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Developing a Unit for Chaff Bagging During Threshing

El-Fakhrany, W. B.;[1] S. A. Shalaby[2] and W. M. El-Balkimy[1]
[1] Agricultural Engineering Research Institute, Agri. Res. Center.
[2] Agricultural Engineering Research Institute, Agri. Res. Center.

ABSTRACT

The aim of the present study is to develop a bagging device depends primarily on a cyclone and fits for bagging the wheat chaff during threshing operation. The developed device was constructed in El-Gemeza Agricultural Research Station El-Gharbia Governorate. For obtaining high performance of the developed device; some parameters were tested at different levels such as; air outlet diameter of 50, 90 and 120 cm, mesh holes diameter of 3, 6 and 10 mm latterly thresher air velocity of 14.4, 17.9, 20.1 and 23.6 m/s. The air velocity at air outlet and chaff outlet were measured, also the chaff losses, grain losses, impurity ratio and cleaning efficiency were determined.The highest air velocity at air outlet of 5.4 m/s was obtained at air outlet diameter of 90 cm, mesh holes diameter of 10 mm and thresher air velocity of 23.6 m/s. The lowest values of air velocity at chaff outlet, chaff losses and grain losses of 0.2 m/s, 0.36% and 0 respectively were obtained at air outlet diameter of 120 cm, mesh holes diameter of 10 mm and thresher air velocity of 14.4 m/s. The lowest value of impurity ratio of 0.03% and the corresponding cleaning efficiency of 97.7% were obtained at air outlet diameter of 120 cm, mesh holes diameter of 10 mm and thresher air velocity of 23.6 m/s.

INTRODUCTION

Egyptian farmers consider wheat chaff as a by-product beside grains;while it is indispensable in feeding of livestock throughout the year. The field information indicates that, the monetary value of wheat chaff after threshing directly of about 2000 L.E/fed. and up to 3000 L.E/ fed. through the winter.The traditional way of wheat chaff bagging operation is extremely tedious and requires more time, in addition to it is harmful especially to the respiratory health of workers. Also, the workers cannot entirelyclean the chaff place, which will affect the next crop in that place, in addition to increase the chaff losses.

With regard to utilization the wheat chaff in livestock feedingHanna and Suliman (1982) mentioned that Egypt has a unique agricultural feature. It has a very strong livestock program but with meager green fodders during the summer season. This situation makes the cattle feeding almost entirely dependent on the wheat straw after it has been cut and properly bruised by stationary threshers. Using a combine that usually throws back the wheat into the fields does not provide the exact requirements of the Egyptian farmers.Kaliel and Kotowich (2002) stated that the cost of wintering beef cows in western Canada is the single most important cost of beef production and accounts for 60–65% of the total cost of production in a cow-calf operation.Ellinbank (2005) mentioned that chaff is hay cut into small pieces for feeding to livestock. It is a good fodder, and at its best is cleanly and evenly cut, free of dust, of good colures and with a fresh aroma. Chaff is usually cut into 6 – 10 mm long pieces. Cereal chaff can be up to 20 mm for cheeps and horses, or even slightly longer for cows. Nutritional value is not changed by the cutting from hay to chaff but utilization by the animal may be better. An unevenly cut chaff lacks appeal to the eye and so may be downgraded in value. An excess of fines or dust particles is detrimental to animal health.Hamdia*et al.* (2011)declared that a feed is an important one of production inputs; its value is represented about 58.3% of the total value of agricultural production inputs in 2008. There are about 12 million animal units, the needs of those animal units of green feed were estimated about 39.8 million tons, about 9.6 million tons of straw, and about 15.9 million tons of concentrated feed. These needs were estimated at about 18.4 million tons of starch equivalent, and about 2.1 million tons of protein digested. The available quantity for consumption of feed was estimated about 64.8 million tons of green feed, about 9.2 million tons of straw, and about 5.1 million tons of concentrated feed. The available quantity for consumption were estimated at about 11.6 million tons of starch equivalent, and about 1.8 million tons of protein digested during the average period (2003- 2008). By Estimating the feed balance in Egypt during the average period (2003-2008), showing a surplus in the green feed is estimated at about 24.9 million tons, also showing a deficit in the straw and the concentrated feed about 0.3494, 10.9 million tons respectively. This noted a deficit estimated at about 6.8 million tons of starch equivalent and about 225.2 thousand tons of digested protein.

With regard to specifications of wheat chaff Mckean and Jacobs, (1997) stated that the physical content revealed that parts of wheat plant like internodes (68.5%), leaf-sheath (20.3%), leaf-blade (5.5%), nodes and fines (4.2%) and grains and debris (1.5%) shows varied mass percentage of wheat straw fractions.El-Danasory and Imbabi (1998) showed that yield of straw about 3752 kg/fed., the labor required for manual picking and packing per wheat straw of one feddan after harvesting with combine was 6 labors with 9 working hour per day then the time required per one feddan was 54 hours. Also, they added that the average losses of straw were 13.7% and high cost of picking and packing of straw after harvesting (165 L.E/fed).Khoder and Abdel-Hameed (1999) indicated that farmers and residents are exposed to high levels of organic dusts during harvesting and post harvesting processes. This may lead to adverse health effects. Pulmonary diseases, allergenic and asthma are common between farmers during wheat harvesting season. Consequently, this hazardous agent should be controlled to protect farmers and rural residents against such source of air pollution.

