J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 5 (2):189 – 202 , 2014

THE USE OF PEANUT DIGGER MACHINE IN SUGAR BEET HARVESTING TO MAXIMIZE THE UTILIZATION OF THE MACHINE

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ABSTRACT

This research aimed to study the possibility of using peanut digger machine for lifting sugar beet and investigate some operating parameters such as forward speed, digging depth and vibrating fork affecting on the performance of digger machine to maximize the utilization of the machine. The study was carried out in Port-Said Research Station, Port-Said Governorate, during April 2012. The use of a digger machine not only reduces the cost and time of the lifting operation, but also improved the soil properties as the result of deep digging, as well as increasing productivity of the next crop. The results indicated that increasing forward speed from 1.6 to 3.7 km/h led to increase the average of roots losses percentage from 2.7 to 4.1 and from 2.7 to 4.0% with vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm. Increasing digging depth from 15 to 25 cm tends to decrease the average of roots losses percentage from 3.8 to 2.7% and from 3.8 to 2.9% for vibrating and non-vibrating fork, respectively at forward speed ranged of 1.6 to 3.7 km/h. The least roots losses percentage 2.0 and 2.1% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm with vibrating and non-vibrating fork, respectively. The height roots cleaning percentage 97.45 and 91.3% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively.

INTRODUCTION

Sugar beet is one of the most important cash crops on which large industry depend on. The cropping area of sugar beet has been increasing. Large distillation mills have been establishing that depend on sugar beet as raw material. Several industries that convert the sugar beet by-products into economical and commercial products also established. The area planted with sugar beet increases rapidly because farmers prefer it as cash crop. Several problems have been facing the expansion of sugar beet cropping area. The most critical problems related to the mechanization of sugar beet harvesting operations. Full mechanization of sugar beet harvesting may not be applicable or economic in more than 90% of our field conditions. Partial mechanization has not been well established to fabricate the proper sugar beet harvesting machinery. Technology of mechanized harvesting of sugar beet consists of two basic functions: topping and lifting roots or pulling roots together with leaves. Additional functions are cleaning of roots from soil and gathering them of leaves. Up till now, sugar beet harvesting is still carrying out in Egypt manually by hand digging, pulling the roots out of the soil by shovel and hoe, or by a chisel plow.

Kang and Halderson (1991) designed and tested a two row vibrating blades, digger for the effect of amplitude of vibration, frequency of vibration and travel speed on potato and sugar beet damage and draught requirements. Travel speed was the most dominant factor for all variable measured. Amplitude affected shatter bruise. Tubers were very susceptible to shatter bruise by vibration and travel speed.

Sharobeem et al. (2003) developed and manufactured suitable equipment for harvesting sugar beet roots. The experiments were carried out to evaluate the performance of the constructed harvester compared with the traditional chisel plow. The results showed that for the developed harvester, the maximum harvesting efficiency was 84% at 2.0 km/h forward speed and the minimum damage roots was 4.5% at the same speed. The maximum percentage of lifted roots was about 88.5% with the developed harvester, while that obtained with chiseling was 76.4%. The actual filed capacities were 0.6, 0.9 and 1.14 fed/h at forward speed of 2.0, 3.0 and 3.8 km/h, respectively for the developed harvester. While, Morad et al. (2007) studied manual and mechanical methods of harvesting sugar beet crop. The results indicated that the maximum lifting efficiency and minimum total losses were 93.98% and 8.31% obtained under mechanical planting and sugar beet harvester compared with manual planting method which recorded 92.73% and 10.39%, respectively.

Bahnas (2006) tested the Moroh beet lifter and cleaner machine to examine the required operational factors of the mechanical sugar beet harvesting in the reclaimed lands. The highest beets lifting efficiency (95%) was recorded at forward speed of 2.5 km/h, lifting depth of 0.30 m and share lifter tilt angel of 25°. While the lowest mechanical damage losses of 1.12% was obtained at forward speed of 1.23 km/h and the previous lifting conditions. Nabel et al. (2010) developed an imported sugar beet harvesting machine. They found that, the maximum field capacity, field efficiency, lifting efficiency and total damage were 1.0 fed/h, 93.8%; 95.7% and 2.81% respectively at harvesting speed of 4.14 km/h harvesting depth of 0.2 m and soil moisture content of 17.6 w.b.

