COMPARISION BETWEEN THE MOST COMMON MECHANICAL METHODS AND RICE COMBEIN MODIFIED FOR HARVESTING WHEAT CROP IN THE EGYPTAIN FIELDS

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Abstract

Used modified rice combine for cutting wheat crops to maximize utilization of it. Five wheat harvesting systems were evaluated at three average grain moisture contents of (MC_1 =20.80, MC_2 =18.50 and MC_3 =16.65 %) namely: traditional harvesting (Hand cutting), partial mechanization (modified combine harvester, self-propelled reaper binder, self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower).

The experiments were carried out in wheat fields to determine total grain losses, energy consumed and cost requirements for harvesting wheat crop. The results indicated that, traditional harvesting system gave the lowest values of grain loss by average 2.00, 2.92 and 2.34 % under moisture contents of 20.80, 18.50 and16.65%, respectively. The highest value of cutting efficiency 97.2% was notice under used combine machine with forward speed of 1.5 km/h and moisture content of 16.65 %. The minimum cost requirements values were obtained by using self-propelled reaper binder of 17.17, 15.20 14.00, L.E/fed at the higher forward speed of 3.3 km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively. While the maximum cost requirements was obtained by using modified combine of 73.96, 72.8 and 70.71 L.E/fed at the lower forward speed of 1.5km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively.

INTRODUCTION

Wheat crop is considered one of the most strategic important foods and economical crops in Egypt. Whereas, wheat crop harvesting machines have a great effect on the crop losses in field. Fouad *et al.* (1990) compared the performance of two types of combines in harvesting rice crop in Egypt. The combines were operated at three forward speeds of 0.9, 2.3 and 2.8 km/h for rice combine, and 0.8, 2.1 and 2.9 km/h for the conventional combine. There was a highly significant decrease in total harvesting costs with an increase in operation speed from 0.9 and 0.8 km/h to 2.3 and 2.2 km/h for the rice and conventional combines, respectively. Hassan *et al.* (1994) experimentally investigated the performance of combine device during harvesting operation of both wheat and rice crops. The experimental results revealed that the total grain losses and criterion cost were minimum value, while the performance efficiency was maximizing under following conditions:

- Forward speed of 2.1 km/h for rice and 2.8 km/h for wheat.
- Cutter bar speed of 1.2 m/s for both rice and wheat crops.
- Cylinder speed of 25 m/s for rice crop and 30 m/s for wheat crop.
- Concave clearance of 9.0 mm for rice crop and 12.0 mm for wheat crop.
- Grain moisture content of 22.30 % and 19.20 % for rice and wheat crops.

El-Haddad et al. (1995) reported that combine harvester gave the lowest cost of about 229.0 L.E/fed in comparison with 283.4 L.E/fed for mounted mower and 300.0 L.E/fed for manual sickle system. EL-Sayed et al. (2002) found that increasing forward speed from 1.7 to 2.7 km/h the harvesting unthreshed losses total losses and field capacity increased from 1.3, 1.1, 5.5 %, 1.1 fed,/h to 1.0, 2.4, 5.4 %, 1.4 fed, /h, respectively and the damaged losses, performance efficiency decreased from 1.2, and 94.5 % to 0.86 and 94.0 %, respectively. Too, at using wheat header in harvesting decreased total losses and criterion cost from 27, 15 % and 824 L.E / ton to 8.75 % and 344 L.E/ton respectively. Also, the performance efficiency from 77.72 % to 92.82 % than using the corn header combines. Imara et al. (2003) found that the total grain wheat losses increased by increasing the combine forward speed. The total grain losses of indirect harvesting method (using mower and threshing machine) increased about 2.5 times of that of total grain losses of direct harvesting (using combine). Abo EL- Naga et al. (2010) evaluated the performance of locally combine for harvesting wheat crops. they found that the highest cutting efficiency of 94.81 % was obtained at forward speed of 0.53 km/h and grain moisture content of 12.13 %.The highest effective field capacity and efficiency (0.48 fed,/h and 78.38%) were obtained at forward speed of (1.15 and 0.53 km/h) and grain moisture content of 12.13 %, respectively. Whereas the lowest value of energy requirements of 311.01 kW.h/fed was at forward speed of 1.15 km/h and grain moisture content of 12.13%, respectively. The lowest value of criterion cost of 312.10 L.E / fed was obtained at forward speed of 1.15 km/h and grain moisture content of 12.13%. El-Yamani(2013) used a developed combine harvester type of crop tiger (after modification) to study the effect of forward speed of 1.67, 1.92, 2.33 and 2.64 km/h, drum speed of 18.85, 22.94 and 27.13 and 32.27m/s, concave clearance of 9.5/4.5, 11.5/5.5, 13/6 and 18/8 mm and seeds moisture content of 10.3, 7.9 and 5.4 % for seeds (17.8, 13.2 and 10.6% for straw) at harvesting Egyptian clover seeds on effective field capacity and field efficiency, combine productivity, header losses, total grain losses contain (unthreshed seed losses, threshed seed losses and cleaning losses), total seed damage contain (visible and invisible). Also, determination of specific fuel consumption, operating cost and criterion function cost of Egyptian clover harvesting were done. Results indicated that, the maximum of 1.15 fed/h field capacity and

83.1% field efficiency were recorded. Also, the maximum field productivity was 0.805 ton/fed and a minimum of header losses was o.83%. On the other hand, a minimum of visible damage, invisible damage, total damage and total losses were 0.48, 1.61, 1.09 and 2.44% also minimum specific fuel consumption and cost harvest were o.276 l/kW.h and 83.4 L.E/fed respectively. Finally, the performance characteristics of machine were influenced by the investigated variables.

The aim of the present study is to compare between the more common harvesting machines in Egyptian field wheat to harvest crop and determine the strength and weak points by using different machines.

MATERIALS AND METHODS

Field experiments were carried out on wheat crop at a private farm in Elsharkia governorate during the agricultural summer season 2013. The total experimental area was about 5.5 feddans planted with wheat (Maser-1) crop. This study carried out to determine total grain losses, energy consumed and total cost required by using four different mechanical systems and traditional method for harvest wheat crop, to stand up the optimum method which suitable for harvesting wheat under Egyptian conditions.

Materials:

Table.1 indicated the technical specifications of machines which used in this study.