Utilization of the cyclone in bagging the wheat chaff Ogawa and Hikichi (1981) proposed that the solid particles entering the cyclone immediately bifurcate into two layers of dust due to the eddy current based on the secondary flow on the upper cover surface in the coaxial space between cyclone body and exit pipe. One of them goes around the coaxial space on the upper cover surface and rotates around the exit pipe with the gas flow. The other rotates and descends along the surface of the cyclone body. Then, on the surface of the cone, the dust layer, which is pressed onto the cone surface by the centrifugal force, descends aided by gravitational force and descending airflow in the boundary layer. Lastly, these dust layers are deposited in the dust bunker. However, Zhou and Soo (1990)mentioned that some of the deposited dust rolls up from this dust layer by the secondary flow in the boundary and flows through the exit pipe. Centrifugal effects, which are responsible for collecting fine particles, depend directly on the tangential velocity of the solid particles. Therefore, the tangential velocity of the gas flow, which relates to the pressure drop, must be increased in order to increase cyclone efficiency. These processes are the mechanism of separation of solid particles in cyclones.Ogawa (1997)reported thatcyclones are widely used for removal dust of gaseous flows in industrial processes. Cyclone dust collectors have been used in many industrial facilities to collect solid particles from gas-solid flows and to reduce air pollution originating in chimney smoke from chemical plant drier equipment.

Awady *et al.* (2003) showed that cleaning efficiency and total losses werepositively affected by air speed. Also, El-Balkimy (2006) mentioned that, the total seed losses and cleaning efficiency were increased by increasing the blown air velocity. He added that, increasing the blown air velocity from 1.5 to 3 m/s led to increase the seed losses and cleaning efficiency from 1.2% and 90.71% to 6.17% and 98.53% respectively.

The main objectives of this study was develop and construct a bagging device depends primarily on a cycloneand fit for bagging wheat chaff during threshing operation.

MATERIALS AND METHODS

The developed device was manufactured in the workshop of El-Gemeza Agricultural Research Station El-GharbiaGovernorate. The experiments carried out at July 2016 to study the possibility of connecting a large cyclone to the Turkish threshing machine for bagging the wheat chaff during threshing operation.

The developed device

The developed device consists of a cyclone, four pillars, and base as mentioned in Figs. (1,2). The cyclonehas special dimensionsdepending on the height of the threshing machine, the quantity of wheat chaff, entering air velocity and size of bagging unit. The cyclone consists of chaff and air inlet 50 cm vertical × 40 cm horizontal; barrel 150×100 cm ofD×H; cone 150×75×50 cm of D_1×D_2×H and upper air outlet with variable diameter.The upper air outlet was closed by a lozenge wire mesh with a variable diameter to minimize the chaff losses. The cyclonebased on four removable pillars (pipe 3.75×190 cm ofD×H)and the pillars joined with a removable base (150×150cm)by mean of four fixed pipes 5×20 cm of D×H at a distance of 68 cm from the cyclone(the removable base and pillars to facilitate the transporting of the device). During the work, the removable base is fixed in the soil in front of the threshing machine, and the four removable pillars are joined with the cyclone, then two men can raise the cyclone by the pillars and connect it by the base. Thus, the device was assembled, after that the device is connected to chaff outlet on the threshing machine by a tube of cloth 75 cm in length.Thus, the wheat chaff exit from the threshing machine with air at high velocity then enter to the cyclone by means of the tube of cloth. The cyclone role is separates the chaff from air, as the mix enters the cyclone tangentially and creates a vortex in the cyclone and chaff particulates move toward the cyclone wall and then settle into the bagging unit which located above the base.

The used threshing machine

Turkish threshing machine was used in the following study, the mentioned thresherhas a spike tooth drum with drum diameter of 70 cm, drum length of 120cm and number of spike tooth 44 (30 cm long and 0.8 cm thickness). The power was transmitted from tractor [Nasr, four-stroke diesel engine44.10 kW (60 hp)] to thresher machine by a pulley and belt.

Studying variables

During the experiments, the following parameters were examined: 1-Blown air velocity of the threshing machine 14.4, 17.9, 20.1 and 23.6 m/s. 2-The diameter of upper air outlet in the cyclone 50, 90 and 120cm. 3-The large diameter of the lozenge wire mesh 3.0, 6.0 and 10 mm. All treatments were carried out in three replications for more accurate average data.

Measuring instruments

The following measuring instruments were used during the present study:-

- A digital anemometerDT-618 was used to measure the air velocity.
- Atouch type tachometer DT-2856 was used to measure drum and fan velocities.
- A digital electric balance of 50 kg of capacity and 1gm of accuracy was used to weight different samples.
- A graduate cup was used for determining the bulk and true densities.
- Three sieves with different meshdimensions (3.0, 6.0 and 10 mm) to categorize the chaff.