Toth (1991) tested the Matrol-M-31 self-propelled harvester which can perform topping, root lifting, cleaning and loading of sugar beet from 6 rows. Test results showed that the harvesting losses remained under 3% and root damage under 15% at 3.5-6.4 km/h operating speed. In the same aims, Rybar (1989) analyzed the vibratory lifter of sugar beet harvesters. The results showed that the quantity of grossly and un-harvested beet was related to crop conditions and depth of lifting but did not depend on the frequency and amplitude of vibrations at harvest speed of 3.6 km/h.

Zaalouk (1994) modified the 7-blades chisel plow and designed a fork lifter to be used with chisel plow for sugar beet harvesting. The result indicated that the performance of the designed fork lifter was satisfactory in general, since the average damage was 0.66 and 1.53% with and without topping, respectively. And un-lifted roots were 4.06 and 5.41% with and without topping, respectively. For the modified shanks chisel plow with wing lifter, the averages of damage were 4.21 and 3.6% with and without topping, respectively. The averages of unlifted roots were 6.70 and 8.61% with and without topping, respectively.

Abdel-Galeil (1990) developed suitable harvester for Egyptian farms. He reported that the percentages of lifted tubers were increased by increasing forward speed from 1.8 to 2.8 km/h. While these percentages were decreased by increasing the forward speed more than 2.8 km/h. On the other hand, the continuous increasing of forward speed from 1.8 to 3.8 km/h increased the damaged tuber percent from 1.53 to 2.67%. Mady (1995) designed and constructed a sugar beet harvester. The highest percentages obtained were 96.64% for lifted roots, 95.6% for undamaged roots and 92.27% for harvester efficiency, while the percentage for bruised roots, cut roots and un-lifted roots were 2.1, 2.3 and 3.36%, respectively at lifted wheel diameter of 71 cm; lifter wheel angle of 40°; tilt angle of 25°; forward speed of 1.9 km/h and spinner rotary speed ranged from 40-50 rpm. Increased forward speed from 1.9 to 3.6 km/h led to increased the bruised roots from 3.5 to 4.0%

Abd-Rabou (2004) manufactured a machine used for harvesting sugar beet. He pointed out that the highest value of topping efficiency was 98.1% at soil moisture content of 22.93% wb, forward speed of 0.55 m/s, knife speed of 5.89 m/s (450 rpm) and leaves holder speed of 3.53 m/s (225 rpm). While, the lowest value of damage roots was 3.4% at moisture content of 28.3% wb, forward speed of 0.55 m/s, leaves holder speed of 2.36 m/s (15 rpm) and knife speed of 5.89 m/s (450 rpm). Elyamany et al. (2012) manufactured sugar beet harvester prototype machine suit for topping and lifting of sugar beet in one process. The results showed that the uprooting efficiency was agreed reversely with forward speed and soil moisture content. While, it was directly with topping knife speed. The maximum value of lifting efficiency was 92.6% recorded at forward speed of 2.16 km/h and soil moisture content of 18% w.b.

The aim of this study to study the possibility of using peanut digger machine in sugar beet lifting and cleaning operations and investigate some operating parameters such as forward speed, digging depth and vibrating fork affecting on the performance of digger machine to maximize the utilization of the machine.

MATERIALS AND METHODS

This study was carried out at Port-Said Research Station, Port-Said Governorate, during harvesting season of 2012 (during April 2012). The experimental tests done at clay soil texture and the soil specification are listed in Table (1). A Top multi germ sugar beet (TERI variety, EU-HUNGARY) was manually planted. The harvesting operation was carried out through soil moisture contents of 19.6% wb.

Table (1): The mechanical analysis of the soil.

Soil composition, %				
		Sand, %		Soil texture
Clay, %	Silt, %	Coarse	Fine	
45	26	4.1	24.9	Clay

The digger specifications

The specifications of the digger (lifter and cleaner) machine used in the study were overall width of 200 cm, share long of 140 cm, share width of 20 cm and overall mass of 260 kg.

