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THE TRIANGLE BELT PROVIDED WITH SPOONS TO PLANT POTATO TUBER WITH SPROUTS

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ABSTRACT

The triangle belt vertical metering device of potato planter was constructed and tested to plant potato tubers with previously grown sprouts. The theoretical investigation was carried out to determine the factors affecting the free falling high of tuber during exiting from metering device. Reviewing the different configurations of potato planters, especially automatic machinery, found in the literature as well as the inspection of physical and mechanical properties of tubers with growing buds indicated that possible methods might be most suitable for planting sprouting potato tubers. The constructions of the developed potato planter prototype are mainly: tuber hopper; triangle belt conveyor; the feeding spoons and vibration mechanism. The general trend of tuber void relationship was the percentage of tuber void (v_t%) increased with the increase of planting speed and vibration system ratios. The maximum value of (v_t%) was 6.5% at land wheel speed of 14 rpm and vibration system ratio of 5.2 recorded for category in-between 50-80g, and the minimum value of (v_t%) was 0.9% at land wheel speed of 8 rpm. and vibration system ratio of 10.4 recorded for category 30-50g.

Keywords: planter, potato device, tuber pieces planter and sprouts systems analysis of potato feeding.

INTRODUCTION

Potato is ranked as one of the most important vegetable crops in Egypt. Although, the increase of the yield from 8.34 ton/fedd. in 1986 to 10.50 ton/fedd. in 2000 (Egyptian Ministry of Ag.), the production does not meet the dramatic increase of population and exportation. At the same time, special attention must be given to establish a new suitable technique for potato planting as an important operation influencing the yield. There is a trend towards planting tuber pieces of potato with previously grown sprouts. Increasing productivity of potato in a shorter period is the main goal, which can be achieved by using suitable technology. In fact, the development of a reliable potato planter to suit the prevailing Egyptian conditions still needs more attention, since there is shortage in the suitable machinery design, especially for planting potato tubers with growing buds.

Bouman (1996) tried to pre-germinate potato cv. Bintje tubers sorted to 35-45 mm (a) in small boxes with a capacity of 15 kg; in stacked trays (3.0 X 1.5 m, with 12 cm spacers between trays to admit light) with (b) plastic sheeting or (c) gauze on the bottom of the trays and the tubers in layers 8 cm deep; or (d) in suspended sacks made of plastic webbing, where 32 sacks contained about 4 Mg. of tubers. The number of sprouts per tuber averaged 4.8; 4.1; 4.2 and 4.1 for the four systems, respectively, and machine planting of these tubers led to 19.3; 8.0; 9.9 and 13.2% damaged sprouts respectively.

Carlsson (1990) studied the effects of different sprouting times and conditions, different numbers of sprouts, different planting equipment and pre-sprouting at different latitudes. He showed that the best sprouts (short, tough and 5-10 mm long) were obtained with a pre-sprouting time of 40-50 days at

8°C and 100 flux. Yield was not affected unless >80% of the sprouts were removed. When hand planting was compared with a fully automatic planter, there was little damage to sprouts using either method, and yield differences were small. In the final set of trials, potatoes were pre-sprouted at 6 different latitudes between 56 and 64°N. He cleared that the cultivars used were Bintje, King Edward, Provita, Bellona and Redbad. Pre-sprouting had a better effect on yield and quality in the North than in the South, with the highest benefit being found in Provita and the lowest in King Edward.

Gupta, et al. (1994) compared the workability of a developed single-row power tiller-operated potato planter with a manual traditional method. They reported that the effective field capacity of the developed planting machine at an optimum speed of 1.33 km/h was about 0.04 ha/h., with average field efficiency was about 60%. They added that using that machine reduced 45 and 90% the costs and labor requirements for planting potatoes respectively, compared to the manual traditional method.

Sherif and Chaudhry (1982) reported that mechanical planting of small seed tubers (35-45 mm) and halves of large seed tubers (45-60 mm) are more efficient and labour saving than the planting of large seed tubers. The weight of small and halves of large size seed tubers planted per hectare was 28 and 43% less than the large seed tubers. Sprouting time and tuber yield was significantly affected by the potato cultivars. Sprout emergence and tuber yields were not affected by the seed tuber sizes.

Culpin (1986) classified potato planters into two categories namely semi-automatic and automatic planters. He added that generally, automatic potato planters are working at a higher speed level more than the other category (Semi-automatic). Therefore, the choice of automatic or semi-automatic potato planters depend on the farm size and the available labor of the system. He concluded that the design of cup-feed planter type is a slow-moving belt with a double row of cups for each row of potatoes. This type is usually mounted on two-row planters. The 4-row planter is either trailed or mounted but the 6-row planters are normally trailed. Another type from this category is the "conveyer belt" which improves the metering process by employing a slow-moving transfer belt in the early stage of movement from the hopper and a positive arrangement of the tubers in compartments near the delivery point.

Ismail (in Arabic Ref., 1991) offered another classification for the potato planters according to the metering mechanism type. His classification includes four categories. Those are picker power wheels, chain-cup, belt cup, and belt-spoons. He added that any metering mechanism of the above mentioned categories could be occupied into any trailed, or semi-mounted, or even mounted planter types. In addition, few researchers investigated for planting tuber with growing buds. They recommended that, sprouts should be 5-15 mm long, tough and colored, and attached firmly to seed tubers. They denoted that, losses of up to 20% of sprouts will not reduce potato yield. (Scholz - 1984) and Hamad et al., 1994). Therefore, the aim of this paper is to develop, and to evaluate a vertical triangle belt metering device mechanize of potato planter to suit the planting operation of sprouted tuber with lowest sprout damage.

MATERIALS AND METHODS

The developed planter prototype (vertical triangle belt metering device), is mainly consisting of the following components as shown in Figure (1).

Tuber hopper

A rectangular feeding hopper made of iron sheet (1.5mm thick.) is designed to facilitate the tuber feeding to an elevator belt (belt conveyor) passing through vibration unit. The sides of the hopper are also sloped gradually by an angle great than the angle of repose of the tuber to keep a continuous flow rate of tubers. The hopper also includes a changeable-lid to permit the product to roll out of the discharge point of the hopper slowly and uniformly. Rubber sheets pad all the sides of the hopper to reduce the damage of impact between tubers and hopper sides. To avoid the free falling of tubers from the hopper bottom at the outlet chamber, a cylindrical tube is joined to the hopper bottom. That tube is 80mm in diameter and 140mm in height. That dimensions was regarded to be more than the distance between two sequence cells.