Experimental measurements

The influence of the mentioned variables on the performance efficiency of the developed device was evaluated by carrying the following measurements.

1-Air velocity at chaff and air outlets in the cyclone

The air velocity at the chaff outlet inthe cyclone should be close to zero, so an anemometer instrument was used to measure the air velocity (m/s) at the chaff and air outlets in the cyclone as a result of the change in diameter of air outlet in the cyclone.

Fig. 1. The developed device

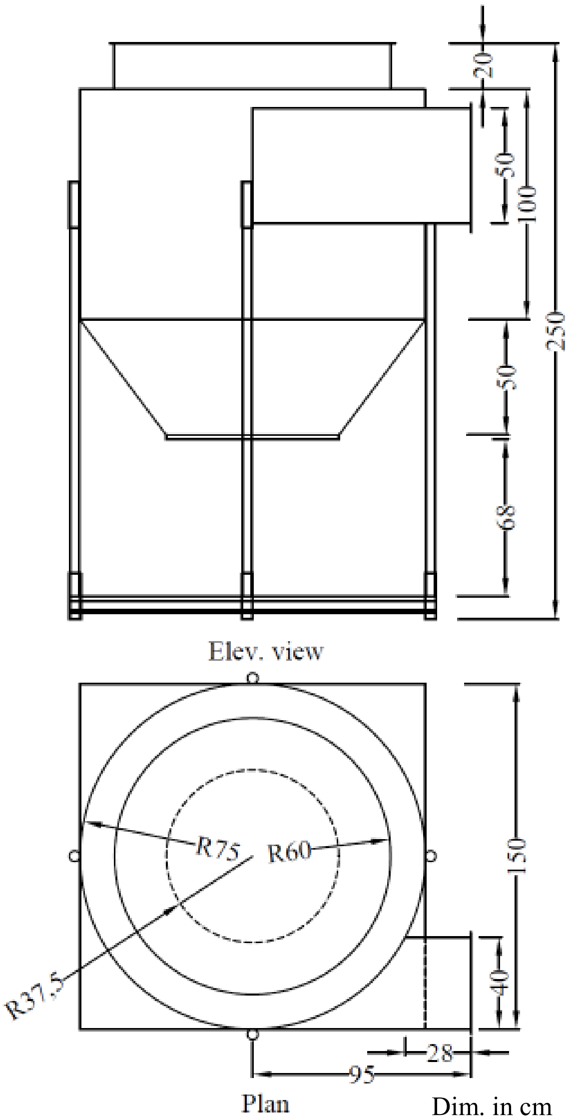

Fig. 2. Elevation and plan views for the developed device

Table 1. The measured specifications of wheat chaff (Gemeza12)

Characteristics	Average value
Particle lengths	
< 3 mm (%)	14.08
3 to 6 mm (%)	8.61
6 to 10 mm (%)	34.04
> 10 mm (%)	43.27
Friction angle	27.91°
Static coefficient of friction	0.53
Repose angle	46.52°
Bulk density, kg/m^3	68.2
True density, kg/m^3	329

2-Chaff losses

The chaff losses are the chaff which blowing with the air either from the chaff outlet or the air outlet in the cyclone, and this item of losses can be determined according to the following formula:-

$$Ch_L = \frac{Ch_w - Ch_b}{Ch_w} \times 100 \qquad (1)$$

$$Ch_w = S_w - (G_w + Gl_w + N_d) \qquad (2)$$

Where:-Ch_L is the percent of chaff losses, Ch_w is the total chaff weight (gm),Ch_b is the obtained weight of chaff from the chaff outlet (gm),S_w is total weight of the sample (gm), G_w is total weight of grain (gm),Gl_w is the weight of grain which collected from the chaff (gm) andN_d is weight of the collected nodes (gm).

3-Grain losses and threshing efficiency

Grain losses are the grains which collected from the chaff as a result for inappropriate fan velocity. These grains were collected, weighed and finally showed as a percentage by the following formula:-

$$Gl = \frac{Gl_w}{G_w} \times 100 \qquad (3)$$

Where:-Gl is the percent of grain losses andGl_w is the weight of grain which collected from the chaff(gm) and G_w is total weight of grain (gm).

4-Impurity ratio and cleaning efficiency

Impurity is foreign materials mixedwith the grainsand was notsuctioned by the suction fan as a result to deficient velocity of fan or more pressure in air outlet. These foreign materials were collected by hand from three randomized samples and weighed, then the impurity ratio was calculated by the following formula:-

$$I = \frac{F_w}{s_w} \times 100 \qquad (4)$$

$$C_e = 100 - I \qquad (5)$$

Where:- I is impurity ratio (%), F_w is weight of the collected foreign materials (gm), s_w is weight of the sample (gm) and C_e is the cleaning efficiency (%).