Table 1. Technical specifications of the used machines

Specification of machines	Modified combine for harvesting (Kubota)	Self-propelled reaper binder	Self- propelled vertical conveyor reaper	Tractor mounted vertical conveyor reaper windrower
Type	CA-385 EG Japan	AR 120	Local	Local
Model	Turbo diesel, 4 stroke, water cooled, 3 cylinder	GS 130 – 2CN Air-cooled, Diesel engine	Local factor Air-cooled, Diesel engine	Tractor, Romania. Engine type Four stroke diesel
Dimensions, mm (LxWxH)	4065 ×1905× 2000	2300 x 1450 x 1000	: 2450 x 1200 x 1000	1800 x 90 x 60
Mass , kg	1980	110	145	165
Working width, mm	1600	1200	1000	1600
Engine power, hp	90	10.5	3	35
Revolution speed, rpm	2700	1800	1200	1440

Modified combine harvester:

To maximize utilization of rice combine by modifying the machine for cutting only. The combine harvest machine was modified to cut crop only instead of combination

processes. The motion was transmitted from power source to cutter bar and separated it about the parts residual. A plate was put in the end of cutter bar to throw the crop beside the machine, it was shown in Fig. (1).

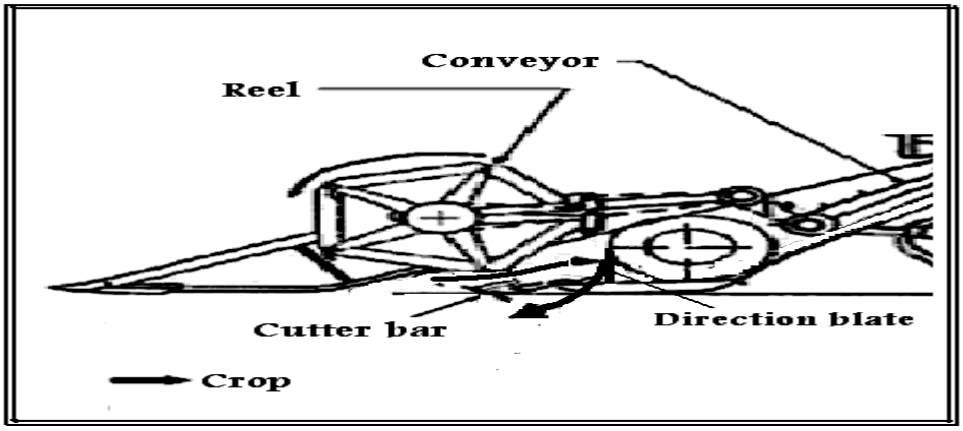

Fig. 1: The layout of modify part of combine machine.

Some wheat crop characteristics:

Some wheat crop characteristics are included in Table 2.

Table 2. Mean values of some characteristics of wheat crop variety (Maser-1).

Characteristics	Mean values
Mean plant height (cm)	99.64
Mean thousand grain mass (g)	43.86
Spike grain mass (g)	2.17
No of grain /spike	53.42
No of spikes / m^2	395.35

Treatments and experimental design:

The plot design pertinently was used moisture content the main factor and forward speed the secondary factor, it was shown in Table 3.

Table 3. The distribution of treatments in field.

	Modified combine harvester			Self-propelled reaper binder			Self- propelled vertical conveyor reaper			Tractor mounted vertical conveyor reaper windrower		
t.	MC_1	MC_2	MC_3	MC_1	MC_2	MC_3	MC_1	MC_2	MC_3	MC_1	MC_2	MC_3
S_1												
S_2												
S_3												

S = forward speed, MC= moisture content (MC_1 =20.80, MC_2=18.50 and MC_3 =16.65 %). The number of plots was three for hand cutting and 36 plots for mechanical harvesting, the plot dimension was 12×49 m.

Methods:

In this study, five harvesting systems were evaluated in wheat fields at three average grain moisture contents of (MC_1 =20.80, MC_2 =18.50 and MC_3 =16.65 %) namely:

1- Traditional harvesting (Hand cutting).

2- Mechanical harvesting machines (Modified combine harvester, Self-propelled reaper binder, Self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower).

In traditional harvesting, 10 workers harvested the experimental (5 fed) area using manual sickles. The forward speed were (2.0, 2.8 and 3.3 km/h) for self-propelled reaper binder and tractor mounted vertical conveyor reaper windrower and for self-propelled vertical conveyor reaper and combine were (0.1, 1.3and 1.5 km/h) and (1.5, 2.1 and 2.7km/h) respectively.

Grain moisture content:

For each treatment, a random grains sample was taken, to determine the moisture content by using apparatus electronic moisture meter(GANN Hydromelle G 86), Made in Western Germany with accurate 0.05.

Total grain losses:

Pre-harvest losses.

Pre-harvesting losses were determined by using a wooden frame at dimension of 1×1 m, it was put randomized through stand crop before harvesting to collect and weight of the grains from the inside it, this case replicated ten times and the percentage of pre-harvest losses was calculated by using the following equation,

$$\text{Pre-harvest losses},\% = \frac{\text{Mass of collected grains, kg}}{\text{Total mass of grains, kg}} \times 100 \quad \text{.....1}$$

Cutting losses:

After harvesting process, the wooden frame was put on the surface land in the harvested area, and collected (seeds, uncut and kernel seeds). The percentage of total grain losses were calculated by using the following equation**:**

$$\textit{Cutting losses},\% = \frac{\left[(seeds + un - cut + \text{kernelseeds})losses - preharvestlosses\right]/\ fed}{totalyield\ /\ fed} \times 100 \quad \text{.....2}$$

Cutting efficiency:

The cutting efficiency (E_c%) was calculated by using the following equation,

$$E_C = \frac{H_a - H_b}{H_a} \times 100 \text{ , \%} \quad \text{..... 3}$$

Where,

H_a = height of stand plant above the soil surface before cutting, cm. and

H_b = height of the stubble after cutting, cm.

The field capacity and field efficiency:

Theoretical field capacity

The theoretical field capacity was determined as the following.

$$F_{th} = \frac{S \times W}{4200} \quad \text{.....4}$$

Where:

F_{th} = theoretical field capacity, fed/h, S = forward speed, m/h., and W = cutter bar width, m.

The actual field capacity:

The actual field capacity was calculated as follows *Abd EL-Aal, et al., 2002*.

$$F_{act} = \frac{60}{t_u + t_i} \quad \text{..... 5}$$

Where:

F_{act} = actual field capacity, fed/h, t_u = the utilized time /fed, min. and t_i = the summation of lost times /fed, min.

Field efficiency (η_f ***,%*)*:***

The field efficiency was calculated by using the following formula:

$$\eta_f = \frac{F_{act}}{F_{th}} \times 100 \quad \text{.....6}$$

Where: F_{th} = Theoretical field capacity, fed/h.

