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RESPONSE OF SOME VEGETABLE CROPS FOR MECHANICAL TRANSPLANTING

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ABSTRACT

This study was carried out to evaluate the response of some vegetable crops such as sweet potato and pepper for mechanical transplanting , to improve the field performance of the hand feed vegetable transplanter in terms of field capacity, field efficiency, transplanting accuracy, that concluded, longitudinal and transverse scattering, seedling depth, number of seedling in meter square, energy requirements, criterion cost and determine the optimum parameters affecting the performance of the modified transplanter that influenced by forward speed, seedling distance in row, and slope angle of feeding tube with vertical. The developed attained by adding two limit switches, Sound source and feeding tube to transplanting machine. when the seedling passes into the guide plate and root seedling presses, it then attached with normal open which lead to the cycle open and don't give any sound, but when the pocket passes into the guide plate without seedling, it is stay normal connected and give sound for labor to put seedling in the tube to compensate the missed hill. The experimental field work executed at the farms of El.Baramon Horticultural Research Station, Dakahlia Governorate Egypt, during the seasons of 2004 and 2005. The results of this study could be revealed that, the uses of the developed transplanter manufactured considered a new technology especially under Egyptian conditions and because fulfill a good results with mentioned measurements. Forward speed 1.5 km/h**,** seedling distance 18 and 31 cm and angle of feeding tube zero degree is recommended for transplanting sweet potato and pepper crop respectively.

INTRODUCTION

According to the statistical books of Egyptian Ministry of agriculture (2004) vegetable crop production from sweet potato and pepper reaches 600000 tons yearly logically, the consumed amount of vegetable will increase consequentially year after another with the continuously rapid growing of populations. Evidently, the increase in vegetables crops production does not depends only on the improvement of soil fertility, new promising varieties, or crop land expansion, but also on using improved technical methods to develop a desirable tillage–planting machinery system. Sweet potatoes and pepper considered two from the most important vegetables crops in Egypt. Up till now, in Egypt the total area of sweet potato and pepper are still cultivated by traditional method (transplanting manually) required the highest numbers of labors to transplanting in a short period of time which increase the labors wages. Also, the problems of manual transplanting still represented; these problems are consuming more time, high cost, non–uniform of plant distribution and creating difficult conditions for mechanical harvesting operations. Abdel – Aal *et al.*, (2002) indicated that, the best performance of transplanter machine actualized at low forward speed for about 1 km/h which caused a decreased of field capacity, while at increasing of transplanting forward speed, the labor unable to feed the seedlings in all tweezers, therefore, some of tweezers pass without seedlings and increased the number of missed seedlings in the row. The aim of this research is include study response of some crops such as sweet potato as the tubercular root crop and pepper as the wedge root one to mechanical transplanting. Improve the field performance and field capacity of the hand feed vegetable transplanters.

REVIEW OF LITERATURE

Harb *et al.*, (1993) showed that, Mechanical transplanters place seedling more uniform than hand transplanting. The uniformity of placing seedling by the mechanical transplanters attributed to the transplanting mechanism design more than the operation condition. And they added that; Mechanical transplanters because more seedling depth

compared to hand transplanting added to this, the percentages of mechanical damage were 5% for mechanical transplanting and give the lowest percentage of defective hill. Also, they showed that Seedling uniform helps to use the modern drip irrigation system in the newly reclaimed area. Mansour. (1997) found that the costs of transplanting onion were 111.27 and 140.57 IE /fed by using Holland and lannen roulette transplanter, respectively. In relation to the manually transplanting, the cost was 155 LE /fed. Also, he added that increasing the transplanter forward speed, both plant density and total yield decreased. Also, he added that the effective field capacity increased by increasing forward speed, but field efficiency decreased. Mohamed *et al.*, (2000) mentioned that the total required cost for Holland and lanenn roulette was less than the total required cost for manual transplanting by 51.9 and 35.5 % respectively. Also, they added that by increasing the transplanter forward speed, both plant density and total yield decreased. Also, he added that the effective field capacity increased by increasing forward speed, but field efficiency decreased. The increasing in actual field capacity was only due to increasing transplanting forward speed. For two rested transplanter at 2.03 km/h the actual field capacity was about 0.62 fed/h while it was about 0.38 fed/h at 0.94 km/h of transplanting forward speed . Mady et at., (2001) showed that there are a highly significant effect of machine forward speed on the theoretical and actual field capacity, field efficiency, power and energy requirement . The theoretical and actual field capacity increased and field efficiency decreased with the increasing of machine forward speed. The power requirements increased and the energy requirements decreased with the increasing of forward speed. The operational cost decreases form 70 LE/fed under manual transplanting to 52. 63 LE/fed under mechanical transplanting at speed of 1.5 km /h. It's also that increasing forward speed form 0.8 to 1.5 and 2.5 km/h decreased the operational cost form 58, 32.25 and 20 LE/fed respectively. Abdel – Aal *et al.*, (2002) said that the higher power requirement was resulted by increasing speed and row spacing, decreased consumed energy due to the increasing of effective field capacity and vice- versa. Also, they added that theoretical and actual field capacity increased, while field efficiency decreased by increasing forward speed, also, they added that increasing row spacing increased field capacity and efficiency. Helmy *et al.*, (2003) showed that the using of transplanter under the lowest forward speeds gave better results under transplanting forward speed of 0.9km/h the field efficiency was 64.82% and values of longitudinal and transverse scattering were 0.39 and 1.08cm, respectively. The percentage of void seedlings was 10.5% and transplanter studding was 9.5%. Hegazy *et al.*, (2003) showed that the manual transplanting cost of one fed. of sweet potatoes is about 1.5 times larger than of mechanical transplanting. Also, they added that the increase of speed form 0.5 to1.0 and 1.25 km/h had a significant effect on transplanting efficiency, this is due to high speed was always associated with high angular velocity of transplanting disc and this decreases the chance of finger (pocket) to catch the seedlings and resulting increase missed hills as the result of increase the damage and unfixed hills. At any planting depth the total consumed power during transplanting operation increased as the forward speed and planting depth increased, also, they indicated that at any transplanter forward speed from 0.55 to 1.6 km/h the required energy (kW.h/fed) was increased at increasing the depth of planting.