RESULTS AND DISCUSSION

Air velocity at air and chaff outlets in the cyclone

Air velocity at upper air outlet

All volume of air which enters the cyclone should come out from the upper air outlet, provided that the diameter of that outlet was adjusted. The data plotted in Fig.(3) showed that, increasing the diameter of upper air outlet from 50to 90cm increased the velocity of the air which comes out from it by425%, 158.3% and 53.6% at mesh holes diametersof 3, 6 and 10mm; and thresher air velocity of 17.9 m/s. Then continued to increase by 23.8% with increasing the diameter to 120cm at mesh holes diameter of 3mmonly, but decreased at 6mm and 10mm of mesh holes diameters by 3.2 and 23.3% at the same air velocity of the thresher of 17.9 m/s. That is because the opened area at the small diameter represents a small portion of the top surface of the cyclone;consequently the air is bumps into the closed area then moves down and comes out from the chaff outlet. Also, at the diameter of 90cm, the air velocity nearby the circumference of the hole was higher than that in the center.In addition to; decreasing the air velocity at 120cm of air outlet diameter with 6 and 10mm of mesh holes diameters is a result of increasing the opened area.The air velocity at air outlet was increased also by increasing each of mesh holes diameter and thresher air velocity. Increasing mesh holes diameter from 3 to 10mm increased the air velocity by 600, 104.8 and 26.9% at 50, 90 and 120cm of air outlet diameters respectively and 17.9% of thresher air velocity. Also, increasing thresher air velocity from 14.4 m/s to 23.6 m/s increased the air velocity at air outlet by 62.5, 50 and 32.1% at air outlet diameters of 50, 90 and 120cm respectively and 10mm of mesh holes diameter.Decreasing air velocity with smallest diameter of mesh holes of 3 mm is a result of partial prevention of air passage from mesh holes. As well, increasing air velocity at air outlet with increasing the thresher air velocity is a result to increase the air pressure in the cyclone which corresponded with increasing the thresher air velocity.

Air velocity at chaff outlet

Air velocity at chaff outlet should be equal to zero or at least close to zero to prevent the chaff losing with air current. The obtained data explained that;any increasing in diameter of air outlet or mesh holes was corresponded with decreasing in air velocity at chaff outlet;on the other hand, the air velocity at chaff outlet was increased by increasing the thresher air velocity as mentioned at Fig.(4). The air velocity at chaff outlet was decreased by 96.82 and 92.4% with increasing the diameter of air outlet from 50 to 120 cm at mesh holes diameter of 10 mmand thresher air velocities of 14.4 and 17.9 m/s respectively; as well, it decreased by 87.50 and 71.43% by increasing the diameter of mesh holes from 3 to 10mm at 120 cm of air outlet diameter andthresher air velocities of 14.4 and 17.9 m/s respectively. This is due to, the air passage from the top (air outlet) become more easily by increasing each ofair outlet diameter and mesh holes diameter; consequently, the air was not repressed inside the cyclone. On the other hand, the air velocity at chaff outlet was increased from1.6, 0.7 and 0.2 m/s to 4.1, 3.8 and 2.4 m/s by increasing the thresher air velocity from 14.4 to 23.6 m/s at air outlet diameter of 120 cm and mesh holes diameters of 3, 6 and 10 mmrespectively.This is due to; the increment of the thresher air velocity led to repress the air inside the cyclone and force it to go out from the down (chaff outlet).

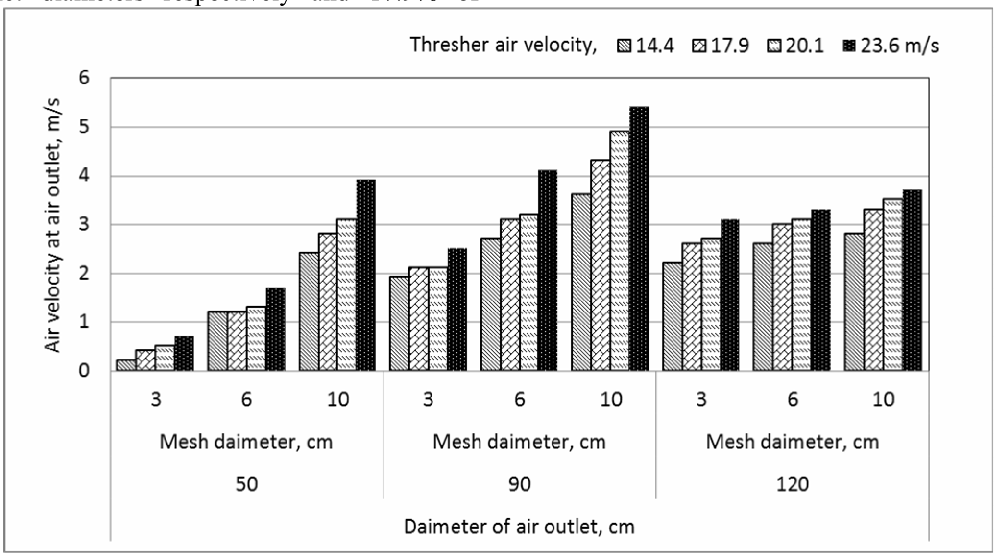

Fig. 3. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on air velocity at air outlet