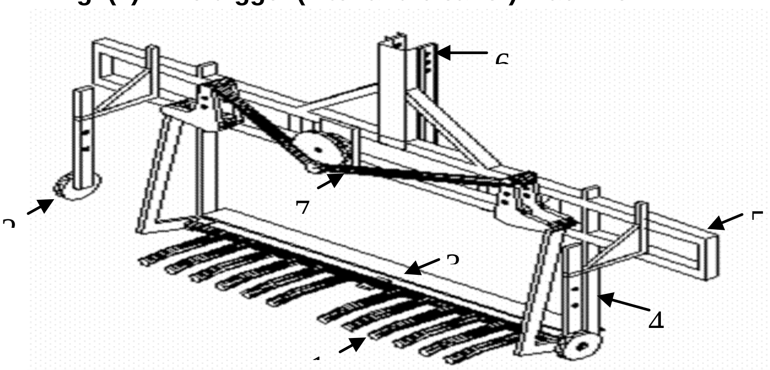
Lifting and cleaning sugar beet operation

The SIMON digger (lifter and cleaner) machine as shown in Figs. (1) and (2) was illustrated to lift and clean sugar beet. The digger includes a share has dimension of 140 cm long and 20 cm width. A vibrating fork fixed at the rear of the share, include two shafts on the straight line. On each shaft six iron bars (28 cm long) were fixed on the shape of fork. The vibrating fork moves up and down, it takes the motion from the tractor rear PTO of 540 rpm.

Tractor specifications

The main specifications of the experimental tractor were model of NEWHOLLAND 110-90, 6 cylinders, diesel engine, 4 wheel drive, max. engine output of 89.55 kW and rear PTO of 540 / 1000 rpm. Measured fuel consumption rate was 9.5 l/h (according to the local calibration in agricultural mechanical station of Port Said).

Fig. (1): The digger (lifter and cleaner) machine.



1- Vibrating fork, **2- wheel adjustment depth,** **3- Digging share,**
4- Beam, **5- Frame,** **6- Hitch adjustment, and**
7- Transmission rod of the vibrating motion.

Fig. (2): Schematic diagram of the sugar beet digger

Properties of sugar beet

Some physical and mechanical properties of sugar beet are summarized and listed in Table (2) according to Kromer et al. (2004).

Table (2): Some properties of sugar beet.

Physical properties:	Range	Mechanical properties:	Range
Length, mm		Coefficient of friction	$0.46^{\pm 0.24}$
- beet	$21^{\pm 139}$	Coefficient of elasticity	$3.085^{\pm 0.275}$
- leaves	$425^{\pm 325}$	Cutting resistance, N/mm^2	$0.685^{\pm 0.395}$
Diameter, mm	$105^{\pm 65}$	Pressure required to drag out, N/mm^2	$0.445^{\pm 0.255}$
Mass, g	$975^{\pm 825}$	Pressure required to break off tail, N/mm^2	$0.12^{\pm 0.03}$
Density, kg/m^3	$1075^{\pm 75}$	Pressure that causes damages of beet during rooting up, N/mm^2	$3.5^{\pm 0.5}$
Bulk density, kg/m^3	$560^{\pm 40}$		

Investigated variables

Four different tractor forward speed levels (1.6, 2.4, 3.1 and 3.7 km/h), are used during the experimental work, three different digging depth levels of 15, 20 and 25 cm, with vibrating and non-vibrating movements are also employed.

Sugar beet seeds

Multi germ beet variety (TERI) was manually planted at flat bed, at 70 cm raised bed spacing, 20 cm between hills in the row.

Harvesting methods

Harvesting operation has been applied in two stages as follows:

1- Removing the vegetative tops: this operation was carried out manually by hand using hand tools before lifting operation by five labors per feddan and two other labors to transport outside of the field

2- Lifting and cleaning sugar beets: these operations were carried out mechanically using the digger (lifter and cleaner) machine.

Traditional method

The traditional (manual) harvest method was carried out as follows

1- Lifting the roots from the soil by 4 labors per feddan.

2- Removing the vegetative top portion at the desired height and separating the roots from foreign materials by 15 labors per feddan.

In the traditional harvest methods, 4 labors per feddan carried out the clean beets consolidation out-side the field and conducted the beets deposition in a track.

Soil moisture content

The moisture content was determined by comparing the mass of a sample before and after drying at 70 ^oC for 48 hours, in an electrical oven. Soil moisture content can be determined using the following formula:

$$MC = [(m_1-m_2) / m_1] \times 100 \quad (1)$$

Where:

MC = Moisture content, %, wb.;

m_1 = Sample mass before drying, g; and

m_2 = Sample mass after drying, g.

