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QUANTIFICATION OF MECHANICAL LOSSES ON OILSEED RAPE HARVESTING

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ABSTRACT

The objectives of the present study are to evaluate and to select the most proper header for harvesting rape-seed crop. Field experiments were conducted at Sakha Agricultural Res. Center, Kafr El-Sheikh Govermorate during the winter season of 2005 using rape-seed crop (Darakar). Experiments were carried out by using two different types of reel namely: (tine and bat reels) to determine the effect of reel speed index, seed moisture content and drum speed on combine performance (header, drum, shoe, rake losses & total losses, and total seed damage), field capacity, machine productivity, energy requirement, operating and criterion function costs were estimated.

The minimum values of energy requirements reached 325.17 and 343.27 MJ/fed at drum speed of 15.36 m/s, seed moisture content of 12.63% and reel speed index of 1.57 for tine and bat reels, respectively.

On the other hand, the criterion function cost showed that tine reel recorded the lowest values compared with bat reel under all conditions. The minimum values of criterion function cost was 573.20 L.E./ton which obtained at reel speed index of 1.57 and combine forward speed of 3.54 km/h.

The results showed that tine reel was strongly recommended for its good performance. However, it gives the lowest values of header loss, total losses, energy requirements and criterion function cost. The optimum operating conditions are at reel speed index of 1.57, drum speed of 19.20 m/s and seed moisture content of about 15.27%.

INTRODUCTION

Oil crops are considered one of the important sources of nutrition for millions of people all over the world. As raw material, it is used in the manufacturing of different products such as; artificial butter oil, soap-gelercine, sweets. In addition, the residues of oil crops are used in forage concentrates manufacturing which is considered an important sources for the development of poultry and animal industry.

In Egypt, 1,129, 000 ton of oil is consumed annually but till now production is only 153,000 ton. This means that production is only about 13.55% of all our needs and import about 86.45% (Oilseed situation and outlook 2002). Oilseed rape (Canola) area, yield and production in Egypt during season 2004 was 1627 fed, 0.752 ton/fed and 1224 ton, respectively (Agricultural ministry pamphlet, 2006). The great importance of this crop and the great loss and damage during harvesting makes it necessary to have a study on harvesting oilseed rape.

Hunt (1983) stated that, the time of harvesting with combines is a major decision for the machinery manager. The amount of losses reached to 13.5 kg/ha each day of delay in harvesting soybean. In the same manner, (Saad *et al* 1993) compared between two combine harvesters Deutz Fahr M/980 as a multi-purpose and Fortschritt E/512 as specialized. The timeliness coefficient for harvesting crop is 6 kg/fed/day at harvesting oilseed rape. The header losses reached to 50% from the total combine losses.

There are five losses relating to the combining of the grain: a) shatter loss: grain laying on the ground or out of reach of the cutter bar, b) cutter bar loss: grain lost due to rough handling by the cutter bar, c) threshing loss: grain lost out the rear of the combine in the from of unthreshed heads, d) separating loss: grain lost out the rear of the combine in the from of threshed grain and. e) cleaning loss: loss in value of the crop due to the presence of foreign matter in the grain tank (Hunt, 2001).

Lotfy *et al.* (2002) found that by using combine harvester (case-International 1620), increasing forward speed from 1.8 to 4.8 km/h increased header losses from 3.7 to 9.9, 4.10 to 10.2, 4.40 to 10.80 and 9.8 to 14.9% at seed moisture content of 22.6, 18.4, 15.3 and 11.2% respectively. By decreasing seed moisture content from 22.6 to 11.2% tends to increase header losses.

El-Shazly (1991) noticed that with increasing the drum speed from 700 to 900 rpm under fixed value of 3mm concave clearance and 15.5% grain moisture content, the unthreshed grain percentage was decreased from 2.5 to 0.8, respectively and the grain damage percentage was increased from 25 to 35%, respectively for rice crop. Also, (El-Behiry *et al.* 1997) found a positive effect on grain damage with increasing the drum speed from 500 to 900 rpm. On the other hand, the unthreshed grain losses increased linearly with increasing drum speed under different grain moisture content.

Threshing efficiency, seed damage percentage and threshing capacity decreased by increasing moisture content and the best of moisture content of 15% gave the lowest seed damage and seed losses (El-Beba 2001).

