

## **MANUFACTURE AND EVALUATION PERFORMANCE OF A GARLIC-CLOVES PLANTER**

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### **ABSTRACT**

The aim of this investigation is to locally manufacturing and evaluate a one row garlic-cloves planter. Field experiments were carried out in salty clay loam soil at the experimental farm of Sakha, Agricultural Research Station Kafr El-Sheikh Governorate. The manufacturing garlic-cloves planter consists of the main frame with three hitching-points, transmission system, two slot weapon planning, feeding device to cover garlic cloves and one-row planting unit. It consists of clove box, vertical disk containing cells of agriculture (A) or (B). cell (A) is a parallelogram dimensions of 4, 2.5 and 2 cm length, width and height, respectively, and closed its aspects except the front side and the front half of the surface and cells (B) is a half-cylindrical shape of 4 cm length, 2 cm radius and closed from the rear side. Small agitators were fixed inside the clove box and operated by means of pulley and V-belt powered from planting disc and ground wheel and transmission shaft to planting disc. The investigated variables of this study were; four different forward planting speeds ( 2.5, 3.2, 4.1 and 5.4 km/h), two various types of cell (A and B) and three different depths of planting (1.5, 4.0 and 6.0 cm). The performance was fudged by missing hills percentage (%), germination percentage (%), productivity (ton/fed), longitudinal scattering (cm), field capacity (fed/h), energy consumed (kW.h/fed) and total cost estimate (L.E./fed). The experimental results reveal that the lowest value of missing hills percentage of garlic was 2.0% which achieved with cell type A at forward speed of 2.5 km/h. The highest value of productivity was (8.55 ton/fed) also obtained with cell type A at forward speed of 2.5 km/h. and planting depth 4 cm. The minimum value of field capacity 0.4 fed/h was recorded at forward speed of 2.5 km/h, and planting depth of 6 cm . The maximum energy consumed of 25.75 kW.h/fed was recorded at forward speed of 2.5 km/h, planting depth of 6 cm. The minimum value of total cost 36.43 L.E./fed was obtained at forward speed of 5.4 km/h, and planting depth of 1.5 cm .

Finally, it is recommended to apply a garlic-cloves planter using cell (A), depth of planting 4 cm and forward planting speed 2.5 km/h to achieve the maximum germination percentage and the highest value of productivity.

### **INTRODUCTION**

Garlic is considered one of the most important vegetables crops in the world as well as in Egypt. It also contains relatively low levels of the trace minerals copper, iron, zinc, calcium, manganese, and aluminum, although it may vary with soil conditions where the garlic was grown. The prevailing planting of garlic in Egypt is manually in total area of 45, 600 feddans producing about 400, 000 tons (Ministry of Agriculture, 2012). Harb and Abdel Mawla (1997) developed a metering belt system garlic planter to plant seeds at 10 cm distance along the rows. The planter opens a furrow for irrigation and plants two rows of garlic on both sides of the furrow top. They showed that the machine plants garlic cloves more uniformity at low forward speeds. At high forward speeds (above 3 km/h) the percentage of unsuccessful fed

increased to more than 20% and accordingly the mean number of seeds dropped per meter along the furrow decreased. This is mainly due to the centrifugal force action. Moreover, 90% of the mechanically planted garlic germinated at the third week. Yehia (1997) and Awady et al. (2000) designed a garlic clove metering device with vertical wheel with groove device. They studied the effect of feeder speeds, groove shapes (rectangle, trapezoidal, and triangle), and groove wide on cloves discharge, damage and longitudinal cloves-distribution. They found that groove wide of 24 mm for a triangular shape and feeder speed of 20 rpm considered the best longitudinal cloves distribution. Jiaporn (2002) stated that the major problem in planting garlic was a very expensive payment for employment of man power to plant by hand .The capacity of man power is very low about 0.05 ha./man/day and payment for planting is 11.9% of the total cost of production. According to the problems mentioned above, the development of garlic planter has been started in 1999. After the gathering of data about traditional garlic planting method, the studies of effect planting method on the final yield were tested in the farmer field. The results showed that the drilling method was appropriated for fabricating the garlic planter. Hence, the design and development of garlic planter was identified with the concept of the drilling planter attached to 5 hp tiller. Helmy et al. (2005) modified and evaluated the feeding mechanism of the mechanical (Gasprdo) planter to plant garlic cloves under four different levels of planting forward speeds of 1.5, 2.5, 4.0 and 6.0 km/h and two different speeds of planter of 0.6 and 0.8 with three various levels of seed hopper capacity of 4.5, 2.25 and 1.125 kg. In addition, the mechanical planting compared with traditional one. They found that the best limit of planting forward speeds of 1.5 to 2.5 km/h, planter speed ratio of 0.6 and seed hopper capacity is more than 50% of its capacity. El-Sharabasy and Ali (2011) developed and evaluated the planting unit of (Gaspardo) planter for planting garlic cloves. It was evaluated to find out the optimum operating parameters for planting garlic cloves using nine different moving horizontal discs with three different cell diameters and three different disc thickness and four planting speeds. The obtained results revealed that the minimum missing hills of 5.10%, the minimum longitudinal scattering of 0.48 cm and the maximum garlic yield of 8498 kg/fed were recorded at lower forward speed of 1.17 km/h, cell diameter of 30 mm and disc thickness of 30 mm. Zhou and Jiayu (2011) found that the environment of garlic planting is complicated, the garlic cloves are usually been put in the garlic-box, and planted in the field artificially. In the natural conditions, as the spatial position and direction of garlic cloves are random uncertain in the garlic-box, it is quite difficult to distinguish each garlic clove, recognize their spatial position and direction. So the information provided to manipulator to complete planting is not so clear. According to years of experimental research, the paper proposed a method of garlic clove direction identification based on machine vision, developed an identification system taking single chip as control unit, and identified garlic clove by technical identification device. Moheb and El-Sharabasy (2011) found that the mean depth of furrows opened at the medium setting of both openers are 20 mm. However, the suitable planting depth is achievable with the adjustment of the opening devices according to type of seed verity. The

average depth of both furrow openers were 40.21 and 45.67cm which were suitable for planting, zucchini and groundnut, respectively. Gao and Hui (2013) found that the position identification method of garlic clove based on machine vision; it elaborated the image processing method of self-adaptation and edge extraction, studied on the identification theory of local information collection, designed the identification device, developed the identification control system, and conducted a large number of experiments. The results demonstrated that the method can realize the position identification of garlic clove, and lay the foundation for the development of garlic planting machine. Yet the research plan is not completed, and the experiment is not adequate, it still needs to be studied further.