Belt conveyer

The belt conveyor is made of 162 mm endless flat flax fibers belt. A set of spoons are distributed on an equal distances along the belt to pick the tubers from the chamber room. The belt runs over three free rotating rollers, the first roller is laid at the bottom of the chamber room, and fixed to the main frame by two changeable bolts for adjusting the belt tension. The second roller is fixed at the top of Furrow opener and connecting to a small sprocket of (15 teeth). The third roller is fixed above the first roller and fixed to the main frame also by two changeable bolts as shown in Figure (2). The main specifications of the belt conveyor are 162 mm in length, 110 mm in width, 6 mm in thickness, number of spoons (12), 110 mm is the length of drum and 100 mm is the diameter of rotating drum.

Feeding Spoons

The feeding spoons on the belt conveyor are made of iron metal. These spoons are covered from outside with sponge layer to reduce sprouts damage. Each spoon is turgid to pick and carry an individual tuber from the hopper and towards it to the land surface. The developed spoons shape and dimensions are depended on the physical properties of the tested tubers. They are arranged on the belt circumference at an equal distance of 0.135 m.

The vibration mechanism

The vibration mechanism is equipped down the hopper and consists of a small cam, connecting rod and free moving surface (200mm × 200mm) equipped with hopper bottom by means of two hinges. The used cam has numerous speed ratios to get multi vibration frequencies (Figure 3).

Power transmission system

The transmission system is adapted to get a tuber space in row about 23cm. For preventing slip a chain-sprocket transmission system is used to transmit the motion from the planter wheel (D=440mm) to both feeding mechanism and the vibration mechanism. The designed transmission system consists of land wheel, wheel shaft, main gear, sprocket, main shaft and the conveying chain of the vibration mechanism. A schematic diagram of the horizontal metering mechanism planter prototype is shown in Figure(4) while, Figure (1) shows the fabricated vertical metering mechanism.

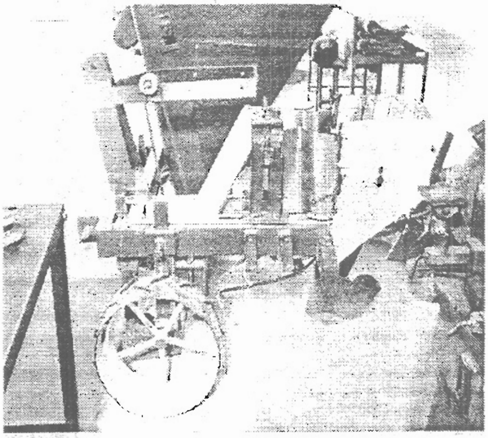

Figure (1): The developed potato planter

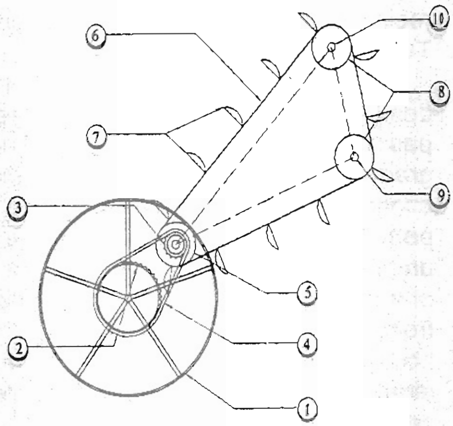

Figure (2): Belt conveyor components

1- Land wheel 2- Sprocket (39 teeth) 3- Sprocket (15 teeth) 4- Chain 5- The Driver roller 6- Flat flax fibers belt 7- Spoons 8-rollers 9-10- Shaft

Performance Evaluation of Potato Tubers Planting Methods

The tuber depositing processes are concerned to evaluate the vertical potato device. The tuber deposing performance has been evaluated in terms of the uniformity of the tuber void ratio, tuber double ratio, distribution uniformity of the tuber in row, tuber sprouts damage % and tuber metering out ratio. The digital video camera *(Benq 1300)* with high resolution was used to follow and measure the tuber seed deposing performance.

1- Tuber void ratio (Tv, %)

The tuber void ratio was estimated for each treatment by counting the number of spoons that have no tubers (B_n) and counting the number of the used spoons in each treatment per certain time (M). Then the percentage of voids was computed using the following equation (Ismail in Arabic Ref., 1991).

$$Tv,\% = \frac{B_n}{M} * 100 \quad \ldots(1)$$

2- The tuber double ratio (Td %)

The tuber double ratio could was estimated for each treatment by counting the number of spoons that have more than one tuber(A_n) and counting the number of the used spoons in each treatment per certain time (M). Then the percentage of tuber doubles ratio can be calculated as follows:

$$Td,\% = \frac{A_n}{M} * 100 \quad \ldots(2)$$

3- The distribution uniformity of tuber seed in row (UH, %)

The uniformity of the tuber seed in row could be considered as the third indicator for the seed disposing performance. It was estimated by calculating the tuber void ratio (Tv) and the tuber double ratio (Td). Then the percentage of the uniformity of the tuber seed in row can be calculated as follows:

$$UH.\% = 100 - (Tv,\% + Td.\%) \quad (3)$$

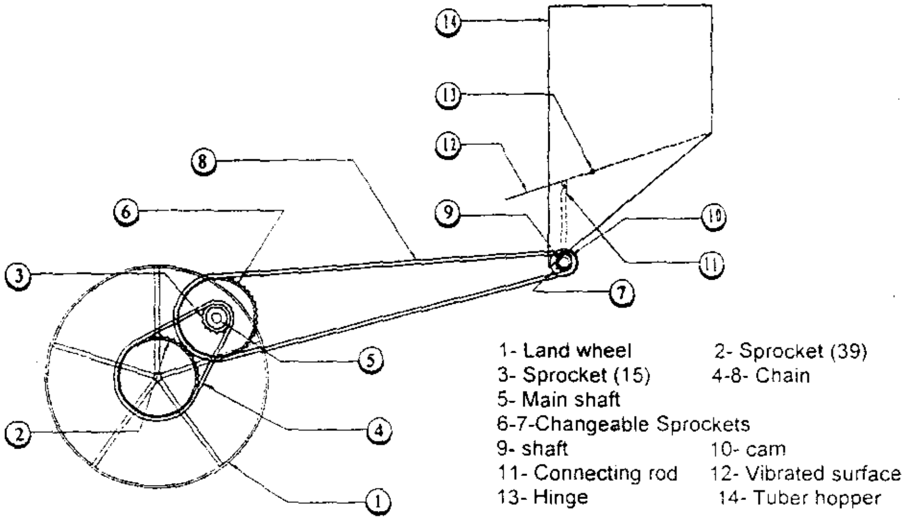

Figure (3): The main components of vibration mechanism.