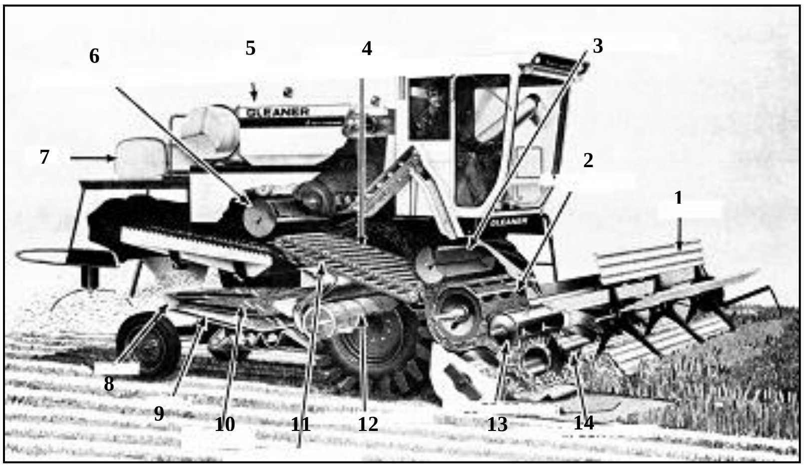
Szot *et al.* (1995) collected sample from harvested rapeseed from field crops by a standard combine harvester to determine the effect of the speed and settings of the mechanism on seed damage. Damage at a rotor speed of 600 rpm was around 4%, increasing to around 14% at 1000 rpm. This confirms that if higher rotor speeds are needed to achieve threshing, seed damage is likely to result.

Mohamed and Mohamed (2004) Showed that, the terminal velocity of oilseed rape was 7.23 m/s. The productivity of the designed machine increased by increasing of cylindrical sieve slope angle of 7 degrees and increasing of flat sieve speed up to 0.88 m/s. Also, the maximum value of cleaning efficiency of 99.85% at cylindrical sieve slop angle of 7 degrees and flat sieve speed of 0.88 m/s.

Morad and Arnaout (1994) found that, the fuel consumption (l/fed) decreased by decreasing combine power and increasing unit area. The small-combine (23.5 kW) consumed minimum amount of fuel about 6.41 l/fed. The objectives of the present study are to evaluate and to select the most proper combine header for harvesting oilseed rape crop.

MATERIALS AND METHODS

The present study was carried out during agricultural season of 2005 at the experimental farm of Sakha Agric. Res. Station in an area of about two feddans. Two different types of combine reel were used namely: Metal reel bats and reel tines. Both two reels are used in Allis-Chalmers Gleaner F2 combine harvester. The two proposed reels were used for harvesting oilseed-rape. Technical data and specifications are indicated in Table 1 and Figure 1.



1. Reel	2. Cylinder	3. Thresher wing beater
4. Raddle	5. Bin	6. Separator beater
7. Tank	8. Shoe	9. Sieve
10. Chaffer	11. False bottom	12. Transverse fan
13. Feeder beater	14. Header conveyor	

Fig. 1 : Combine harvester (Gleaner F2 Allis-Chalmers).

Tests were carried out at four different ratios of reel peripheral speed to forward speed (reel speed index) of about 1.13, 1.35, 1.57 and 1.86 (corresponding to 0.43, 1.00, 1.54 and 2.03 m/s reel peripheral speed and 1.38, 2.65, 3.54 and 4.37 km/h combine forward speed) and three drum speeds of 600 (15.36), 750 (19.20) and 900 rpm (23.04 m/s) at three different levels of seed and (straw) moisture contents of 12.63 (16.21), 15.27 (20.04) and 19.15 (24.32%). Some physical properties of oilseed-rape are shown in Table 2.

1- Miscellaneous equipment: a) Measuring tape, b) Electric oven, c) Square frame, d) Long sheet of canvas, e) Balance and f) Photo-Sensing tachometer to measure the rotating speed for both threshing drum and reel.

2- Combine losses: The total losses of the combine were those occurred in the field during harvesting operation such as header loss and losses from the rear of the combine harvester (drum loss, shoe loss and rake loss).

a) Header losses:

The header losses were determined by inserting three V-shaped collecting trays with dimension of 100 cm length × 50 cm width × 10 cm height between plant rows. When the combine header (cutter-bar and reel) passed over the trays, the combine harvester will be stopped and packed. The materials shattered by the header were collected from the trays and then weighed. The percentage of header loss were estimated by using the following equation (Hassan *et al.* 1994).

