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ENGENEERING PARAMETERS AFFECTING ROW UNIFORMITY AND PRODUCTIVITY FOR POTATO PLANTER

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ABSTRACT

The aim of the investigation is to study the effect of the planter forward speed, spacing between seeds and ridging time on the germination, lateral deviation, double and void tubers percentage, productivity, power and energy requirement. The field experiments were conducted at forward speeds of 2.0, 2.7 and 3.6 km/h, planting depths of 14, 17 and 20 cm spacing between seeds of 25, 30 and 35 cm under ridging with planting and ridging after emergence. The results revealed that the forward speed has a negative effect on germination, lateral deviation, productivity, energy requirements and positive effect on the double and void tubers percentage. Meanwhile, the planting depth has a negative effect on the germination, productivity and positive effect on the lateral deviation, power and energy requirement. The ridging after emergence gave a significant increase of the germination and productivity as compared with ridging with planting. The highest germination of 98.6% was found at forward speed of 2.0 km/h, spacing between seeds of 30 cm, planting depth of 14 cm without ridging during planting (ridging after emergence). Meanwhile, the highest productivity of 11.21 ton/fed. was obtained at forward speed of 2.0 km/h, spacing between seeds of 25 cm, planting depth of 14 cm with ridging after emergence.The lowest double tubers of 3.3%, void tubers of 2.9% were found at forward speed of 2.0 km/h., but the minimum value of lateral deviation of 10.68% was found at forward speed of 3.6 km/h. The highest power requirements of 40.85 kW was obtained at forward speed of 3.6 km/h and planting depth of 20 cm. While the lowest energy requirements of 31.69 kW. h/fed. was found at forward speed of 3.6 km/h and planting depth of 14 cm.

INTRODUCTION

Potato is one of the most important crops which is widely used as food stuff in Egypt. The production of potato tubers in 1991 was 1786057 t. taken from 210077 fed. with an average of 8.5 t. / fed. While in 1999 the potato tubers production was 159521 t. taken from 160386 fed. with an average of 9.66 t. / fed. This means that, the vertical extension increased by 13 % and the horizontal extension decreased by 23.7 %. (Agric. Ex. Iss.,2001). In Egypt, most of the planting areas of potato tubers are still planted manually. Most of manual planting problems of potato are the apparent of high deviation between tubers in the row, subsequently decreasing of density of potato plants per square meter and potato production in addition to increasing the consumed time during potato planting.

Mechanization of production becomes one of the most essential goals for raising potato production and minimizing the production cost, subsequently increasing the net income for potato production.

Bernacki and Kanafojski (1972) stated that the size of potato seeds in mechanical sowing should be in the range of 60-100 mm in diameter and the weight of individual seed should be about 40- 60 grams. They reported

that the permissible lateral deviation of deposited potato seeds from the center of opener should be 2 cm. Also, they indicated that furrow opener is a working element to ensure tuber deposition in soil.

Misener (1982) evaluated the effects of seed piece size and type on potato planter performance. Seed size was found to be important parameter affecting uniformity of seed piece spacing with the cup planter. For good performance from these machines as measured by uniformity of spacing, the larger seed pieces or the use of whole seed appears to be advantageous. With the pick type planter, performance was found to be less sensitive to seed size. Also, he added that the tuber unit planters, which were equipped with seed cutters, were found to give an even seed piece spacing. The uniformity of spacing decreased when large tubers were planted

El-haddad and Ahmed (1983) designed and constructed a mounted two row semi-automatic planter for potato tuber planting. They reported that the average number of tubers per kasaba, planting depth spacing between adjacent rows and spacing between tubers in row were 16.2 tubers. 25.5 cm, 65.5 cm and 22 cm respectively. The field capacity, field efficiency, cost per feddan and total time per feddan were 0.36 fed/h, 83 %, 13.75 LE / fed and 2.75 h / fed., respectively. They also reported that, in Egyptian culture practice, potato is planted on ridges with row plant spacing of 60-70 cm. In this case potato seeds are usually planted at spacing of 20-30 cm and 15-25 cm depth.

Siepman (1983) reported that in order to facilitate and realize mechanical planting operation in the field, planting should meet the following conditions: straight row, uniform planting depth as shallow as possible, equal spacing between the rows, fairly accurate spacing in the row.

El- Shal and Shehata (1987) modified a Nard potato planter. They found that the modified planter reduced the planting cost by 15.88 % and required time decreased from 8 to 7 hours compared with manual method. Also, they reported that the yield increased by 2.6 and 4.8 t./fed. by using modified planter compared with the manual and unmodified planters respectively.

Khalifa (1988) studied the performance of two different commercial and mechanical planters. He calculated the percentage of hills having two and three seeds and the percentage of missing hills. He found that, as the machine forward speed increased, the percentage of cells having 2-3 seeds decreased. He concluded that increasing machine forward speed is followed with an increase in the percentage of missing hills.

Ismail (1989) stated that the operational speed of planting machine at manual filling of buckets is very low and in the range from 1.5 to 1.6 km / h (0.4 to 0.44 m / sec). Also, he stated that the span of time necessary for the operation of taking out potato seed from the box and placing it into the bucket amounts to approximately 0.75 seconds.

Glukou (1994) brief descriptions are given of two varieties bred, tested and multiplied scenarists of the all Russian Institute of Potato Farming at their base at Belousovskoe Experimental Farm in the Kaluga provice of European; Russia: Zhukovskii Rannii and Belousriuskii. The farmer is able to give yield

of 15 t/ha within 60 days of planting. The variety gives a mean yield of 50 ton/ha (20.9 t. /fed) and is suitable for mechanical harvesting.

Ismail and Abo Elmagd (1994) found that the operation cost of the automatic planter (cramer) was 20.1 LE / fed, compared with 12.4 LE / fed for the semi-automatic planter (local).

