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DEVELOPMENT OF A POTATO HARVESTER SUITABLE FOR EGYPTIAN FARMS

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ABSTRACT

A potato harvester was modified to suitable for Egyptian farms. The performance of potato harvester was carried out to investigate some engineering parameters affecting the harvesting effectiveness, such as forward speed, tilt angle, distance between the blade and elevator chain, chain speed, riddle speed and riddle inclination.The energy required to the performance and cost operation were considered and compared with traditional system.

The optimum engineering parameters for the development harvester which achieved the highest undamaged, lowest damaged and losses tubers percentage was obtained under forward speed of 2.3 km/h, digger tilt angle of 14°, distance between the blade and elevator chain of 5 cm, chain speed (V) of 100 rpm (2.41m/s), riddle speed of 4.63V rpm and riddle inclination of 7°. The mechanical harvesting reduced the cost operation of harvesting by 37.04, 47 and 51.61% under forward speed of 1.5, 2.3 and 3.1 km/h compared with traditional system.

INTRODUCTION

Potato is one of the most important vegetable crops in Egypt. The cultivated area is about 200,000 feddans yearly, producing about 2 million tons, according to the Ministry of Agriculture (1999). Mechanization becomes one of the most essential goal for raising potato production and minimizing the production cost, subsequently increasing the net income for potato producers. Most of mechanical harvesting problems of potato tubers are the apparent damage caused in potato root and unlifted roots during harvesting.

Abdel-Galeil (1990) found that the optimum forward speed, digging depth and tilt angle was 2.8 km/h, 20 cm and 18° which achieved a highly lifted tubers percent. Increasing forward speed from 1.8 to 3.8 km/h, the damaged tubers increased from 1.53 to 2.67 %.

Hamad et al. (1991) indicated that increasing blade tilt angle of 8°, 12°, 16° and 20°, the surface tubers were increased of 10.32, 20.27, 52.06 and78.36%

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and the bruised tubers decreased of 86.77, 73.57, 40.36 and 11.41% respectively. They also found that increasing forward speed of 1.03, 2.1 and 3.05 km/h, the undamaged tubers were increased of 86.91, 89.43 and 95.26% and the damaged tubers decreased of 13.09, 10.57 and 4.74% respectively.

Sayed et al. (1996) found that increasing forward speed from 3.5 to 5.5 km/h in sandy soil and 2.5 to 4.5 km/h in clay soil, the damaged tubers decreased from 9.62 to 5.93 % and 11.72 to 9.24% for lifter. They also found that the lowest damage tuber of 5.93 and 9.07%, the highest undamaged tubers of 89.73 and 85.26% and the optimum total costs per unit area of 12.93 and 16.71 L.E/fed were obtained statistically at the optimum forward speed of 5.5 and 3.5 km/h for sandy and clay soil by using lifter respectively.

El-Sayed et al. (1997) found that the lowest buried tubers value was obtained with the length 35 cm of separating rod and 10° rake angle which recorded 8.2, 6.9 and 5.8%, but the lowest damaged tubers value was obtained with the length 15 cm of separating rod and 12° rake angle which recorded zero, 0.8 and zero % under forward speeds of 1.73, 3.10 and 4.13 km/h respectively. The minimum draft-force at mechanical harvesting of 1.43 kN was obtained with the length 15cm of separating rod and 8° rake angle at forward speed of 1.73 km/h saved 28.66% of energy and reduced the cost operating of harvesting by 18.7% compared with traditional system for potato digging.

Emam (1999) showed that increasing digging depth from 25 to 30 cm, share angle from 18° to 24° and decreasing forward speed from 3.0 to 2.0 km/h, the lifted and undamaged tubers increased from 84.73 to 93.81% and 82.4 to 91.73%, but the unlifted, bruised and cut tubers decreased from 15.27 to 5.19 %, 9.1 to 4.57% and 8.5 to 3.7% by using chisel share respectively.

Mady (1999) found that the lowest and highest energy requirements of 66.43 and 187.9 kW.h/fed and the highest and lowest values of cost per ton of 245.28 and 44.65 L.E/ton were obtained at digging depth of 25 and 40 cm and forward speed of 3.6 and 1.5 km/h respectively.

