LIST OF CONTENTS

Page No.

Page No.

Page No.

6. SUMMARY AND CONCLUSION

Sugar beet is one of the most important crops, not only for sugar production, but also for producing fodder and organic matter for the soil. Mechanical sugar beet harvesters are not common in Egypt, manual methods are exhaustive, and impractical. Sugar beet harvesting is carried out in Egypt manually by hand digging, pulling the roots out by shovel and hoe, or by using a chisel plow to dig out and collecting the roots manually. Mechanical harvesting of sugar beet resulted in drastic reduction of 86 % in hard labor required for harvested beet and up to 69 % in cost of harvest.

The main objectives of the present study may be summarized as follows:

1- To manufacture a combine machine from the local materials to suit the lifting, topping and collecting operations of sugar beet roots in one process.

2- To evaluate the performance of the fabricated combine machine under the Egyptian condition using the available power tiller on farms.

3- To evaluates the effect of forward speed, leaves holder speed, knife speed an various soil moisture content on the following factors. Lifting and topping efficiency, total damaged roots (cut and bruise damage), harvesting efficiency, effective field capacity, specific fuel consumption, power and energy requirements, draft force requirements and cost harvesting,

General specifications of the manufactured machine which used for harvesting sugar beet were 240 cm total length, 110 cm total width and 300 kg total mass,. The technical specifications of the machine parts which used for harvesting sugar beet crop are root lifting unit, beet conveyer unit, leaves removing unit, beet elevator, beet collecting tank and power transmission system. The machine was fabricated with locally available materials at the Manufacture Center of Kafr El –Sheikh. A 60 hp Nasr tractor drew it and the power was transmitted from the tractor to the machine gearbox through the P.T.O. shaft. The experiment was carried out at Almorabin village, Kafr El–sheikh Governorate during agricultural season of 2002 – 2003, the sugar beet (Beta poly) was used and the total planted area was about 4 feddans.

The variables under study were as follows:

a- Four levels of forward speeds (0.55, 0.69, 0.86 and 1.06 m /s).

b- Four level of leaves holder speeds of 2.36 (150), 2.83 (180), 3.53 (225) and 4.71 (300) m/s (r.p.m).

c- Four level of knife speeds of 2.95 (225), 3.67 (280), 4.91(375) and 5.89 (450) m/s (r.p.m).

d- Four level of soil moisture content of 28.30, 25.62, 22.93 and 18.60 % (w.b.).

The study revealed the following results:

1- Lifting efficiency (%) :

It was noticed that as the soil moisture content decreased from 28.30 to 22.93 % (w.d.) the lifting efficiency increased from 96.5 to 98 %, at forward speed of 0.55 m/s and holder speed of 2.36 (150) m/s (r.p.m). Decreasing the soil moisture content from 22.93 to 18.60 % tends to decrease the lifting efficiency from 98 % to 95.0 % at the same conditions. Increasing the forward speed from 0.55 to 1.06 m/s tends to decrease lifting efficiency from 98.4 to 96.5 % at 25.62 % soil moisture content and leaves holder speed of 4.71 (300) m/s (r.p.m). The highest lifting efficiency of 98.9 % was obtained at 22.93% soil moisture content, 0.55 m/s forward speed and leaves holder speed of 4.71 (300) m/s (r.p.m).

2- Topping efficiency,(%):

By increasing forward speed the topping efficiency decreased. The topping efficiency values were 97.20, 96.56, 95.77 and 94.50 % at forward speeds of 0.55, 0.69, 0.86 and 1.06 m/s, respectively, soil moisture content of 22.93, %, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s(r.p.m).Increasing the leaves holder speed from 3.53 (225) to 4.71 (300) m/s (r.p.m) tends to decrease the topping efficiency at soil moisture content of 28.30,%, different knife speed, forward speed 0.55 and 0.69 m/s. Because increasing leaves holder speed with decrease the forward speed tends to difficulty of keeping the lives beet adjusted with the conveyer beet unit. It is clear that, increasing the knife speed and decrease the forward speed tends to increase topping efficiency. The topping operation are included on the over topping and under topping.

3- Total damaged roots (cut and bruise damage) (%) :

Increasing knife speed and decrease the forward speed tends to decrease total damaged roots. While, increasing leaves holder speed tends to increase total damaged roots. It is clear that, increasing forward speed from 0.55, 0.69, 0.86 and 1.06 m /s tends to increase the total damaged roots from 4.51, 4.80, 5.10 and 5.40 % at soil moisture content of 22.93 %, leaves holder speed 2.36 (150) and knife speed 2.95 (225) m/s (r.p.m), respectively. The highest value of the total damaged roots of 6.2 % was obtained at soil moisture content of 18.60 %, forward speed of 1.06 m /s, leaves holder speed of 4.71 (300) and the knife speed of 2.95 (225) m/s (r.p.m). Therefore, the lowest value of the total damaged 3.4 % was obtained at soil moisture content 28.30 %, forward speed of 0.55 m /s,

leaves holder speed of 2.36 9150) and knife speed of 5.89 (450) m/s (r.p.m).