MATERIALS AND METHODS

1- The developed transplanter:

This study was conducted on the Holland type 1600 transplanter, (Figures 3.1 and 3.2), to modify, test, and evaluate developed transplanter for improving its efficiency. The modification aimed to reduce a high cost of labors needed for patching the missed hills at using high transplanting forward speed, to increase field capacity, and field efficiency of the developed transplanter. The performance of the modified transplanter will be influenced by tractor forward speed, seedling distance in row, and slope angle of feeding tube. The specifications of hand feed vegetable transplanting machine were in figures (3.1) and (3.2). The hand feed vegetable transplanter Holland type 1600 was used consists of two transplanting units. Every transplanting unit consists of one furrow; number of tweezers connected with periphery the disk packing wheels and seedlings box. The frame of machine attached by three Point hitch tool bar plant is placed manually into the transplanting tweezers

Figure (3.1): A Plan view for developed transplanter

Figure (3.2) developed transplanter while working in the field

1. frame	6. Pocket
2. furrow	7. limit
3. Guide plate	8.limit
4.Press Wheel	9. Hopper
5.Transplanting	10. sound

1. Limit switch seedling	**3. Sound**
2. Limit switch hop wheel	**4. Dry battery**

Figure (3.3): Schematic diagram for modified transplanter.

The specifications of agricultural tractor are Romanian type Model D 110 had 47.8 kW (65 hp), P.T.O shaft speed 540 r.p.m and its weight 3160 kg. The working system to give a sound at missed seedling, The first case (normal case) in case of placed seedlings in the pocket, limit switch hub wheel is connected and limit switch seedling is not connected and the cycle is opened and sound source no sent any signal sound. The second case, in case of not placed seedlings in the pocket, limit switch hub wheel is connected and limit switch seedling is connected which results the cycle is closed and sound source sent signal sound. The third case, in case of the pocket no passes on the front of the limit switch hob wheel there is no connected in the cycle. The pepper seedlings were prepared from the vegetable crop nursery while the sweet potato seedlings were prepared from the stems of the previous sweet potato crop by clever labors. The specifications of seedlings used are Mabroka and California wonder varieties for sweet potatoes and pepper crops.

2 Methods:

2.1 The field experiments:

The field experiments were carried out during two seasons by using two different types of seedlings (sweet potatoes and pepper) to evaluate the performance, accuracy of seedling, power, energy and cost analysis requirement for all operations of transplanting machine before and after modifications. All the experimental plots were chiseled twice; the second tillage was carried out by rotary plow and leveled by land leveler before transplanting operations. Agricultural practices except methods of transplanting, such as irrigation, fertilization, pest control etc.…were carried out in all treatments due to the technical recommendations. The main treatments used in this study were four levels of forward speeds (F) 1, 1.25, 1.5, and 1.75 km /h, these forward speeds were adjusted by the stop watch and the throttle lever, three levels of distance between seedlings in the row (cm) have been used. For sweet potatoes crop were three distances between seedlings in the row (18, 23 and 25 cm) and (31, 34 and 38 cm) for pepper crop and three levels of Slope angle of feeding tube (degree) have been used in this study were (0.0, 15 and 30 degree) with vertical, each treatment was replicated three times to take the mean. The field experiments were designed to test the effect of the different mentioned variables on different measurements and on power requirements for sweet potatoes and pepper crops. The area of experiments was about 3.6 feddan for sweet potatoes and pepper crops. For recording the observation in all studied characteristics four samples, each of 10.0 m length were selected randomly from each treatment and the data were recorded after 21 days from the transplanting date. From each samples the following data were recorded: Machine capacity, transplanting accuracy, energy requirements and criterion cost.

2.2 Measurements:

2.2.1 The longitudinal and transverse scattering:

Deviation in the longitudinal and transverse direction from the average distance of 10 meter along the transplanted for each mechanical and manual transplanting method were determined by using the following equation;

$$C.V = \frac{sd}{\overline{X}} \times 100 \qquad (3.1)$$

$$sd = \sqrt{\frac{\Sigma(X - X^{-})^2}{n}} \qquad (3.2)$$

Where:
sd = standard deviation (σ). X = Distance between seedlings in the row, cm.
$\overline{X}$ =Mean distance between seedlings at longitudinal and transverse scattering, cm.
n = number of observation.

2.2.2. Seedling depth:

20 seedlings pulled out randomly from the soil and measured seedling depth by ruler.

2.2.3 Plant density:

The average plant density (plant/m^2) was measured after transplanting for each transplanting method by counting the number of theoretical seedlings in unit area minus defective seedlings and damage seedling.

2.3.4 Fuel consumption and Energy requirement:

Fuel consumption rate was determined by measuring volume of fuel consumed for each forward speed of transplanter by a graduate cylinder as follow:

1. The tank was completely filled with fuel.
2. The transplanting operation was carried out and the time elapse was measured by a stop watch, and transplanting area was also calculated.
3. After the transplanting operation had been the fuel consumption (f_1) was measured.
4. The fuel tank refilled completely again and the consumed fuel (f_2) by tractor with transplanter measured.

$$Fc = \frac{F_1 - F_2}{t} \times c \quad \text{...} \quad (3.3)$$

Where:
Fc = fuel consumption, L/h
F_1=volume of fuel consumed during the test, cm^3 for both tractor and transplanter
F_2 = volume of fuel consumed during the test, cm^3 for tractor without transplanter
t = test time, sec and c = 3.6 a constant conversion of test time.

While the fuel consumption per feddan calculated as below:

$$Fc = \frac{F_1 - F_2}{t} \times F_{act} \quad \text{.........} \quad (3.4)$$

Where: F_{act} = Effective total time in sec per feddan

The engine energy required for each transplanting treatment was calculated by using the following equation (Embapy 1985):

$$E_R = (Fc \times \frac{1}{3600}) \times \frac{\rho \times L.C.V \times 427 \times \eta_{th} \times \eta_m}{75 \times 1.36 \times F_{act}} \quad \text{(kW.h/fed)...........} \quad (3.5)$$

Where:
Fc = Fuel consumption. .... L/h - ρ = Density of fuel .. kg/L. (0.85 kg/L. for diesel)

L.C.V = Lower calorific value of fuel... k cal/kg (L.C.Vof fuel is 10000 k cal/kg)

427 = Thermo.mechanical equivalent............... Kg.m/kcal.