**The objectives of the present study are devoted to:**

- Manufacturing and evaluate the performance of one- row garlic-cloves planter.
- Comparison between two types of the cell of Agriculture, which was also manufactured.
- Access to the higher efficiency of the process of agriculture and reduce the total cost.

## **MATERIALS AND METHODS**

The field experiments were carried out during the end of September 2013 seasons at Sakha Agricultural research station, Kafr El-Sheikh using one-row garlic-cloves planter in order to suit the process of planting garlic. It was fabricated with locally available materials at the manufacture Center of Kafr El-Sheikh. A 44.78kW (60 hp) Nasr tractor run it and the power was transmitted from the ground wheel. The distance between rows was adjusted to be 55 cm and the distance between garlic-cloves in row of 10 cm. Each cell disk contains one clove of garlic per grove. The garlic cloves Chinese variety are used in the field experiments. Planting requires about 150 kg/fed of cloves. The soil texture has been determined at two sub surface layers 0 - 20 cm and 20 - 40 cm. The soil texture may be classified as a clay soil with average bulk density of 1.22 g/cm<sup>3</sup> and average soil moisture content of 21% wb. The field was divided into a rectangular plots 24 x 60 m. The physical properties of Chinese garlic-cloves were measured on 50 cloves sample by Mohsenin,1986 methods. The mean length, width and thickness of the garlic cloves used in the experiments were 32.3, 25.8 and 17.3 mm, respectively.

### **Design of the experiment**

The experiment were carried out during the end of September 2013 seasons in order to evaluate the performance of one-row garlic-cloves planter. The variables of this study were; evaluate the performance of one-row garlic-cloves planter. The variables of this study were; four different forward planting speeds ( 2.5, 3.2, 4.1 and 5.4 km/h), two various types of cell (A and B) and three different depths of planting (1.5, 4.0 and 6.0 cm). These variables were examined to study their on missing hills percentage (%), germination percentage (%), productivity (ton/fed), longitudinal scattering

(cm), field capacity (fed/h), energy consumed (kW.h/fed) and total cost estimate (L.E./fed).

### The garlic-cloves planter

The general specifications of the garlic-cloves planter are sketched in Fig.(1).

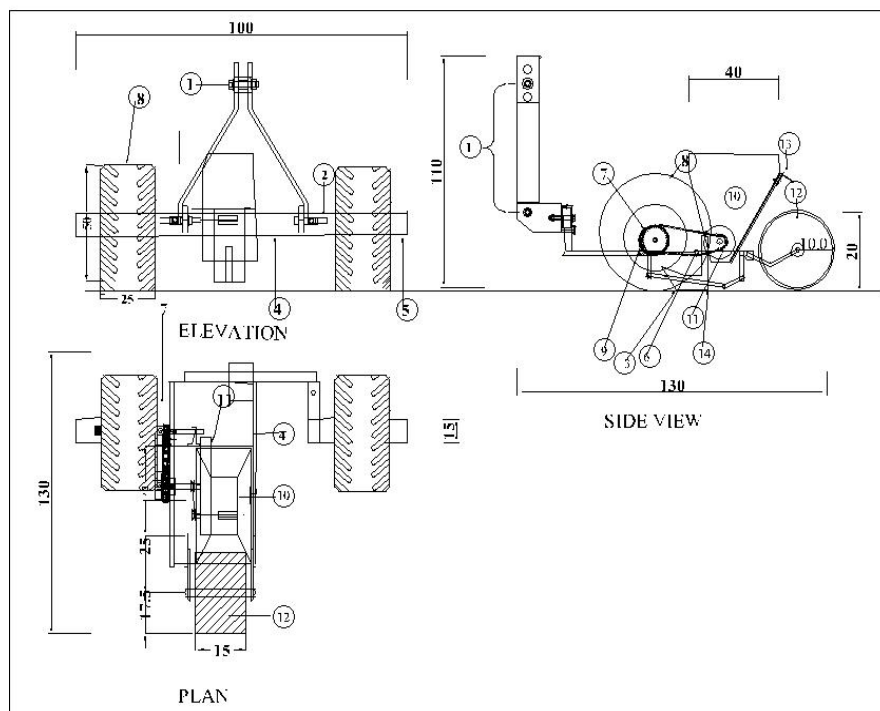


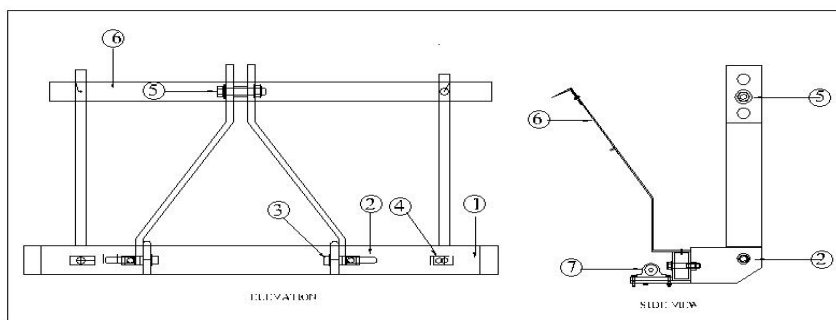
Fig. 1: Elevation, side view and plane of the garlic-cloves planter.