Abdou (1995) designed and manufactured two prototypes of combination units for mechanical potato planting with belt and chain. The obtained data from this work showed that:

1- The prototype with belt gave a higher yield of 8.8 t. /fed, while the prototype with chain and manual planting gave 8.4 and 7.5 t. / fed., respectively.
2- The mechanical planting gave a higher potato yield 12-17 % comparing with manual planting.
3- Mechanical planting saved 27 % and 50 % of operation time and cost compared with manual planting.
4- The manufacturing of the combination unit from local materials was 20 % from the same imported unit.

MATERIALS AND METHODS

The experiment were carried out on clay soil at Dakkahlia Governorate during season of 2001-2002. Daiemont variety of potato was used in this study. The experiments were conducted to study the effect of forward speed, planting depth, spacing between potato seeds and ridging time on the germination ratio, lateral deviation, double and void tubers percentage, in addition to productivity, power and energy requirements. A local planter were used include two main feeding systems (semi-automatic and automatic) mounted in the rear of Landini tractor 71 Hp (52.2 kW), model(A4-236). This study used only automatic feeding system. The characteristics of this machine (fig.1) as follows:

No. of rows : two rows;
Row spacing : adjustment 70 cm;
Seed spacing : ranged from 25-35 cm;
Feeding system : automatic feeding vertical belt with 20 spoons for each row
Furrow opener : two;
Furrow closures : three ridgers with moving wings;
Working width : 150 cm;
Light mass : 600 kg;

Experimental variables
Independent variables:

1- Three forward speeds of 2.0, 2.7 and 3.6 km/ h;
2- Three planting depths of 14, 17 and 20 cm;
3- Three spacings between potato seeds of 25, 30 and 35 cm;
4- Ridging time, with planting and after emergency;

Fig. 1: Automatic potato planter

Dependent variables:

1- Germination, %;
2- Lateral deviation, %;
3- Double tubers, %;
4- Void tubers, %;
5- Productivity, t. / fed.;
6- Power and energy requirements, kW, kW. h / fed;

Measurements:

1- Germination percentage:

The germination percentage (**Gr**) was determined in the field after period of 45 days from planting operation using the following equation.

Gr = [Np / Ns] %

where:

Np = No. of potato plants within area of 30 square meters.

Ns = No. of potato seeds deposited with the same area (30 square meters)

2- Lateral deviation.

After planting was carried out the lateral distribution of tubers was calculated. Along the longitudinal axis for row, the number of planted tubers

and the spacing in between are measured. Also, the deviations around the longitudinal axis more than 2 cm are counted. The percentages of deviated and linear distributed tubers were calculated with reference to the total number of planted tubers in 10 m length, as follows.

Ld = Nd / N x 100

where:

Ld = The lateral deviation, %;

Nd= No. of tubers deviated around the longitudinal axis of row; more than 2 cm in 30 m length;

N = No. of planted tubers in 30 m length.

3- Double tubers percentage

After planting was carried out, the double tubers were counted in 30 m length. It is considered that each double tuber represent only one tuber. The double tubers percentage was calculated as following:

Dt = n / N x 100

where:

Dt = double tubers percentage

n = No. of double tubers in 30m length .

4- Void tubers percentage

After planting was carried out, the void tubers were counted in 10m length . If the spacing between two planted tubers was40-50 cm or more it could be considered as void tuber. The void tubers percentage was calculated as following:

Vt = Nv /N x 100

where:

Vt = Void tubers, %;

Nv= No. of void tubers in 30 m length.

5- Productivity (tubers yield).

During potato harvesting by using chisel plow , potato tubers at the soil surface of 30 square meters were collected and weighed (W) kg to determine the lifted tubers (Lt). While the un-lifted tubers (Ult) were harvested by hand digging for the same mentioned area (30 square meters) and weighed (M) kg to calculate the lifted and un-lifted tubers according to the following equations.

Lt = W x 0.14 (t. / fed.)

Ult = M x 0.14 (t. / fed.)

The total tubers yield was calculated as follows: **Yt = Lt + Ult**

6- Power and energy requirements;

Fuel consumption (FL) was determined at each forward speed and planting depth (L/sec). The power requirement (P) was calculated according to following equation.

P= Fc x Fd x Cv x [427 / 75] x 0.746 x ηth x ηn,

where:

Fc = Fuel consumption, L/sec;

Fd = Density of solar, 0.85 kg/L;

Cv =Calorific value of fuel, (10000 km/ k cal);

427 = Thermal – mechanical equivalent, kg. m /k cal;
0.746 = Equivalent value of, kW/Hp;
ηth = Thermal efficiency of engine (considered to be 40 % for diesel engine);
ηn=Mechanical efficiency of engine (considered to be 80 % for diesel engine);

The energy requirements"E" (kW . h / fed.) was calculated at different forward speeds for each planting depths according to the following equation:

E = kW / Fca,

where:

Fca = Actual field capacity at different forward speeds and planting depths, fed / h.

RESULTS AND DISCUSSION

Effect of different parameters:

Effect of forward speed:

Data presented in Table (1) show that the planter forward speed had negative effect on the germination, lateral deviation, machine productivity, energy requirements and positive effects on the double tubers, void tubers and power requirements. The highest germination values of 94.26%, lateral deviation of 19.09%, machine productivity of 10.22 t./fed., energy requirements of 48.03 kW. h/ fed. and the least values of double tubers of 2.9% and power requirements of 28.27kW were obtained at forward speed of 2.0 km/h. On the other hand, the minimum values of germination of 91.32%, lateral deviation of 10.68%, machine productivity of 9.13 t./fed., energy requirements of 36.46 kW. h/ fed. and the highest double tubers of 6.5%, void tubers of 5.4% and power requirements of 36.63 kW were recorded at forward speed of 3.6 km/h.