η_{th} = thermal efficiency of engine (40% for diesel engine). η_m = Mechanical efficiency of engine (80% for diesel engine). - F_{act} = Actual field capacity .... fed/h.

RESULTS AND DISCUSSION

Field experiments for sweet potatoes and pepper crops transplanting, using the developed transplanter, were carried out to evaluate the effects of the tested factors on the transplanting processes evaluation criteria. The tested factors were forward speed, seedling distance in row and slope angle of feeding tube. The transplanting processes evaluation criteria were longitudinal and transverse scattering, seedling depth, the number of seedling in meter square, power requirement, field efficiency, and cost.

1- Effect of the tested factor on the coefficient of variation (C.V. %) of longitudinal scattering of seedling for sweet potatoes and pepper crops:

Inspection of data tabulated in Figure (4.1) shows the effect of forward speed on C.V. of longitudinal scattering of seedling for sweet potatoes and pepper crops. The results show that for the same distance between seedlings, and slope angle of feeding tube increasing the tractor forward speed tends to increase the C.V. of longitudinal scattering and there was a positive relationship between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and slope angle of feeding tube of 0 degree, increasing the forward speed from 1 to 1.75 km/h/; increased the C.V. of longitudinal scattering from 6.38 to 15.2 % and from 3.45 to 11.65 % in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the forward speed means increasing the feeding rate and makes the numbers of the transplanting seedling more dense. Which substantially cause an increasing in the amount of seedlings and increase the C. V. of longitudinal scattering of seedling for sweet potatoes and pepper crops. It is clear that, the optimum forward speed was the smallest one (1 km/h). Also, these foregoing mentioned data show that for the same forward speed and slope angle of feeding tube increasing the seedling distance in row decreased the C. V. of longitudinal scattering of seedlings and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of forward speed 1 km/h and slope angle of feeding tube of 0 degree increasing seedling distance in row from 18 to 25 cm and from 31 to 38 cm decreased the C. V. of longitudinal scattering of seedling from 6.38 to 4.65 % and from 3.45 to 1.75 % in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the seedling distance in row means decreasing the C. V. of scattering of the transplanting seedlings. From the obtained data it is clear that, the optimum seedling distance in row was the highest one (25 and 38 cm in sweet potatoes and pepper crops respectively). These obvious data show that for the same distance between seedlings, and forward speed increasing the slope angle of feeding tube increased the C. V. of longitudinal scattering of seedlings and there was a direct proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed 1 km/h, increasing slope angle of feeding tube from 0 to 30 degree increased the C. V. of longitudinal scattering of seedling from 6.38 to 8.15 % and from 3.45 to 5 % in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the slope angle of feeding tube means increasing the C. V. of scattering of the transplanting seedlings. Which cause a decreasing in the amount of seedlings and increase the C.V. of longitudinal scattering. From the obtained data it is clear that, the optimum slope angle of feeding tube was the smallest one (0 degree).

In general view, it is clear that, the C. V. of longitudinal scattering of seedling in transplanter after modification lower than before modification, where for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed of 1 km/h, the C.V. of longitudinal scattering of seedling in transplanter before modification was 8.83 % and 5.65 % in sweet potatoes and pepper crops respectively, while in manual method the C. V. of longitudinal scattering higher than the two mentioned methods where, at the same mentioned conditions, it was 10.83 and 15.15 % in sweet potatoes and pepper crops respectively, this may be due to the transplanter before modification achieved avoiding ratio more than developed transplanter that caused increasing C. V. of longitudinal scattering, while the higher ratio in manual methods may be due to nonsystematic of hand of labor. The smallest percent of the C. V. of longitudinal scattering of seedling recorded at the lowest of each forward speed (1 km/h) and slope angle of feeding tube (0 degree) and the highest of seedling distance (25 and 38 cm respectively).

The following equation was the obtained regression equations,

For sweet potatoes crop:

C.V. of long. Scat.(%) =-0.26+11.0 F-0.281 S.D+0.0668 S.A. -- (4.1) where,R^2 = 92.3 %

For pepper crop:

C.V. of long. Scat.(%) = - 4.47 + 11.1 F - 0.233 S. D + 0.0621 S.A.. (4.2)where,R^2 = 91.8 %

Where:, C.V. of long. Scat.(%) = percent of coefficient of variation of scattering .

F (km/h) = forward speed, S.D (cm) = seedling distance in row.