The investigated prototype including the following parts;

- 1- Principal body, 2- Lower hitch point, 3- Glens weapon Seed, 4- Support, 5- axis wheel,
- 6- Puling track, 7- Chain, 8- Wheel, 9- Bearing, 10- Seed hopper, 11- Seed disk, 12- Press wheel, 13- Stand and 14- Seeds dropping

### The frame

The main frame (chassis) as shown in Fig. (2), It's fabricated from U shape iron with cross sectional area of 100 x 50 x 5 mm. The min outer dimensions of the frame are 130 cm length, 100 cm width and 110 cm height. This frame has three points used to mount the machine unit on the tractor and two rubbers tire wheels of 50 cm diameter were connected on the main frame. This frame has two weapons digger to work planting lines in order to be in the process of agriculture both sides of the line.



1- Principal body, 2- Lower hitch point, 3- Pin, 4- Support, 5- Upper hitch point, 6- Back holder and 7- Bearing body

Fig. 2: The garlic planter frame

**The planting unit**

The planting unit as shown in Fig. 3 and plate 1 consists of the following main parts;

- The clove hopper is made from sheet steel of 3 mm thickness. The hopper was rectangular shaped cross section at the top of 400 x 250 mm and 60° sloping bottom From the back side. The full capacity was 6.0 kg. The clove hopper also contains a vertical plate sheet iron to prevent the flow of cloves around disk heavily, thereby hindering the movement.

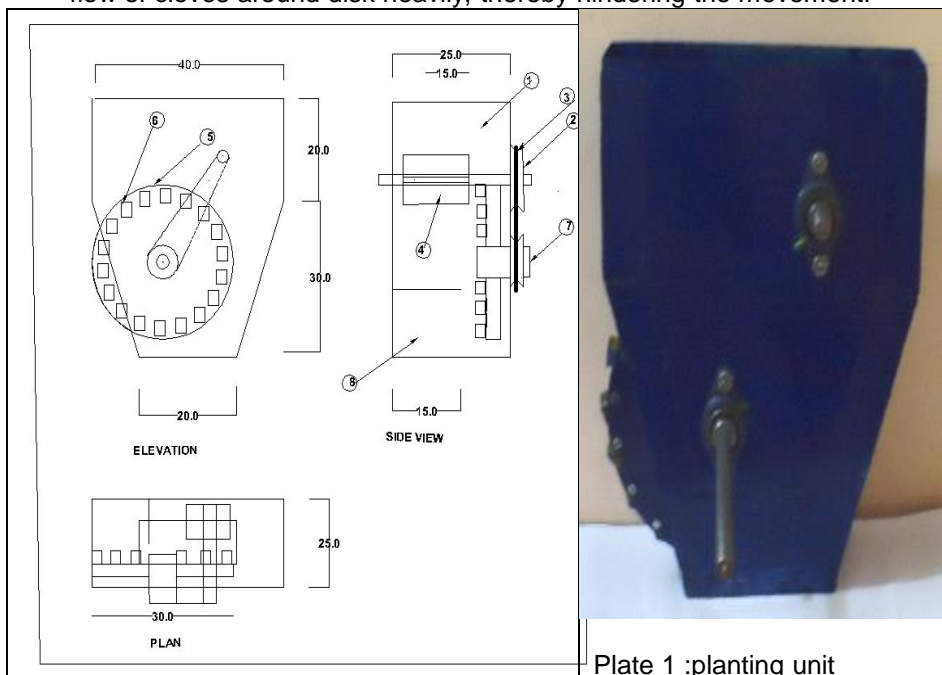
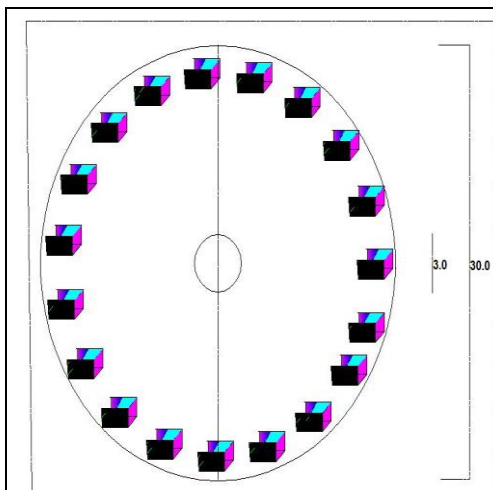


Plate 1 :planting unit

1- Clove hopper 2- Pulley 3- V-belt 4- Agitators 5- Planting disk 6- Cell 7- Shaft and 8- Partition

Fig. 3: The planting unit of the machine to plant garlic in the drill

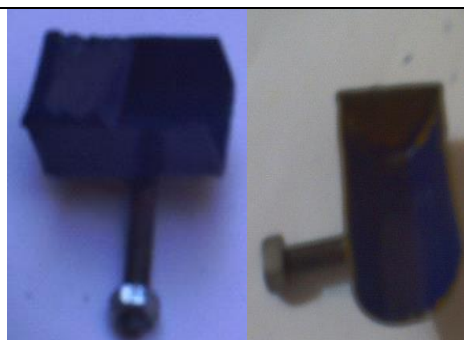
- The planting device: The planting device as shown in Fig. 4 and plate 2. It has is a vertical disk with circular diameter of 30 cm and thickness of 0.5 cm. Its located inside the hopper feeding. It also contains of 18-cell to feed the garlic cloves and there are two different types of cell can be replaced easily from the disk by loosening the nut of the screw connecting the cell. The vertical disk containing cells of agriculture (A) or (B) as shown in plate 3, cells (A) is a parallelogram dimensions of 4, 2.5 and 2 cm length, width and height, respectively, and closed its aspects except the front side and the front half of the surface and cells (B) is a half-cylindrical shape of 4 cm length, 2 cm radius and closed from the rear side. The feed shaft of 400 mm length and 20 mm diameter. It made of steel and fixed on the left side of planting hopper. It is concocted to the metering-device housing by one ball bearing and another is connected by main frame. It was operated by means of sprockets and chains powered from the ground wheel. The glens weapon on the shoe shape feeders rotate with the shaft in the cases (housing), bring cloves and eject them into the funnels of the tubes through the doing a gully to put the garlic cloves the inside of.