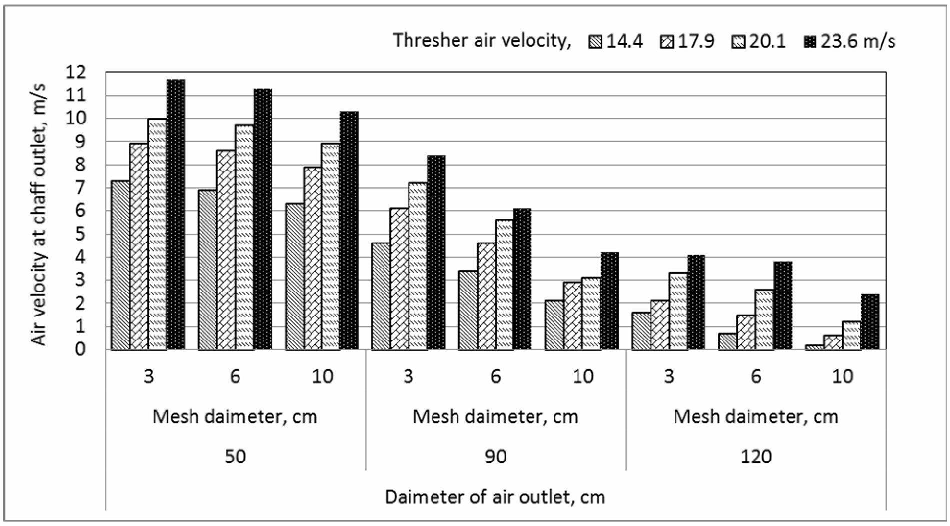

Fig. 4. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on air velocity at chaff outlet

Chaff losses

A negative relation was remarked between the percent of chaff losses and each of air outlet diameter and mesh holes diameter; while, the relation was positive between the percent of the chaff losses and the thresher air velocity as clarified in Fig.(5). Increasing the diameter of air outlet from 50 to 120 cm decreased the chaff losses by 99.46 and 98.90% at 14.4 and 17.9 m/s of thresher air velocities respectively and 10 mm of mesh holes diameter. Also increasing the diameter of mesh holes from 3 to 10 mm decreased the chaff losses by 96.61 and 93.65% at 14.4 and 17.9 m/s of thresher air velocities respectively and 120 cm of air outlet diameter. The reason of that, the smallest diameters of air outlet and mesh holes cause high velocity of air at chaff outlet, which causes more chaff losses as a result of blowing the chaff which collected inside the bag.On the other hand, the percent of chaff losses was increased from 10.61, 3.81 and 0.36% to 23.73, 18.03 and 8.93% by increasing the thresher air velocity from 14.4 to 23.6 m/s at diameter of air outlet of 120 cm and diameters of mesh holes of 3, 6 and 10 mm respectively. This is due to increase the velocity of air passed from chaff outlet by increasing the thresher air velocity.The lowestvalue of chaff losses of 0.36 % was obtained at 120 cm, 10 mm and 14.4 m/s of air outlet diameter, mesh holes diameter and thresher air velocity respectively. While, the highestvalue of chaff losses of 88.71% was obtained at 50 cm, 3 mm and 23.6 m/s of air outlet diameter, mesh holes diameter and thresher air velocity respectively.

Grain losses

The grain losses represent the grains which suctioned with the chaff as a result to inappropriate fan velocity. The obtained data referred to, neither diameter of air outlet nor diameter of mesh holes affected the grain losses, but it was increased by increasing the thresher air velocity as mentioned in Fig.(6). The percent of grain losses increased from 0.0 to 0.86% by increasing the thresher air velocity from 14.4 to 23.6 m/s at 120 cm and 10 mm of air outlet diameter and mesh holes diameter respectively. The reason of that, increase the suction force of fan to be more than the critical velocity of wheat grains, causing suction of grains with the chaff.

Impurity ratio and cleaning efficiency

Impurity ratio was decreased with increasing each of; air outlet diameter, mesh holes diameter and thresher air velocity as mentioned in Fig. (7), whereas the cleaning efficiency was increased as mentioned in Fig. (8). Increasing the diameter of air outlet from 50 to 120 cm decreased the impurity ratio by 59.83 and 76.96%, while the cleaning efficiency was increased by 1.47 and 1.39% at mesh holes diameter of 10 mm and thresher air velocities of 14.4 and 17.9 m/s respectively.Also, the impurity ratio decreased by 55.55 and 73.20% and the cleaning efficiency increased by 1.23 and 1.14% with increasing the diameter of mesh holes from 3 to 10 mm at air outlet diameter of 120 cm and thresher air velocities of 14.4 and 17.9 m/s respectively. This is due to, the small diameter of air outlet and mesh holes cause high air pressure inside the cyclone, which decreases the fan efficiency. In addition to, increasing the thresher air velocity from 14.4 to 23.6% decreased the impurity ratio from 0.96 to 0.03% and increased the cleaning efficiency from 99.04 to 99.97% at air outlet diameter of 120 cm and mesh holes diameter of 10 mm. This is because of increasing the thresher air velocity means increase the suction force of fan, consequently; decreasing impurity ratio and increasing cleaning efficiency.