The bruised roots percentage (B_r)

It was calculated randomly for area of 6 m^2 according to the following equation:

B_r = [M1 / M] x 100 (2)

Where:

M1= the mass of each bruised roots, kg; and

M = total mass of lifted sugar beet roots, kg

The cut roots percentage (C_r)

It was calculated according to the following equation:

C_r = [M2 / M] x 100 (3)

Where:

M2 = the mass of cut roots, kg

The undamaged roots percentage (Ur)

It was manually lifted by hand digging for area of 6 m^2. The undamaged roots percentage was calculated according to the following equation:

U_r = [M3 / M] x 100 (4)

Where:

M3 = the mass of undamaged roots, kg

The percentage of beet losses (Ulr)

The percentage of un-lifted sugar beet roots (Ulr) were manually lifted by hand digging for the same mentioned area of 6 m^2. The percentage of un-lifted sugar beet roots were calculated according to the following equation:

ULr = [m / Mt] x 100 (5)

Where:

Mt = the mass of total roots (lifted and un-lifted roots), kg; and

m = the mass of un-lifted sugar beet roots in, kg

The cleaning percentage (CLr)

It was calculated according the following equation:

CLr = [(w1) / (w1 +w)] x 100 (6)

Where:

w_1 = the soil mass removing from the roots of sample, kg; and

w = the soil mass of un-removed soil, kg.

The digger (lifter and cleaner) machine efficiency

The digger (lifter and cleaner) machine efficiency (E) was calculated according to the following equation:-

E = [100 – (B_r% + C_r% +UL_r %)] (7)

Energy requirements

Specific machine energy requirements, (SME) were estimated according to Bahnas (2006) as follows:

SME = (11.41 X FC) / AFC MJ / fed. (8)

Where:

FC = the fuel consumption, l/h;

11.41 = the transformation coefficient; and

AFC = the actuel field capacity, fed /h.

Actuel field capacity
It was calculated according the following equation
AFC = 1 / ATT fed/h; (9)
Where:
ATT = the actual total time in hours required per feddan.

Statistical analysis of data

The SPSS statistical package, version 10.0 (SPSS Inc., Michigan, USA), was used for the statistical analysis. Bivariate correlations analysis was done to establish the significance of differences in both forward speed and digging depth as dependent parameters and cut roots, bruised roots, and undamaged roots as independent parameters.

RESULTS AND DISCUSSION

The bruised roots percentage

Fig. (3) shows the effect of different forward speeds, different digging depths and different vibrating movements on the bruised roots percentage. The results indicated that, there is a positive relationship between the forward speed and bruised roots percentage. On the other hand, there is an inverse relationship between the digging depth and bruised roots percentage. Increasing forward speed from 1.6 to 3.7 km/h lead to increase the average of bruised roots percentage from 2.15 to 3.65% and from 2.34 to 3.9% with vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm. Decreasing digging depth from 25 to 15 cm tends to increase the average of bruised roots percentage from 2.7 to 3.1% and 2.9 to 3.4% at forward speed ranged of 1.6 to 3.7 km/h for vibrating and non-vibrating fork, respectively.

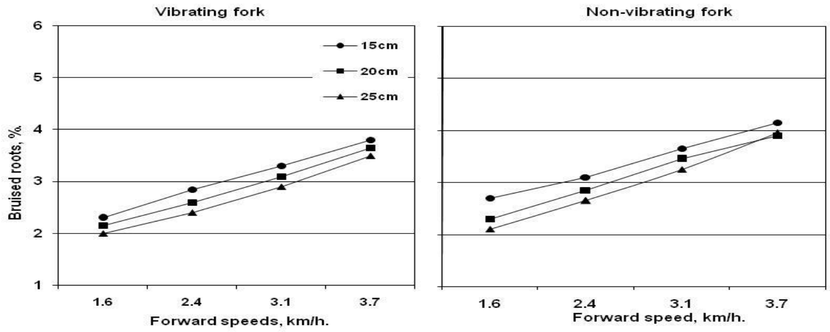


Fig. (3): Effect of different forward speeds and different digging depths on bruised roots percentage.

The height bruised roots percentage 3.8 and 4.15% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively. The least bruised roots percentage 2.0 and 2.1% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm with vibrating and non-vibrating fork, respectively. Using vibrating fork has non-significant effect on the bruised roots as compared for non- vibrating fork. This result may be attributed to vibrate of machine above and low with high speeds subsequently caused high damaged.

