" in crops in peace and war, USDA Yearbook: 353-356.
USDA Yoorbook (2004). United States Department of Agriculture, Foreign Agric. Service, Production estimates and crop assessment div., Ag. Box 1045, Washington, DC 20250-1045.
Waelti, H; P.K. Turnquist and V.E. Matter (1971). Harvesting techniques for reducing grain sorghum losses. Trans. of the ASAE, 14(5): 797-800.
Yunus, P. (1987). Grain losses at harvesting and threshing of paddy in Turkey. Ag. Mech. in Asia, Africa and Latin America, 18(4): 61-64.
نشرة الأعلاف الصيفية الخضراء (٢٠٠٥). وزارة الزراعة – مركز البحوث الزراعية. قسم بحوث العلف.
يونس. س. م. (١٩٩٧). إدارة المكينة الزراعية – قسم الهندسة الزراعية – كلية الزراعة جامعة القاهرة.

استخدام نظام التحكم الإلكتروني للمواد المدروسة على غرابيل آلة الدراس لتقليل فاقد سورجم الحبوب

رزق محمد خليف - رفاعى رفاعى أبو شعيشع وسامى عبد الجيد مرعى
معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – الجيزة – مصر.

تهتم معظم دول العالم وبخاصة الدول المتقدمة بتغذية الحيوان لأنة يعتبر المصدر الرئيسي للحصول على البروتين الحيواني وهو أفضل أنواع البروتينات لبناء جسم الإنسان وإمداده بالأحماض الأمينية الأساسية. ويعتبر توافر العلف الأخضر على مدار العام من المقومات الأساسية لهذه التغذية. ومن ثم تنشأ أهمية الأعلاف وتوافرها ولقد أدخلت فى مصر أعلاف جديدة وتدريجياً تزداد المساحة المنزرعة منها سنوياً. ولما كان محصول علف هجين السورجم أهم محاصيل العلف فى الموسم الصيفى حيث يتميز بارتفاع نسبة المادة الجافة ونسبة البروتين الخام به يتراوح من ١٠ –١٤٪ حسب العمر الذى تحش فيه النباتات بالإضافة إلى أنه متعدد الحشات حيث يعطى ٣ –٤ حشات حسب ميعاد الزراعة ويعطى محصولاً خضرياً يتراوح ما بين ٤٠ – ٥٠ طن/فدان (مركز البحوث الزراعية ٢٠٠٥). لذا كانت ومازالت مشكلة نقص العلف الصيفى بؤرة اهتمام الباحثين من خلال توفير وسائل الإنتاج وتقديم التكنولوجيا اللازمة لدراس وحصاد سورجم الحبوب الذى سوف يتم زراعة حبوبه كسورجيم علف علاوة على استخداماته العديدة فى الصناعات الغذائية. ونظراً لاستخدام آلات الدراس لهذه المحاصيل فكان من الملاحظ زيادة نسبة الحبوب فى القش وبالتالى زيادة نسبة الفواقد الكلية وللتغلب على هذه المشكلة فقد تم تصميم دائرة إلكترونية للتحكيم فى زمن مكوث الحبوب على الغربال بمركز ميكنة الأرز بميت الديبة. واختبرت الآلة المطورة باستخدام محصول سورجم الحبوب (هجين ١٠٢) لتحديد الظروف الملائمة لتشغيل الآلة لتعطى أفضل أداء للآلة، وقد قيمت الآلة تحت العوامل التالية:-

١. أربع سرعات خطية لدرفيل الدراس وهى: ١٧,٤٢، ٢٠,١٢، ٢٣,٦١، ٢٦,١٨ م/ث.
٢. أربعة أزمنة لمكوث الحبوب على الغربال وهى: صفر، ٢٠، ٤٠، ٦٠ ثانية.
٣. ثلاثة معدلات تغذية وهى: ٥,٠، ٧,٥، ١٠,٠ كجم/دقيقة.

وقد تم دراسة تأثير العوامل السابقة على المتغيرات التالية:-

نسبة فاقد الحبوب غير المدروسة – نسبة فاقد الحبوب الناتجة مع القش – نسبة التلف الظاهري وغير الظاهري للحبوب – كفاءة التنظيف – الطاقة المستهلك فى التشغيل.

ويمكن تلخيص النتائج المتحصل عليها كما يلى:-

١. استخدام نظام التحكم الإلكتروني أدى إلى تقليل نسبة فاقد الحبوب فى القش بنسبة ٧٨,٨٠٪ بالمقارنة بالمعاملة الكنترول (بدون تحكم) عند سرعة درفيل الدراس ٢٦,١٨ م/ث ومعدل تلقيم ٥ كجم/دقيقة وزمن مكوث الحبوب على الغربال ٦٠ ثانية.
٢. انخفضت نسبة الفواقد الكلية إلى ٤٩,٨٥٪ باستخدام نظام التحكم الإلكتروني عند زمن مكوث الحبوب على الغربال ٦٠ ثانية ومعدل تلقيم ٥ كجم/دقيقة وسرعة درفيل الدراس ١٧,٤٢ م/ث.
٣. تزداد نسبة تلف البذور بزيادة سرعة درفيل الدراس وكانت أقل قيمة للتلف ٠,٥٧٪ عند أقل سرعة درفيل ١٧,٤٢ م/ث ومعدل تلقيم ١٠ كجم/دقيقة فيما لم يكن هناك تأثير لأزمنة المكوث على نسبة التلف.
٤. أقل قيمة للطاقة المستهلكة فى عملية الدراس لحبوب السورجم كانت ١٠,٢١ كيلوات. ساعة/ميجا جرام عند سرعة درفيل ١٧,٤٢ م/ث ومعل تلقيم ١٠ كجم/دقيقة.
٥. أعلى كفاءة تنظيف كانت ٩٦,٣٥٪ عند زمن مكوث للحبوب ٦٠ ثانية وسرعة درفيل ١٧,٤٢ م/ث ومعدل تلقيم ٥ كجم/دقيقة باستخدام نظام التحكم الإلكتروني.
٦. توصى الدراسة بزمن ٤٠ ثانية لمكوث المواد المدروسة على غرابيل آلة الدراس وسرعة درفيل ٢٣,٦١ م/ثانية ومعدل تغذية ٧,٥ كجم/دقيقة حيث أعطت انسب نسبة فاقد وتلف للحبوب وكذلك أعلى كفاءة تنظيف وأقل استهلاك نوعى للطاقة.