S. A. (degree) = slope angle of feeding tube.

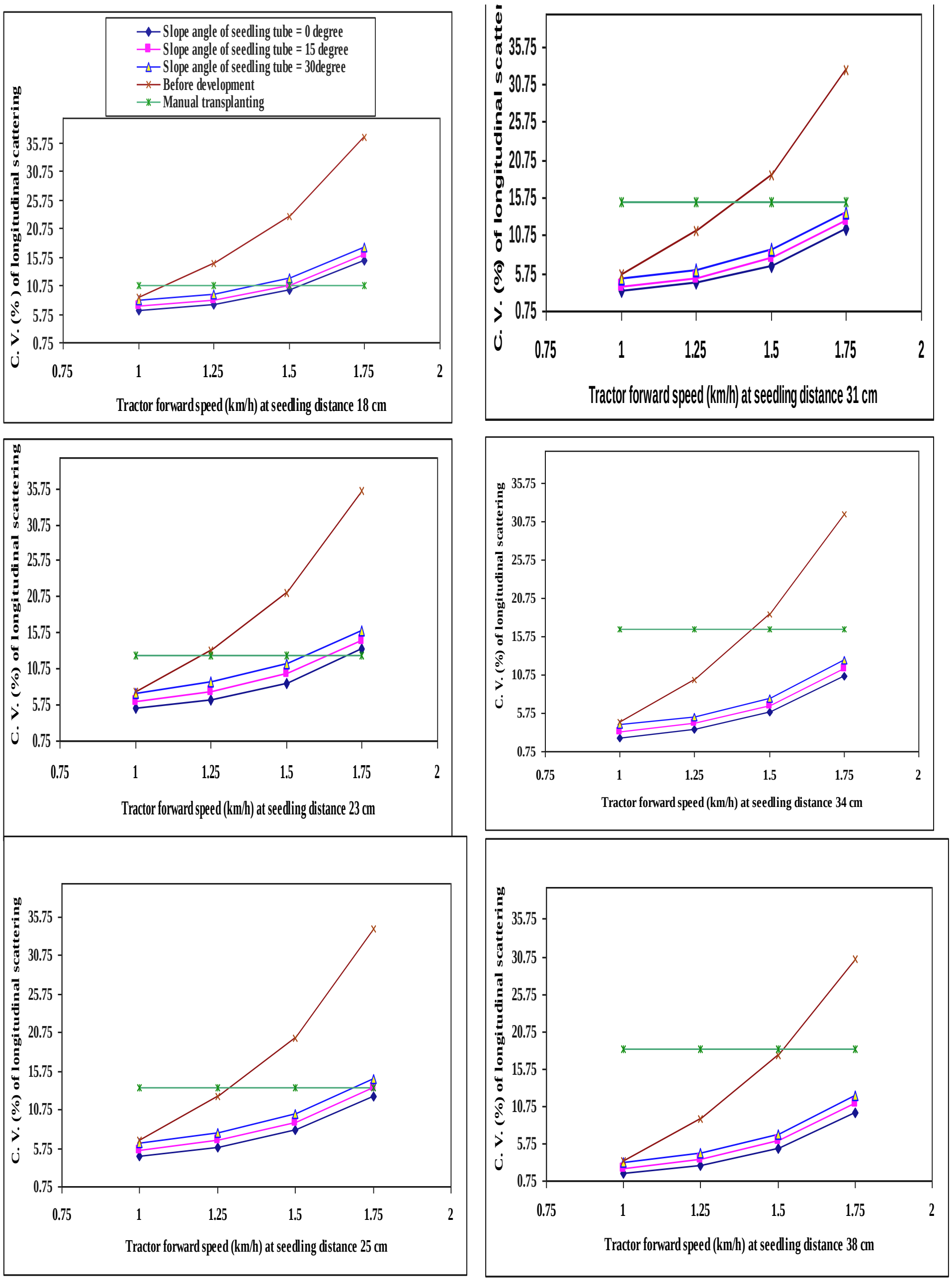

Figure (4.1) Effect of tested factors on longitudinal scattering of seedlings for sweet potatoes and pepper crops.

2. Effect of the tested factors on the coefficient of variation (C.V. %) of transverse scattering of seedling for sweet potatoes and pepper crops:

From data tabulated in Figure (4.2) shows that for the same distance between seedlings, and slope angle of feeding tube increasing the forward speed tends to increase the C.V. of transverse scattering and there was a direct proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and slope angle of feeding tube of 0 degree, increasing forward speed from 1 to 1.75 km/h/; increased the C.V. of transverse scattering from 7.73 to 23.55 % and from 3.33 to 18.35 % in sweet potatoes and pepper crops respectively. Also, it is clear that, the optimum forward speed was the smallest one (1 km/h). Data show that for the same forward speed and slope angle of feeding tube increasing the seedling distance in row decreased the C. V. of transverse scattering of seedlings and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of forward speed 1 km/h and slope angle of feeding tube of 0 degree increasing seedling distance in row from 18 to 25 cm and from 31 to 38 cm decreased the C. V. of transverse scattering of seedling from 7.73 to 5.33 % and from 3.33 to 1.09 % in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the seedling distance in row means decreasing the C. V. of transverse scattering of the transplanting seedlings. Also, the optimum seedling distance in row was the highest one (25 and 38 cm in sweet potatoes and pepper crops respectively).

These data obtain that for the same distance between seedlings, and forward speed increasing the slope angle of feeding tube increased the C. V. of transverse scattering of seedlings and there was a direct proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed 1 km/h, increasing slope angle of feeding tube from 0 to 30 degree increased the C. V. of transverse scattering of seedling from 7.73 to 11.04 % and from 3.33 to 5.25 % in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the slope angle of feeding tube means increasing the C. V. of scattering of the transplanting seedlings. Which substantially cause a decreasing in the amount of seedlings and increase the C.V. of transverse scattering. It is clear that, the optimum slope angle of feeding tube was the smallest one (0 degree).Generally, from the same mentioned data, it is clear that, the C. V. of transverse scattering of seedling in transplanter before modification lower than after modification, where for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed of 1 km/h, the C.V. of transverse scattering of seedling in transplanter before modification was 4.14 % and 1.73 % in sweet potatoes and pepper crops respectively, while in manual method the C. V. of transverse scattering higher than of the two mentioned methods where, it was 23.25 and 23.13 % in sweet potatoes and pepper crops respectively. The higher ratio in manual methods may be due to nonsystematic a hand of labor.