Energy consumed:

To estimate the energy consumed during harvesting process, the decrease in fuel level was accurately measured immediately after each treatment. The following formula was used to estimate the engine power. *Hunt, 1983.*

$$E_P = (F_C \times \frac{1}{3600}) PE \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36} \quad \text{..... 7}$$

Solving equation (7) as:-

Engine power (*Diesel*) =1.96. *f c kW* . ,..... 8

Engine power (Otto) = 3.16 . *f c kW* . , ... 9

Where:-

f.c = The fuel consumption, *l*/h**,**

PE = The density of fuel, kg/*l* (for Gas oil = 0.85 and Gasoline = 0.72) **,**

L.C.V = The lower calorific value of fuel, 11.000 k.cal/kg**,**

η_{th} = Thermal efficiency of the engine (35 % for Diesel and 25% for Otto) **,**

427 = Thermo-mechanical equivalent, Kg.m/k.cal and

η_m = Mechanical efficiency of the engine (80 % for Diesel and 85% for Otto).

Hence, the specific energy consumed can be calculated as follows:-

$$\textit{Consumed energy ,kW.h/fed.} = \frac{Enginepower, kW.}{Feildcapacity, Fed/h.} \quad \text{..... ....} \quad 10$$

Human energy:

For each operation the consumed human energy **(** E_H **)** was estimated based on the power of one laborer, which considered being about 0.1 hp.

Harvesting cost:

The total cost of harvesting operation was estimated using the following equation, *Awady 1982*:-

$$\textit{Cost requirements, L.E./Fed.} = \frac{Machine\cos t, L.E/h.}{Actualfieldcapacity, Fed/h.} \quad \text{.....} \quad 12$$

Machine cost was determined by using the following equation*, Awady 1978*:-

$$C = \frac{p}{h}\left(\frac{1}{a} + \frac{i}{2} + t + r\right) + \left(0.9 \times w \times S \times F\right) + \frac{m}{144} \quad \text{.....} \quad 13$$

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* = Fuel 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.and

144 = Reasonable estimation of monthly working hours.

RESULTS AND DISCUSSION

In this study, the discussions will cover the effect of harvesting systems as function of machines forward speeds and grain moisture contents on total grain losses, cutting efficiency, field capacity and efficiency, energy consumed and total cost requirements for harvesting wheat crop. Too, description of a crop condition before

harvest operation was an important factor in a machine performance and has a great effect on loss and final conditions of grain and straw yield.

The effect of crop moisture content and forward speed on grain losses:

Loss is defined as a measurable decrease of the food quantity and quality, loss should not be confused with harvesting method. Fig.2. Shows the total grain losses during harvesting wheat crop by using traditional harvesting system, so the highest value was 3.2% at moisture content 16.65%, and the lowest value was 2.4% at moisture content 20.80%. Add to that the maximum value of total grain losses by using modified combine harvester, self-propelled reaper binder, self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower were about 4.72, 5.05, 5.24 and 6.12% under moisture content of 16.65 %, and forward speeds of 2.7, 3.3, 1.5 and 3.3km/h respectively. The minimum value of total grain losses during harvesting wheat crop by using modified combine harvester, self-propelled reaper binder, self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower were about 3.52, 3.64, 4.12 and 4.25% under moisture contents of 20.80 %, and forward speed 1.5, 2.0, 1.0 and 2.0 km/h respectively(Fig.3). It is worth to mention, that the decrease of grain moisture content leads to increase total grain losses due to more increasing in both pre- harvest losses and cutting losses, which cause more shattering losses by cutter bar consequently combine modified was gave the lowest total grain losses 3.5%. The descently value of harvest methods as tractor mounted vertical conveyor reaper windrower, self-propelled vertical conveyor reaper, self-propelled reaper binder, combine harvesting system and traditional harvesting system.

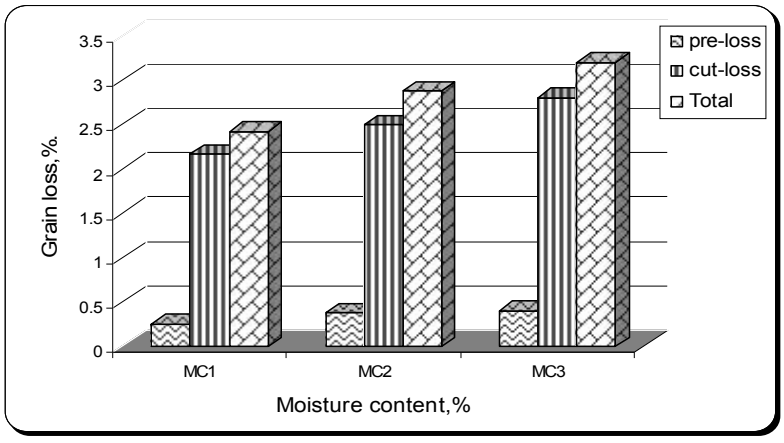

Fig.2. Effect of moisture content on grain losses by using traditional method.