The cut roots percentage

Results presented in Fig. (4) show the effect of different forward speeds, different digging depths and different vibrating movements on the cut roots percentage. The results indicated that, increasing cut roots percentage at any increase of forward speed. On the other side, decreasing cut roots percentage at any increase of digging depth. For example increasing forward speed from 1.6 to 3.7 km/h lead to increase the average of cut roots percentage from 1.9 to 3.8% and from 2.25 to 3.9% for vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm.

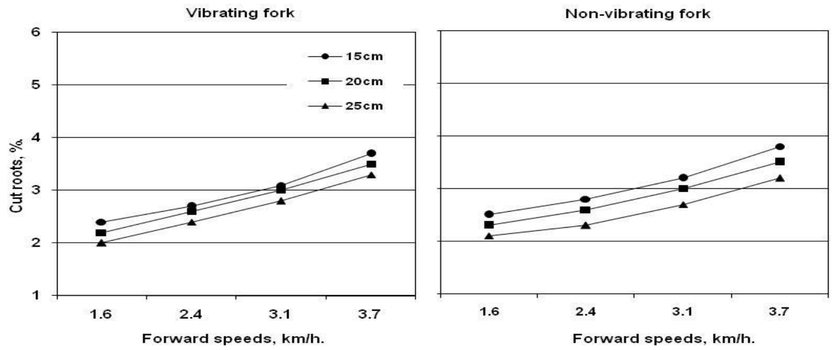


Fig. (4): Effect of different forward speeds and different digging depths on the cut roots percentage.

The decreasing digging depth from 25 to 15 cm tends to increase the average of cut roots percentage from 2.5 to 3.1% and 2.7 to 3.3% at forward speed ranged of 1.6 to 3.7 km/h, respectively. The height cut roots percentage 4 and 4.1% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm at vibrating and non-vibrating fork, respectively. The least cut roots percentage 1.6 and 2.0% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm for vibrating and non-vibrating fork, respectively. Using vibrating fork has non-significant effect on the cut roots as compared with non- vibrating fork. This result may be attributed to vibrate of machine above and low with high speed subsequently caused high cut roots. High speed subsequently caused high cut roots.

The undamaged roots percentage

Data presented in Fig. (5) indicated that increasing forward speed and decreasing digging depth lead to decrease the undamaged roots percentage. Increasing forward speed from 1.6 to 3.7 km/h lead to decrease the average of undamaged roots percentage from 96.0 to 92.6% and from 95.45 to 92.6% for vibrating and non-vibrating fork, respectively.

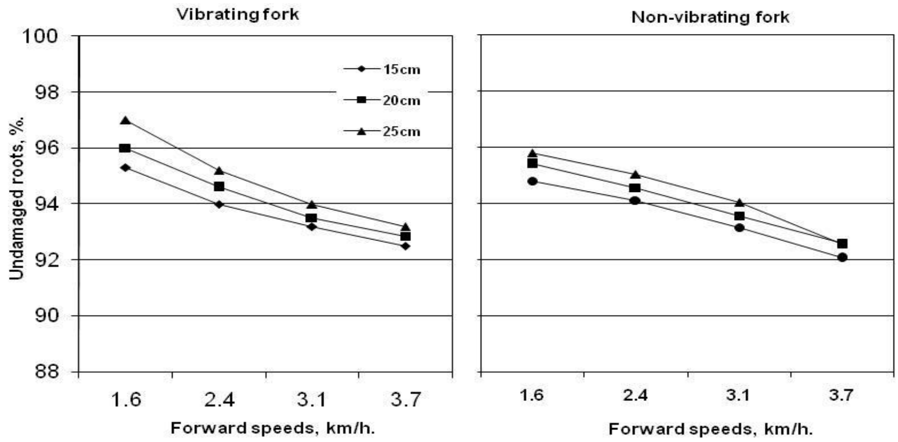


Fig. (5): Effect of different forward speeds and different digging depths on the undamaged roots percentage.