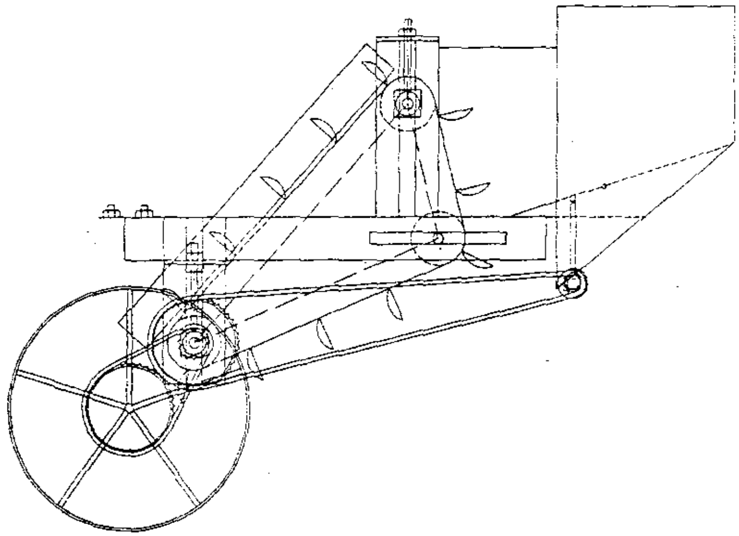

Figure (4): A schematic diagram of the vertical triangle mechanism.

4- The tuber sprouts damage ratio (Ts, %)

The tuber sprouts damage ratio was estimated for each treatment by counting the number of tubers that have damaged sprouts (S_D) and counting the number of all falling tubers in each treatment (S_A). Then the percentage of sprout damage sprouts was calculated from the following equation:

$$Ts, \% = \frac{S_D}{S_A} * 100 \quad \text{.......... ....(4)}$$

5- The tuber metering out ratio (To, %)

The tuber out ratio was estimated for each treatment by counting the number of all falling tubers (T_F) and counting the number of all spoons or cups in each treatment (S). Then the percentage of out ratio was calculated as follows:

$$To, \% = \frac{T_F}{S} * 100 \quad \text{.......... ....(5)}$$

6- Statistical Analysis

The obtained data for Vertical Metering Mechanism of potato tubers were analyzed using program of ***Microsoft Excel*** in Department of Agriculture Engineering, Faculty of Agriculture, Mansoura University.

Theoretica Investigation

The vertical triangle belt metering mechanism conveys the tuber to furrow, which get out with angle "β". This angle depended not only on engineering parameters for vertical triangle device but also shape and the size of tubers. The potato tubers differ considerably one from another in diameters and their surface is highly irregular, then let us consider the tuber with spherical shape which having diameter (d_t). Angle of tuber out "β" for the vertical triangle belt metering mechanism can be determined by referring to Fig. (5):

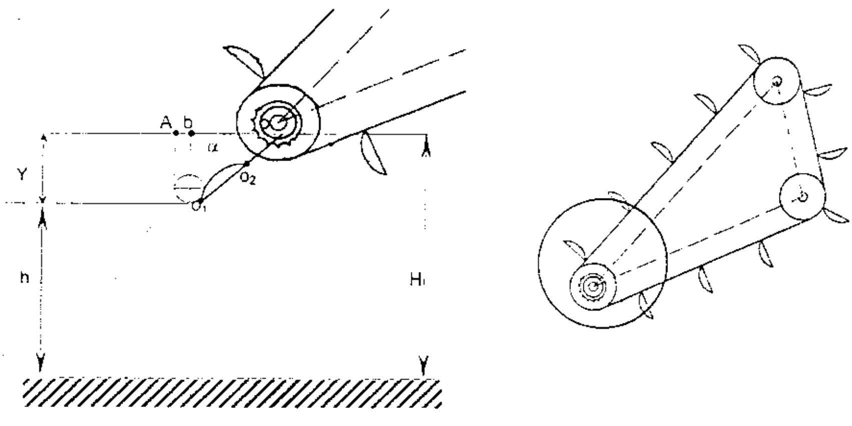

Fig. (5): The moment of the tuber get out from metering device.

$$\cos \alpha = \frac{ob}{oo_1} = \frac{cA - Ab}{oo_2 + o_2o_1}$$

$$\cos \alpha = \frac{(R_{dis} + L) - d_t/2}{R_{dis} + L}$$

$$\alpha = \arccos\left(1 - \frac{d_t/2}{R_{dis} + L}\right)$$

Ismail (1989) found that, the relation between high of free of tuber (h) and planting speed (V_m) may be:

$$h = v_m \cos\beta \times t + (1/2) \times g\, t^2$$

where:

d_t	: diameter of tuber, mm
V_m	: planting speed, m/s
T	: times of tuber drop, s
g	: gravitational constant, m/sand
β	: angle of tuber out from device surface, degree
R_{dis}	: feeding device radius, mm

Then, the time of tuber drop is express as the following form:-

$$t = \frac{v_m \cos\beta \pm \sqrt{v_m^2 \cos^2\beta + 2gh}}{g}\ \text{, sec}$$

From Fig. (1), the tuber drop high (h) may be equal:

$$h = H - y$$

But,

$$y = ob \, . \tan\alpha$$

$$y = (R_{disc} - d_t/2) \times \tan\alpha$$

$$= (R_{disc} - d_t/2) \times \tan(\arc\cos((1 - \frac{d_t/2}{R_{dis} + L}))$$

Then,

$$h = H - \left[R_{disc} - d_t/2) \times \tan(\arc\cos(1 - \frac{d_t/2}{R_{dis} + L})) \right]$$

where:

H	: the total height of tuber dropping. mm
h	:the free height of tuber

Theoretical relation between engineering parameter (β, h, t) and tuber diameter for the feeding disc device is illustrated in diagram Fig. (6). From diagram, angle of tuber out increased with increasing tuber diameter. The maximum of tuber out angle is found at 54° while the operational angle of disc device is 22° 33'. On the other hand, increasing tuber out angle decreases the time of tuber drop while the times of tuber drop increased exponentially with increasing height of free fall of tubers.