Effect of planting depth:

The results illustrated in Table (1) revealed that, increasing planting depth lead to decrease the germination, machine productivity and increase the lateral deviation, power and energy requirements. The highest germination of 93.67%, machine productivity of 10.08 t./ fed. and the lowest lateral deviation values of 10.68%, power requirements of 28.3 kW and energy requirements of 35.69 kW. h/ fed. were obtained at planting depth of 14 cm. On the other hand, the minimum germination of 92.4%, machine, productivity of 9.26 t. /fed. and the highest lateral deviation of 15.49%, power requirements of 36.29 kW and energy requirements of 48.42 kW. h/fed. were recorded at planting depth of 20cm.

Effect of spacing between seeds:

The results in Table (1) indicate that the spacing between seeds had negative effects on the machine productivity. Increasing spacing between seeds tends to decrease machine productivity. The highest machine productivity of 10.1 t./fed. was obtained at spacing between seeds of 25 cm

while the lowest machine productivity of 9.26 ton/fed. was recorded at spacing between seeds of 35 cm. However, the highest germination value of 94.28% and the lowest value of lateral deviation of 14.79% were obtained at spacing between seed of 30 cm. Each increase or decrease in spacing between seeds more or lower than this limit (30 cm) tends to decrease the germination and increase the lateral deviation.

Effect or ridging time:

The results in table (1) reveal that there are significant effects of ridging time on the germination and machine productivity. The ridging after emergence increased the germination and machine productivity, as compared with ridging with planting. The highest germination of 94.82% and machine productivity of 9.97 t./fed. were obtained under ridging after emergence. But the minimum germination
of 91.19% and machine productivity of 9.38 t./fed. were recorded under ridging with planting.

Table (1): Effect of forward speed, planting depth, spacing between seeds and ridging time on the germination, productivity, lateral deviation, power and energy requirements, double and void tubers.

Treatments	Germin-ation %	Productivity ton/fed.	later deviation %	Power kW	Energy kW.h/fed	Double tubers %	Void tubers %
Forward speed							
2.0 km/h	94.26	10.22	15.34	28.27	48.03	3.3	2.9
2.7 km/h	93.27	9.70	19.09	31.95	41.07	4.5	3.8
3.6 km/h	91.32	9.13	10.68	36.62	36.46	6.5	5.4
L.S.D 5%	(0.10)	(0.11)	(0.14)	(0.16)	(0.23)	(0.10)	(0.10)
Planting depth							
14 cm	93.67	10.08	14.6	28.3	35.69	-	-
17 cm	92.94	9.73	14.99	31.91	41.44	-	-
20 cm	92.40	9.26	15.49	36.29	48.42	-	-
L.S.D. 5%	(0.10)	(0.11)	(0.14)	(0.16)	(0.23)	-	-
Spacing between seeds							
25 cm	92.29	10.1	15.14	-	-		
30 cm	94.28	9.68	14.79	-	-		
35 cm	87.44	9.26	15.18	-	-		
L.S.D.	(0.10)	(0.11)	(0.14)	-	-		
Ridging time							
With planting	91.19	9.38	-	-			
After emergence	94.82	9.97	-	-			
L.S.D. 5%	(0.08)	(0.09)					

Interaction effects:

The results in Fig. (2and 3) indicate that there are highly significant effects of the interaction between forward speed and planting depth on the germination, productivity, power and energy requirements and no significant effects of this interaction on the lateral deviation. The highest germination of 94.97%, machine productivity of 10.51 t./fed. and the least power requirements of 24.13 kW were recorded at forward speed of 2.0 km/h and planting depth of 14 cm. Meanwhile, the lowest germination of 90.63%,

machine productivity of 8.65 t./fed. and the highest power requirements of 40.85 kW were obtained at forward speed of 3.6 km and planting depth of 20 cm. On the other hand, the highest lateral deviation of 19.54% and energy requirements of 56.3 kW. h/fed. were recorded at forward speed of 2.0 km/h and planting depth of 20 cm. However, the least lateral deviation of 10.33 % and energy requirements of 32.64 kW. h/fed. were obtained at forward speed of 3.6 km/h and planting depth of 14 cm.

The results in Fig. (4) reveal that there are highly significant effect of the interaction between forward speed and spacing between seeds on the germination; lateral deviation and no significant effect of this interaction on the machine productivity. The highest germination of 95.87% was obtained at forward speed of 2.0 km/h and spacing between seeds of 30 cm. However, the lowest germination of 90.8% was recorded at forward speed of the 3.6 km/h and spacing between seeds of 25 cm. On the other hand, the treatment of forward speed of 3.6 km/h with spacing between seeds of 25 cm had a significant effect on the lateral deviation as compared with other treatments, which reduced the lateral deviation up to 10.57 %.

The results in Fig. (5) illustrate that there are significant effects of the interaction between forward speed and ridging time on the machine productivity. Decreasing forward speed under ridging after emergence tends to increase the machine productivity. The highest productivity (10.57 t./fed) was obtained at forward speed of 2.0 km/h under ridging after emergence. Meanwhile the minimum productivity of 8.89 t./fed. was recorded at forward speed of 3.6 km/h under ridging with planting.

The results in Fig. (6) show that there are significant effects of the interaction between planting depth and ridging time on the germination and no significant effect on the machine productivity. The highest germination of 95.26% and machine productivity (10.26 ton/ fed.) were recorded at planting depth of 14 cm under ridging after emergence. Meanwhile, the lowest germination of 90.66% and machine productivity of 8.91 t./fed. were found at planting depth of 20 cm under ridging with planting.

The results in Fig. (7) indicate that the interaction of spacing between seed and ridging time had a significant effect on the germination and no significant effect on the productivity . The highest germination of 96.38% was found at seeds spacing of 30 cm under ridging after emergence. Meanwhile, the highest machine productivity of 10.4 t./fed. was obtained at seeds spacing of 25 cm under ridging after emergence. On the other hand, the lowest germination and productivity of 91.70% and 8.97 t./fed., respectively were recorded at spacing of 35 cm under ridging with planting.