Increasing digging depth from 15 to 25 cm tends to increase the average of undamaged roots percentage from 93.4 to 94.8 and from 93.4% to 94.6% for vibrating and non-vibrating fork, respectively. The height undamaged roots percentage 96.4 and 95.9% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm for vibrating and non-vibrating fork, respectively. The least undamaged roots percentage 92.2 and 91.75% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm at vibrating and non-vibrating fork, respectively. The using vibrating fork has non-significant effect on the undamaged roots as compared with non-vibrating fork.

The percentage of beet losses

The effects of different forward speeds, different digging depths and different vibrating movements on the losses of roots percentage are shown in Fig. (6). The obtained results revealed that, there is a positive relationship between the forward speed and roots losses percentage.

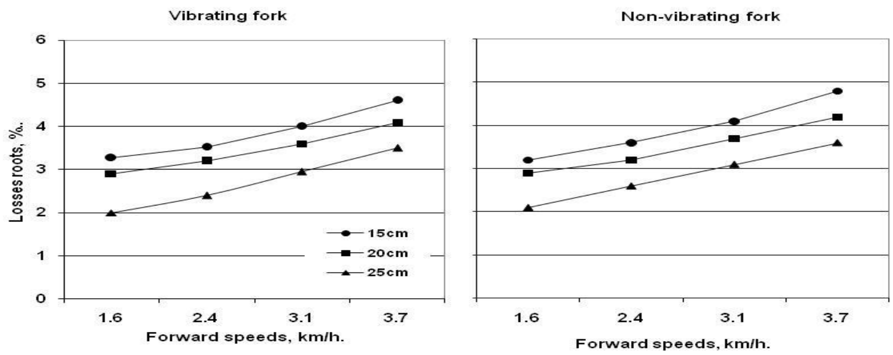


Fig. (6): Effect of different forward speeds and different digging depths on the losses of roots percentage.

Data shown that there is an inverse relationship between the digging depth and roots losses percentage. Increasing forward speed from 1.6 to 3.7 km/h lead to increase the average of roots losses percentage from 2.7 to 4.1 and from 2.7 to 4.0% with vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm. Increasing digging depth from 15 to 25 cm tends to decrease the average of roots losses percentage from 3.8 to 2.7% and from 3.8 to 2.9% for vibrating and non-vibrating fork, respectively at forward speed ranged of 1.6 to 3.7 km/h. The height roots losses percentage 4.6 and 4.5% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively. The least roots losses percentage 2.0 and 2.1% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm with vibrating and non-vibrating fork, respectively. Using vibrating fork has non-significant effect on the roots losses as compared with non- vibrating fork. This result may be due to vibrate of machine up and down with high speeds tends to lift some of roots inside the soil.

The cleaning percentage

Fig. (7) shows the effect of different forward speeds, different digging depths and different vibrating movements on the cleaning percentage. The results indicated that, there was a significant affect of forward speed for vibrating fork on the roots cleaning percentage. Meanwhile, there were a significant affect of forward speed and digging depth on the roots cleaning ratio under non-vibrating. Increasing forward speed from 1.6 to 3.7 km/h lead to increase the average of roots cleaning percentage from 91.8 to 96.1% and from 83.7 to 89.4% for vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm. Increasing digging depth from 15 to 25 cm lead to decrease the average of roots cleaning percentage from 95.3 to 92.2% and from 88.2 to 85.0% for vibrating and non-vibrating fork, respectively at forward speed ranged from 1.6 to 3.7 km/h. The height roots cleaning percentage 97.45 and 91.3% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively.

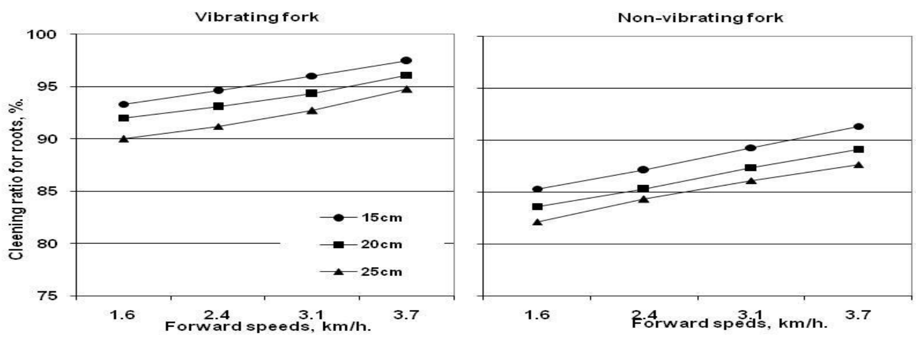


Fig. (7): Effect of different forward speeds and different digging depths on the cleaning percentage.