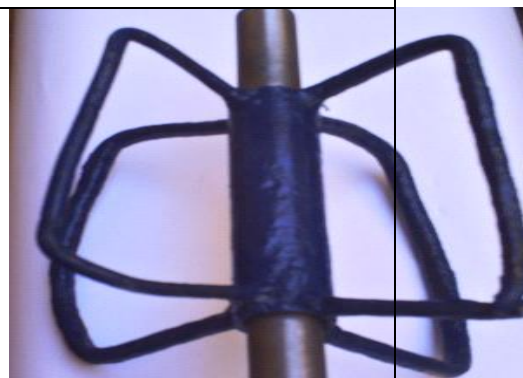
**Fig. 4: The planting disk**



**Plate 2: planting disk**



**Cell (A)                      Cell (B)**  
**Plate 3: The cell A and B shapes**



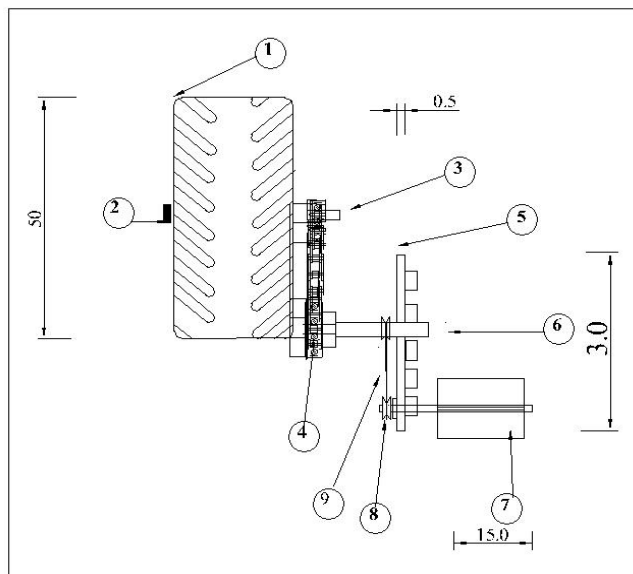
**Plate 4: The agitators**

**Covering device**

The covering device of 20 cm wheel diameter and width of 15 cm and hollow inside. Its connected with the main frame machine by the two chair bearings, which facilitates movement and cover the cloves behind the machine. There is also have another job which is in the process of controlling the depth of agriculture and lifting it to the top to give a chance for the A weapon as deeply as agriculture and vice versa.

**Transmission system**

Transmission system as shown in Fig. 5 consists of sprockets, chains, pulleys, bearing body, bearing, shaft drive, shaft disk and v-belts were used as transmission system. Thy transferred the motion from ground wheel to the metric device and gave the availability of changing feed shaft rotating speed to allow different application of feed rates.



1-Wheel, 2- Bearing body, 3- Shaft drive, 4- Chain, 5- Clove disk, 6- Shaft disk ,7- Agitators, 8- Pulley and 9- V- belt

**Fig. 5: The transmission system of the garlic planter prototype**

**Methods**

The field tests were carried out to study the effect of operating parameters on garlic-cloves planter performance.

**Missing hills percentage, %**

Missing hills percentage, % (Percentage absent for cells that do not contain the cloves of garlic during the agriculture process and given hills absent) The theoretical adjusted hills numbers in 25-m long distance in the row were determined and the actual were accounted and the missing hills numbers was found in the same distance. The percentage of the missing hills was given using the following equation:

$$\text{Missing plants, \%} = \frac{\text{No of missig hills}}{\text{No of theortical hills}} \times 100 \dots\dots\dots(1)$$

**Germination percentage, %**

The theoretical adjusted plants numbers in 25-m long distance in the row were determined and the actual were accounted and the missing plants (absent hills + cloves garlic, broken) numbers was found in the same distance. The percentage of Germination percentage was given using the following equation:

$$\text{Germination percentage, \%} = \frac{\text{No of plants}}{\text{No of plants} + \text{absent hills} + \text{cloves garlic broken}} \times 100 \dots\dots(2)$$



**Planting depth, cm**

Three replicate of actual planting depth in 1- m long distance in the same row were measured chosen randomizly and smoothly removing the soil cover over and measuring the covering height.

**Productivity, ton/fed.**

After completing the maturity of the garlic crop, harvest has a process by lifting its bulbs and left them two weeks to natural drying on soil surface, till bulbs moisture content was about 65%. Roots or bulbs were removed from the green and their weight was recorded by ton/fed.

**Longitudinal scattering, cm**

The distance between 60 plants in row for all treatments was measured. The longitudinal scattering of clove placements was determined statistically by standard deviation of the measured distances according to **Steel and Torrie (1980)**.

**Field capacity, fed/h**

Field capacity was calculated according to **Kepner et al. (1982)** using the following formula:

$$\text{Field capacity, fed./h} = \frac{1}{ATT} \dots\dots\dots(3)$$

Where:

ATT is the actual total time in hours required per Fadden .

**Power required**

To estimate the engine power during harvesting process the decrease in fuel level accurately measuring immediately after each treatment by fuel consumption device that is connected with the diesel pump. Hunt's equation (1983), was used to estimate the engine power.

$$E_p = ( F_c \frac{1}{1.36} \times \frac{1}{75} ) \rho_F \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{3600} \text{ Kw,} \dots\dots\dots(4)$$

Where:

- E<sub>p</sub>** = Power required;
- F<sub>c</sub>** = the fuel consumption, L/h;
- ρ<sub>F</sub>** = the density of fuel, 0.85 kg/l ;
- L.C.V** = the lower calorific value of fuel, 10000 k cal/kg
- η<sub>th</sub>** = the thermal efficiency of engine, 35% for diesel engine.
- 427** = thermo – mechanical equivalent, kg.m/k.cal, and
- η<sub>m</sub>** = the mechanical efficiency of engine, 80% for diesel engine.