Table 1: Combine specifications:

Model, Name, Made: Gleaner F2, Allis-Chalmers, U.S.A.		
Dimensions:		
	Length, mm	7196
	Width, mm	2842
	Height, mm	3312
	Weight, kg	5235
Engine:		
	Power, hp (kW	95 (70.9)
	Fuel tank capacity, lit	265
Header sizes:		
	Length, m	6.1
	Height	Hydraulic
	Sickle stroke, mm	83
	Reel type	Metal 5 bats and reel tines
Cylinder:		
	Type	Rasp bar
	Diameter, mm	489
	Width, mm	952
Thresher housing:		
	Concave	Closed bottom with 5 steel channel bars
	Concave door	Spring loaded latch
	Concave bottom	Swing down
	Concave area, cm^2	3394
	Transition area, cm^2	4639
Separator:		
	Straw walker type	Closed bottom- Extendable
	Number	4
	Width, mm	254
	Length, mm	2286
	Area, cm^2	26030
Chaffer sieve:		
	Type	Adjustable
	Width, mm	1034
	Area, cm^2	11260
Shoe sieve:		
	Type	Transverse- dual outlet;
	Width, mm	991
	Diameter, mm	279
	Speed, rpm	1000
Grain tank:		
	Capacity, m^3	2.82

Table 2: Some physical properties of oilseed rape variety Darakar

No. of sample	Plant height, cm	No. of branches/plant	Pod dimension, mm			Seed dimension, mm		Seed index (g/1000 seed)	Seed yield, kg/fed.	Straw yield, kg/fed.	Grain straw ratio
			Length	Width	Thickness	Length	Diameter				
1	161	8	63.4	4.56	2.85	2.40	2.03	4.17	1386	2919	1:2.11
2	170	9	56.4	4.92	2.96	2.33	1.98	3.91	1297	2826	1:2.18
3	165	7	72.3	4.13	2.69	2.57	2.07	4.20	1436	3078	1:2.14
4	157	8	81.6	3.19	2.61	2.65	2.11	4.12	1376	2791	1:2.03
5	173	9	75.0	3.85	2.67	2.61	2.09	3.85	1429	2953	1:2.07
Mean	165.2	8.2	69.76	4.13	2.76	2.51	2.06	4.05	1384.8	2913.4	1:2.11

$$\text{Total header loss},(H_L) = \frac{\text{Total header loss, kg/fed}}{\text{Total yield, kg/fed}} \times 100 \quad \text{------------------ (1)}$$

b) Rear losses (drum loss, shoe loss and rake loss):

-Threshing loss was determined by dragging two canvas sheets (10.0 m/length) at the rear of the combine one above the other. The upper sheed collected unthreshed seeds (drum loss) straw and threshed seeds. The unthreshed seeds were threshed, cleaned and then weighed. The percentage of drum loss was calculated by using the following equation:

$$\text{Drum loss},(D_L) = \frac{\text{Drum loss, kg/fed}}{\text{Total yield, kg/fed}} \times 100 \quad \text{------------------ (2)}$$

- The free seed collected from the upper canvas represent the shoe loss. The percentage of shoe loss was calculated according the following equation:

$$\text{Shoe loss},(S_L) = \frac{\text{Shoe loss, kg/fed}}{\text{Total yield, kg/fed}} \times 100 \quad \text{------------------ (3)}$$

- At the same time the material collected from the lower canvas include the free seed discharged from the sieves (rake loss). The percentage of rake loss was calculated by using the following equation:

$$\text{Rake loss}(R_L) = \frac{\text{Rake loss, kg/fed}}{\text{Total yield, kg/fed}} \times 100 \quad \text{------------------ (4)}$$

-Total losses: was calculated by using the following equation:

$$\text{Total losses, \%} = \frac{H_L + D_L + S_L + R_L}{H_L + D_L + S_L + R_L + T_Y} \times 100 \quad \text{------------------ (5)}$$

Where:

H_L = Total header loss, kg/fed.,
D_L = Drum loss, kg/fed.,
S_L = Shoe loss, kg/fed.,
R_L = Rake loss, kg/fed.,
T_Y = Total grain yield, kg/fed.

3- Total seed damage (visible and invisible):

a) Visible seed damage: It was determined by separating the damage seed by hand from a mass of 100 grams the samples were taken randomly from the threshed seed. The percentage of seed damage was calculated as follows:

$$\text{Seed damage},(\%) = \frac{\text{Mass of damaged seed}}{\text{Mass of sample}} \times 100 \quad \text{------------------ (6)}$$

b) Invisible seed damage: A germination test was carried out using Petri dishes. The samples of these tests were taken randomly after separating the damage seed (visible damage). One hundred seeds were put in Petri dish on a filter paper, covered with water and incubated at 25º C for 24h. the germinated seeds were collected from each dish and expressed as a percentage of the original number of seed.