The objectives of this work can be summarized as follows:

- Modification of potato harvester suitable for Egyptian farms and evaluate the performance of the modified model.
- Study the effect of forward speed, blade tilt angle, distance between the blade and elevator chain, chain speed, riddle speed and riddle inclination on lifted tubers (undamaged and damaged), unlifted (losses) tubers, fuel consumption, power, energy requirements and economical cost.

MATERIALS AND METHODS

To fulfill these objective a machine was modified in the workshop in Meet-Ghamr and the field experiments were carried out in a clay loam soil taxture at

Beheda Meet-Ghamr, Dakahlia Governorate during 1999-2000 season. The field experiments were performed and determined its operating optimum parameters which were forward speed of 1.5, 2.3 and 3.1km/h; tilt angle of 8°,14°and 20°; distance between the blade and elevator chain of 5, 8 and 11cm; chain speed (V) of 100 rpm (2.41m/sec),130 rpm (3.13 m/sec) and 160 rpm (3.85 m/sec); riddle speed of 2.4V, 3.16V and 4.63V rpm and riddle inclination of 5°,7° and 9° and study the effect of this parameters on lifted (undamaged and damaged), unlifted (losses) tubers, fuel consumption, power, energy requirements and economical cost.

Materials:

The machine specifications:

1-Tractor:

a- Model Nasr 65M 34/T, diesel engine, four stroke, 48.8 kW power, 2540 kg mass.

B- Model KOBOTA L.2402-M, diesel engine, 3 cylinders, 22.44 kW power, 850 kg mass, 2800 rpm (PTO).

2- potato harvester:

a - Before development :

The potato harvester before modifying is one-row potato harvester, drawn behind the tractor several hitching points. This implement consists of side hitching points, separating system (consists of elevator chain only and shaking apron), digging blade, frame, gear box, wheel, chain, riddle device and controlling inclination system as shown in Fig. (1). The elevator chain power is taken off operated (PTO).

B -After development:

The modified harvester is one-row harvester, trailled behind the tractor and PTO operated implement, to be fitted on the tractor's two hitch systems. This implement consists of digging blade, frame, gear box, hitching system at the center of rear wheels axes of tractor, riddle system, steel sheet, belt, pulley, controlling riddle system and controlling distance between the blade and elevator chain system. The modified harvester is shown in Figs. (2, 3 and 4).

Measuring instruments:

1) **Tachometer:** To measure the PTO speed.
2) **Vernier caliper:** To measure the dimensions of potato tubers.
3) **Drawbar hydraulic dynamometer:** A drawbar hydraulic dynamometer (statimeter, measuring range from 0 to 10 KN, accuracy 100 N was used to measure the rolling resistance and the drawbar pull.