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

$$\text{Consumed energy} = \frac{\text{Engine power, (kW)}}{\text{Field capacity, (fed / h)}}, \text{ kW.h/fed} \dots\dots\dots(5)$$

**Cost estimate**

The total cost of the tractor user account and machine manufactured by using the following equations (Awady 1982)

$$C = \frac{p}{h} \left( \frac{1}{a} + \frac{i}{2} + t + r \right) + (1.2 W \cdot S \cdot F) + \frac{m}{144} \dots\dots\dots(6)$$

$$C_1 = \frac{p}{h} \left( \frac{1}{a} + \frac{i}{2} + t + r \right) \dots\dots\dots(7)$$

Where:

C = hourly cost of tractor, L.E /year; C<sub>1</sub> = hourly cost of machine, L.E /year;  
 P = price of machine, L.E; H = yearly working hours, hours;  
 a = life expecting of the machine, year  
 i = interest rate/ year ratio, t = taxes, overheads ratio,  
 r = repairs and maintenance ratio, W = power, hP;  
 S = specific fuel consumption (l/kW.h) and. F = fuel price (L.E. ).  
 144 = Reasonable estimation of monthly working hours for the tractor.

Operational cost can be determined using the following equation:

$$\text{Operational cost} = \frac{\text{Hourly cost } (L.E / h)}{\text{Field capacity } (fed / h)}, (L.E/fed) \dots\dots\dots(8)$$

## RESULTS AND DISCUSSIONS

### Missing hills percentage, %

The observations in Fig. 6 shows the effect of forward speed on missing hills percentage for two types of cell. The data reveal that the percentage of missing hills increased by increasing the forward speed for two types of cell. However, increasing forward speed from 2.5 to 5.4 km/h, tends to increase the percentage of missing hills from 2.0 to 8.3 % with cell (A) and increase from 3.4 to 10.1 % with cell (B). Increase the percentage of loss may be due to the garlic cloves with the cell (B) is greater than the rate of (A) cell because the (B) cell walls are smooth. Absent plants ratio be less with the use of (A) cell because the cell (A) retains lobes garlic inside during the rotation does not fall unallocated her place.

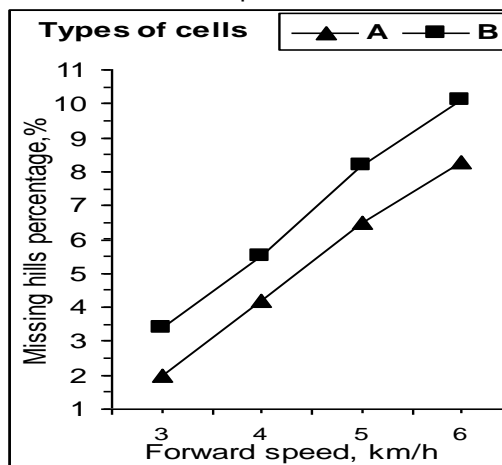


Fig. 6 : Effect of forward speed on missing hills percentage, at two types of cell.

### **Germination percentage, %**

Figure 7 shows the effect of forward speed on germination percentage for two cells type and planting depth. It can be mentioned that by increasing the forward speed tends to decrease the number of garlic per unit area consequently decrease the germination percentage with two types of cell. It was found that as the planting depth increased from 1.5 to 4.0 cm tend to increase the germination percentage but when increase from 4.0 to 6.0cm tend to decrease the germination percentage. This is due to the presence of a large layer of soil above the garlic cloves turn off the spigot germination process. However, increasing the forward speed from 2.5 to 5.4 km/h tends to decrease the germination percentage from 88 to 80 %, and from 77 to 70 %, at planting depth of 1.5 cm, and tow type of sells (A,B) respectively. The maximum germination percentage of 95, % was recorded at forward speed of 2.5 km/h, planting depth of 4 cm and sell type (A). The minimum germination percentage of 70 %, was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm and cell type (B).It can be noticed that the planting depth increase from 4 to 6 cm tends to decrease the germination percentage from 89 to 87 % at forward speed of 4.1 km/h and sell type (A) . Low percentage of germination with the first depth due to excessive exposure cloves garlic, water and birds. Low germination percentage with third depth due to exposure to large cloves garlic layer of soil is difficult to penetrate some plants losing. Less than the percentage of germination with increasing forward speed of the machine due to increased hills absent

### **Productivity, ton/fed.**

Figure 8 shows the effect of forward speed on prototype productivity. It can be mentioned that by increasing the forward speed tends to decrease the productivity for two types of cell. However, increasing the forward speed from 2.5 to 5.4 km/h tends to decrease the productivity from 8.1 to 7.605 ton/fed and from 7.747 to 6.66 ton/fed at planting depth of 6 cm, for tow types of cell (A,B) respectively. The maximum productivity of 8.55 ton/fed was recorded at forward speed of 2.5 km/h, planting depth of 4 cm and sell type (A). The minimum productivity of 6.3 ton/fed was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm and cell type (B).It can be noticed that the planting depth increased from 4 to 6 cm tends to decrease the productivity from 8.28 to 7.965 ton/fed at forward speed of 3.2 km/h and sell type (A). Increasing the forward speed tends to decrease the productivity because some cells lose the garlic cloves with the increase in the speed of rotation. Increasing the planting depth tends to decrease the productivity because due to exposure to large cloves garlic layer of soil is difficult to penetrate some plants losing. Moreover, increasing the forward speed with increasing the planting depth tends to herder the planter because of the soil resistance on the furrow openness of the units. This tends to show down the machine and consequently the productivity. The quality of cell design led to increase total garlic yield due to increasing the cell space containing garlic gloves during planting operation resulting less missing hills and a good germination percentage, which gave good yield.