4- Harvesting efficiency (%) :

It was found that increasing forward speed from 0.55, 0.69, 0.86 and 1.06 m /s reduce the harvester efficiency from 93.49, 92.40, 91.40 and 89.90 % at soil moisture content of 22.93 %, leaves holder speed 2.36 (150) and knife speed 2.95 (225) m/s (r.p.m). The percentage of harvesting efficiency increased by decreasing the soil moisture content from 28.30 to 22.93 % and decreased by decrease the soil moisture content from 22.93 to 18.60 %,. While the soil moisture content of 22.93 % may be attributed to dynamic effect leads to pulverize the soil by the lifter and helps the roots to be lifted over the soil surface, accordingly the impact and friction in the soil decrease. The highest value of the harvesting efficiency of 94.52% was obtained at soil moisture content 22.93 %, forward speed of 0.55 m /s, leaves holder speed of 3.53 (225) and knife speed of 5.89 (450) m/s (r.p.m). The lowest value was 84.55, % at soil moisture content of 18.60 %, forward speed of 1.06 m / s , leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m) .

5- Effective field capacity (fed/h) :

The forward speed tends to increase the effective field capacity. The effective field capacity values were 0.23, 0.260, 0.290 and 0.320 at forward speeds of 0.55, 0.69, 0.86 and 1.06 m/s, respectively, soil moisture content of 28.30 %, leaves holder speed 2.36 (150) and knife speed 2.95 (225) m/s (r.p.m). The results showed that the highest value of the effective field capacity was 0.376 fed / h at soil moisture content of 22.93 %, forward speed of 1.06 m /s, leaves holder speed of 4.70(300) and knife speed of 5.89 (450) m/s (r.p.m). And the lowest value was 0.230 fed/h at soil moisture content of 28.30 %, forward speed of 0.55 m /s, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m). Therefore, the effective field capacity generally decreased because the machine is one row only. The results indicated that, there was high significant effect of the forward speed, leaves holder speed, knife speed on effective field capacity and significant effects for the interaction between forward speed, leaves holder speed and knife speed.

6- Specific fuel consumption (l/kW.h) :

The results showed that increasing the forward speed, leaves holder speed and knife speed tends to decrease the specific fuel consumption. It was found that the obtained values of the rate of specific fuel consumption were 0.416, 0.411, 0.405 and 0.394 l/kW.h. at soil moisture content of 28.30 %, forward speed of about 0.55, 0.69, 0.86 and 1.06 m

/s, respectively, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m).While the specific fuel consumption decreased by decreasing the soil moisture content from 28.30 to 22.93 % (w.b). The results showed that, the highest specific fuel consumption of 0.416 l/kW.h, was obtained at soil moisture content of 28.30 %, forward speed of 0.55 m /s, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m). While the lowest amount requirement of 0.358 l/kW.h, was obtained at soil moisture content of 22.93 %, forward speed of 1.06 m /S, leaves holder speed of 4.71 (300) and knife speed of 5.89 (450) m/s (r.p.m) was obtained.

7- Power requirements, (kW) :

Increasing forward speed from 0.55, 0.69, 0.86 and 1.06 m/s tends to increase the energy requirement from 9.97, 10.52, 11.56 and 12.47 kW at soil moisture content of 22.93,leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m). While increasing leaves holder speed from 2.36 (150) to 4.71 (300) m/s (r.p.m) tends to increase the energy requirement from 14.40 to 16.62 kW at soil moisture content of 22.93, forward speed of 1.06 m/s and knife speed of 5.89 (450) m/s (r.p.m). Also, the results indicated that the highest energy requirement of 18.84 kW was obtained at soil moisture content of 18.60 %, forward speed of 1.06 m /s, leaves holder speed of 4.71(300) and knife speed of 5.89 (450) m/s (r.p.m).

8- Energy requirements (kW.h. /fed):

It was found that increasing forward speed from 0.55, 0.69, 0.86 and 1.06 m/s tends to decrees the energy requirement from 39.88, 37.61, 37.29 and 36.68 at soil moisture content of 22.93%, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m). The highest energy requirements of 56.18 kW.h/fed was obtained at soil moisture content of 28.30 %, forward speed of 0.55 m /s, leaves holder speed of 4.71 (300) and knife speed of 5.89 (450) m/s (r.p.m). The lowest amount energy requirements of 36.68 kw.hr. /fed was obtained at soil moisture content of 22.93 %, forward speed of 1.06 m /s, leaves holder speed of 2.36 (150) and knife speed of 2.95 (225) m/s (r.p.m).