The lowest value of impurity ratio of 0.03 %with the corresponding highest value of cleaning efficiency of 99.97% were obtained at 120 cm, 10 mm and 23.6 m/s of air outlet diameter, mesh holes diameter and thresher air velocity respectively. While, the highestvalue of impurity ratio of 4.49% with the corresponding lowest value of cleaning efficiency of95.51% were obtained at 50 cm, 3 mm and 14.4 m/s of air outlet diameter, mesh holes diameter and thresher air velocity respectively.

Economic analysis

Through the season of storage of wheat chaff of 2016, the field study indicates that, the total cost of storing one feddan of wheat chaff by workers is 500 L.E; where, this work can be distributed evenly over 8 workers with 2 carts; consequently, the wage of the worker is 50 L.E./fed.

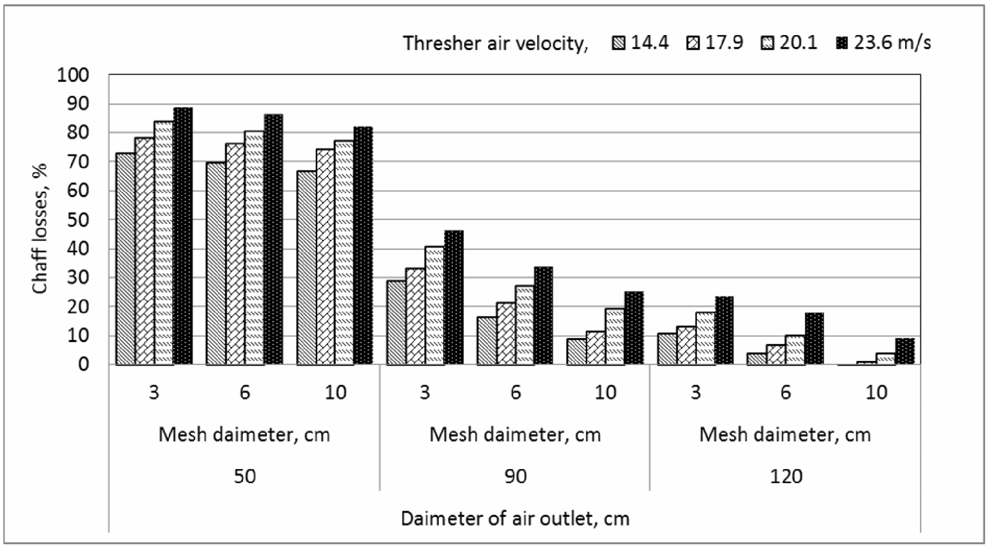

Fig. 5. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on chaff losses

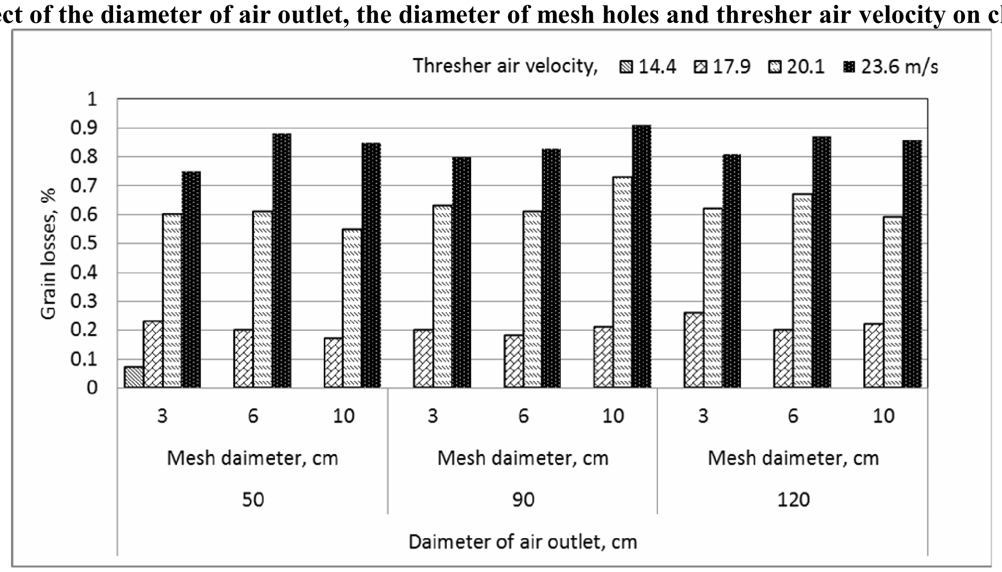

Fig. 6. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on grain losses

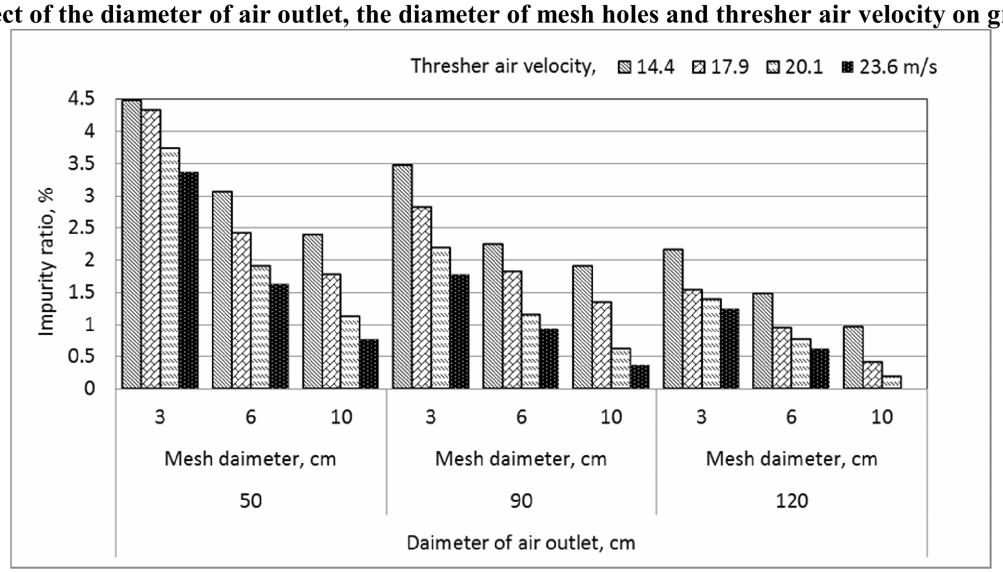

Fig. 7. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on impurity ratio

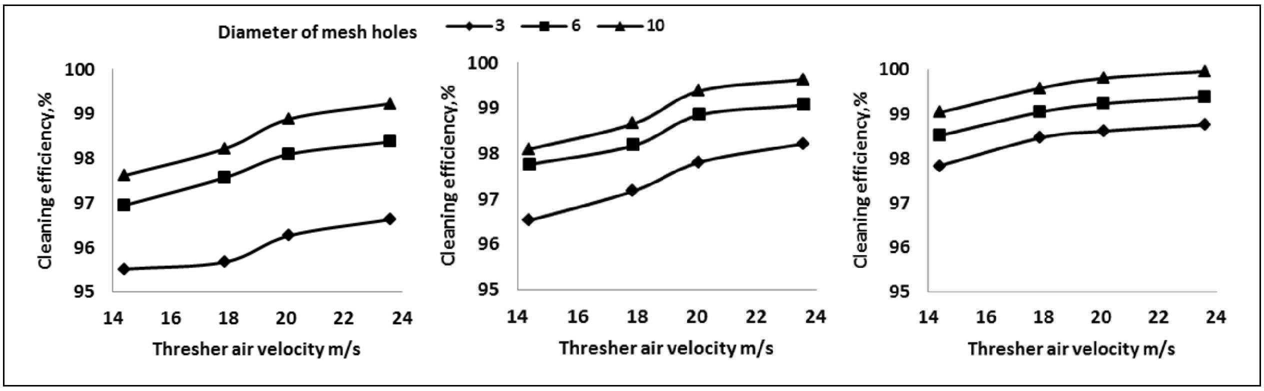

Fig. 8. Effect of the diameter of air outlet, the diameter of mesh holes and thresher air velocity on cleaning efficiency

The bagging operation is conducting by 4 workers, so the total cost of bagging operation by workers is 200 L.E/fed. The total cost of manufacturing the developed device is about 2500 L.E, and can perform throughout a later five seasons. Assuming that the length of threshing season is one month and daily operating time is 8 hours, so the developed device can perform about 1200 hours (live hours), so the fixed cost is about 2.5 L.E/h.. Whereas, the normal range of the time required for threshing one feddan of wheat is 4 hours; consequently, the total fixed cost of bagging wheat chaff of one feddan by the developed device is 10 L.E/ fed