RESULTS AND DISCUSSION

Experiments was proceeded to test and evaluate the performance and efficiency (tuber void,%, tuber doubles,%, tuber space uniformity,% and sprout damage,%) of the tuber sprout potato planting machine (vertical metering device) in laboratory under the following different operational conditions:

1. Four speeds of land wheel, 0.18; 0.23; 0.28 and 0.32 m/s (8; 10; 12 and 14 rpm respectively).
2. Two tuber mass categories, (30-50 and 50-80g).
3. Three different vibration system ratios, (5.2; 7.8 and 10.4).
4. Two different levels of tuber hopper gate heights, (8.5 and 9.5 cm).

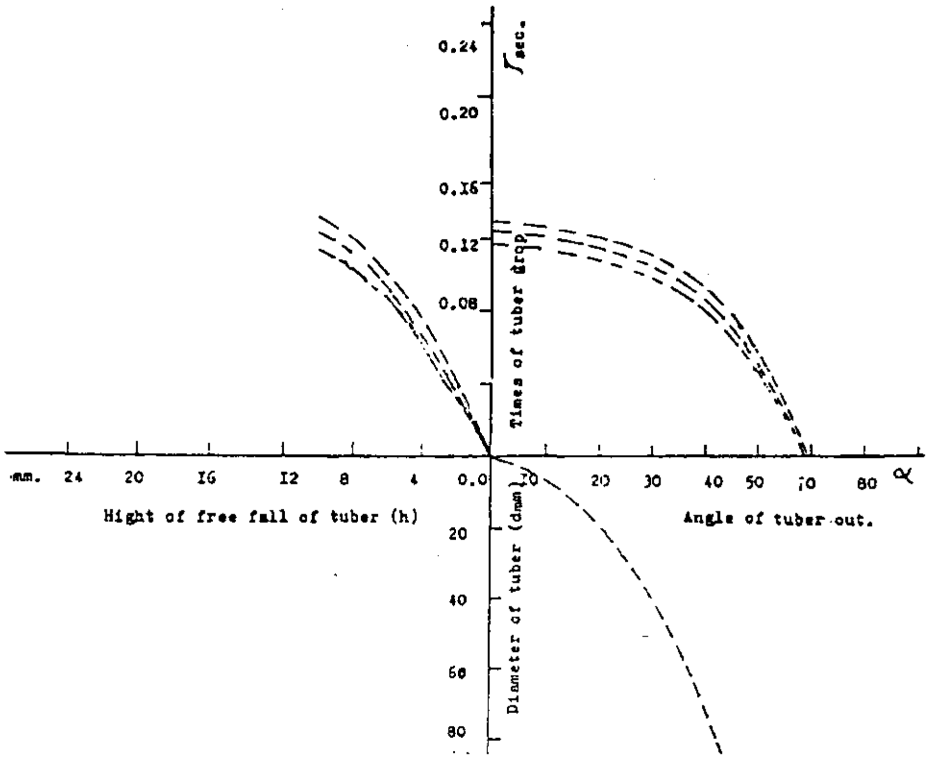

Fig. (6): The theoretical diagram of disc device engineering parameters

1- Tuber void, (V_t,%)

The experimental study on void tuber (V_t,%) was carried out in laboratory to evaluate the performance specification of vertical metering mechanism. The result of tuber void ratio (V_t,%) versus planting speed (rpm) and vibration system ratios are shown in Figures. (7-A) and (7-B).

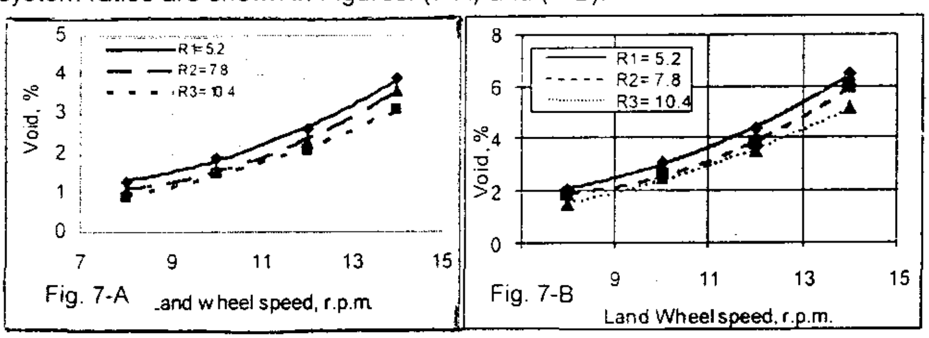

Fig (7): The tubers void as affected by land wheel speeds and vibration ratios.

The general trend of this relationship is that the percentage of tuber voids increase with the increase of planting speed and Vibration System Ratios. It may be noticed that the increasing rates of (V_t,%) for tuber category "50-80g" were more than that for tuber category "30-50g" (Figure 8-A). The maximum value of (V_t,%) for category "30-50g", was 3.9% at land wheel speed of 14 rpm and Vibration System Ratio 5.2, while, the minimum value of (V_t,%) was 0.9% at land wheel speed of 8 rpm and vibration system ratio 10.4.

On the other hand, the maximum value of (V_t,%) for category 50-80 g, as shown in Figure (7-B), was 6.5 % at land wheel speed of 14 rpm and vibration system ratio R= 5.2, and the minimum value of (V_t,%) was 1.5% at Land wheel speed of 8rpm and vibration system ratio (R=0.4).

In addition, the result of tuber void ratio (V_t%) versus land wheel speed (rpm) and heights of hopper gate (H_1 and H_2) was drawn as shown in Figs. (8-A) and (8-B). The general trend of this relationship was the percentage of tuber void increased with the increase of planting speed and the heights of hopper gate. It could be noticed that the increasing rates of (V_t%) of tuber category 50-80 g (Fig. 8-A) were more than these of tuber category 30-50 g.