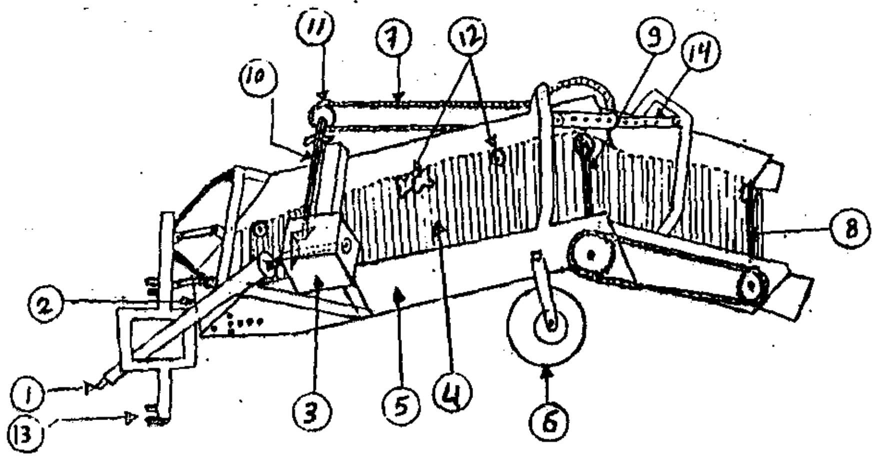

Fig. (1) : View of the potato harvester before modifying

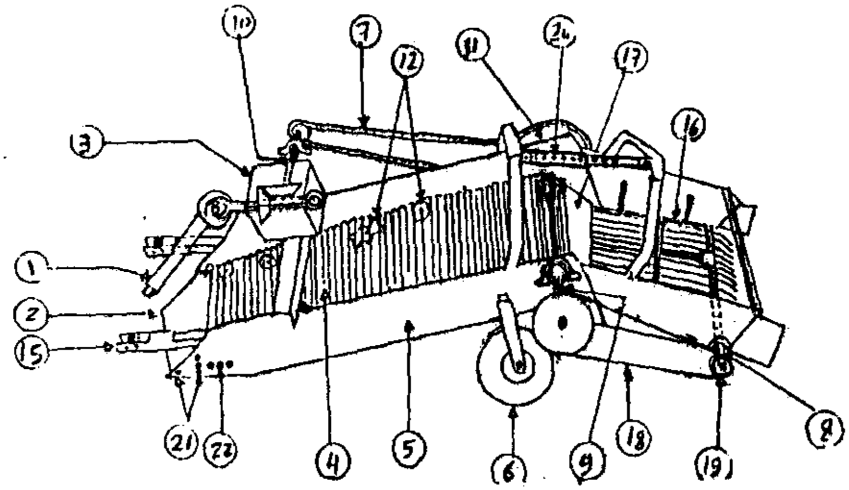

Fig. (2) : View of the modified potato harvester.

R	Name	R	Name
1	Universal joint	12	Shaking apron system
2	Digging blade	13	Hitching point
3	Gear box	14	Controlling inclination system
4	Elevator chain	15	Hitching system
5	Frame	16	Riddle system
6	Wheel	17	Steel sheet
7	Chain	18	Belt
8	Third rod with crank	19	Pulley
9	Second rod	20	Controlling ridle system
10	Frist rod	21	Controlling blade system
11	Sproket	22	Controlling distance between the blade and elevator chain system

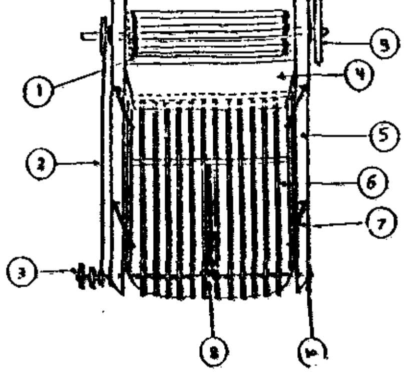

Fig.(3) :The riddle device.

R	Name	R	Name
1	Elevator chain	6	Links of the riddle
2	Belt	7	Links which carried the riddle
3	Pulleys	8	Crank
4	Steel sheet	9	Sproket
5	Frame	10	Ball-bearing

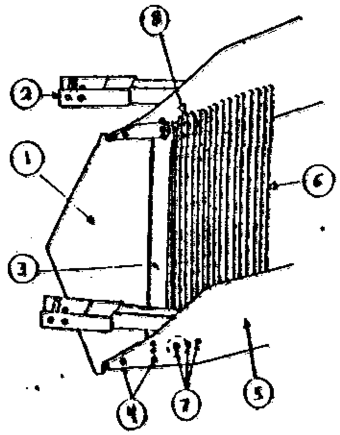

Fig. (4) : The hitching system and digging blade.

R	Name	R	Name
1	Digging blade	5	Frame
2	Hitching system	6	Elevator chain
3	Distance between the blade and elevator chain	7	Controlling distance between the blade and elevator chain system
4	Controlling blade system	8	Roller

4) **Firmness tester plate:** It was used to measure the firmness of tubers.

Methods:

Soil texture was clay loam of 52.47% clay, 23.48% silt, 13.79% fine sand, 1.26% coarse sand and 3.4% $CaCO_3$. The average soil moisture content was 16.73%. The experiments were carried out in a rectangular shape of one feddan. The plot area of each treatment of 60 m^2 (1x 60 m).Potato tubers (Sponta varieties) were planted by traditional method (850 kg/fed) at the second week of January. The distance between rows was 100 cm and plant spacing of 25cm. The haulm was removed manually befor harvesting to decrease the elevator chain and riddle loads. The removal and harvesting transporting of the haulm required four men feddan. 30 plants were selected randomly and the profile of tubers distribution and dimensions were studied. The tuber distribution in ridges is ellipse shape with 17.71 and 24.94 cm diameters. The distances between the ridge top and the deepest and nearest tubers were 20.75 and 2.45cm respectively. The tuber dimensions and frequency distribution in the ridge were used to adjust the harvesting depth. The average tuber length and diameter were 10.72 and 6.32 cm and firmness was 5.7 kg/cm^2.