CONCLUSION

For optimizing the wheat threshing machines, minimizing each of grain and chaff losses of wheat, maintaining the cleaning efficiency andprotecting the health of workers; a chaff wheat bagging device was developed and evaluated,and the following is a summary of the obtained results:-

1- Increasing the air outlet diameter from 50 to 120 cm decreased the air velocity at chaff outlet, chaff losses, andimpurity ratio and increased the cleaning efficiency. The air velocity at air outlet increased by increasing the diameter of air outlet from 50 to 90 cm, and then decreased by increasing it to 120 cm. The grain losses not affected by varying of air outlet diameter.
2- Increasing the mesh holes diameter from 3 to 10 mm decreased the air velocity at chaff outlet, chaff losses and impurity ratio, while it increased the air velocity at air outlet and cleaning efficiency. The grain losses not affected by varying of mesh holes diameter.
3- Increasing the thresher air velocity from 14.4 to 23.6 m/s increased air velocity at air outlet, air velocity at chaff outlet, chaff losses, grain losses and cleaning efficiency, while it decreased the impurity ratio.
4- The optimum conditions for using the developed device are 120 cm of air outlet diameter, 10 mm of mesh holes diameter and 17.9 m/s of thresher air velocity. Where, the air velocity at air outlet was 3.3 m/s, air velocity at chaff outlet was 0.6 m/s, chaff losses was 0.82%, grain losses was 0.22%, impurity ratio was 0.41% and cleaning efficiency was 99.59%.
5- The total costs of the developed device were about 10 L.E/fed. compared with 200 L.E/fed. for the traditional method.