The maximum value of (V_t%) for category 30-50g, was 3.8% at Land wheel speed of 14 rpm and the gate height 8.5 cm, and the minimum value of (V_t%) was 0.9% at land wheel speed of 8 rpm and the gate height of 9.5 cm.as shown in Fig. 8-A. And for category 50-80g, the maximum value of (V_t%) was 6.4% at Land wheel speed of 14 rpm and the gate height 8.5cm, and the minimum value of (V_t%) was 1 5% at Land wheel speed of 8rpm and the gate height of 9.5 cm (Fig. 8-B).

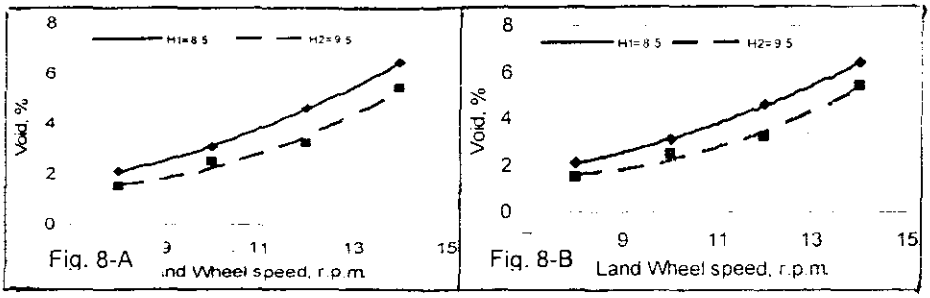

Fig (8): The tubers void as affected by land wheel speeds and the gate heights

In addition, the results of tuber void ratio (V_t,%) versus the vibration system ratios (R_1, R_2 and R_3) and heights of hopper gate (H_1 and H_2) was drawn as shown in Figs. (8-A) and (8-B). The general trend of this relationship was, the percentage of tuber void decreased with the increase of Vibration System Ratios and heights of hopper gate. It could be noticed that the decreasing rates of (v_t, %) of tuber category 50-80 g were more than those of tuber category 30-50 g

For category 30-50 g, (Fig.8-A) the maximum value of (v_t,%) is 2.7% at vibration system ratio 5.2 and gate height 8.5 cm, and the minimum value of (v_t, %) is 1.7 % at vibration system ratio 10.4 and gate height 9.5 cm. And for category 50-80 g,(Fig,8-B) the maximum value of (v_t, %) is 4.5 % at vibration system ratio 5.2 and gate height 8.5 cm, while, the minimum value of (v_t, %) is 2.8 % at vibration system ratio 10.4 and gate height 9.5 cm.

2- Tuber doubles (Td, %)

The experimental study on tuber doubles (Td %) is also carried out in the laboratory. The result of tuber doubles ratio (Td %) versus planting speed (rpm) and vibration system ratios are shown in Fig (10-A) and Fig (10-B). The general trend of this relationship was the percentage of tuber doubles decreased with the increase of planting speed and decreases the vibration system ratios.

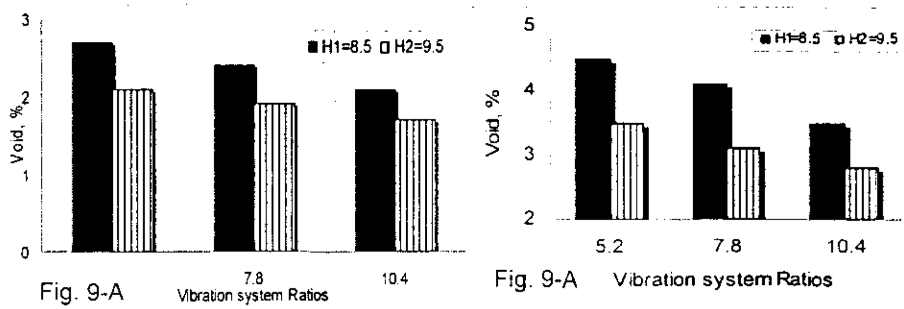

Fig (9): The void, % as affected by gate heights and vibration system ratios.

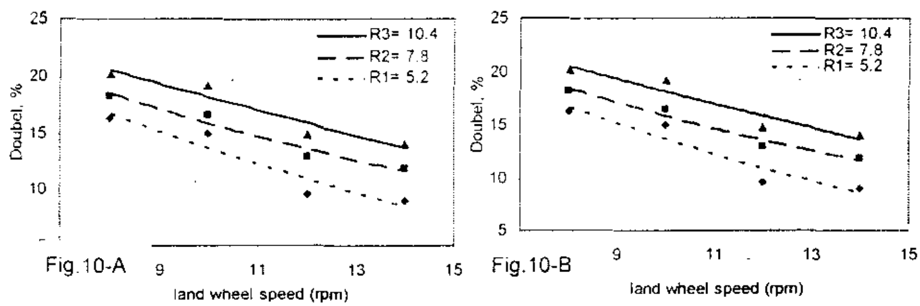

Fig (10): The tubers double as affected by land wheel speeds.

For category 30-50 g,(Fig. 10-A) the maximum value of (Td,%) was 25.3% at Land wheel speed of 8rpm and vibration system ratio of 10.4, and the minimum value of (Td,%) was 11.2% at land wheel speed of 14rpm and vibration system ratio of 5.2. And for category 50-80g, (Fig.10-B) the maximum value of (Td,%) was 20.2% at Land wheel speed of 8rpm and vibration system ratio of 10.4, and the minimum value of (Td,%) was 9% at land wheel speed of 14rpm and vibration system ratio of 5.2.

In addition, the result of tuber doubles ratio (Td,%) versus planting speed (rpm) and heights of hopper gate (H_1 and H_2) was drawn as shown in Figs.(11-A) and (11-B). The general trend of this relationship is, the percentage of tuber doubles decreases with the increase of planting speed and heights of hopper gate. For category 30-50 g. (Fig.11-A) the maximum value of (Td,%) was 28.1% at land wheel speed of 8rpm and gate height of 9.5cm, and the minimum value of (Td,%) was 10.4% at land wheel speed of 14rpm and gate height of 8.5 cm. And for category 50-80 g, (Fig.11-B) the maximum value of (Td,%) was 22.5% at land wheel speed of 8rpm and gate height of 9.5cm, and the minimum value of (Td,%) was 8.3% at land wheel speed of 14rpm and gate height of 8.5cm.