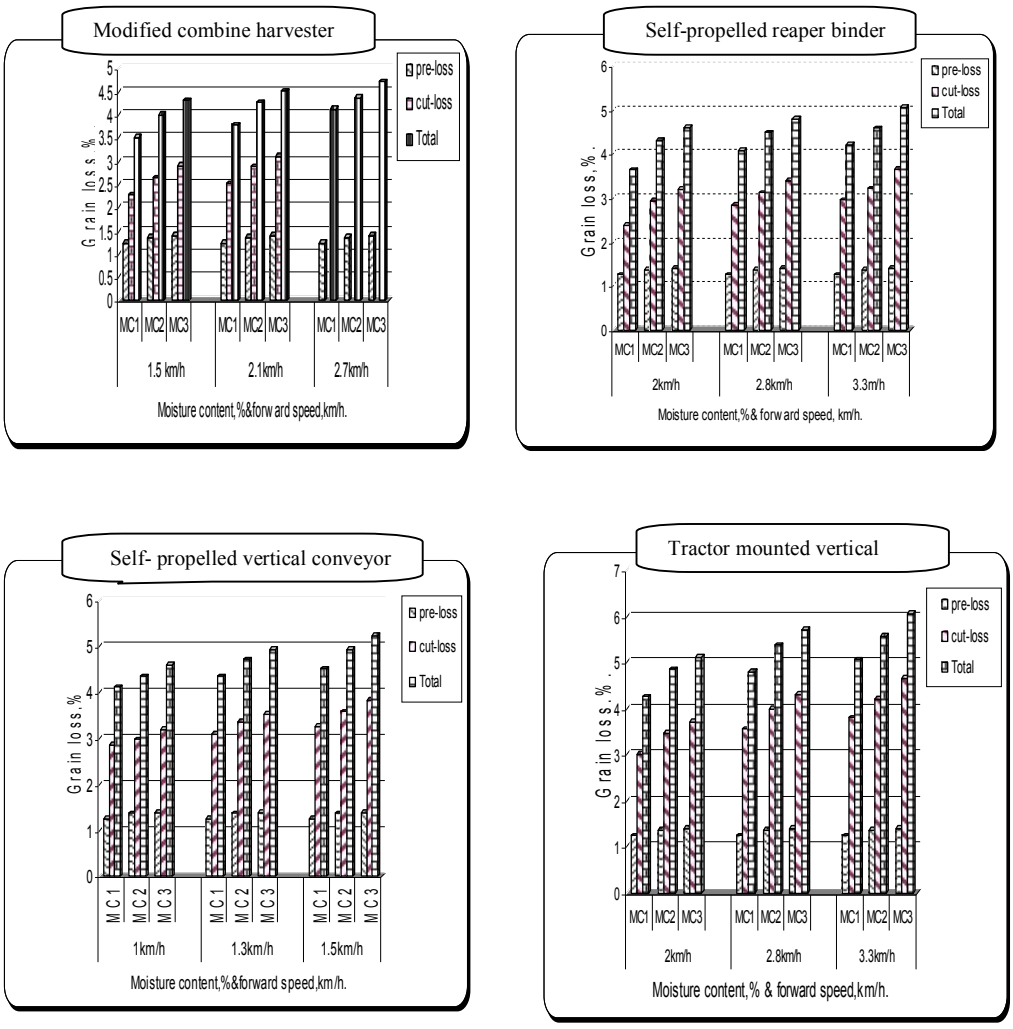

Fig.3. Effect of moisture content and forward speed on grain losses by using mechanical methods.

Effect of crop moisture content and forward speed on cutting efficiency.

It is clear that the highest value of 97.2% was noticed under using combine machine with forward speed of 1.5 km/h and moisture content of 16.65 %. But the maximum value of self-propelled reaper binder was 96.4% with forward speeds 2.0 km/h and moisture content of 16.65 %. And the maximum value of traditional harvesting system was 94.0% with moisture content of 16.65 %. While the maximum value of self- propelled vertical conveyor reaper was 93.2% with forward speed of 1.0 km/h and moisture content of 16.65 % and the maximum value of tractor mounted vertical conveyor reaper windrower was 92.4% with forward speed of 2.0 km/h and moisture content of 16.65 %. On the whole, it was noticed that the increasing of forward speed tend to decrease the cutting efficiency at different grain moisture contents. This trend may be due to bending of stems under the cutter bar increases by increasing the forward speed. Too, the increasing of moisture content tends to

increase the cutting efficiency at different forward speeds. These data and another data were showing in Fig.4.

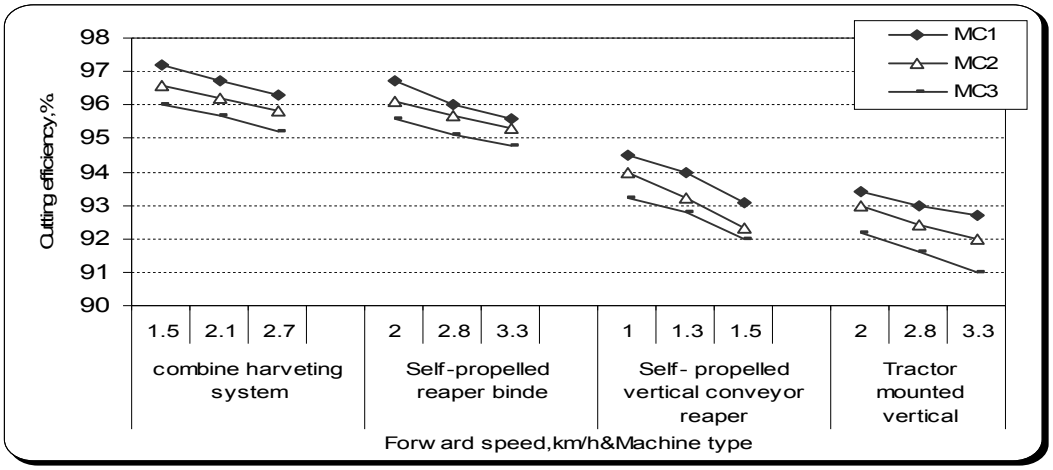

Fig.4. Effect of moisture content and forward speed on cutting efficiency by mechanical method.

Effect of harvesting method on field capacity and efficiency:

The field capacity and efficiency are very important parameters, which should be taking into consideration when evaluated machine performance. The actual field capacity is affected by many factors such as effective machine width, machine forward speed, cutter bar velocity and grain moisture content. The effect of machine forward speed on actual field capacity was shown in Fig. 5. By increasing forward speed of combine harvester from 1.5 to 2.1 to 2.7 km/h the actual field capacity was increased by average from 0.50 to 0.66 to 0.82 fed/h and decrease field efficiency by average from 84.50 to 81.93, and 79.23% at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively. On the other side, by increasing forward speed for self-propelled reaper binder from 2.0 to 2.8 to 3.3 km/h increased actual field capacity by average from 0.46 to 0.62 to 0.73 fed/h and decrease in field efficiency by average from 85.13 to 82.30, and 79.64% at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively. Whereas, the increase in forward speed for self- propelled vertical conveyor reaper from 1.0 to 1.3 to 1.5 km/h due to increase in actual field capacity by average from 0.19 to 0.26, 0.32 fed/h and decrease field efficiency by average from 86.14 to 82.87, and 80.00%, at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively. Too, the increase forward speed for tractor mounted vertical conveyor reaper windrower from 2.0 to 2.8 to 3.3km/h increased actual field capacity by average from 0.60 to 0.85, 1.05 fed/h

and decreased field efficiency by average from 81.64 to 77. 73, and 74.68%, at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively.