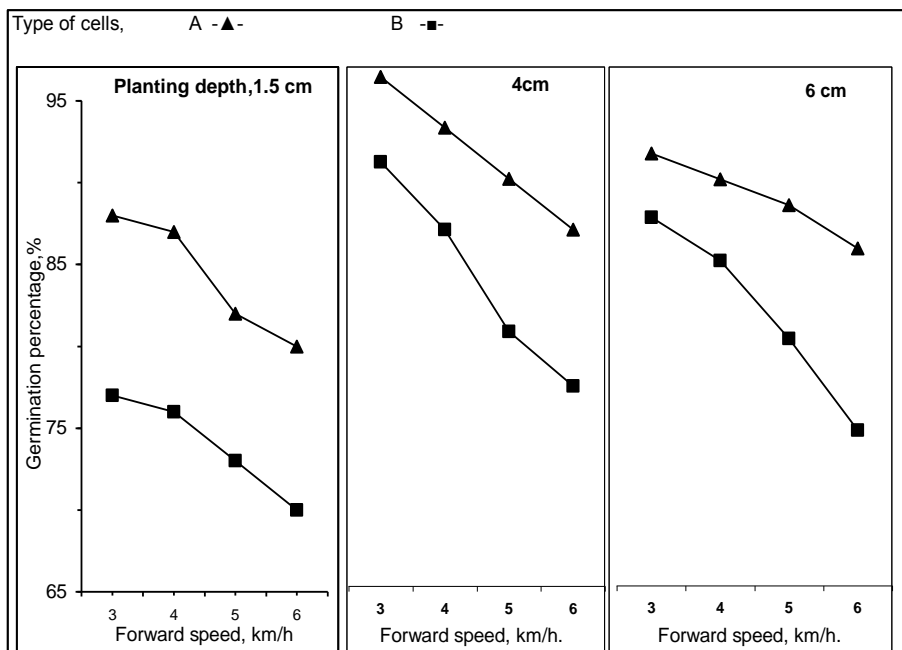


Fig. 7 : Effect of forward speed on germination percentage at type cells and planting depth.

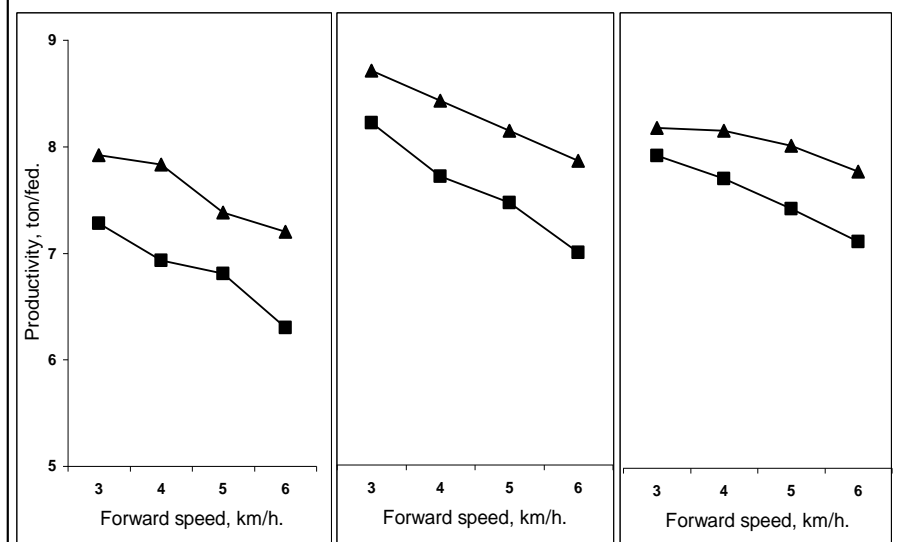


Fig. 8 : Effect of forward speed on productivity at type cells and planting depth.

**Longitudinal scattering, cm**

Figure 9 shows the effect of forward speed on longitudinal scattering and planting depth. It was found that by increasing the forward speed, the longitudinal scattering tends to increase with all planting depth. However, increasing the forward speed from 2.5 to 5.4 km/h tends to increase the longitudinal scattering from 0.7 to 3.5 cm at planting depth of 4 cm. The maximum longitudinal scattering of 4.3 cm was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm. The minimum longitudinal scattering of 0.2 cm was recorded at forward speed of 2.5 km/h, planting depth of 6 cm. It can be noticed that the planting depth increase from 4 to 6 cm tends to decrease the longitudinal scattering from 3.5 to 1 cm at forward speed of 5.4 km/h.

**Field capacity, fed/h**

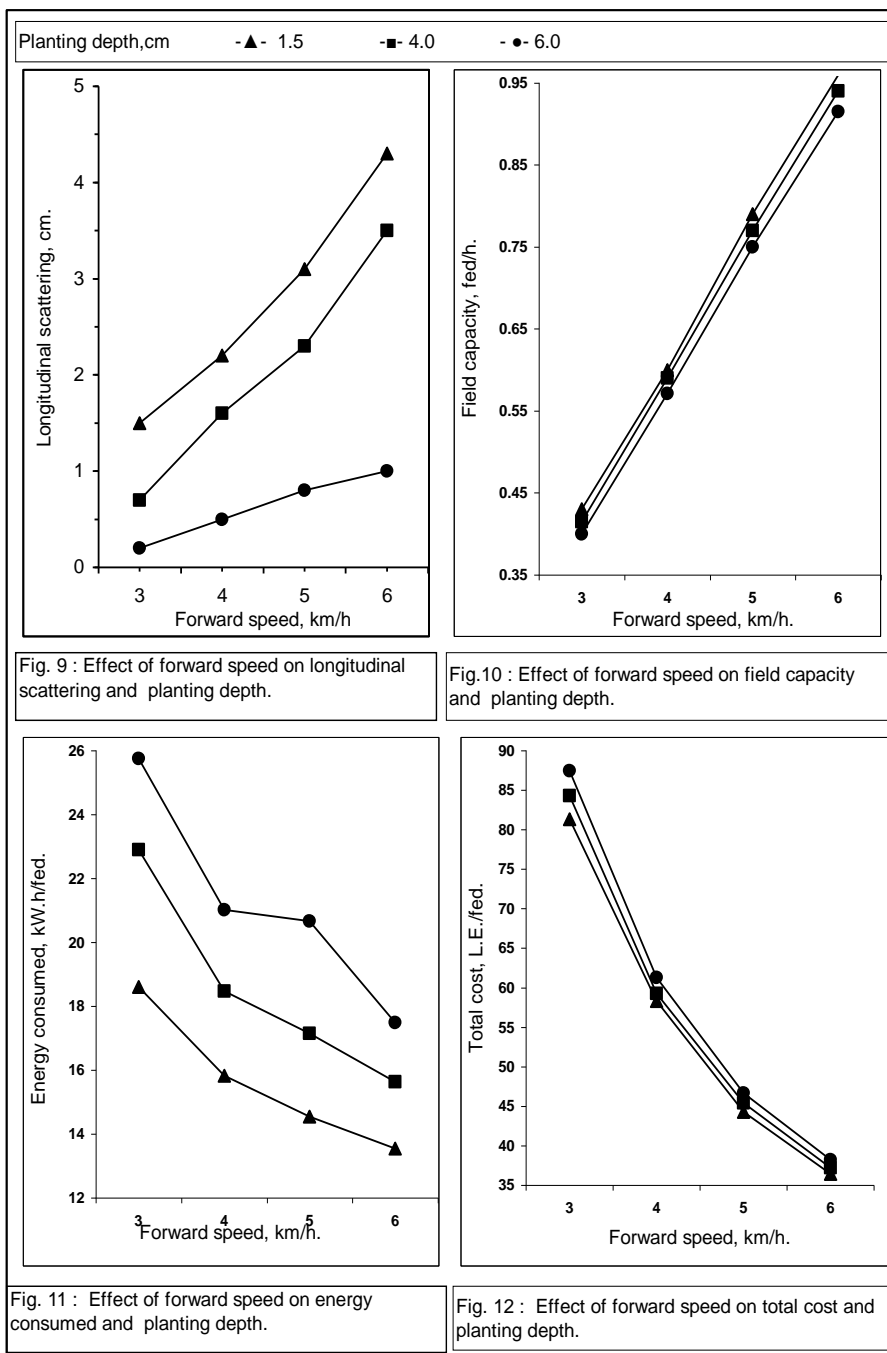
Figure 10 shows the effect of forward speed on field capacity and planting depth. It was found that by increasing the forward speed tends to increase the field capacity with all planting depth. However, increasing the forward speed from 2.5 to 5.4 km/h tends to increase the field capacity from 0.415 to 0.94 fed/h at planting depth of 4 cm. The maximum field capacity of 0.96 fed/h was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm. The minimum field capacity of 0.4 fed/h was recorded at forward speed of 2.5 km/h, planting depth of 6 cm. It can be noticed that the planting depth increase from 4 to 6 cm tends to decrease the field capacity from 0.94 to 0.915 fed/h at forward speed of 5.4 km/h.