Tuber harvesting:

After the harvesting, lifted tubers were collected from a row length of 60 m. and the losses tubers were exctracted manually by hand digging tool for the same length. The lifted, damaged tuber percentage (**lif_t, D_t %**) and harvester efficiency (**E%**) were determined from the followin g:

$$Lif_t\ \% = \frac{m_1}{m_1 + m_2} \times 100$$

$$D_t\ \% = \frac{m_3}{m_1 + m_2} \times 100$$

$$E\ \% = \frac{m_4}{m_1 + m_2} \times 100$$

Where:

m_1 : mass of lifted tubers (kg/plot).

m_2 : mass of unlifted tubers (kg/plot).

m_3 : mass of damaged tubers (kg/plot).

m_4 : mass of undamaged tubers (kg/plot).

Power and Energy requirements:

The power and energy required were calculated by the following :

$$Power(kW) = \frac{Draft\text{-}force\ (kN) \times speed\ (km/h)}{3.6}$$

- **Energy requirements (kW.h/fed)= power (kW) x productivity(h/fed)**

Fuel consumption:

The fuel consumption rate was calculated by reffilling method.

Cost of potato harvester:

The costs were determined from equation (**Awady 1978**):

$$C = \frac{P}{h}\left(\frac{1}{a} + \frac{i}{2} + t + r\right) + (1.2\ W.S.F)\ \frac{M}{144}$$

Where: **C:** hourly cost, **P:** price of the machine, **h :** yearly working hours, **a:** life expecting of the machine, **i :** interest rate / year, **t:** taxes overheads ratio, **r:** repairs and maintenance ratio, **1.2 :** a factor accounting for lubrication **W:** power hp, **S:** specific fuel consumption L.E/hp, **F :** fuel price L.E/h, **M :** operator monthly salary, **144 :** the monthly average working hours.

RESULTS AND DISCUSSION

The field experiments were carried out to evaluate the effect of some factors related to the modified potato harvester.Also to use the best results obtained from the primary experiments to modify the potato harvester to be more suitable for Egyptian farms.

1- Pre- Experiments :

Experiment No 1:

The main objective of the present work is to identify the main factors affecting the harvesting operation of potato tubers.Potato harvester were evaluated before modifying to investigate such the problems facing the harvester to considered during modifying.

The primary experiment was carried out at forward speed of 3.0 km/h, tilt angle of 14 °, the distance between the blade and elevator chain of 8.0 cm and chain speed of 200 rpm (4.82 m/sec) by using tractor (Nasr 65 hp).

The results of this experiment can be summarized as follows:

The undamaged, damaged and losses tubers were 79.3, 13.5 and 7.2% respectively. The power requirements of 12.87 kW to pull the potato harvester and specific fuel consumption of 4.07 lit/h.

Experiment No 2:

This experiment was conducted to determine the optimum distance between the blade and elevator chain of 5.0, 8.0 and 11.0 cm after development and to select the suitable distance.

Data obtained in Fig.(6) shows that the optimum distance between the blade and elevator chain was 5.0 cm which achieved the highest undamaged tubers of 97.21%, lowest damaged and losses tubers of 1.54 and 1.25%.

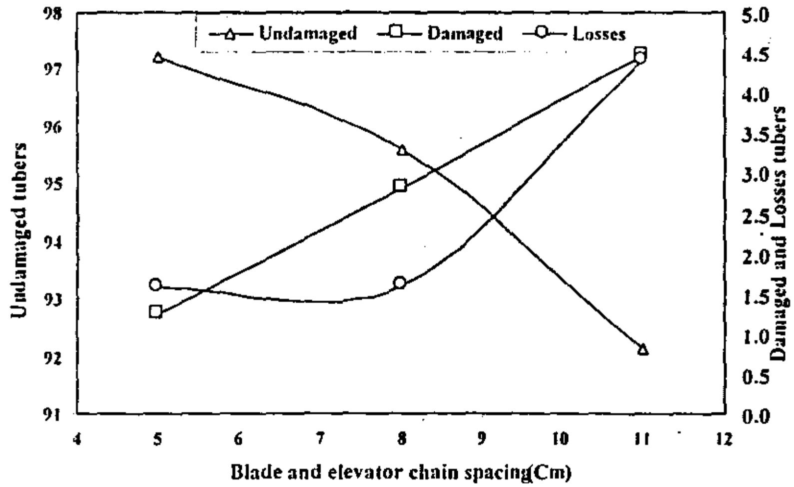

Fig.(6): Effect of distance between the blade and elevator chain on lifted and losses tubers.