The results in Fig. (8) reveal that there are highly significant effects of the interaction between planting depth and spacing between seeds on the germination and no significant effect of this interaction on the lateral deviation and machine productivity. The highest germination of 95.02% and the lowest lateral deviation of 14.33% were found at planting depth of 14 cm and spacing between seeds of 30 cm. Meanwhile, the highest productivity (10.29 t. /fed) was found at planting depth of 14 cm and spacing of 25 cm. On the other hand, the lowest germination of 91.75% and productivity (8.76 ton/ fed.) were found at planting depth of 20 cm and spacing of 35 cm.

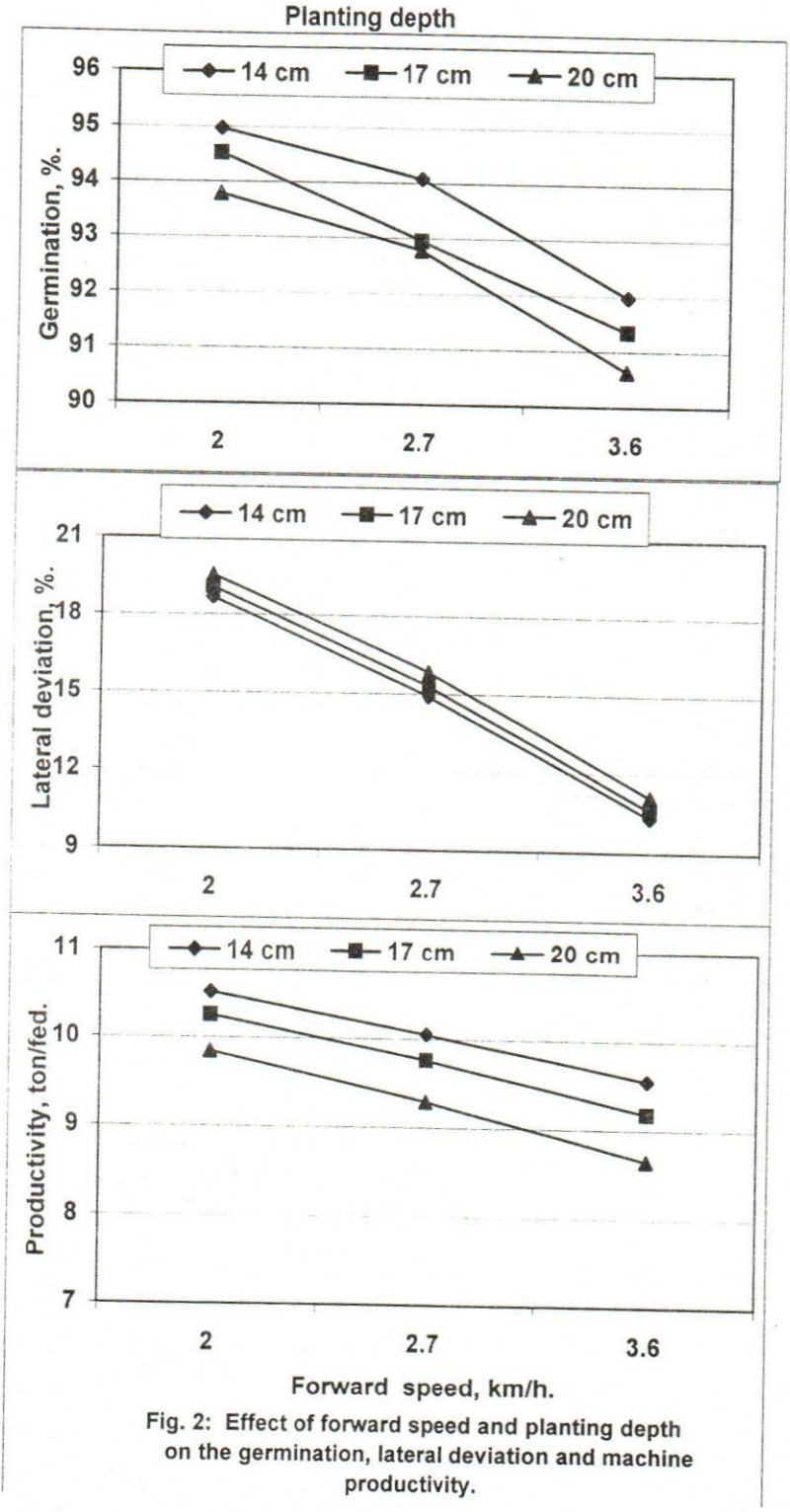


Fig. 2: Effect of forward speed and planting depth on the germination, lateral deviation and machine productivity.