Total seed damage, % = (Visible seed damage, % + Invisible seed damage, %) ----(7)

4- Power requirement:

The following formula was used to estimate the power requirements according to (Barger, *et al.*, 1979)

$$P = FC\left(\frac{1}{3600}\right) \times \rho_f \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36},\ kW \quad (8)$$

Where:

P = Power requirements, kW;
FC = Fuel consumption rate, l/h;
ρ_f = The density of the fuel, 0.85 kg/l;
L.C.V = Lower calorific value of fuel 10000 kcal/kg;
427 = Thermo-mechanical equivalent, kg.m/kcal;
η_{th} = Thermal efficiency of engine, 35% for diesel engine, and
η_m = Mechanical efficiency of engine, 80% for diesel engine.

5- Specific energy:

Specific energy was calculated by using the following equation:

$$\text{Specific energy} = \frac{\text{Power requirement, kW}}{\text{Machine productivity ton/h}},\ \text{kW.h/ton} \quad (9)$$

6- Operation costs:

The cost of machine work was calculated by using the following formula (Awady, 1978):

C = P/h (1/a +i/2 + t + r) + (1.2 W.S.F) + m/144 ------------------------------------ (10)

Where:

C = Hourly cost, L.E/h;
P = Price of machine, L.E;
h = Yearly working hours, h;
a = Life expecting of the machine, year;
i = Interest rate /year ratio;
t = Taxes, overheads ratio;
r = Repairs and maintenance ratio,
W = Power, hp;
S = Specific fuel consumption (l/hp.h);
F = Fuel price, L.E;
m = Operator monthly salary L.E./h;
1.2 = A factor to take lubrication and greasing into account, and
144 = The monthly average working hours.

7- Cost analysis:

The total harvesting cost was calculated as the sum of fixed and operating costs for each type of header. The criterion function (C_f) was calculated as the sum of unit (U_c) plus the losses cost (L_c) using the following equation (Helmy, 1988).

$C_f = U_c + L_c$, (L.E./ton) -- (11)

Where:

L_c = 10^{-2} C_{pr} (T_L + 0.50 T_D), (L.E./ton).
C_{Pr} = Current price of one ton of oilseed rape in 2005 (1300 L.E./ton).
T_L = Total grain losses, percent.
T_D = Total grain damage, percent.

RESULTS AND DISCUSSION

1. Header loss:

Figure 2 shows the effect of reel peripheral speed to forward speed (reel speed index), reel type (tines and bats reel) and seed moisture content on header loss. It can be mentioned that, increasing the reel speed index from 1.12 to 1.68 tends to increase the header loss from 8.29 to 11.42, 6.41 to 9.43 and 4.34 to 7.50% for tine reel at seed moisture content of 12.63, 15.27 and 19.15%, respectively. Meanwhile, it was increased from 10.34 to 13.25, 8.45 to 11.50 and 6.41 to 9.95% for bats reel at the same above mentioned seed moisture contents. These may be attributed to higher shattering occurred with higher reel speed index and high impacts of cutter-bar and reel. In general bats reel gave the highest values of header loss among the two reels where higher impacts of bats reel was observed.

On the other hand, decreasing the seed and straw moisture content from 19.15 (24.32) to 12.63% (16.21%) tends to increase the header loss from 7.5 to 11.42 and 9.95 to 13.25% for tine and bat reels, respectively. These may be due to over maturity of seed which other wise increases seed shattering.

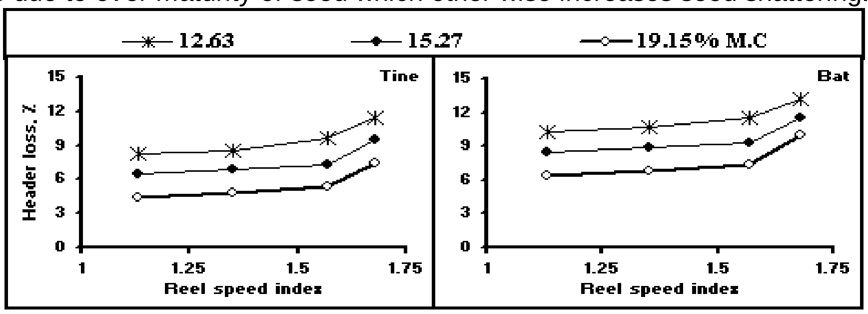


Fig. 2: Effect of reel speed index, seed moisture content and reel types on header loss.

2. Drum loss:

Figure 3 illustrates the effect of drum speed, reel speed index and seed moisture content on drum loss. It can be stated that, increasing drum speed from 15.36 to 23.04 m/s tends to decrease drum loss from 3.10 to 2.36, 4.19 to 3.25 and 4.58 to 3.93% at reel speed index of about 1.68 and seed moisture content of 12.63, 15.27 and 19.15%, respectively. These may be due to repeated impacts by cylinder bars at higher drum speeds.