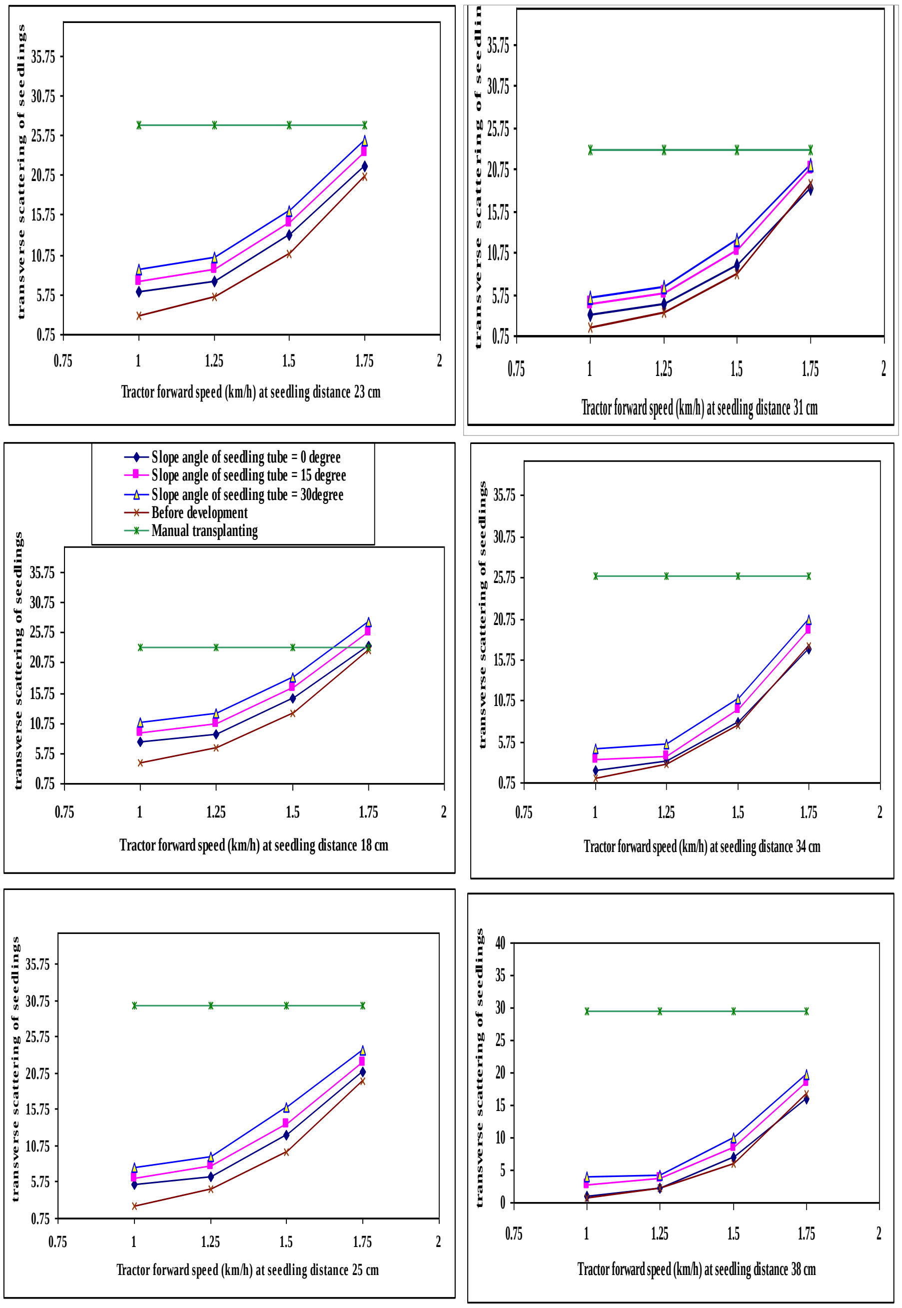

Figure (4.2) Effect of tested factors on transverse scattering of seedlings for sweet potatoes and pepper crops.

The smallest percent of the C. V. of transverse scattering of seedling recorded at the lowest of each forward speed (1 km/h) and slope angle of feeding tube (0 degree) and the highest of seedling distance (25 and 38 cm). The following equation was the obtained regression For sweet potatoes and pepper crops respectively were as below:

C.V. of long. Scat.(%) = - 10.3 + 22.1 F- 0.306 S.D+ 0.0589 S.A - (4.3)(R^2 = 87.3 %)

C.V. of long. Scat.(%) = - 14.3 + 20.8 F- 0.293 S.D + 0.0913 S.A .. (4.4) (R^2 = 89.8 %)

Where: C.V. of long. Scat.(%) = percent of coefficient of variation of transverse scattering. F (km/h) = forward speed.S.D (cm) = seedling distance in row.

S. A. (degree) = slope angle of feeding tube.

4.3 Effect of the tested factors on the depth of seedling for sweet potatoes and pepper crops:

Inspection of data in Figure (4.3) shows that for the same distance between seedlings, and slope angle of feeding tube increasing the forward speed tends to decrease the depth of seedling and there was a negative relationship between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and slope angle of feeding tube of 0 degree, increasing the forward speed from 1 to 1.75 km/h/; decreased the depth of seedling from 6.7 to 3.7 cm and from 7.4 to 4.3 cm in sweet potatoes and pepper crops respectively, these results can be attributed to increasing forward speed means shallow of furrow opener and the labor can not placing the root of seedlings inside the pocket justly which may led to decreasing depth of the seedlings for sweet potatoes and paper respectively.

Which substantially cause an increasing in amount of seedlings and decrease the depth of seedling for sweet potatoes and pepper crops. From the obtained data it is clear that, the optimum forward speed was the smallest speed (1 km/h). These data show that for the same forward speed and slope angle of feeding tube increasing the seedling distance in row increased the depth of seedlings slightly and there was a direct proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of forward speed 1 km/h and slope angle of feeding tube of 0 degree increasing seedling distance in row from 18 to 25 cm and from 31 to 38 cm increased the depth of seedling from 6.55 to 7.25 cm and from 7.35 to 7.80 cm in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the seedling distance in row means increasing the depth of seedlings. From the obtained data it is clear that, the optimum seedling distance in row was the highest one (25 and 38 cm in sweet potatoes and pepper crops respectively) These data show that for the same distance between seedlings, and forward speed increasing the slope angle of feeding tube decreased the depth of seedlings and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed 1 km/h, increasing slope angle of feeding tube from 0 to 30 degree decreased the depth of seedling from 6.55 to 5.80 cm and from 7.35 to 6.85 cm in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the slope angle of feeding tube means decreasing the depth of seedlings.