The lowest roots cleaning percentage 90% and 82.2% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm for vibrating and non-vibrating fork, respectively.

The digger (lifter and cleaner) machine efficiency

Fig. (8) demonstrates the effect of different forward speeds, different digging depths and different vibrating movements on the machine efficiency. It reveals that decreasing forward speed from 3.7 to 1.6 km/h lead to increase the average of machine efficiency from 88.7 to 93.3 and from 88.1 to 92.65% for vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm. Increasing digging depth from 15 to 25 cm tends to increase the machine efficiency from 90.2 to 92.0% and 89.2 to 91.5% for vibrating and non-vibrating fork, respectively at forward speed ranged from1.6 to 3.7 km/h. This result refers to reduce the percent of damaged roots and roots losses by increasing forward speed and decreasing digging depth. The height machine efficiency 94.4 and 93.8% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm for vibrating and non-vibrating fork, respectively. The lowest machine efficiency 88 and 87.25% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively.

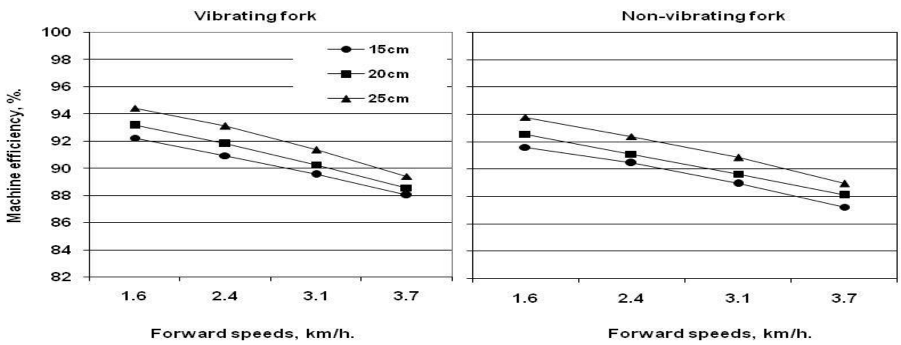


Fig. (8): Effect of different forward speeds and different digging depths on the machine efficiency.

Actual field capacity

The results have shown the effect of forward speed on actual field capacity. The actual field capacities were 1.89, 1.24, 0.97 and 0.81 h/fed at forward speeds of 1.6, 2.4, 3.1 and 3.7 km/h, respectively.

Energy requirements

The obtained data also show the effect of machine field capacity on energy requirements. The energy requirements were 193.8, 126.8, 99.7 and 83.4 MJ/fed at actual field capacities of 1.89, 1.24, 0.97 and 0.81 h /fed, respectively.

The Pearson correlation coefficient for measurements as affecting by different forward speeds, different digging depths and different vibrating movements are listed in Table (2).

As shown in Table (2) there are many significant correlations between the studied parameters such as forward speed with cut roots, bruised roots, cleaning ratio and energy requirements were as an order of positive correlation (0.01 level) at vibrating and non-vibrating movements, respectively; meanwhile as an order of negative correlation (0.01 level) with undamaged roots and machine efficiency at vibrating and non-vibrating movements, respectively.

While, Digging depth with roots losses was as an order of negative correlation (0.05 level) at vibrating and non-vibrating, respectively; meanwhile cleaning ratio was an order of negative correlation (0.05 level) at vibrating only.

Whilst, digging depth with energy requirements were as an order of positive correlation (0.05 level) at non-vibrating only.

Table(3):The Pearson correlation coefficient for measurements as affecting by different forward speeds, different digging depths and different vibrating movements.