2- Second experiment:

The experiment was carried out to obtain the results which evaluate the performance of the modified harvester.

1- The results of the modified harvester.

1-1 Effect of forward speed and tilt angle on lifted and losses tubers.

Data presented in Fig.(7) shows that, the highest undamaged tubers of 87.4% was obtained at forward speed of 2.3 km/h and tilt angle of 14°,but the lowest percentage was 81.86% at forward speed of 3.1km/h and tilt angle of 8°.The highest damaged may due to the floating blade and increasing of circulating of the soil on the blade. Increasing forward speed from 1.5 to 3.1km/h, the undamaged tubers decreased from 82 to 81.86% and damaged tubers increased from 2.26 to 3.87% under tilt angle of 8°. Increasing tilt angle from 8° to 20° with forward speed of 1.5 km/h, the undamaged tuber increased from 82 to 83.9 % and the damaged tubers decreased from 2.26 to 1.30%. Whereas the highest damaged tubers of 3.87% was obtained at forward speed of

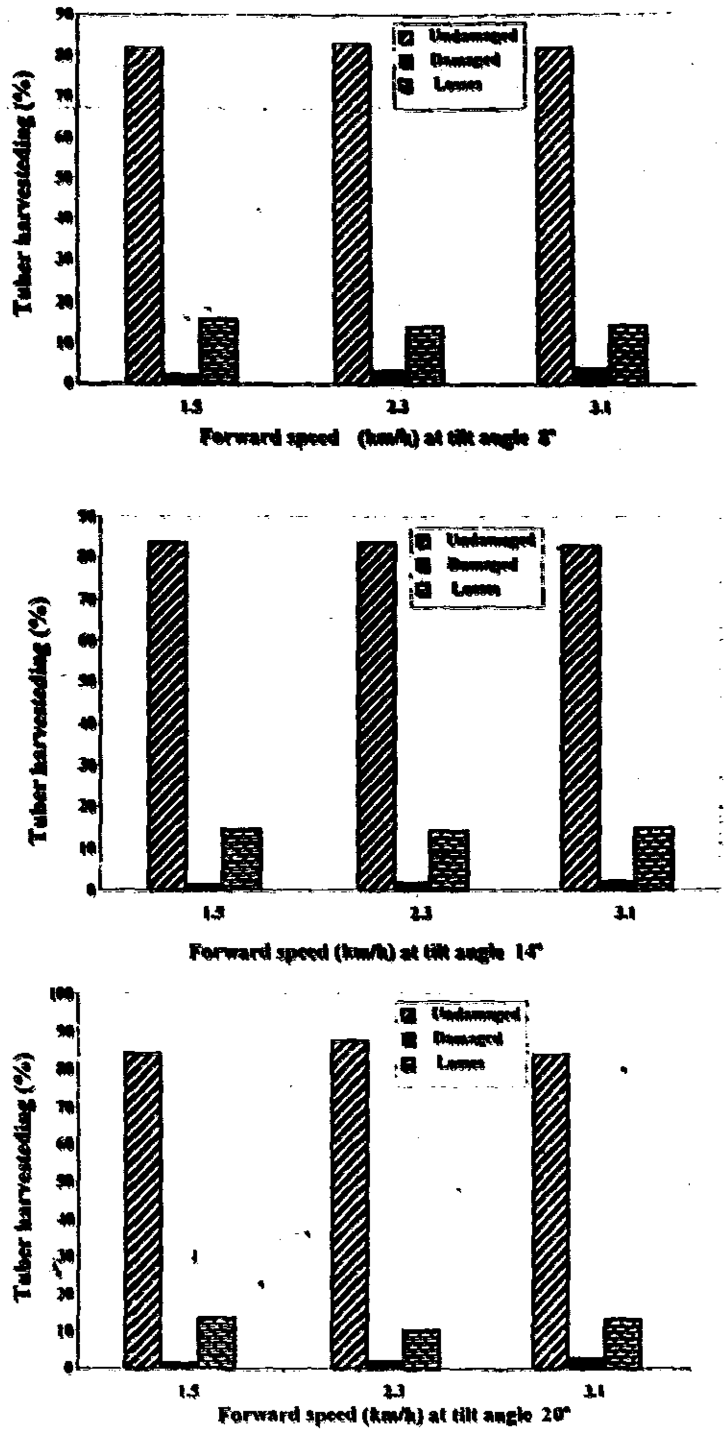

Fig. (7) : Effect of forward speed and tilt angle on the lifted and losses tubers.