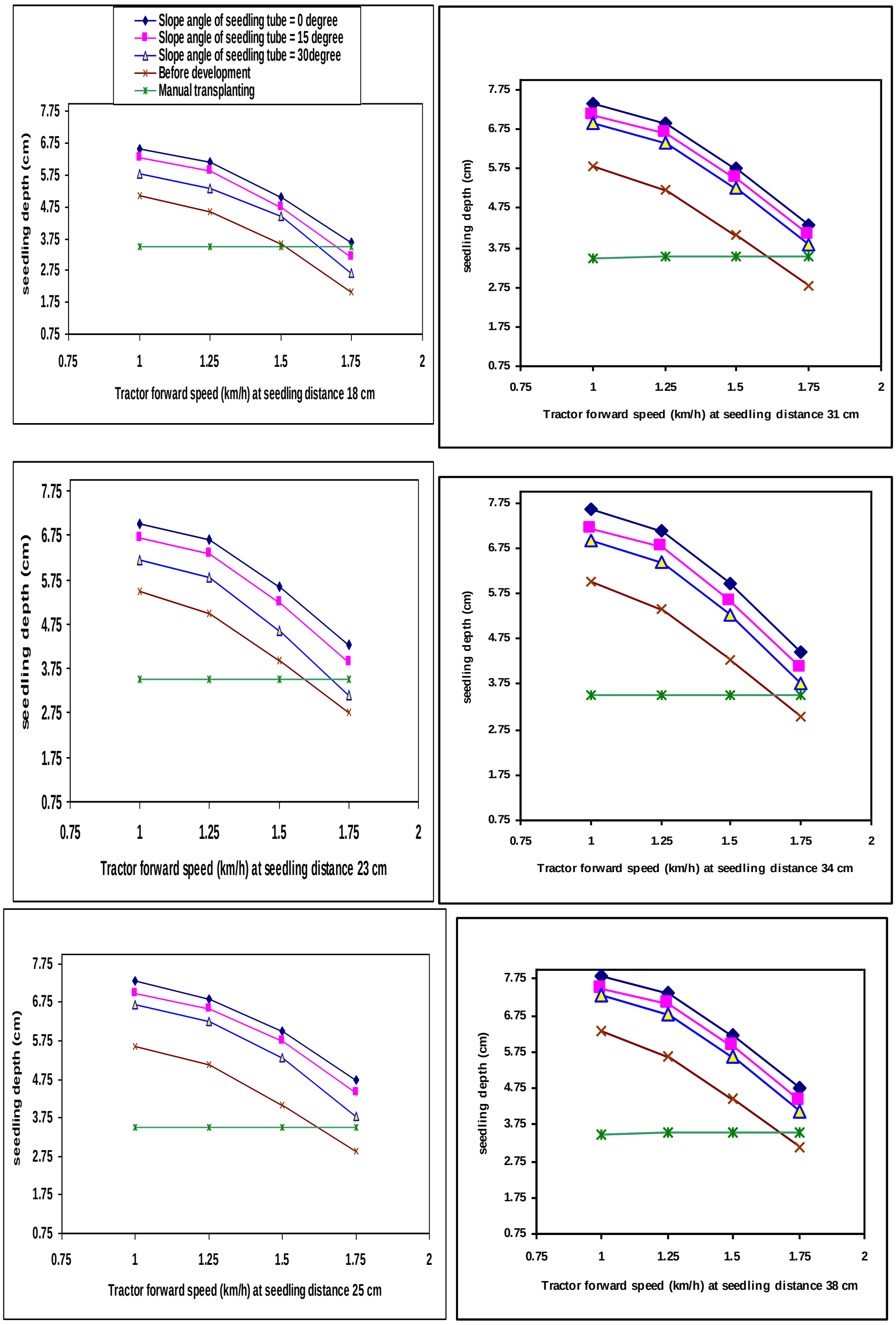

Figure (4.3) Effect of different tested factors on depth of seedlings for sweet potatoes and pepper crops.

Generally, from the same mentioned data, it is clear that, the depth of seedling after modification of transplater higher than before modification, where for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed of 1 km/h, the depth of seedling in transplanter before modification was 6.55 and 7.35 cm in sweet potatoes and pepper crops respectively, this may be due to increasing the number of labors led to increasing the weight of transplanter that led to increasing the penetration of the furrow opener in the soil. While in manual method the depth of seedling lower than the two mentioned methods where, at the same mentioned conditions, it was 3.50 and 3.52 cm in sweet potatoes and pepper crops respectively. At the same time, the smallest percent of the depth of seedling recorded at the lowest of each forward speed (1 km/h) and slope angle of feeding tube (0 degree) and the highest of seedling distance (25 and 38 cm respectively). The following equation was the obtained regression equations.
For sweet potatoes and for pepper crops:
D.S. = 8.48 - 3.82 F + 0.121 S.D - 0.0275 S.A -- (4.5) (R^2 = 93.9 %)
D. S. = 11.0 - 4.16 F + 0.0474 S.D - 0.0197 S.D --- (4.6) (R^2 = 95.1 %)
Where: D. S = depth of seedling &F (km/h) = forward speed. S.D (cm) = seedling distance in row. S. A. = slope angle of feeding tube.

4.4 Effect of the forward speed on the number of seedling/m² for sweet potatoes and pepper crops:

Inspection of data in Figure (4.4) shows that for the same distance between seedlings, and slope angle of feeding tube increasing the forward speed tends to decrease the Number of seedling/m2 and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and slope angle of feeding tube of 0 degree, increasing the forward speed from 1 to 1.75 km/h/; decreased the Number of seedling/m^2 from 8.99 to 8.44 seedlings/m^2 and from 4.47 to 4.20 seedlings/m^2 in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the forward speed means increasing the feeding rate and makes the numbers of the transplanting seedling more dense. Which substantially cause a increasing in the amount of seedlings and increase the number of seedling in meter square for sweet potatoes and pepper crops. From the obtained data it is clear that, the optimum forward speed was the smallest speed (1 km/h). Data show that for the same forward speed and slope angle of feeding tube increasing the seedling distance in row decreased the number of seedlings and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of forward speed 1 km/h and slope angle of feeding tube of 0 degree increasing seedling distance in row from 18 to 25 cm and from 31 to 38 cm decreased the number of seedling from 8.99 to 8.97 seedlings/m^2 and from 4.47 to 4.45 seedlings/m^2 in sweet potatoes and pepper crops respectively, these results can be attributed to increasing the seedling distance in row means decreasing the number of seedlings /m^2. From the obtained data it is clear that, the optimum seedling distance in row was the highest one (25 and 38 cm in sweet potatoes and pepper crops respectively).