Effect of machine forward speed on consumed energy:

On the whole, it is observed that by increasing forward speed, the consumed energy will decrease. The maximum energies consumed were obtained by using modified combine harvester 17.86, 15.23, and 14.11 kW.h/fed at the lower forward speed of 1.5 km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively. While the minimum energies consumed was obtain by using self-propelled vertical conveyor reaper 9.04, 8.34, and 7.01 kW.h/fed at the highest forward speed of 1.5 km/h under different grain moisture contents of 20.80, 18.50 and 16.65% respectively. Increase forward speed of modified combine from 1.5 to 2.1 to 2.7 km/h increased actual field capacity by average from 0.46 to 0.66 to 0.82 fed/h and decrease field efficiency by average from 84.50 to 81.93, and 79.23 at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively. But for other machines, tractor mounted vertical conveyor reaper came in second stage by maximum value of 13.46 kW.h/fed at forward speed 2km/h and minimum value of 11.05 kW.h/fed at forward speed of 3.3km/h, self-propelled reaper binder came in third stage by maximum value of 10.8 kW.h/fed at forward speed of 2km/h and minimum value of 8.21 kW.h/fed at forward speed of 3.3km/h. These data were shown in Fig. 6.

Effect of harvesting machine on cost requiems:

The total cost for harvesting wheat crop depends on some variables such as, machine price, engine power, specific fuel consumption, fuel price and yearly working hours. The effect of machine forward speed on cost requirements under different grain moisture contents is shown in Fig.7. The minimum total cost requirements values were obtained by using self-propelled reaper binder of 17.17, 15.20 14.00, L.E/fed at the higher forward speed of 3.3 km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively. While the maximum cost requirements values were obtained by using modified combine of 73.96, 72.8 and 70.71 L.E/fed at the lower forward speed of 1.5km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively. But for the other machines, tractor mounted vertical conveyor reaper came in second stage by maximum value of 38.68 L.E/fed at forward speed of 2km/h and minimum value of 20.04 L.E/fed at forward speed of 3.3km/h, and self-propelled reaper binder came in third stage by maximum value of 29.33 L.E/fed at forward speed of 2km/h and minimum value of 14.20 L.E/fed at forward speed of 3.3km/h.

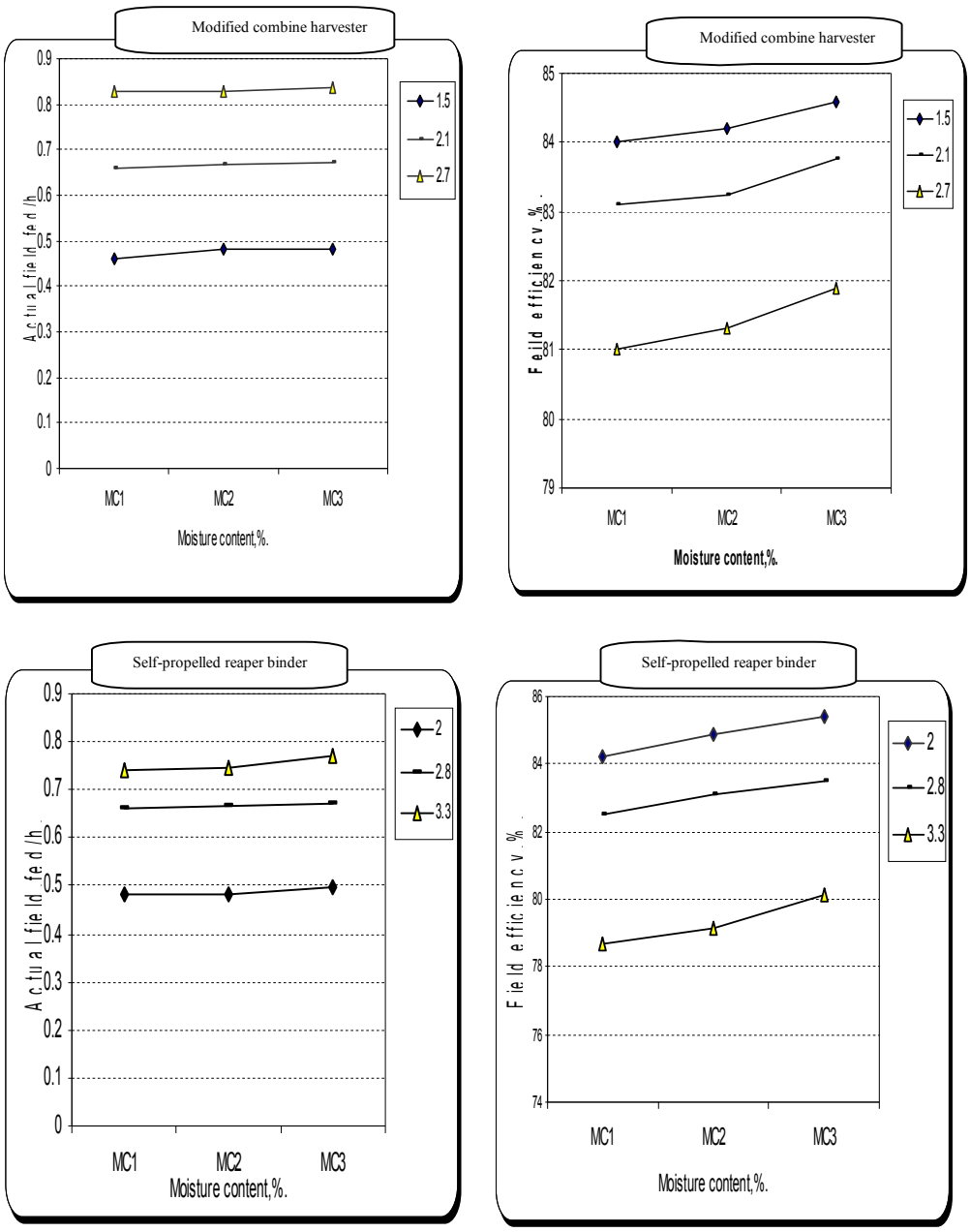

Fig.5. Effect on moisture content on field capacity.