**Energy consumed, kW.h/fed.**

Figure 11 shows the effect of forward speed on energy consumed and planting depth. It was found that by increasing the forward speed tends to decrease the energy consumed with all planting depth. However, increasing the forward speed from 2.5 to 5.4 km/h tends to decrease the energy consumed from 18.6 to 13.54 kW.h/fed at planting depth of 1.5 cm. The maximum energy consumed of 25.75 kW.h/fed was recorded at forward speed of 2.5 km/h, planting depth of 6 cm. The minimum energy consumed of 13.54 Kw.h/fed was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm. It can be noticed that the planting depth increase from 4 to 6 cm tends to increase the energy consumed from 15.63 to 17.48 kW.h/fed at forward speed of 5.4 km/h.

**Total cost estimate, L.E./fed.**

Figure 12 shows the effect of forward speed on total cost and planting depth. It was found that by increasing the forward speed tends to decrease the total cost with all planting depth. However, increasing the forward speed from 2.5 to 5.4 km/h tends to decrease the field capacity from 87.45 to 38.23 L.E./fed at planting depth of 6 cm. The maximum total cost of 87.45 L.E./fed was recorded at forward speed of 2.5 km/h, planting depth of 6 cm. The minimum total cost of 36.43 L.E./fed was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm. It can be noticed that the planting depth increase from 4 to 6 cm tends to increase the total cost from 45.42 to 46.64 L.E./fed at forward speed of 4.1 km/h.



## CONCLUSIONS

### The obtained results were summarized as follows:

1. The data reveal that the percentage of missing hills increase by increasing the forward speed with two types of cells.
2. The maximum germination percentage of 95, % was recorded at forward speed of 2.5 km/h, planting depth of 4 cm and cell type (A).
3. The minimum productivity of 6.3 ton/fed was recorded at forward speed of 5.4 km/h, planting depth of 1.5 cm and cell type (B).
4. The minimum total cost of 36.43 L.E./fed was recorded at forward speed of 5.4 km/h, and planting depth of 1.5 cm .

## REFERENCES

- Awady, M.N. (1982). Tractor and farm machinery. Text book, Faculty of Agriculture, Ain-Shams. University.pp: 164-167.
- Awady, M.N., H.A., AbdelMawla, I. Yehia and A.H., Mohamed (2000) "Design of a Drill Metering-Device for Garlic Cloves" 8<sup>th</sup> Conf. Misr Soc. Agr. Eng., 25-26 Oct. 110-122.
- El-Sharabasy, M. M. A., and M. M., Ali (2011) "Development and Evaluation of the metring device of planter to be suitable for garlic gloves Planting. Misr J.Agric. Eng., 28 (2) 282-300.
- Gao, C., and G., Hui (2013) "Direction Identification System of Garlic Clove Based on Machine Vision" Laiwu Vocational and Technical College, China , Vol. 11, No. 5, May pp. 2323 - 2329 e-ISSN: 2087-278X.
- Harb, S.K., and H.A., Abdel-Mawla (1997) "Development of Two-Row Garlic Planter" Misr J. Ag. Eng., 14(1) 144-155.
- Helmy, M.A., S.M.,Gomaa and M.E.Badawy (2005) "Evaluation of Garlic Planter" Misr J.Agric. Eng., 22(2) 663-687.
- Hunt, D., (1983) " Farm Power and Machinery Management" 8<sup>th</sup> Ed. Iowa state Univ., press Ames, USA. Ames, Iowa, USA 364-368.
- Jiaporn, B., (2002). Final report "Design and Development of Garlic Planter Attached to 5 Hp Power Tiller." Project Dept. of Agr. Eng., Fac. of Eng., King Mongkuts Institute of Technology Ladkrabang, Thailand.
- Kepner, R.A., R., Beiner and E.L., Barger (1982) "Principles of Farm Machinery" 3<sup>rd</sup> Ed . The AVI Pup. Com.Inc. 527 pp.
- Ministry of Agriculture, (2012) "Agricultural Statistics" Economic Issues sector, Cairo, Egypt: 78-115.
- Moheb M.A and M. M. A., El-Sharabasy, (2011) "Manually Operated Planter for Planting Different Seeds in Small Areas" Misr J. Ag. Eng., 28(4) 865-882.
- Mohsenin, N.N.(1986). Physical Properties of Plant and Animal Materials. Gordon and Breach Sc. Pub., N.Y.