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تطوير وحدة لتعبئة التبن أثناء الدراس

وليد البنداري السعيد الفخراني ، سمير عبد الحميد شلبي ووائل محمد زكي البلكيمي
معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية.

الهدف من الدراسة هو تطوير جهاز لتعبئة التبن أثناء عملية الدراس، واختبار أداء جهاز تعبئة التبن المطور في تعبئة تبن القمح (جميزة ١٢) حيث اجريت التجارب بمحطة البحوث الزراعية بالجميزة فى يوليو ٢٠١٦. ويتكون الجهاز المطور من سيكلون مثبت على أربع قوائم سهلة الفك والتركيب، وتثبت القوائم الأربع على قاعدة الجهاز المربعة الشكل والمغطاه بالصاج المجلفن، وهي تستخدم لتثبيت الجهاز في التربة وحمل وحدة التعبئة وتسهيل فكها أثناء التشغيل. والسيكلون يتكون من جزء علوي برميلي الشكل بقطر ١,٥ م وإرتفاع ١ م ويحتوي هذ الجزء على فتحة الإتصال بآلة الدراس أثناء التشغيل وفتحة أخرى علوية لخروج الهواء المنفصل والتي تم دراسة مستويات مختلفة لطول قطرها وهي ٥٠، ٩٠ و١٢٠ سم ، وتم أيضاً غلقها بشبكة سلكية ذو فتحات معينة الشكل تم دراسة أطوال مختلفة لقطرها وهي ٣، ٦ و١٠مم والهدف من استخدام هذه الشبكة السلكية هو تقليل فاقد التبن مع الهواء. والسيكلون يتكون من جزء آخر سفلي مخروطي الشكل قطره العلوي هو قطر الجزء البرميلي وقطره السفلي ٧٥ سم وارتفاع المخروط ٥٠ سم والفتحة السفلية منه هي فتحة خروج التبن. وتم أيضاً دراسة تأثير مستويات مختلفة من سرعة الهواء المندفع من مروحة الشفط في آلة الدراس وهي ١٤,٤، ١٧,٩، ٢٠,١ و٢٣,٦ م/ث وذلك على كل من سرعة الهواء عند فتحة خروج الهواء وسرعة الهواء عند فتحة خروج التبن ونسبة الفاقد من التبن ونسبة الفاقد من الحبوب خلال المروحة ونسبة الشوائب وكفاءة التنظيف. وقد تبين من النتائج أن:-زيادة قطر فتحة خروج الهواء من ٥٠ إلى ١٢٠ سم أدى إلى تناقص كل من:- سرعة الهواء عند فتحة خروج التبن ونسبة الفاقد من التبن وكذلك نسبة الشوائب مع الحبوب. بينما سرعة الهواء عند فتحة خروج الهواء إزدات بزيادة القطر من ٥٠ إلى ٩٠ سم ثم تناقصت بزيادته مره أخرى إلى ١٢٠ سم. أيضاً نسبة الفاقد من الحبوب من خلال مروحة الشفط لم تتأثر بزيادة قطر فتحة خروج الهواء.زيادة قطر فتحات الشبكة السلكية من ٣ إلى ١٠مم أدى إلى تناقص كل من:- سرعة الهواء عند فتحة خروج التبن ونسبة الفاقد من التبن وكذلك نسبة الشوائب، بينما إزدات سرعة الهواء عند فتحة خروج الهواء وكذلك كفاءة التنظيف. أيضاً نسبة الفاقد من الحبوب من خلال مروحة الشفط لم تتأثر بزيادة قطر فتحات الشبكة السلكية.زيادة سرعة الهواء المندفع من مروحة الشفط من١٤,٤إلى٢٣,٦م/ث أدى إلى زيادة كل من:- سرعة الهواء عند فتحة خروج الهواء،وسرعة الهواء عند فتحة خروج التبن، ونسبة الفاقد من التبن،ونسبة الفاقد من الحبوب، وكذلك وكفاءة التنظيف،بينما تناقصت نسبة الشوائب مع الحبوب. وبينت النتائج أن القطر المناسب لفتحة خروج الهواء هو ١٢٠ سم وقطر فتحات الشبكة السلكية هو ١٠ مم وأن سرعة الهواء المندفع من مروحة الشفط في آلة الدراس هو ١٧,٩ م/ث، حيث كانت سرعة الهواء عند فتحة خروج التبن هي ٠,٦ م/ث وسرعة الهواء عند فتحة خروج الهواء ٣,٣ م/ث ونسبة فواقد التبن ٠,٨٢% وفواقد الحبوب من خلال المروحة ٠,٢٢% ونسبة الشوائب ٠,٤١% وكفاءة التنظيف ٩٩,٥٩%.