3.1km/h and tilt angle of 8°, but the lowest percentage of 1.3 % at forward speed of 1.5 km/h and tilt angle of 20°. Data in the same Fig., shows that the highest losses tubers of 15.74% was obtained at forward speed of 1.5 km/h and tilt angle of 8°, but the lowest percentage was 10.62% under forward speed of 2.3 km/h and tilt angle of 14°.

1-2 Effect of chain and riddle speed on lifted and losses tubers at different riddle inclination.

Data in table (4) showed that the highest undamaged tubers were 97.74, 98 and 96.41% at riddle speed of 4.63V_1 rpm, but the lowest percentage of 94.1, 94.42 and 92.94% were obtained at riddle speed of 2.4V_3 rpm under riddle inclination of 5°,7° and 9° respectively. This means that increasing riddle speed from 2.4V_1 to 4.63V_1 rpm, the undamaged and damaged tubers increased from 95.87 to 97.74%; 96.12 to 98% and 95.41 to 96.41% and 1.9 to 2.06 %; 1.05 to 1.5% and 0.76 to 0.99% and the losses tubers decreased from 2.23 to 0.2%; 2.83 to 0.5% and 3.83 to 2.6% under riddle inclination of 5°, 7° and 9° respectively. On the other hand, increasing chain speed from 100 to 160 rpm (2.41 to 3.85 m/sec) at riddle speed of 2.4V rpm, the damaged tubers increased from 1.9 to 3.18%, 1.05 to 2.71% and 0.76 to 1.25% under riddle inclination of 5°, 7° and 9° respectively. Whereas the highest damaged tubers of 3.83, 3.28 and 2.11% were obtained at riddle speed of 4.63V_3 rpm, but the lowest percentage were 1.9, 1.05 and 0.76% at riddle speed of 2.4V_1 rpm under riddle inclination of 5°, 7° and 9°. Meanwhile the highest losses tubers of 2.72, 2.87 and 5.81% were obtained at riddle speed of 2.4V_3 rpm, but the lowest percentage were 0.2, 0.5 and 2.6% at riddle speed of 4.63V_1 rpm under riddle inclination of 5°, 7° and 9°.

1–3 Effect of chain speed and riddle inclination on lifted and losses tubers.

Table (4) showed that the highest undamaged tubers was 98% at chain speed of 100 rpm (2.41m/sec) and riddle inclination of 7°,but the lowest percent was 94% at chain speed of 160 rpm (3.85m/sec) and riddle inclination of 9°. Data appeared that increasing riddle inclination from 5° to 9° with riddle speed of 4.63 V_1 rpm, the damaged tubers decreased from 2.06 to 0.99%. Whereas the highest damaged tubers was 3.83% at riddle speed of 4.63V_3 rpm and riddle inclination of 5°, but the lowest percentage was 0.76% at riddle speed of 2.4V_1 rpm and riddle inclination of 9°. The highest losses tubers of 5.81% was obtained at riddle speed of 2.4V_3 rpm and riddle inclination of 9°, but the lowest percentage was 0.2% at riddle speed of 4.63V_1 and riddle inclination of 5°.

1-4 Effect of riddle speed and riddle inclination on lifted and losses tubers under different chain speeds.

Data in table (4) shows that the highest undamaged tubers of 98% was obtained at riddle speed of 4.63V_1 rpm and riddle inclination of 7°, but the lowest percentage was 95.41% at riddle speed of $2.4V_1$ rpm and riddle inclination of 9°. From the same table, it is appeared that increasing riddle speed from $2.4V_1$ to $4.63V_1$ rpm with riddle inclination of 5°, the damaged tubers increased from 1.9 to 2.06%. Meanwhile, increasing riddle inclination from 5° to 9° with riddle speed of $2.4V_1$ rpm, the damaged tubers decreased from 1.9 to 0.76 %.