- Steel, K.L. and S.O. Torrie (1980) "Principes and Procedures of Statistics" Mc Graw- Hill Company N.Y.
- Yehia, I., (1997) "Factors Affecting the Design of a Feeding Device for Crop Seeders" ph.D. Th., Fac. Of Ag. Ain Shams U. 109-116 .
- Zhou J., and C., Jiayu (2011) "Moving Obstacle Detection Based on Machine Vision for Agricultural Mobile Robot" Transactions of the Chinese Society for Agricultural Machinery. 42(8) 39-43.

### تصنيع وتقييم أداء آلة لزراعة فصوص الثوم عادل فتحي عبد ربة ، محمد محمود البيلى و صفية مصطفى الجيار معهد بحوث الهندسة الزراعية – الدقي – الجيزة – مصر

يعتبر محصول الثوم من أهم محاصيل الخضار التي تزرع بمصر نظرا لأهميته الاقتصادية العالية فأنة يساهم في توفير العملة الصعبة نتيجة تصديره للخارج. وتبلغ المساحة الكلية المنزرعة من الثوم في مصر حوالى ٤٥٦٠٠ فدان و تحتل مصر المرتبة الثانية عالميا في انتاج الثوم بعد اسبانيا. وتعتبر الزراعة اليدوية من العمليات المكلفة جدا وهذه من المشاكل التي تواجه الفلاح المصري في زراعة الثوم فأما استيراد آلات من الخارج وهذا مكلف جدا ويحتاج إلى عملة صعبة والدولة في حاجة إليها وإما اللجوء للتصنيع المحلى. لذلك اهتم هذا البحث بتصنيع آلة جديدة بالخامات المحلية لتستخدم في زراعة الثوم في جور وتعلق هذه الآلة على الجرار وتأخذ حركتها عن طريق العجلة الأرضية للآلة. يهدف هذا البحث أيضا إلى تقييم أداء هذه الآلة بالحقل. وتتكون هذه الآلة من صندوق فصوص الثوم مثبت على شاسية يتم تعليقه بالجرار الزراعى وبداخله قرص راسى يحتوى على الخلايا التي تمتلئ فصوص الثوم. ويوجد نوعين من الخلايا هما (A,B) الخلية (A) عبارة عن متوازي مستطيلات أبعادها ٤ سم طول و ٢,٥ سم عرض و ٢ سم ارتفاع وهى مغلقة من جوانبها ما عدا الجانب الأمامى ونصف سطحها الأمامى. بينما الخلية (B) عبارة عن شكل نصف اسطوانى بطول ٤ سم ونصف قطر ٢ سم ومغلقة من الجهة الخلفية. ويمكن فكهم وتركيبهم بالقرص بسهولة عن طريق مسمار مثبت بالخلية وصامولة بالجهة الأخرى من القرص. كما يوجد قلاب لفصوص الثوم لمنع تكسد الفصوص على القرص مما يعيق حركته وهو يحتوى على أربع ريش مفرغة من الداخل وعبارة عن إطار فقط من أسياخ الحديد بقطر ١ سم. كما يوجد بالشاسية سلاحين أماميين لعمل الخطوط ويوجد إمام صندوق الفصوص فجاج صغير لثقب الخط لزراعة الفصوص على شكل حذاء وفي نهايته فتحة لإسقاط الفصوص بها من خلايا القرص ويوجد خلف الفجاج عجلة لتغطية للفصوص كما يمكن التحكم فى عمق الزراعة من خلالها. وتم تقييم الآلة حقليا وتم دراسة العوامل الآتية: أربع سرعات أمامية للآلة (٢,٥ - ٣,٢ - ٤,١ - ٥,٤ كم/ساعة) ونوعين من خلايا الزراعة للفصوص و ثلاث أعماق للزراعة وهى (١,٥ - ٤,٠ - ٦,٠ سم) على نسبة الجور الغائبة و نسبة الإنبات والإنتاجية والتشتت الطولى والسعة الحقلية والطاقة المستهلكة والتكاليف الكلية. وكانت النتائج كالتالى:

- ١- اعلى نسبة إنبات هي ٩٥ % وسجلت عند سرعة أمامية ٢,٥ كم/ساعة وعمق زراعة ٤ سم ونوع الخلية A بينما كانت اقل نسبة ٧٠% وسجلت مع سرعة أمامية ٥,٤ كم/ساعة وعمق زراعة ١,٥ سم ونوع الخلية B.
- ٢- اعلى إنتاجية هي ٨,٥٥ طن/فدان وسجلت عند سرعة أمامية ٢,٥ كم/ساعة وعمق زراعة ٤ سم ونوع الخلية A بينما كانت اقل نسبة ٦,٣ طن/فدان وسجلت مع سرعة أمامية ٥,٤ كم/ساعة وعمق زراعة ١,٥ سم ونوع الخلية B.
- ٣- اعلى طاقة مستهلكة ٢٥,٧٥ كيلووات. ساعة/فدان وسجلت عند سرعة أمامية ٢,٥ كم/ساعة وعمق زراعة ٦ سم.
- ٤- اقل تكاليف هي ٣٦,٤٣ جنيه/فدان وسجلت عند سرعة أمامية ٥,٤ كم/ساعة وعمق زراعة ١,٥ سم بينما كانت اعلى تكاليف ٨٧,٤٥ جنيه/فدان مع سرعة أمامية ٢,٥ كم/ساعة وعمق زراعة ٦ سم. ولذا فإنه يوصى باستخدام تلك الآلة لزراعة فصوص الثوم مع استخدام القرص (A) وعمق زراعة ٤ سم وسرعة أمامية ٢,٥ كم/ساعة. لتحقيق اعلى نسبة إنبات واعلى إنتاجية.