Measurements	Vibrating motion	Digging depth	Forward speed
Cut roots	vibrating	-0.283	0.947**
	Non-vibrating	-0.411	0.889**
Bruised roots	vibrating	-0.256	0.960**
	Non-vibrating	-0.263	0.955**
Undamaged roots	vibrating	0.342	-0.927**
	Non-vibrating	0.296	-0.938**
Roots losses	With vibrating	-0.668*	0.719**
	Non-vibrating	-0.621*	0.769**
Machine efficiency	vibrating	0.407	-0.903**
	Non-vibrating	0.422	-0.898**
Cleaning percentage	vibrating	-0624*	0.769**
	Non-vibrating	-0.520	0.849**
Energy requirements	vibrating	0.530	0.841**
	Non-vibrating	0.625*	0.771**

*** Correlation is significant at the 0.05 level.**
**** Correlation is significant at the 0.01 level.**

CONCLUSION

The result in the present study could be summarized in the following conclusion:

1- Increasing forward speed from 1.6 to 3.7 km/h led to increase the average of roots losses percentage from 2.7 to 4.1 and from 2.7 to 4.0% with vibrating and non-vibrating fork, respectively at digging depth ranged from 15 to 25 cm.

2- Increasing digging depth from 15 to 25 cm tends to decrease the average of roots losses percentage from 3.8 to 2.7% and from 3.8 to 2.9% for vibrating and non-vibrating fork, respectively at forward speed ranged of 1.6 to 3.7 km/h.

3- The least roots losses percentage 2.0 and 2.1% were obtained at forward speed of 1.6 km/h and digging depth of 25 cm with vibrating and non-vibrating fork, respectively.

4- The height roots cleaning percentage 97.45 and 91.3% were obtained at forward speed of 3.7 km/h and digging depth of 15 cm for vibrating and non-vibrating fork, respectively.

5- Energy requirements were 193.8, 126.8, 99.7 and 83.4 MJ/fed at actual field capacities of 1.89, 1.24, 0.97 and 0.81 h /fed, respectively.

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استخدام آلة حصاد الفول السودانى فى عملية حصاد بنجر السكر لتعظيم الاستفادة من الآلة

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أجريت هذة الدراسة فى نطاق محطة البحوث الزراعية ببورسعيد (اراضى جنوب محافظة بور سعيد) فى أراضى طينية القوام بهدف دراسة إمكانية استخدام آلة حصاد الفول السودانى فى عمليتى رفع وتنظيف بنجر السكر لتعظيم الاستفادة من الآلة وكذلك دراسة تأثير بعض العوامل المؤثرة على آداء آلالة.

أجريت التجارب الحقلية عند أربع سرعات أمامية للآلة وهى ١.٦ ، ٢.٤ ، ٣.١ ، ٣.٧ كم/ساعة مع ثلاث أعماق للحفر وهى ١٥ ، ٢٠ ، ٢٥ سم مع حركتين لجهاز الاهتزاز (شوكة هزازة وبدون شوكة هزازة).

أثبتت التجارب نجاح ألة حصاد الفول السودانى فى إجراء عمليتى الرفع (التقليع) والتنظيف لبنجر السكر وذلك يعظم الاستفادة من الآلة ، حيث يختلف ميعاد حصاد محصول الفول السودانى عن ميعاد حصاد محصول بنجر السكر.

وكانت النتائج كالأتى:-

١-زيادة السرعة الأمامية للألة من ١.٦ الى ٣.٧ كم/ساعة أدت الى زيادة الجذور المخدوشة ، الجذور المكسورة ، الجذور المفقودة بنسبة ٦٩.٨ ،٥٢.٥٩ ، ٣٣.٢% على التوالى.

٢-تقليل عمق الحفر من ٢٥ الى ١٥ سم أدى الى زيادة الجذور المخدوشة ، الجذور المكسورة ، الجذور المفقودة بنسبة ١٣.٣ ، ١٦.٣٦ ، ٢٧.٨% على التوالى.

٣-استخدام الشوكة الهزازة أثناء الحصاد مع زيادة السرعة الأمامية للآلة من ١.٦ الى ٣.٧ كم/ساعة وتقليل عمق الحفر من ٢٥ الى ١٥ سم أدى الى زيادة نسبة النظافة للجذور بما يعادل ٩.٢٣ ، ٨.٤% على التوالى.

٤-السعة الحقلية الفعلية كانت 1.89 ،1.24 ، 0.97 و ٠.٨١ ساعة / فدان عند السرعات الامامية 1.6،2.4 ، 3.1 و 3.7 كم / ساعة على التوالي.

٥-متطلبات الطاقة اللازمة كانت 193.8 ،126.8 ، 99.7 و 83.4ميجاجول/ فدان عند سعات حقلية فعلية مقدارها 1.89،1.24 ، 0.97 و ٠.٨١ ساعة / فدان، على التوالي.

قام بتحكيم البحث

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