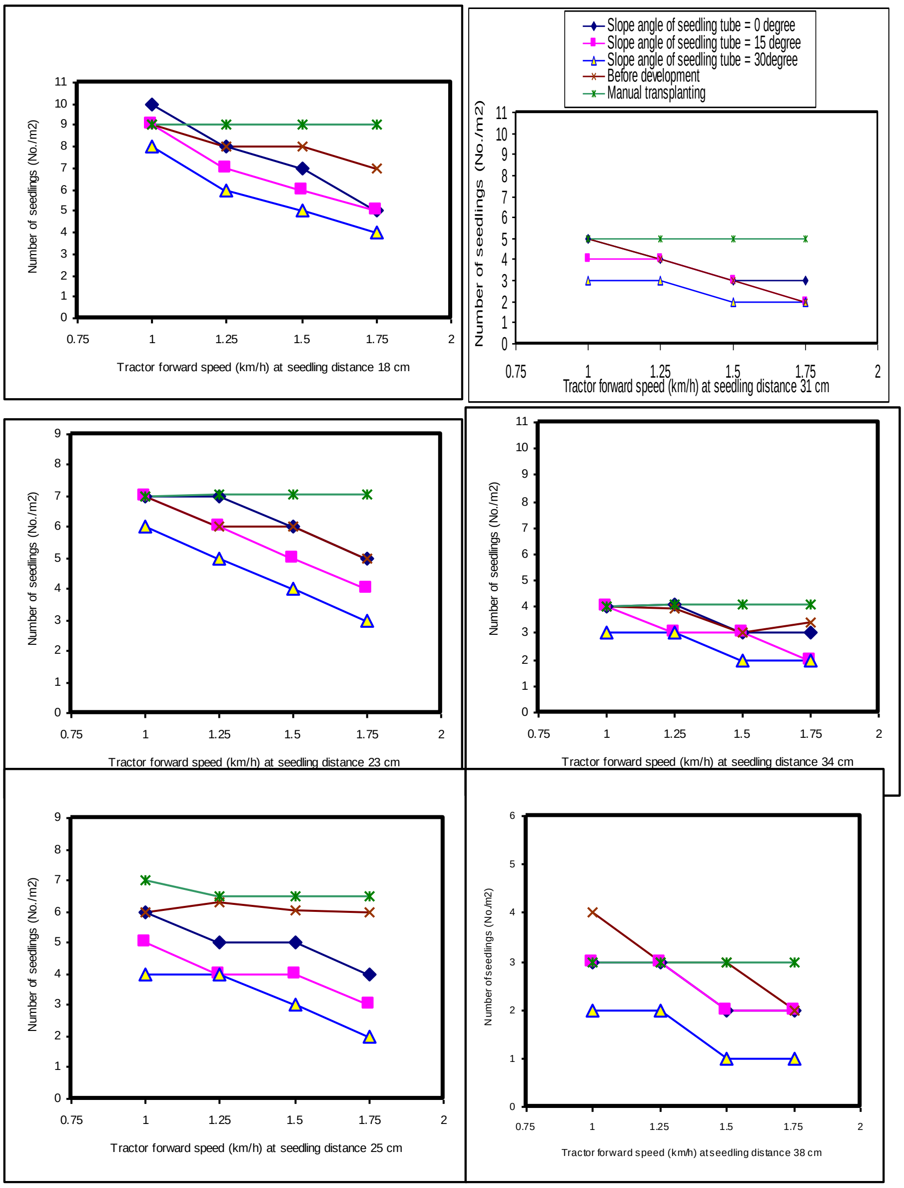

Figure (4.4) Effect of tested factors on number of seedlings (No./m^2) for sweet potatoes and pepper crop

For the same distance between seedlings, and forward speed increasing the slope angle of feeding tube decreased the number of seedlings/m^2 and there was an indirect proportional between of them in all of sweet potatoes and pepper crops, as an example, for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed 1 km/h, increasing slope angle of feeding tube from 0 to 30 degree decreased the number of seedlings/m^2 from 8.99 to 8.97 seedlings/m^2 and from 4.47 to 4.45 seedlings/m^2 in sweet potatoes and pepper crops respectively. The number of seedlings/m^2 after modification higher than before modification, where for the same conditions of distance between seedlings, 18 cm and 31 cm and forward speed of 1 km/h, the number of seedling/m2 in transplanter before modification was 8.83 seedlings/m^2 and 4.39 seedlings/m^2 in sweet potatoes and pepper crops respectively, while in manual method the number of seedlings/m^2 higher than the two mentioned methods where, at the same mentioned conditions, it was 9.02 seedlings/m^2 and 4.49 seedlings/m^2 in sweet potatoes and pepper crops respectively, this may be due to the transplanter before modification achieved avoiding ratio more than developed transplanter that caused increasing number of seedlings/m^2, while the higher ratio in manual methods may be due to nonsystematic of hand of labor.

In other wards, the highest percent of the number of seedlings/m^2 recorded at the lowest of each forward speed (1 km/h), slope angle of feeding tube (0 degree) and the seedling distance (18 and 31 cm respectively). The following equation was the obtained regression equations for sweet potatoes and pepper crop:

No. S.= 19.3 - 3.91 F - 0.346 S.D. - 0.0583 S.A.----- (4.13) (R^2 = 91.3 %)

No. S. = 8.69 - 1.96 F - 0.122 S.D. - 0.0361 S.A. ------- (4.14) (R^2 = 90.8 %)

Where: No. S. (m^2) = Number of seedling in meter square. F (km/h) = forward speed.

S.D (cm) = seedling distance in row &. S. A. (degree) = slope angle of feeding tube.

4.5: Energy requirements:

The actual demands of energy in kW.h/fed, the values of energy were (65.97, 52.87, 44.34, and 41.71 kW.h/fed) for sweet potato and pepper crops at previous conditions respectively at forward speed of 1, 1.25, 1.5 and 1.75 km/h respectively.

4.6. Transplanting cost analysis:

The values of hourly cost, 16.16 and 4.95 L.E / h. of tractor and transplanting machine respectively. While, the highest values of transplanting cost with manual transplanting (150 L.E. / fed) and the cost values of mechanical transplanting were 88.03, 68.19, 55.52 and 46.86 L.E / fed for transplanting sweet potato at forward speed of 1, 1.25, 1.5 and 1.75 km/h respectively and this values were 72.83, 57.00, 46.86 and 39.05 L.E / fed for transplanting pepper at the same previous conditions.