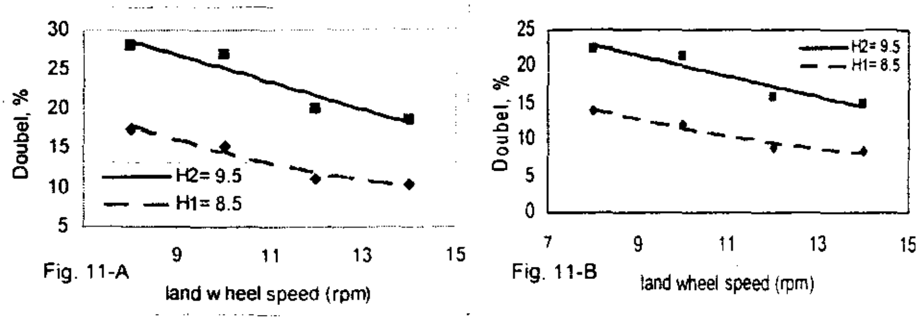

Fig (11): The tubers double as affected by land wheel speeds & gate heights

Also, the result of tuber doubles ratio (Td%) versus vibration system ratios (R_1, R_2 and R_3) and heights of hopper gate (H_1 and H_2) was drawn as shown in Figs.(12-A and 12-B). The general trend of this relationship is, the percentage of tuber doubles increases with the increase of Vibration System Ratios and heights of hopper gate. For category 30-50g, (Fig.12-A) the maximum value of (Td,%) was 27.5% at vibration system ratio of 10.4 and gate height of 9.5cm, and the minimum value of (Td, %) was 11.6% at vibration system ratio of 5.2 and gate height of 8.5cm. And for category 50-80g, (Fig.12-B) the maximum value of (Td,%) was 22% at vibration system ratio of 10.4 and gate height of 9.5 cm, and the minimum value of (Td,%) was 9.3% at vibration system ratio of 5.2 and gate height of 8.5cm.

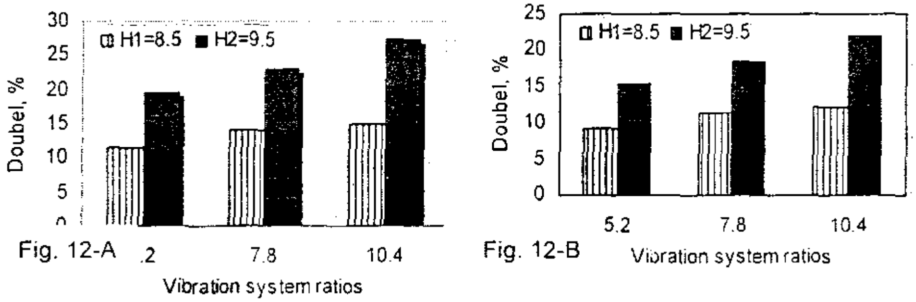

Fig (12): The tubers double as affected by gate heights & vibration system

3- Tuber space uniformity, (UH %)

The tuber space uniformity was calculated by using both, the tuber void ratio and the tuber doubles ratio. The result of tuber space uniformity (UH %) versus planting speed (rpm) and vibration system ratios are shown in Figs. (13-A and 13-B). The general trend of this relationship is that, the percentage of tuber space uniformity increased with the increase of planting speed, and decreases the Vibration System Ratios.

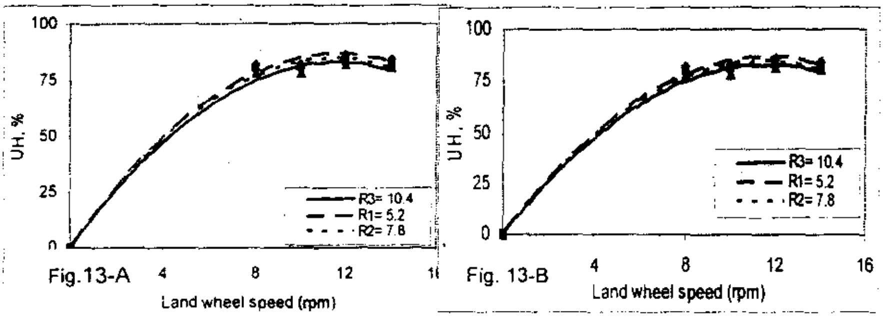

Fig (13): The tubers UH, % via land wheel speeds and Vibration System Ratios

The previous relationship is correct in range from 0 to 12 (rpm) of land wheel speeds (S). However, in case of the land wheel speed exceed 12 (rpm), the relationship between the percentage of tuber space uniformity and the planting speed become reversed. For category 30-50 g,(Fig.13-A) the maximum value of (UH, %) was 85.4% at land wheel speed of 12rpm and vibration system ratio of 5.2, and the minimum value of (UH, %) was 73.86 % at land wheel speed of 8rpm and vibration system ratio of 10.4.

But for category 50-80 g, (Fig.13-B) the maximum value of (UH%) was 86.04 % at land wheel speed of 12 rpm and vibration system ratio of 5.2, and the minimum value of (UH, %) was 78.33 % at land wheel speed of 8 rpm and vibration system ratio of 10.4.

In addition, the result of tuber space uniformity ratio (UH%) versus planting speed (rpm) and heights of hopper gate (H_1 and H_2) was drawn as shown in Figs. (14-A and 14-B). The general trend of this relationship is the percentage of tuber space uniformity increases, with the increase of planting speed and the decrease of the heights of hopper gate. The previous relationship is correct at range from 0 to 12(rpm) of land wheel speeds. However, at case of the land wheel speed exceed 12 (rpm), the relationship between the percentage of tuber space uniformity and the planting speed become reversed.