Table(4): Effect of chain and riddle speed on the lifted and losses tubers under different riddle inclination.

Riddle inclination	5°			7°			9°		
Tuber harvesting / Riddle speed (rpm)	Undamaged (%)	Damaged(%)	Losses(%)	Undamaged (%)	Damaged(%)	Losses(%)	Undamaged(%)	Damaged(%)	Losses(%)
$2.4\ V_1$	95.87	1.90	2.23	96.12	1.05	2.83	95.41	0.76	3.83
$2.4\ V_2$	95.30	2.15	2.55	96.00	1.15	2.85	94.34	0.83	4.83
$2.4\ V_3$	94.10	3.18	2.72	94.42	2.71	2.87	92.94	1.25	5.81
$3.16\ V_1$	96.93	2.02	1.05	97.48	1.40	1.12	96.30	0.80	2.90
$3.16\ V_2$	96.60	2.20	1.20	97.21	1.54	1.25	95.39	0.95	3.66
$3.16\ V_3$	94.95	3.55	1.50	95.23	3.17	1.60	94.19	1.72	4.09
$4.63\ V_1$	97.74	2.06	0.20	98.00	1.50	0.50	96.41	0.99	2.60
$4.63\ V_2$	96.33	2.25	0.87	97.25	1.70	1.05	96.00	1.37	2.63
$4.63\ V_3$	95.26	3.83	0.91	95.45	3.28	1.18	94.25	2.11	3.64

where : V_1 : chain speed of 100 rpm (2.41m/sec).

V_2 : chain speed of 130 rpm (3.13 m/sec)

V_3 : chain speed of 160 rpm (3.85 m/sec).

1-5 Effect of forward speed and tilt angle on draft-force,power,energy required and fuel consumption.

Data in table (5) shows that, the highest draft-force, power and energy requirements of 9.3 KN, 7.86 kW and 13.28 kW.h/fed were recorded at forward speed of 3.1km/h and tilt angle of 20°, but the lowest values were 7.3 KN, 2.98 kW and 10.43 kW.h/fed under forward speed of 1.5 km/h and tilt angle of 8°.

Data in table (5) revealed that, the highest fuel consumption value of 4.48 L/fed was recorded at forward speed of 3.1km/h and tilt angle of 20°, but the lowest value was 3.5 L/fed under forward speed of 1.5 km/h and tilt angle of 8°.

Table(5): Effect of forward speed and tilt angle on draft-force,time operating, power, energy required and fuel consumption.

Tilt angle	Forward speed (km/h)	Draft-force (KN)	Power (kW)	Energy required (kW.h /fed)	Time operating (h/fed)	Fuel consumption (L/fed)
8°	1.5	7.3	2.98	10.43	3.85	3.5
	2.3	7.9	4.95	11.28	2.50	3.76
	3.1	8.2	6.93	11.74	1.86	3.89
14°	1.5	7.5	3.07	10.74	3.85	3.85
	2.3	7.9	5.08	11.58	2.51	3.99
	3.1	8.4	7.10	12.00	1.88	4.10
20°	1.5	8.3	3.39	11.87	3.86	4.38
	2.3	8.9	5.58	12.72	2.50	4.20
	3.1	9.3	7.86	13.28	1.94	4.48

Economical cost of potato harvesting.

The total harvesting cost per one fedden by development harvester of 188.24, 158.7 and 144.7 L.E/fed were remarked under forward speed of 1.5, 2.3 and 3.1 km/h (table 6).On the other hand, the value by traditional manual methods of 299 L.E/fed.The lowest economical cost of harvesting of 1087.72 L.E/fed was obained at forward speed of 2.3 km/fed and tilt angle of 14°,while the highest value was 1537.87 L.E/fed under forward speed of 1.5 km/h and tilt angle of 8°.

Table (6): Economical cost of harvesting under different forward speed and tilt angle of digging blade.