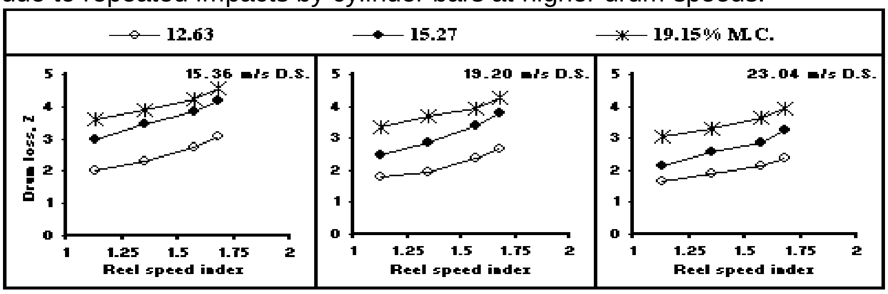


Fig. 3: Effect of reel speed index, drum speed and seed moisture content on drum loss.

Also, increasing the reel speed index from 1.13 to 1.68 tends to increase drum losses at all experimental parameters where, it increase from 2.03 to 3.10, 2.96 to 4.19 and 3.61 to 4.58% for seed moisture content of about 12.63, 15.27 and 19.15%, respectively. This observations may be due to more dense of rape crop at higher reel speed index.

In the same manner increasing the seed moisture contents tends to increase drum loss at all drum speeds and reel speed index. The highest values were noticeable at seed moisture content of about 19.15% and they reached 3.07, 3.31, 3.64 and 3.93% at reel speed index of 1.13, 1.35, 1.57 and 1.68, respectively. These results may be due to the difficulty of detach the pods from rape crop.

3.Shoe loss:

The obtained results showed in Fig. 4 indicated the relation between shoe loss, reel speed index, drum speed and seed moisture content. It can be stated that, increasing the reel index from 1.13 to 1.68 tends to increase shoe loss from 1.72 to 2.16, 1.80 to 2.27 and 1.85 to 2.35 at seed moisture content of about 12.63% and drum speeds of 15.36, 19.20 and 23.04 m/s, respectively.

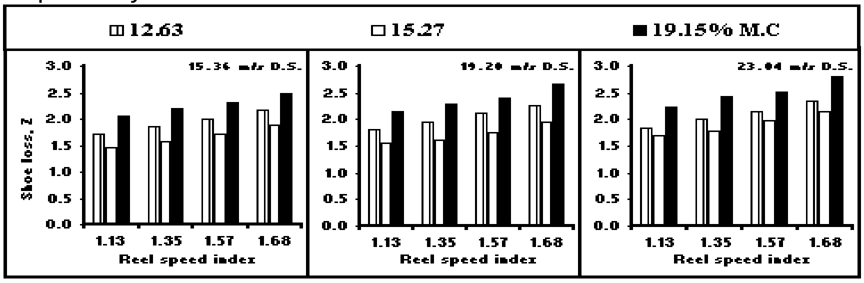


Fig. 4: Effect of reel speed index, drum speed and seed moisture content on shoe loss.

This increase may be due the increase in feed rates whereas the air flow is insufficient to break up conglomerates grain and chaff.

In the same manner, increasing drum speed from 15.36 to 23.04 m/s slight increase in shoe loss was occurred. The reason for that, increasing the drum speed tends to increase the broken straw and chaff on the sieve, which other wise increase the shoe loss. Similar results reported by Kepner *et al.,* (1982).

Results indicated in the above mentioned Figure gave the following values of shoe loss: 2.16, 1.90 and 2.50% were obtained with seed moisture contents of about 12.63, 15.27 and 19.15%, respectively at reel speed ratio of 1.68 and drum speed of 15.36 m/s. The other drum speeds and reel speed gave the above mentioned trend.

4. Rake loss:

Fig. 5 demonstrates the effect of drum speed, reel index and seed moisture content on rake loss. It can be mentioned that reel speed indexes of about 1.13, 1.35, 1.57 and 1.68 gave the following values of rake loss: 0.71, 0.82, 1.05 and 1.17%, respectively at drum speed of 15.36 m/s and seed moisture content of 12.63%. The other drum speeds and seed moisture contents had the same above mentioned trend. It is evident that for all drum speeds and seed moisture contents, the rake loss increased by increasing reel speed index. The reason is due to the exponential decrease of concave rake efficiency with increasing the feed rate, that tends to increase rake loss. Similar results have been obtained by Wang *et al.,* 1988.

The obtained values of rake loss were found to be 0.71, 0.68 and 0.55% with drum speeds of about 15.36, 19.20 and 23.04 m/s, respectively and seed moisture content of about 12.63%. However, for all forward speeds and seed moisture content increasing the drum speed tends to decrease the rake loss. This attributed to increasing the centrifugal force by increasing drum speed, that tends to decrease rake loss.