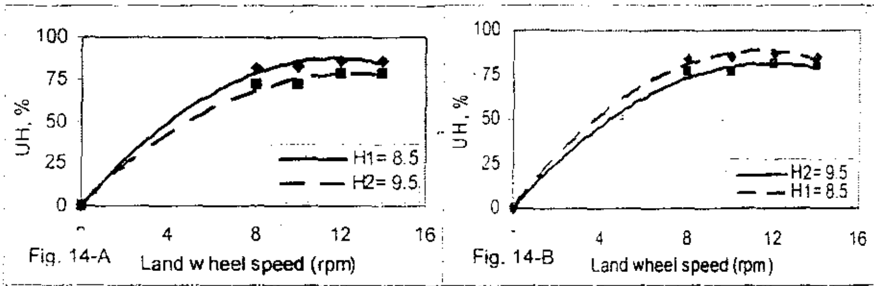

Fig (14): The tubers UH, % as affected by land wheel speeds and gate heights

For category 30-50g, (Fig.14-A) the maximum value of (UH, %) was 86.14 % at land wheel speed of 12 rpm and gate height of 8.5cm, and the minimum value of (UH,%) was 70.96 % at land wheel speed of 8rpm and gate height of 9.5 cm. And for category 50-80 g, (Fig.14-B) the maximum value of (UH, %) was 86.53 % at land wheel speed of 12 rpm and gate height of 8.5 cm, and the minimum value of (UH, %) was 75.97% at land wheel speed of 8 rpm and gate height of 9.5 cm.

In addition, the result of the tuber space uniformity ratio (UH,%) versus vibration system ratios (R_1, R_2 and R_3) and heights of hopper gate (H_1 and H_2) was drawn as shown in Fig (15-A) and Fig (15-B).The general trend of this relationship is, the percentage of tuber space uniformity decreases with the increase of vibration system ratios and heights of hopper gate.

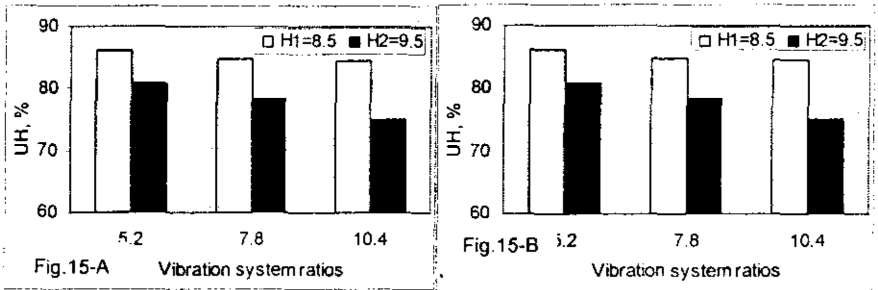

Fig.15-A Fig.15-B

Fig. (15): The tubers UH, % as affected by gate heights and vibration system ratios

For category 30-50g, (Fig.15-A) the maximum value of (UH%) was 85.72% at vibration system ratio of 5.2 and gate height of 8.5cm, and the minimum value of (UH%) was 70.84% at vibration system ratio of 10.4 and gate height of 9.5cm. And for category 50-80g, (Fig.15-B) the maximum value of (UH%) was 86.25% at vibration system ratio of 5.2 and gate height of 8.5cm, and the minimum value of (UH%) was 75.21% at vibration system ratio of 10.4 and gate height of 9.5cm.

4- Sprout damage, (Ts, %)

The result of tuber sprout damage ratio (Ts, %) versus planting speed (rpm) and vibration system ratios are as shown in Figs. (16-A and 15-B). The general trend of this relationship was the percentage of tuber sprout damage increased with the increase of planting speed and vibration system ratios. It could be noticed that the increasing rates of (Ts%) of tuber category 50-80g were more than those of tuber category 30-50g. For category 30-50g, (Fig.16-A) the maximum value of (Ts%) was 5.3% at land wheel speed of 14rpm and vibration system ratio of 10.4, and the minimum value of (Ts%) was 2.5% at land wheel speed of 8rpm and vibration system ratio of 5.2. And for category 50-80g,(Fig.16-B) the maximum value of (Ts%) was 6.3% at land wheel speed of 14rpm and vibration system ratio of 10.4 and the minimum value of (Ts%) was 2.9% at land wheel speed of 8rpm and vibration system ratio of 5.2.

In addition, the result of tuber sprout damage ratio (Ts, %) versus planting speed (rpm) and heights of hopper gate (H_1 and H_2) was drawn as shown in

Fig. (17-A) and Fig. (17-B). The general trend of this relationship was the percentage of tuber sprout damage increased with the increase of planting speed and heights of hopper gate.