Tilt angle	Forward speed (km/h)	Damaged tubers (%)	Damaged tubers (kg/fed)	Losses Tubers (%)	Losses Tubers (kg/fed)	Total losses of price (L.E/fed)	Total harvesting cost (L.E/fed)	Economical cost of harvesting (L.E/fed)
8°	1.5	2.26	226	15.74	1574	1349.6	188.24	1537.87
	2.3	3.15	315	13.85	1385	1234.0	158.70	1392.70
	3.1	3.87	387	14.27	1427	1296.4	144.70	1441.10
14°	1.5	1.73	173	14.02	1402	1190.8	188.24	1379.04
	2.3	1.98	198	10.62	1062	928.8	158.92	1087.72
	3.1	2.81	281	13.46	1346	1189.2	144.70	1333.90
20°	1.5	1.30	130	14.78	1478	1234.4	188.46	1422.86
	2.3	1.83	183	14.21	1421	1210.0	158.70	1368.70
	3.1	2.13	213	14.93	1493	1279.6	146.45	1426.05

Economical cost of harvesting (L.E/fed) = Total losses of price (damaged and buried) + Total harvesting cost.

Total losses of price (L.E/fed) = $L_1 (p_0 - p_1) + L_2 p_0$.

Assuming that the price of one kg equal to 0.8 and 0.4 L.E. for intact (p_0) and damaged (p_1) potato tubers respectively.

CONCLUSION

From the obtained data, it can be concluded that:

1) The optimum distance between the blade and elevator chain of 5 cm achieved the highest undamaged (97.21%), lowest damaged and losses tubers (1.57 and 1.25%).

2) The optimum forward speed of 2.3 km/h and tilt angle of 14^0 gave the highest undamaged (87.4%), lowest damagd and losses tubers (1.98 and 10.62%) and lowest economical cost of harvesting (1087.72 L.E/fed).

3) The optimum chain speed (V) of 100 rpm (2.41m/sec), riddle speed of 4.63V rpm and riddle inclination of 7^0 gave the highest undamaged (98%), lowest damagd and losses tubers (1.5 and 0.5%).

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تطوير آلة حصاد بطاطس لتناسب المزارع المصرية

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تعتبـــر عملـــية الحصـــاد من أهم مشاكل محصول البطاطس والتى تعتبر من أهم محاصيل الخضر الرئيسية فى مصر،نظرا لأرتفاع تكاليف الحصاد بالطريقة اليدوية وزيادة نسبة الدرنات التالفة والمفقـــودة فى الحصاد الآلى،وللتغلب على هذه المشاكل أجرى هذا البحث بتطوير آلة حصاد بطاطس لتناســب العمل فى المزارع المصرية تحت ظروف التربة الطينية الخفيفة. وقد تم إجراء تجربة أولية للآلة وذلك لتحديد أنسب مسافة بين السلاح والحصيرة مستخدما المسافات (٥ – ٨ – ١١سم) ، ثم تم دراسة تأثير العوامل الهندسية التالية:السرعة الأمامية للآلة مستخدما السرعات (١,٥– ٢,٣– ٣,١ كم / ســـاعة)،زاوية ميل السلاح مستخدما الزوايا (٨° – ١٤° – ٢٠°) ،سرعة الحصيرة (V) مستخدما للســـرعات {١٠٠(V_1)–١٣٠(V_2)–١٦٠(V_3) لفة/دقيقة(٢,٤١–٣,١٣–٣,٨٥متر/ثانية) }،السرعة الدورانـــية لجهـــاز الفصل مستخدما السرعات (V٢,٤٠– V٣,١٦– V٤,٦٣ لفة/دقيقة) ،زاوية ميل جهـــاز الفصـــل مســـتخدما الـــزوايا (٥° – ٧° – ٩°)على نسبة الدرنات الظاهرة(السليمة والتالفة) والمدفـــونة(المفقـــودة) كمـــا تم حساب القدرة اللازمة للآله وتكاليف الحصاد الآلى ومقارنته بالحصاد اليدوى.

وقد أوضحت نتائج الدراسة أن أفضل العوامل الهندسية لتشغيل آلة حصاد البطاطس المعدلة و التـــى تحققـــت عـــندها أعلى نسبه للدرنات السليمة وأقل نسبة للدرنات التالفة والمفقودة والتى يوصى باســـتخدامها عند لجراء الحصاد الآلى تحت نفس الظروف هى سرعة أمامية للآلة٢,٣٠ كم / ساعة، زاوية ميل السلاح ١٤ °، ومسافة بين السلاح والحصيرة ٥سم، وسرعة الحصيرة (V) ١٠٠لفة/دقيقة (٢,٤١متر/ثانية)، وسرعة جهاز الفصلV٤,٦٣ ، وزاوية ميل جهاز الفصل ٧ °.

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