9 – Draft force requirements, (kN) :

The result indicated that, decreasing the soil moisture content from 28.30, 25.62 and 22.93 tends to decrease the draft force from 3.7,3.1 and 2.7 kN at forward speed 0.55 m/s and 3.20 kN at soil moisture content 18.6,% . The highest draft force requirements 5.25 the forward speed 1.06 m/s and soil moisture content of 28.30,% . And the lowest draft force of 2.7 kN at forward speed 0.55 m/s and soil moisture content 22.93,%

(w.b.). It can be noticed that increasing forward speed from 0.55 to 1.06 m/s tends to increase draft force from 3.7 to 5.25, 3.1 to 4.60, 2.70 to 4.30 and 3.20 to 4.80 kN at soil moisture content of 28.30,25.62, 22.93 and 18.60.

10 – Cost harvesting (L.E./fed):

Increasing the leaves holder speed from 2.36 (150) to 4.71 (300) m/s (r.p.m) tends to decrease the cost of harvesting from 36.41 to 33.34 L.E./fed at soil moisture content of 28.30, %, forward speed of 1.06 m/s and knife speed of 5.89 (450) m/s (r.p.m). It can be noticed that increasing the knife speed from 2.95 (225) to 5.89 (450) m/s (r.p.m) tends to decrease the cost of harvesting from 34.91 to 34.30 L.E./fed at soil moisture content of 22.93 %, forward speed of 1.06 m/s and leaves holder speed of 2.36 (150) m/s (r.p.m). The cost of harvesting decreased by increased forward speed, leaves holder speed and knife speed .The highest value of the harvesting cost 51.6 L.E / fed at soil moisture content of 28.30, forward speed 0.55 m /s, leaves holder speed 2.36 (150) and knife speed 2.95 (225) m/s (r.p.m). Mechanical harvesting resulting in drastic reducation of 95 % in labor requirement per feddan and up to 80 % of total cost for sugar beet harvesting.

Several multiple regression equations were obtained and can be used to predicting the lifting efficiency, topping efficiency, total damaged roots, harvesting efficiency, effective field capacity, fuel consumption, energy requirement, draft force and cost harvesting.

The optimum parameters may by summarized as fallows :

1-The optimum soil moisture content was 22.93 % (w.b.).

2- The optimum leaves holder speed was 3.53 m/s (225 r.p.m) at forward speed of 0.55,0.69 m/s and 4.71 m/s (300 r.p.m) at forward speed 0.86, 1.06 m /s.

3- The optimum forward speed was 0.55 m /s.

4- The optimum the knife speed was 5.89 m/s (450 r.p.m).

5- The highest value of lifting efficiency was 98.9 % at soil moisture content 22.93 %, forward speed 0.55 m /s and leaves holder speed of 4.71 m/s (300 r.p.m) .

6-The lowest value of damaged roots, was 3.4 % at soil moisture content of 28.30 %, forward speed of 0.55 m /s, leaves holder speed of 2.36 m/s (150 r.p.m) and knife speed 5.89 m/s (450 r.p.m) .

7- The highest value of topping efficiency was 98.1 % at soil moisture content of 22.93 %, forward speed of 0.55 m/s, knife speed of 5.89 m/s (450 r.p.m) and leaves holder speed of 3.53 m/s (225 r.p.m) .

8- The highest value of harvester efficiency, was 94.52 % at soil moisture

content of 22.93 %, forward speed of 0.55 m /s, knife speed of 5.89 m/s (450 r.p.m) and leaves holder speed of 3.53 m/s (225 r.p.m) .

9- The highest value of effective field capacity, was 0.376 fed / h at soil moisture content of 22.93 %, forward speed of 1.06 m /s, knife speed of 5.89 m/s (450 r.p.m) and leaves holder speed of 4.71 m/s (400 r.p.m).

10- The lowest value of specific fuel consumption, was 0.358 l /kW.h. at soil moisture content of 22.93 %, forward speed of 1.06 m/s, knife speed of 5.89 m/s (450 r.p.m) and leaves holder speed of 4.71 m/s (300 r.p.m) .

11-The lowest value of energy requirements was 36.68 kW.h/fed at soil moisture content of 22.93 %, forward speed of 1.06 m /s, knife speed of 2.95 m/s(225 r.p.m) and leaves holder speed of 2.36 m/s(150 r.p.m).

12-The lowest value of cost harvesting, was 31.56 L.E./fed at soil moisture content of 22.93 %, forward speed of 1.06 m /s, knife speed of 5.89 m/s (450 r.p.m) and leaves holder speed of 4.71 m/s (300 r.p.m)

13- The machine harvesting resulting in drastic reeducation of 95 % in labor requirement per feddan and up to 80 % of total cost for sugar beet harvesting .

The future objectives that can be studied in this subject:

1- To study the possibility of sugar bee harvester usage in harvesting root and tuber crops such as potato and sweet potato.

2 – To study the addition possibility of self- propelled unit for this machine to decrease the power unit requirements.

3 – To study the manufacturing of this machine in a big scale because it is suitable for the majority of the Egyptian small holdings and it decreases the total operational cost.