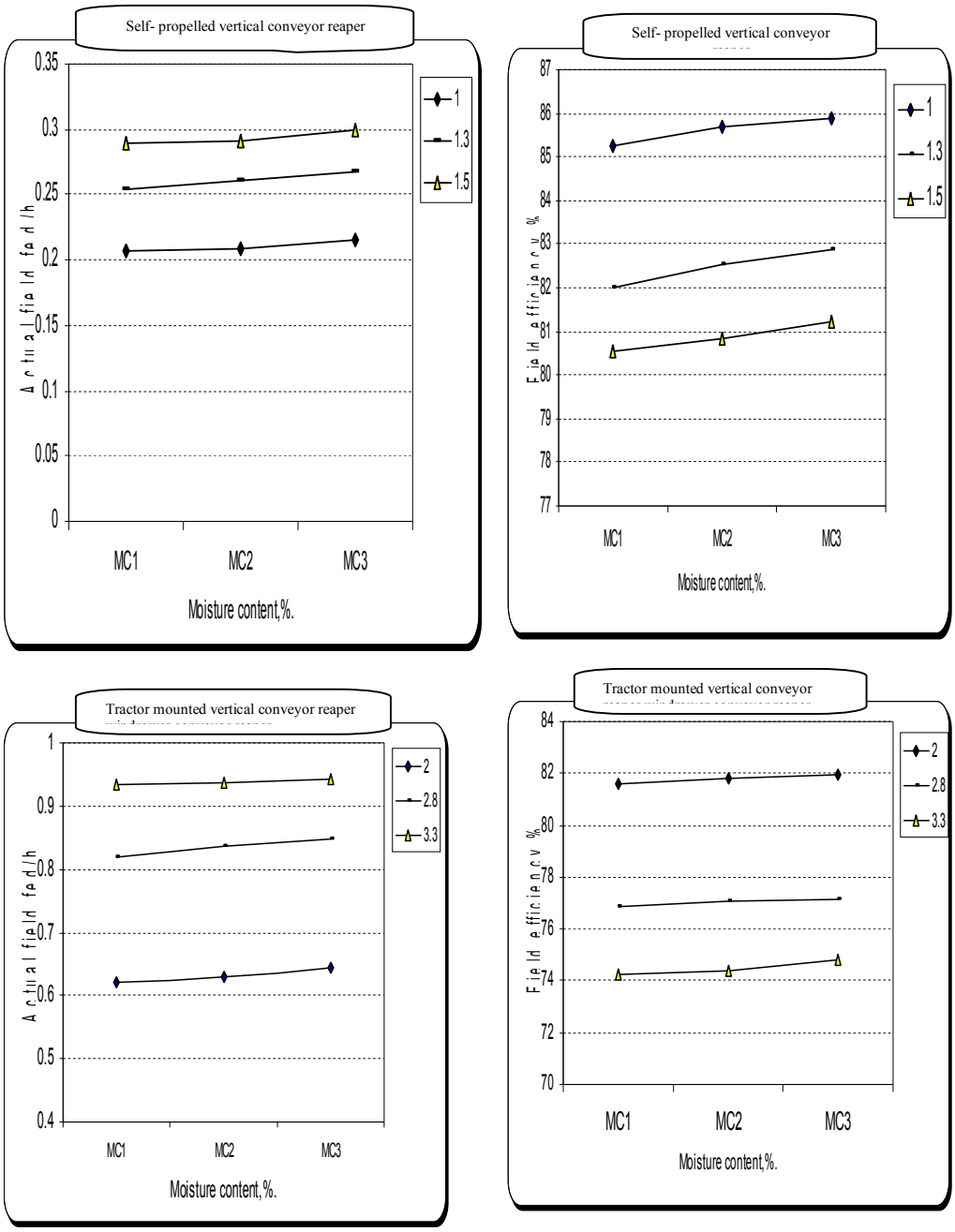

Fig.6. Effect of harvesting machine on field capacity and efficiency

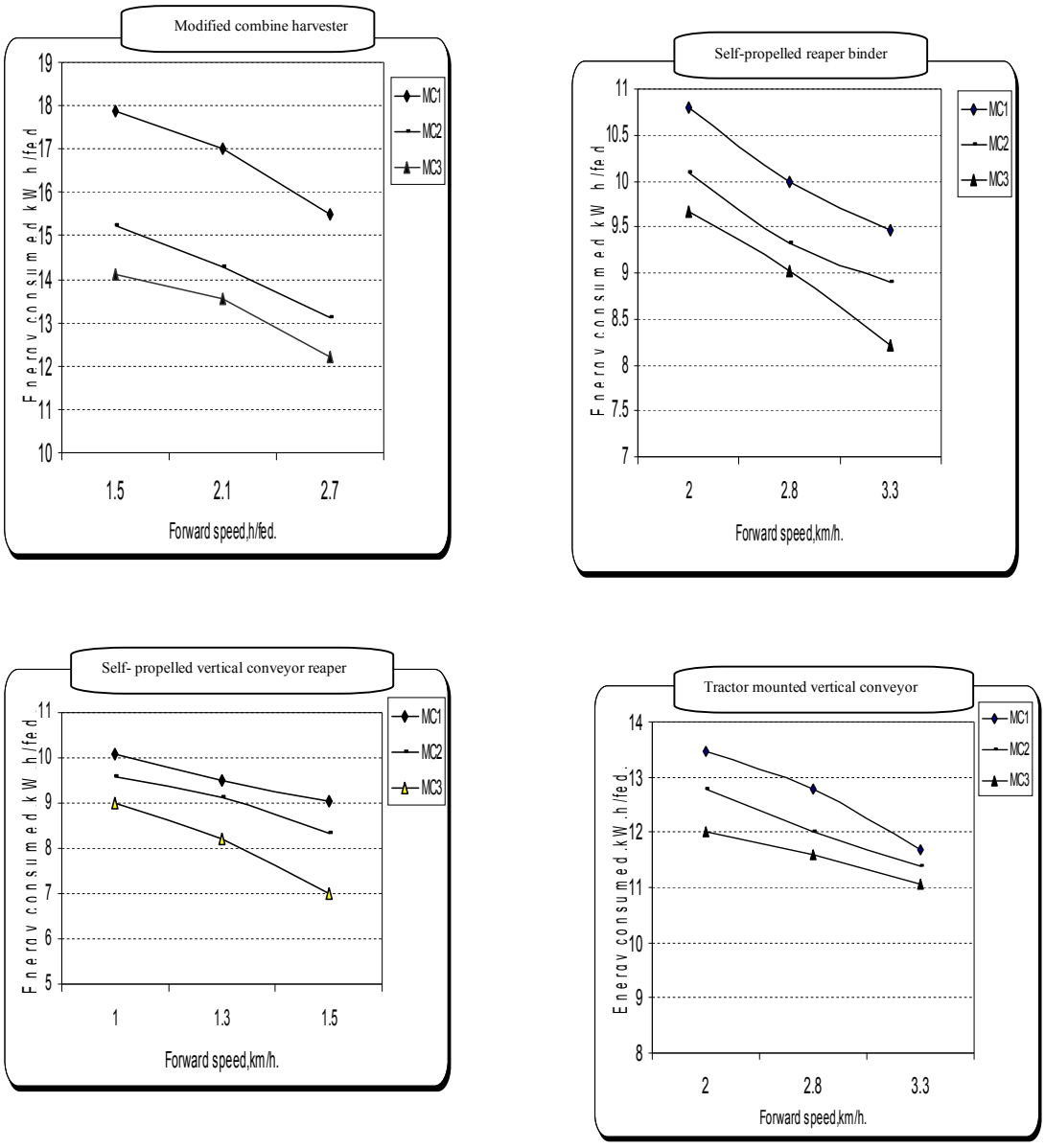

Fig.7. Effect of machine forward speed on consumed energy.