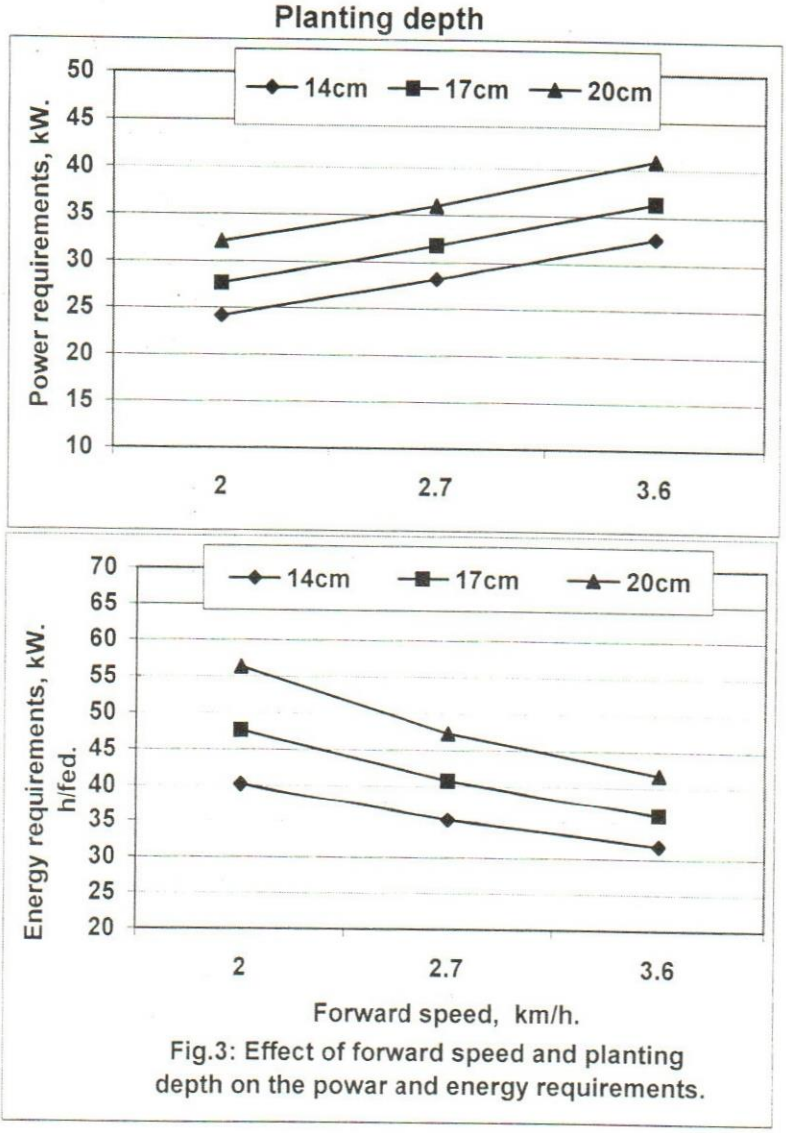


Fig.3: Effect of forward speed and planting depth on the powar and energy requirements.

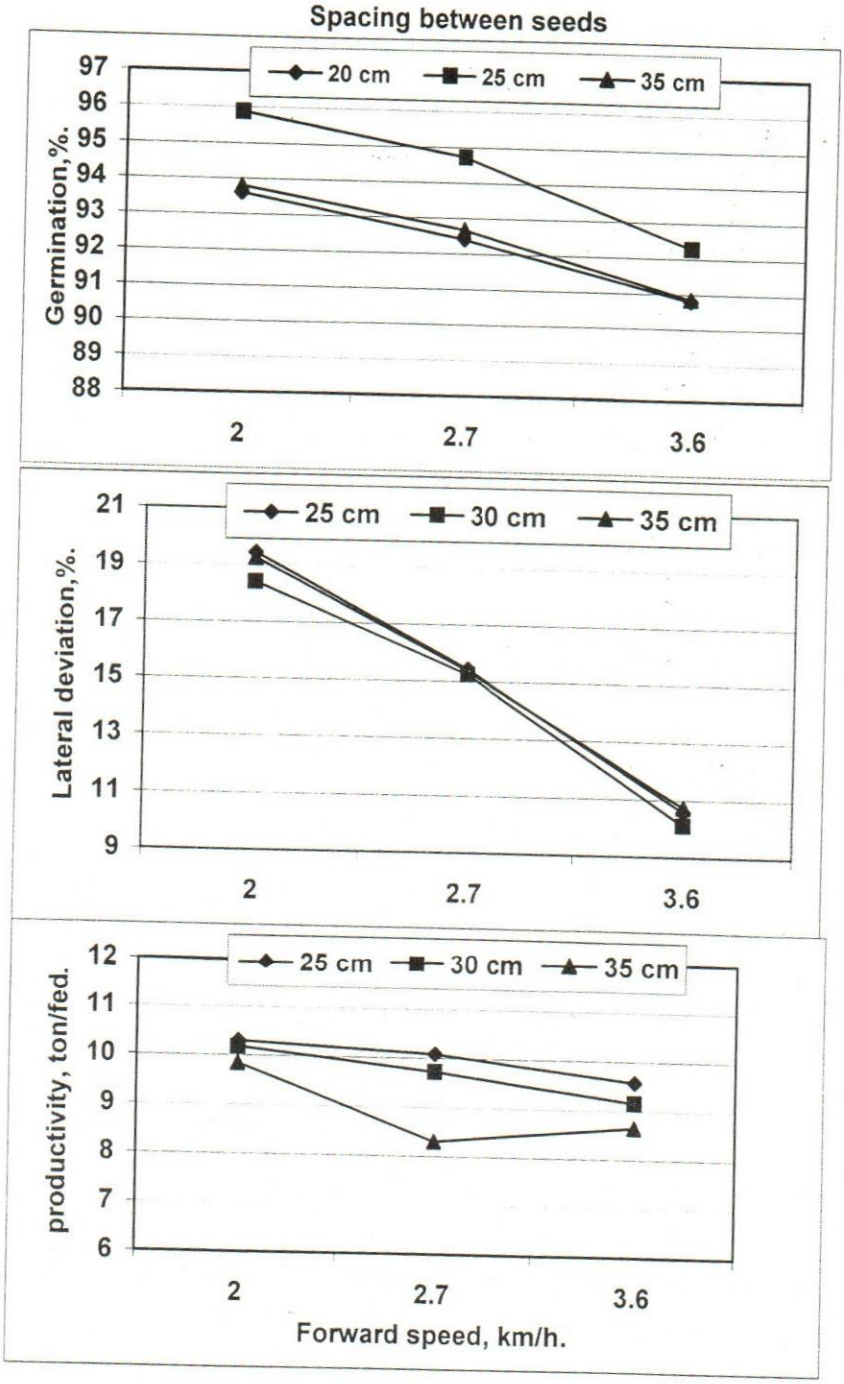


Fig.4: Effect of forward speed and spacing between seeds on the germination, lateral deviation and productivity