5. SUMMARY AND CONCLUSION

The uses of the developed transplanter manufactured considered a new technology especially under Egyptian conditions. There is a direct proportional between C. V. of longitudinal scattering and C. V. of transverse scattering and forward speed and slope angle of feeding tube. Also, they have an indirect proportional with seedling distance for sweet potatoes and pepper crops. There is an indirect relationship between depth of seedlings and forward speed and slope angle of feeding tube. But it has a positive proportional with distance for sweet potatoes and pepper crops. There is an indirect relationship between number of seedlings /m2 and forward speed, slope angle of feeding tube and seedling distance in row for sweet potatoes and pepper crops. There is a positive relationship between energy requirement and forward speed, for sweet potatoes and pepper crops. The hourly cost, 16.16 and 4.95 L.E / h. for tractor and transplanting machine. But, the highest values of transplanting cost with manual transplanting (150 L.E. / fed) and the cost values of mechanical transplanting were 75.99, 60.79, 50.66 and 43.27 L.E / fed for transplanting sweet potato and pepper crops at forward speed of 1, 1.25, 1.5 and 1.75 km/h respectively. Forward speed 1.5 km/h, seedling distance 18 and 31 cm and angle of feeding tube zero degree is recommended for transplanting sweet potato and pepper crop by using the modified machine.

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إستجابة بعض محاصيل الخضر للشتل الآلى

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تعتبر عملية الشتل من أكثر العمليات التى تتبع فى زراعة معظم محاصيل الخضر وللحصول على أفضل إنتاجية من حيث الكم والشكل والجودة لما لذلك من أهمية بالغة من الناحية الإقتصادية والناحية التسويقية ونظراً لأن الشتل الآلى يتم تحت سرعات تقدم محدودة لا تتجاوز 1.0 كم/س كما أوضحته الدراسات السابقة وما يترتب على ذلك من إنخفاض فى السعة الحقلية لآلة الشتل أيضاً زيادة عدد الشتلات الغائبة مع الزيادة فى سرعة التقدم لآلة الشتل وعليه كان الهدف الرئيسى لهذا البحث ممثلاً فيما يلى:

1. تطوير آلة شتل الخضر ذات التلقيم اليدوى لتجنب غياب الشتلات وملائمتها لشتل محصولى البطاطا والفلفل.
2. تحديد العوامل المثلى التى تؤثر على أداء الشتالة المطورة.

ولذلك تم إعداد دائرة كهربية تصدر صوتاً فى حالة مرور الماسك دون شتلة وأنبوب لتلقيم الشتلات مخروطى الشكل بطول 66 سم يتم وضع الشتلة داخله عند سماع الصوت والدائرة مكونة من عدد إثنين مفتاح وألة تنبيه وبطارية جافة. تم تثبيت المفتاح الأول بمقدمة الدليل بالشتالة على مسافة 5.5 سم من بداية الدليل بينما المفتاح الثانى تم تثبيته بمؤخرة الدليل على بعد 7.5 سم من نهاية الدليل. أما مصدر الصوت(كلاكس) وأنبوب التلقيم المخروطى الشكل تم تثبيتها على فجاج الشتالة. أجريت تجارب هذا البحث خلال موسمى الزراعة لعام 2004 – 2005 بالمزرعة البحثية للخضر بالبرامون – محافظة الدقهلية – مصر. تم إستخدام الصنف مبروكة لمحصول البطاطا وصنف كاليفورنيا وندر للفلفل وتمت التجربه على مساحة بلغت حوالى 3.6 فدان .

القياسات التى تمت:

- التشتت الطولى والعرضى للشتلات داخل الصف الواحد لكلا المحصولين وكذلك عمق الشتلة و كثافة الشتلات بعد عملية الشتل / م^2 - السعة والكفاءة الحقلية لآلة الشتل قبل وبعد التطوير- متطلبات الطاقة لعمليات الشتل بآلة الشتل قبل وبعد التطوير- متطلبات التكاليف لعمليات الشتل بآلة الشتل قبل وبعد التطوير.

أوضحت التجارب الحقلية النتائج التالية:

معامل إختلاف كل من التشتت الطولي والعرضى لشتلات البطاطا والفلفل تناسبت طردياً مع سرعة التقدم وزاوية ميل أنبوب التغذية وعكسياً مع المسافة بين الشتلات. عمق الشتل لشتلات البطاطا والفلفل تناسبت عكسياً مع سرعة التقدم وزاوية ميل أنبوب التغذية وطردياً مع المسافة بين الشتلات. عدد الشتلات فى المتر المربع لشتلات البطاطا والفلفل تناسبت عكسياً مع سرعة التقدم وزاوية ميل أنبوب التغذية والمسافة بين الشتلات. بلغ مقدار الطاقة المطلوبة لشتل محصولى البطاطا والفلفل 65.97 ، 52.87 ، 44.34 و 41.71 كيلووات.ساعة/فدان عند سرعات تقدم 1 ، 1.25 ، 1.5 و 1.75 كم/س على التوالى . بلغت السعة الحقلية (0.28 و 0.35 و 0.41 و0.48 فدان / ساعة) فى شتل محصولى البطاطا و الفلفل بالآلة قبل وبعد التطوير عند سرعة تقدم للشتل (1 و1.25 و1.5 و1.75 كم / س) كما بلغت الكفاءة الحقلية (85.00 و 83 و 82 و 81 %) فى شتل محصولى البطاطا والفلفل تحت الظروف السابقة على التوالى. بلغت تكاليف الشتل آلياً لمحصولى البطاطا والفلفل 75.99 ، 60.79 ، 50.66 و 43.27 جنيه/ للفدان عند سرعات تقدم 1 ، 1.25 ، 1.5 و 1.75 كم/س على التوالى. أما تكاليف الشتل اليدوي للبطاطا و الفلفل بلغت 150 جنيه / للفدان.

التوصيات

1) يوصى بإستخدام آلة الشتل المعدلة فى شتل البطاط ا والفلفل ومحاصيل الخضر الأخرى .
2) أفضل سرعة تقدم لشتل محصول البطاطا والفلفل 1.5 كم / س مع آلة الشتل المعدلة.
3) أفضل مسافة بين الشتلات فى الصف الواحد يوصى بها أثناء شتل البطاطا والفلفل بالشتالة المعدلة 18 سم و 31 سم على التوالى.
4) أفضل قيمة لزاوية ميل لقادوس التلقيم (صفر درجة) مع شتل البطاطا والفلفل بالشتالة المعدلة.