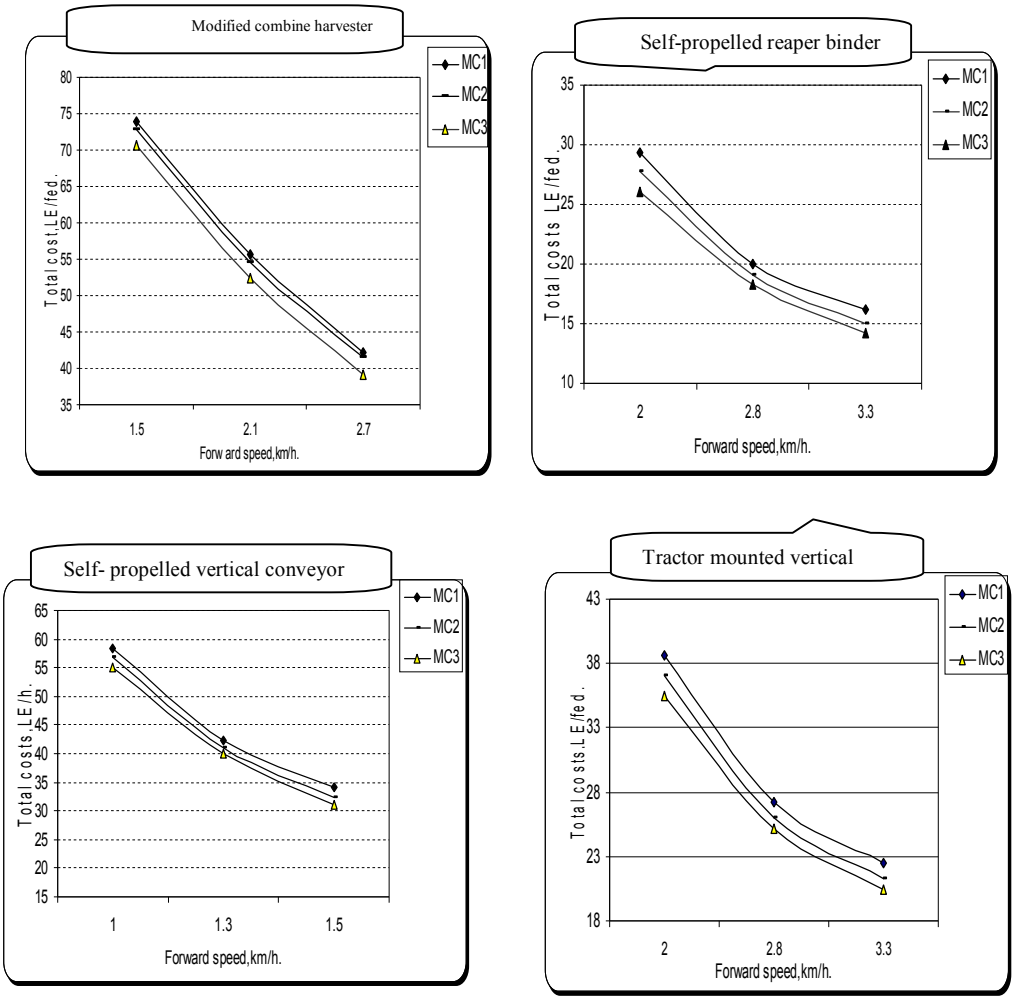

Fig.8. Effect of harvesting machine on cost requirements.

Statistical analysis:

The major results in statistical analysis appeared that the high significant and significant were obtained under using moisture contents of 16.65 and 18.50%, with first and second speeds with high cut. Also, statistical analysis appeared that the high significant and significant were obtain under using moisture contents of 20.80 and 18.50%, with first and second speeds. So, the high speeds and high moisture contents of seed were not recommended for harvest wheat by these machines. These data were shown in Table 4.

Table 4. ANOVA analysis.

Measurements	t.	Combine harvester modification			Self-propelled reaper binder			Self- propelled vertical conveyor reaper			Tractor mounted vertical conveyor reaper windrower		
		MC_1	MC_2	MC_3	MC_1	MC_2	MC_3	MC_1	MC_2	MC_3	MC_1	MC_2	MC_3
Height cut	S_1	*	**	**	ns	*	**	ns	**	**	ns	*	**
	S_2	ns	**	**	ns	*	*	ns	*	**	ns	*	**
	S_3	ns	ns	*	ns	*	*	ns	ns	*	ns	ns	ns
Seed loss	S_1	**	**	**	**	*	*	**	**	**	**	**	*
	S_2	*	*	ns	**	**	ns	**	**	**	*	*	ns
	S_3	*	ns	ns	**	ns	ns	*	*	ns	*	ns	ns

S = Forward speed, km/h, MC = moisture content (MC_1 =20.80, MC_2 =18.50 and MC_3 =16.65 %)

** = highly significant at a level of 1 % * = significant at a level of 1 %, ns=non significant

CONCLUSION

In this study, five harvesting systems were evaluated in wheat fields at three average grain moisture contents of (MC_1 =20.80, MC_2 =18.50 and MC_3 =16.65 %) namely:

1- Traditional harvesting (Hand cutting).

2- Partial mechanization (modified combine harvester, self-propelled reaper binder, self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower). Data from this study led to the following conclusions:-

The highest value was 3.2% at moisture content 16.65%, and the lowest value was 2.4% at moisture content 20.80%. Add to that the maximum value of total grain losses by using modified combine harvester, self-propelled reaper binder, self-propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower were about 4.72, 5.05, 5.24 and 6.12% under moisture content of 16.65 %, and forward speeds of 2.7, 3.3, 1.5 and 3.3km/h respectively.