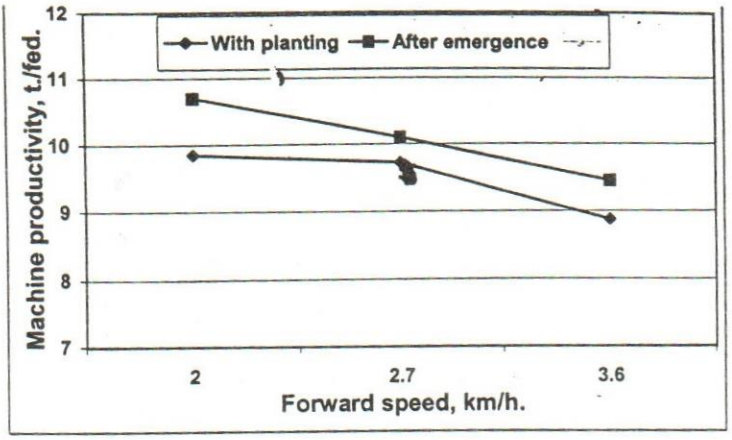


Fig. 5: Effect of forward speed on the germination and machine productivity under ridging with planting and after emergynce.

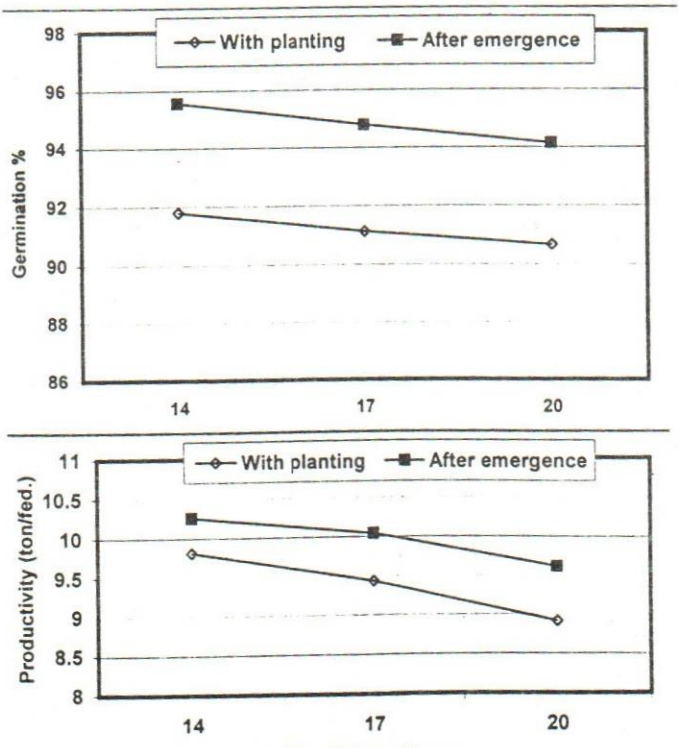
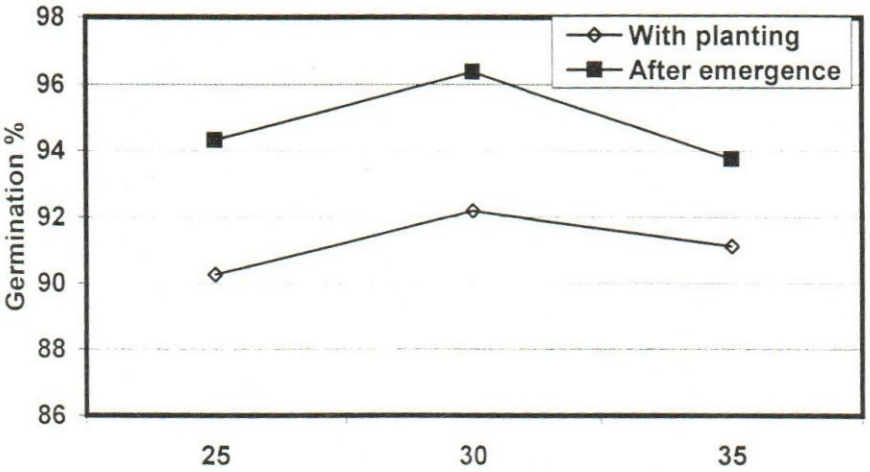
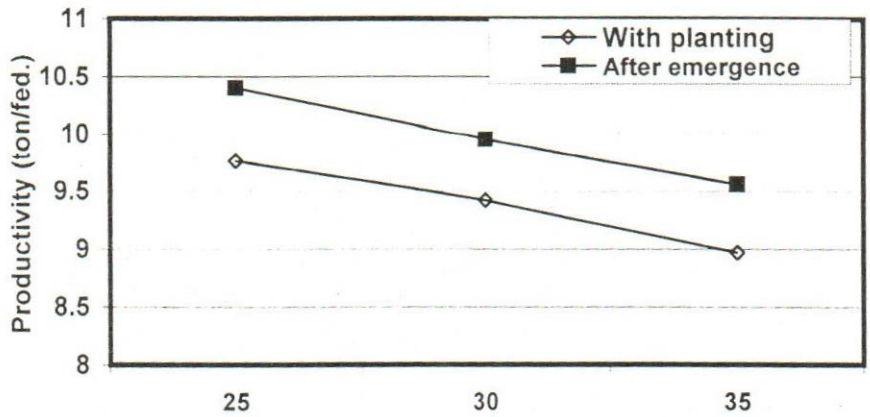


Fig. 6: Effect of planting depth on the germination and productivity under ridging with planting and ridgingafter emergence





Spacing between seeds, cm.