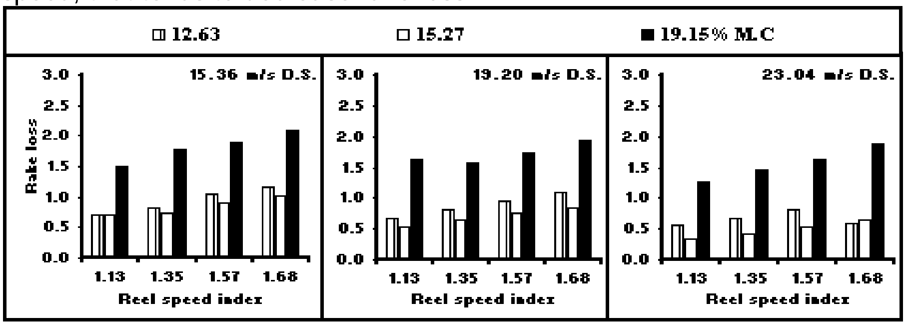


Fig. 5: Effect of reel speed index, drum speed and seed moisture content on rake loss.

It is clear that the seed moisture contents of about 12.63, 15.27 and 19.15% gave the following values of rake loss: 0.71, 0.70 and 1.50%, respectively at reel speed index of 1.13 and drum speed of 15.36 m/s. the other drum speeds and reel speed indexes had the same above mentioned trend.

5. Total losses:

Dealing with the effect of reel speed index, drum speed and seed moisture content on total losses Fig. 6. It was found that, increasing the reel speed index from 1.13 to 1.68 tends to increase the total losses from 12.34 to 17.08, 10.58 to 15.47 and 10.92 to 16.10 at drum speed of 23.04 m/s and seed moisture contents of about 12.63, 15.27 and 19.15%, respectively for tine reel. However the values of total losses increases from 15.23 to 17.88, 12.46 to 15.04 and 14.14 to 16.75% at the same above mentioned drum speeds and seed moisture contents for bats reel.

At the same time, increasing drum speed decreases the total losses and this may be due to the decrease of unthreshed pods (drum loss) at all conditions. However, decreasing the grain moisture content from 19.15 to 12.63% increases the total seed losses from 16.02 to 17.63 and 11.52 to 12.75% at drum speed of 15.36 m/s and reel speed index of 1.13 for bat and tine reels, respectively. It can be mentioned that, bat reel gave the highest values of total seed losses compared with tine reel under all tested conditions.

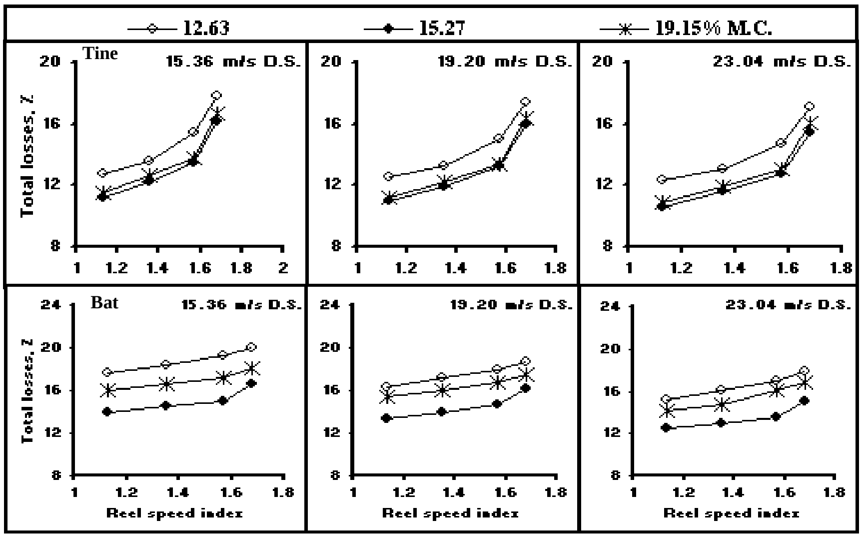


Fig. 6 : Effect of reel speed index, drum speed and seed moisture content on total losses for tine and bat reels.

6. Total seed damage (visible and invisible):

Figure 7 shows the effect of drum speed, reel speed index and seed moisture content on total seed damage. It is obvious that, increasing the drum speed from 15.36 to 23.04 m/s leads to increase total seed damage from 4.55 to 6.25, 2.65 to 3.70 and 3.81 to 4.78% at reel speed index of about 1.13 and seed moisture contents of 12.63, 15.27 and 19.15%, respectively.