The highest value of cutting efficiency of 97.2% was noticed under the use of By increasing forward speed of combine harvester from 1.5 to 2.1 to 2.7 km/h the actual field capacity was increased by average from 0.50 to 0.66 to 0.82 fed/h and decrease field efficiency by average from 84.50 to 81.93, and 79.23% at different grain moisture contents of 20.80, 18.50 and 16.65%, respectively. On the whole by increasing forward speed of harvest machine the actual field capacity was increase and decreased field efficiency. Too, by increasing forward speed the consumed energy will decrease. The minimum cost requirements value was obtained by using self-propelled reaper binder of 17.17, 15.20 14.00, L.E/fed at the higher forward speed of 3.3 km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively. While the maximum total cost requirements value was obtained by using

modified combine of 73.96, 72.8 and 70.71 L.E/fed at the lower forward speed of 1.5km/h under different grain moisture contents of 20.80, 18.50 and 16.65 %, respectively.

-From this study, data obtained recommended to use modified combine harvester, self-propelled reaper binder, self- propelled vertical conveyor reaper and tractor mounted vertical conveyor reaper windrower with medium speed and low grain moisture content, to minimize both consumed energy and cost requirements.

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مقارنة بين أكثر الطرق الآلية شيوعا وكومبين الارز المعدل لحصاد محصول القمح فى الحقول المصرية

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يعتبر القمح من الحاصيل الإستراتيجية الهامة بالنسبة للإقتصاد المصرى حيث تستورد مصر سنويا ما يقرب ٩,٩ مليون طن وتعتبر عملية الحصاد من اكثر العمليات الزراعية اهمية بالنسبة لفقد الحبوب فى الحقل فالطريقة المناسبة للحصاد توفر الجهد والوقت والمال ولزيادة كفاءة استخدام كومبين الارز تم تعديلة ليقوم بعملية حصاد محصول القمح وبالتالى رفع كفاءتة ٠ ويوجد على الساحة المصرية العديد من آلات حصاد القمح ويقوم المزارع بإستخدامها دون الأخذ فى الإعتبار الفواقد المترتبة على استخدامها، فكان من الضرورى الوقوف على مميزات وعيوب كل آلة من حيث فواقد الحبوب وكفاءة عملية القطع والطاقة المستهلكة وكذلك التكاليف الكلية اللازمة لعملية الحصاد٠ وذلك لتسليط الضوء على أفضل الآت الحصاد ٠

وقد تم فى هذا البحث تعديل آلة الحصاد الجامعة (الكومبين) لتسخدم فى حصاد المحصول فقط وذلك عن طريق فصل الحركة عن جهاز النقل والفصل والدراس ماعدا جهاز القطع مع وضع صفيحة مسطحة بمحازاة جهاز القطع وفى نهايتة لتوجية المحصول الى السقوط بجوار الآلة٠

وقد تم دراسة بعض عوامل التشغيل التى تؤثر على آداء آلات الحصاد وهى السرعة الامامية للآلة ونسبة رطوبة الحبوب عند الحصاد وذلك لتحديد أنسب تلك العوامل التى يتحقق عندها أقل فواقد كلية للحبوب و طاقة مستهلكة وأقل تكاليف عند الحصاد، وقد إشتملت عوامل الدراسة على ثلاث سرعات امامية لكل آلة، فكانت ٢ و ٢،٨ و ٣،٣ كم/س للمحشة ذاتية الحركة والمحشة الملحقة بالجرار بينما كانت للكومبين

المعدلة للحصاد ١،٥ و ٢،١ و ٢،٧ كم/س و١ و ١،٣ و ١،٥ كم/س لمحشة المقادة بوسطة الإنسان٠

عند ثلاث مستويات لرطوبة الحبوب ٨٠،٢٠ و ١٨،٥٠ و ١٦،٦٥ %

وقد أظهرت النتائج المتحصل عليها ما يلى:-

أقل فواقد للحبوب كانت بإستخدام الطريقة التقليدية ٢% وكانت نسبة رطوبة الحبوب ٨٠،٢٠ % بينما أعطت الكومبين المعدل للحصاد ٤،٧٢ % والمحشة ذاتية الحركة ٠٥،٥% و المحشة المقادة بالانسان ٥،٢٤ % أما المحشة الملحقة بالجرار فكانت ٦،١٢ % تحت اسرعات الأمامية ٧،٢ و٣،٣ و ١،٥ و ٣،٣ كم/س على التوالى ونسبة رطوبة للحبوب ١٦،٦٥%٠

– وقد أظهرت النتائج أيضا أن أعلى قيمة لكفاءة القطع كانت ٩٧،٢ % باستخدام الكومبين المعدل لحصاد بسرعة أمامية ١،٥ كم/س و نسبة الرطوبة للحبوب ١٦،٦٥% تليها المحشة ذاتية الحركة بكفاءة قطع ٩٤،٥ % وسرعة أمامية ٢،٠ كم/س و نسبة لرطوبة للحبوب ١٦،٦٥% أما الحصاد اليدوى فكان ٩٤،٠ % بنسبة لرطوبة للحبوب ٦٥ ،١٦% والمحشة المقادة بالانسان فكانت ٩٣،٢ % و المحشة الملحقة بالجرار بنسبة ٩٢،٤ % تحت السرعات الأمامية ١،٠ و ٢،٠ كم/س على التوالى ونسبة رطوبة للحبوب ٦٥،١٦%٠وكانت أقل طاقة مستهلكة بإستخدم لحصاد اليدوى ٢،٩ كيلوات ساعة/فدان ونسبة رطوبة الحبوب ٦٥،١٦% وأعلى قيمة كانت بإستخدام الكومبين المعدل للحصاد ٨٦،١٧ كيلوات ساعة/فدان وسرعة امامية ١،٥ كم/ساعة ونسبة رطوبة الحبوب ٦٥،١٦% ٠ واقل تكاليف كانت بإستخدام المحشة زاتية الحركة ١٤،٠ جنية/فدان بسرعة امامية ٣،٣ كم/س ونسبة رطوبة للحبوب١٦ ،٦٥% بينما أعلى قيمة للتكاليف بإستخدام الكومين ٩٦،٧٣ جية/فدان بسرعة امامية ١،١٥ كم/س ونسبة رطوبة للحبوب ٢٠،٨٠%٠

– ومن هنا نجد انخفاض معدل فقد الحبوب بالنسبة للفدان وزيادة كفاءة القطع فى حالة استخدام الكومبين المعدل للحصاد مقارنة بطرق الحصاد الآلية الآخرى مع ملاحظة زيادة الطاقة المستهلكة والتكاليف بالنسبة للفدان٠