Fig. 7 : Effect of spacing between seeds on the germination and productivity under ridging with planting and after emergence

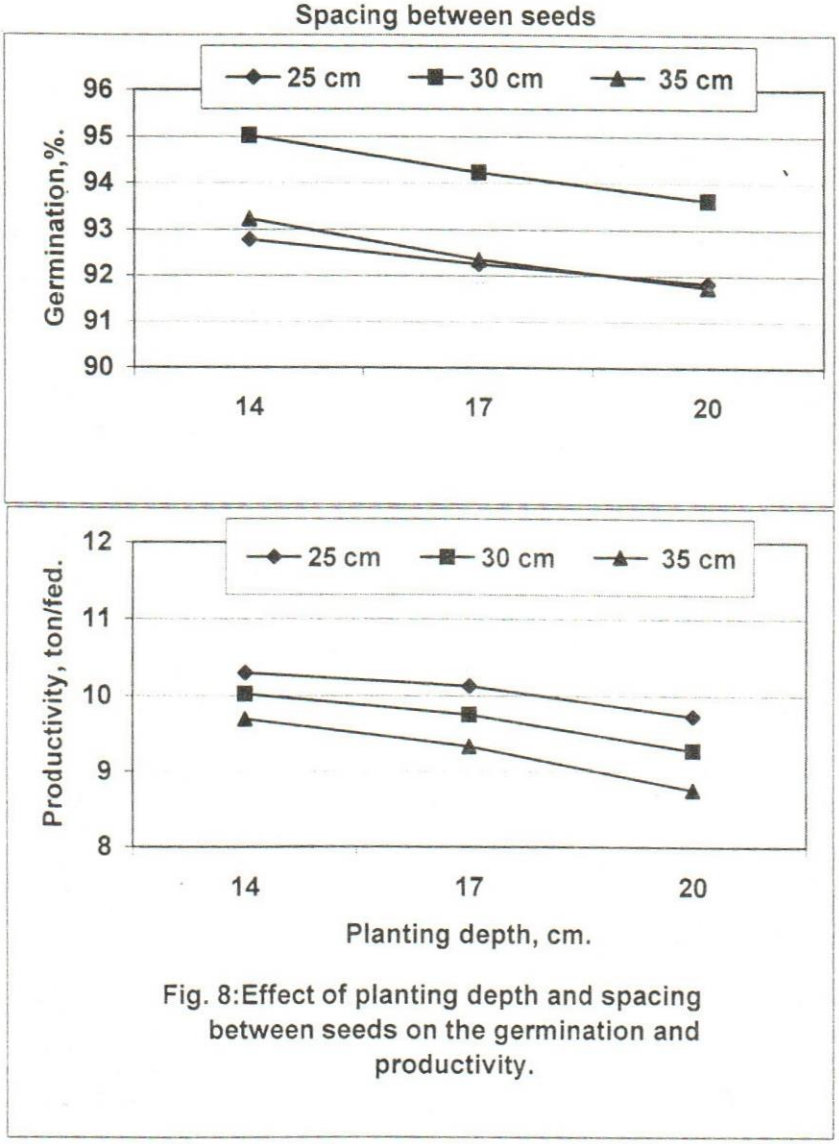


Fig. 8:Effect of planting depth and spacing between seeds on the germination and productivity.

The results in Fig. (9) reveal that there are highly significant effects of the interaction between forward speed, spacing between seeds and ridging time on the germination and no significant effect on the productivity. The highest germination of 97.83% and productivity of 10.5 t/fed. were found at forward speed of 2.0 km/h, spacing between seeds of 30 cm without ridging during planting. On the other hand, the minimum germination of 89.03% was found at forward speed of 3.6 km/h, spacing between seeds of 25 cm under ridging with planting. Meanwhile, the lowest productivity of 8.46 t/fed. was obtained at forward speed of 3.6 km/h, spacing between seeds of 35 cm under ridging with planting.

The results in Fig. (10) indicate that the interaction of spacing between seeds, planting depth and ridging time had a highly significant effect on the germination and no significant effect on the productivity. The highest germination of 97.2% was recorded at spacing between seeds of 30 cm, planting depth of 14 cm without ridging during planting (ridging after emergence).But, the highest productivity of 10.67 t./fed. was found at spacing between seeds of 25 cm, planting depth 14 cm under ridging after emergence. Meanwhile, the lowest germination of 89.93% was found at spacing of 25 cm, planting depth of 20 cm under ridging with planting. Meanwhile, the lowest productivity of 8.41 ton/fed. was obtained at spacing of 35 cm, planting depth of 20 cm under ridging with planting.