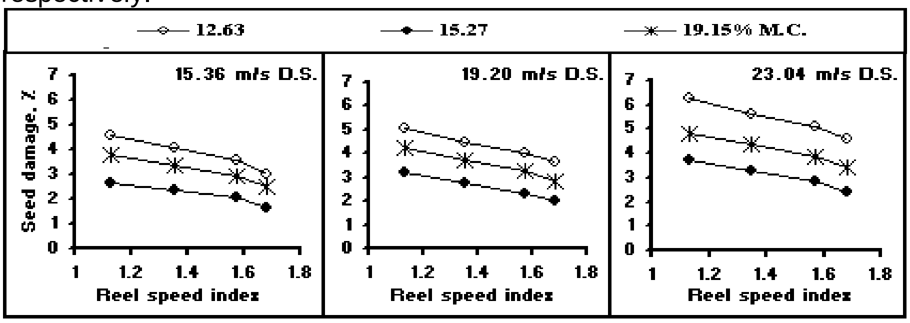


Fig. 7: Effect of reel speed index, drum speed and seed moisture content on seed damage.

Hence, the increase in reel speed index from 1.13 to 1.68 tends to decrease the total seed damage from 4.55 to 3.02% at drum speed of 15.36 m/s and seed moisture content of 12.63%. These attributed to the greater density of the layer of material passing between the cylinder and the concave bars at high feed rate in terms of higher reel speed index apparently provides more of protection for the seeds, thereby reducing the probability of repeated impacts by cylinder bars (Kepner *et al.*, 1982).

In the same manner, results also showed that seed moisture content above or below 15.27% increases the total seed damage. The highest value of total seed damage was 6.25% which obtained from seed moisture content of 12.63, drum speed of 23.04 m/s and reel speed index of 1.13.

7. Energy requirements:

Table 3 indicates the effect of drum speed, reel types and seed moisture content on the energy requirements. It is clear that, the increase of drum speed from 15.36 to 23.04 m/s leads to increase the energy requirements from 325.17 to 373.58, 377.51 to 439.85 and 427.67 to 479.75 MJ/fed at seed moisture contents of about 12.63, 15.27 and 19.15%, respectively, for tine reel. However, they were increased from 343.27 to 396.45, 395.36 to 462.73 and 445.05 to 502.36 MJ/fed at the same mentioned above seed moisture content and bat reel.

The obtained values of energy requirements showed that, the highest values were obtained by using bats reel under all conditions. The highest mean value reached 502.36 MJ/fed was obtained by using drum speed of 23.04 m/s and seed moisture content of 19.15%.

Table 3: Effect of drum speed and seed moisture content for two different types of header

Drum speed, m/s	Energy requirements, MJ/fed.					
	Tines reel			Bats reel		
	Seed moisture content, %			Seed moisture content, %		
	12.63	15.27	19.15	12.63	15.27	19.15
15.36	325.17*	377.51	427.67	343.27	395.36	445.05
19.20	347.45	398.32	448.34	365.74	419.51	470.28
23.04	373.58	439.85	479.75	396.45	462.73	502.36

*** Each value represents the average of the values obtained at for reel speed indexes.**

8. Harvesting costs:

Results listed in Table 4 showed that, increasing the forward speed from 1.38 to 4.37 km/h tends to increase both the effective filed capacity from 1.537 to 2.809 fed/h and the machine productivity from 2.06 to 3.615 ton/h, respectively. Moreover, the same increase in forward speed reduces the total operating cost by 43.02%. Results in the same Table indicated that, the lowest criterion function cost were 373.20 and 390.75 L.E./ton obtained was reel speed index of 1.57 and forward speed of 3.54 km/h for tine and bat reels, respectively.

Table 4: Effect of reel speed index on performance efficiency operating cost and criterion function cost for tine and bat reels

Reel speed index	Forward speed, km/h	Mean values of mach. prod., ton/h	Mean values of operating cost, L.E./ton	Mean values of Eff. field capacity, fed/h	Criterion cost, (L.E./ton)	
					Tine reel	Bat reel
1.13	1.38	2.060	345.15	1.537	508.95	539.37
1.35	2.65	3.249	218.84	2.461	391.94	418.20
1.57	3.54	3.828	185.74	2.933	373.20	390.75
1.68	4.37	3.615	196.68	2.809	394.01	407.74

*** Each value represents the mean of the values obtained at reel speed index of 1.35.**

Conclusion

From the above results, it can be concluded that:

1. Bat reel gave the highest values of energy requirement where it reached 502.36 MJ/fed at drum speed of 23.04 m/s and seed moisture content of

19.15%. However the lowest value reached 325.17 MJ/fed with drum speed of 15.36 m/s and seed moisture content of 12.63% with tine reel.