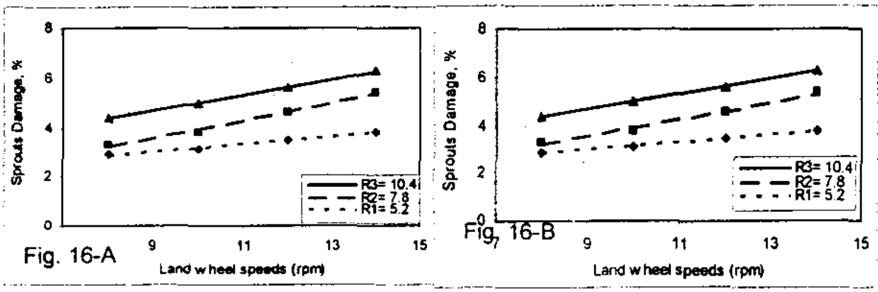

Fig (16): The sprouts damage as affected by land wheel speeds

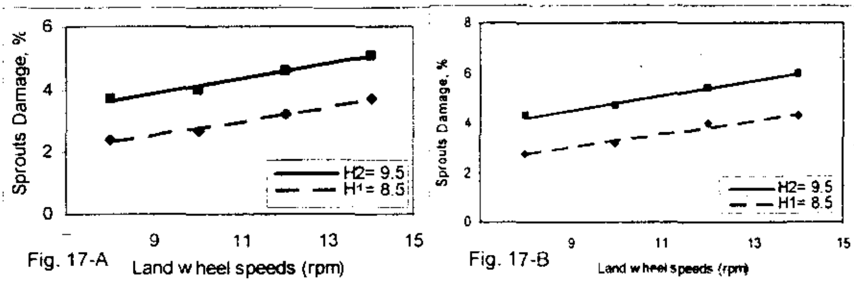

Fig (17): The sprouts damage as affected by land wheel speeds & gate eights

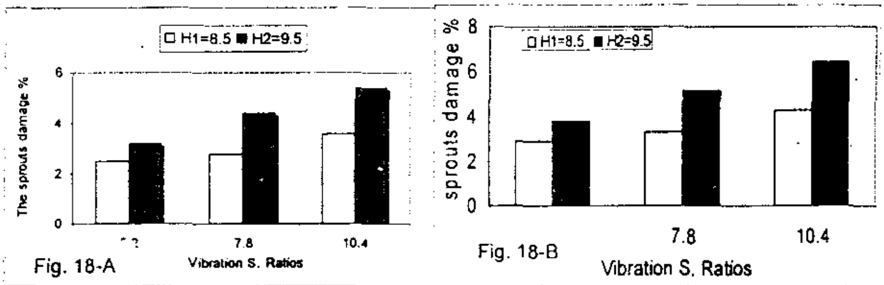

Fig (18): The sprouts damage as affected by gate heights & vibration system

For category 30-50 g, (Fig.17-A) the maximum value of (Ts, %) was 5.1% at land wheel speed of 14 rpm and gate height of 9.5 cm, and the minimum value of (Ts, %) was 2.4% at land wheel speed of 8 rpm and gate height of 8.5 cm. And for category 50-80 g, (Fig.17-B) the maximum value of (Ts, %) was 6 % at land wheel speed of 14 rpm and gate height of 9.5 cm, and the minimum value of (Ts, %) was 2.8 % at land wheel speed of 8 rpm and gate height of 8.5 cm.

Also, the result of tuber sprout damage ratio (Ts%) versus vibration system ratios (R_1, R_2 and R_3) and heights of hopper gate (H_1 and H_2) was drawn as shown in Fig (18-A) and Fig (18-B). The general trend of this relationship is the percentage of tuber sprout damage increases with the increase of vibration system ratios and heights of hopper gate.

For category 30-50 g, (Fig.18-A) the maximum value of (Ts, %) was 5.4 % at vibration system ratio of 10.4 and gate height of 9.5 cm, and the minimum value of (Ts, %) was 2.5 % at vibration system ratio of 5.2 and gate height of 8.5 cm. And for category 50-80 g, (Fig.18-A) the maximum value of (Ts, %) was 6.4 % at vibration system ratio of 10.4 and gate height of 9.5 cm, and the minimum value of (Ts, %) was 2.9% at vibration system ratio of 5.2 and gate height of 8.5 cm.

CONCLUSION

1. Vertical metering mechanism with vibration system method was found to be the best method for planting sprout potato tubers.
2. The designed potato planting machine (vertical metering mechanism with vibration system) can be fabricated in local manufactures with the required specification.
3. The machine (vertical metering mechanism with vibration system) should be used for planting different types of crops such as onion and sweet potato in order to increase its economic value and reduce the planting cost/ton.

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زكريا إسماعيل إبراهيم (١٩٩١): محصول البطاطس (الزراعة ــ الحصاد ــ التداول ــ التخزين) منشأة المعارف بالإسكندرية.

سير مثلث مزود بملاعق لزراعة درنات بطاطس ذات البرعم

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لوحظ وجود عدة مشاكل أثناء استخدام الآلات المستوردة من هذا النوع أهمها مشكلة عدم ملاءمتها لزراعة درنات البطاطس سابقة النمو (التبرعم)، هذا بالإضافة لارتفاع نسبة التلف التي تحققه للبرعم النامي. وربما تعزى مشكلة انخفاض كفاءة الأداء لهذه الآلات المستوردة إلى عدم ملائمة جهاز التلقيم من حيث تصميم فتحة لقط التقاوي واحتكاك الدرنات بجهاز التلقيم وذلك للوصول إلى الجودة العالية في الأداء و رفع وتحسين إنتاجية محصول البطاطس وإمكانية زراعة درنات سابقة النمو مع استخدام التقنيات الآلية الحديثة في مجال ميكنة زراعة محصول البطاطس كان الهدف من هذه الورقة.

المواصفات الأساسية لوحدة التلقيم الرأسي:-

الوحدة تقوم بزراعة البطاطس على مسافات ٢٣سم داخل الخط الواحد و على مسافة ٧٠سم بين كل خطين متجاورين. - جهاز التلقيم على شكل مثلث بحيث يمكن الوصول بنقطة خروج التقاوي إلى أقل ارتفاع سقوط ممكن بالنسبة لسطح الأرض (١٠سم). - جهاز التلقيم مزود بسير ناقل مثبت علية عدد من خلايا لقط الدرنات من نوع الملاعق (١٢ خلية). - صندوق التقاوي مزود بحاجز عرضي بواسطته يمكن التحكم في كمية التقاوي المنصرفة إلى غرفة لقط الدرنات. - صندوق التقاوى مزود بنظام اهتزازى في قاعه يعمل على سهولة تحريك الدرنات إلى غرفة اللقط.

تم إختبار أداء الآلة المطورة تحت ظروف تشغيلية مختلفة من خلال إجراء مجموعة من التجارب المعملية. في هذه المجموعة تم تقييم أداء هذه الآلة المطورة لبعض وظائفها الهامة من حيث نسبة التلف فى البراعم و دقة وانتظامية توزيع التقاوي مع استخدام صنف بطاطس (سيلانى). وكانت عوامل الدراسة لوحدة التلقيم الرأسى:-

- أربع سرعات مختلفة لعجلة الأرض ٠,١٨ و ٠,٢٣ و ٠,٢٨ و ٠,٣٢ م / ث. ٢- مجموعتان وزنيتين من درنات البطاطس و هما ٣٠-٥٠ جرام و ٥٠-٨٠ جرام. ٣- ارتفاعان لبوابة خروج الدرنات من صندوق التقاوى إلى غرفة اللقط. ٤- ثلاث نسب من السرعات للنظام الاهتزازى. وكانت اهم النتائج هي:-
  - انتظام الدرنات: أقصى قيمة كانت ٨٦,٠٤ % و اقل قيم كانت ٧٣,٨٦ %.
  - نسبة الدرنات المزدوجة: كانت اعلى قيمة لها ٢٥,٣ % و أقل قيمة لها كانت ٩ %.
  - نسبة الدرنات الغائبة: وجد أن أقصى قيمة لها كانت ٦,٥ % و اقل قيمة لها كانت ٠,٩ %.
  - نسبة تلف البرعم: وجد أن اعلى قيمة كانت ٦,٣ % و اقل قيمة كانت ٢,٥ %.