2. The lowest values of energy requirements reached 325.17 and 343.27 MJ/fed at drum speed of 15.36 m/s, seed moisture content of 12.63% and reel speed index of 1.57 for tine and bat reels, respectively.
3. The minimum criterion function costs were 373.20 and 390.75 L.E./ton obtained at reel speed index of 1.57 and combine forward speed of 3.54 km/h for tine and bat reels, respectively.
4. Tine reel is strongly recommended since it gives lower header loss and total losses.
5. The optimum operating conditions are at reel speed index 1.57, drum speed 19.20 m/s and seed moisture content of about 15.27%.

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التقدير الكمى للفواقد الميكانيكية فى حصاد محصول الريب

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يعتبر محصول الريب (الكانولا) من أهم المحاصيل الزيتية على مستوى العالم حيث يحتل المركز الثانى بعد فول الصويا بنسبة ١٣٪ من إنتاج الزيت، فى مصر نستهلك ١,١٢٩٠٠٠ طن سنوياً من الزيوت وننتج ١٥٣٠٠٠ طن فقط بما يعادل ١٣,٥٥٪ فقط من الاستهلاك ويتم استيراد ٨٦,٤٥٪ (وزارة الزراعة ٢٠٠٢).

ولكى يتم تغطية هذا العجز لابد من زيادة المساحة المنزرعة من الريب وخاصة فى الأراضي الجديدة بالإضافة إلى زراعته أكثر من مرة على مدار السنة وإيجاد حلول فعالة من خلال استخدام ميكنة حصاد محصول الريب والتى تعمل على زيادة الإنتاج وتقليل الفجوة الناشئة من زيادة الاستهلاك وقلة الإنتاج. ولتحقيق هذا الهدف فقد تم دراسة وتقييم معدل الأداء لآلة الحصاد الجامعة (Allis-Chalmers-Gleaner F2) من خلال المعاملات التالية:

أ- نوع المضرب (بكرة تمايل المحصول ذو الأشواك والعوارض).

ب- نسبة سرعة المضرب إلى السرعة الأمامية (١,١٣ ، ١,٣٥ ، ١,٥٧ ، ١,٦٨).

ج- سرعة درفيل الدراس (١٥,٣٦ ، ١٩,٢٠ ، ٢٣,٠٤ م/ث).

د- المحتوى الرطوبى لكل من الحبوب والقش (١٢,٦٣ ، ١٥,٢٧ ، ١٩,١٥%) و (١٦,٢١ ، ٢٠,٠٤ ، ٢٤,٣٢٪) على الترتيب.

ويمكن تلخيص النتائج كما يلى:-

١- أعلى نسبة فاقد ١٣,٢٥٪ للمضرب ذو العوارض عند نسبة سرعة المضرب إلى السرعة الأمامية ١,٦٨ وسرعة درفيل الدراس ١٩,٢٠ م/ث ومحتوى رطوبى للحبوب ١٢,٦٣٪.

٢- انخفضت الفواقد الكلية لكومباين الحصاد إلى ١٠,٥٨٪ عند استخدام المضرب ذو الأشواك لأقل نسبة سرعة المضرب إلى السرعة الأمامية ١,١٣ وسرعة درفيل الدراس ٢٣,٠٤ م/ث ومحتوى رطوبى للحبوب ١٥,٢٧٪

٣- أقل قيمة للطاقة المستهلكة كانت ٣٢٥,١٧ ، ٣٤٣,٢٧ ميجا جول/فدان عند سرعة درفيل ١٥,٣٦ م/ث ومحتوى رطوبى للحبوب ١٢,٦٣٪ ونسبة سرعة المضرب إلى السرعة أمامية ١,٥٧ عند استخدام المضرب ذو الأشواك والعوارض على الترتيب.

٤- انخفضت تكاليف التشغيل إلى ٣٧٣,٢٠ ، ٣٩٠,٧٥ جنية/طن عند نسبة سرعة المضرب إلى السرعة الأمامية ١,٥٧ وسرعة تقدم ٣,٥٤ كم/ساعة لكل من نوعى المضرب ذو الأشواك والعوارض على الترتيب.

٥- توصى الدراسة باستخدام المضرب ذو الأشواك عند نسبة سرعة المضرب إلى السرعة الأمامية ١,٥٧ وسرعة درفيل ١٩,٢٠م/ث ومحتوى رطوبى للحبوب ١٥,٢٧٪ حيث كانت أقل نسبة فاقد وتكاليف وأعلى إنتاجية.