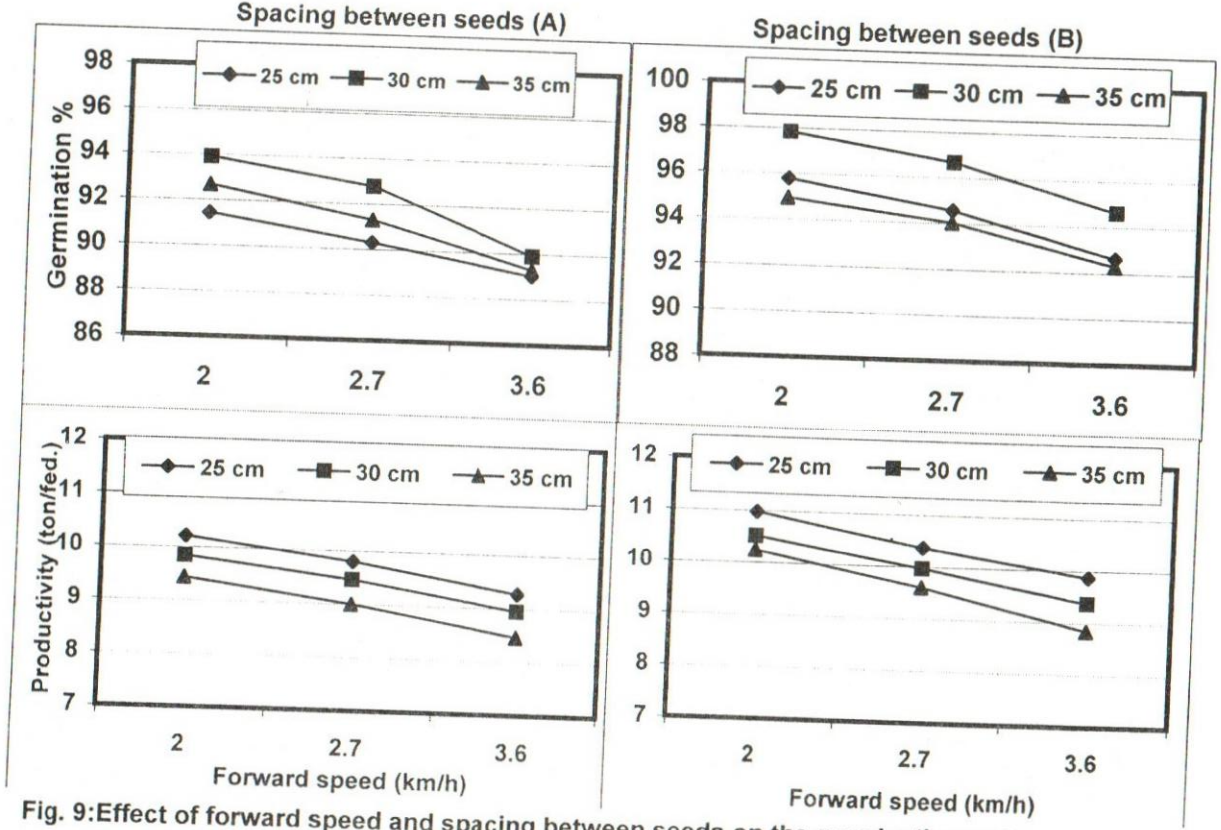


Fig. 9:Effect of forward speed and spacing between seeds on the germination and productivity under ridging with planting(A) and ridging after emergenc(B).

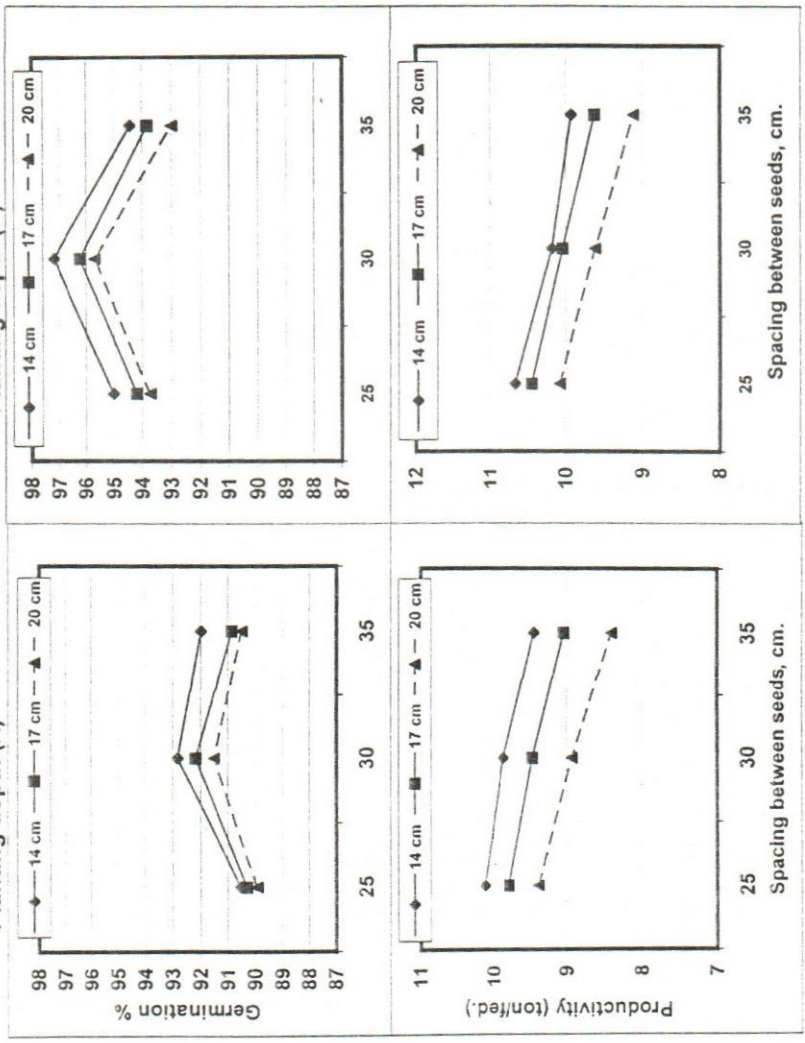


Fig. 10: Effect of spacing between seeds and planting depth on the germination and productivity under ridging with planting (A) and ridging after emergence (B).

CONCLUSIONS

From the previous results it can be concluded that.

1- Increasing forward speed led to increase double and void tubers percentage and decrease the germination ratio, lateral deviation percentage and productivity (t./fed.).
2- Increasing planting depth tends to increase lateral deviation and power requirements and decrease the germination percentage and productivity.
3- The ridging after emergence significantly increased the germination ratio by 3-5 % and the productivity by 5-10 % as compared with the ridging with planting.
4- The spacing between potato seeds ranged from 25-30 was the suitable spacing which increase the germination percentage and productivity.
5- The highest germination values of 98.6 and 94.3 % under ridging after emergence and ridging with planting respectively, were found at forward speed of 2.0 km / h , planting depth of 14 cm and spacing seeds of 30 cm.
6- The lowest double and void tubers percentages were 3.3 and 2.9 % at forward speed of 2.0 km / h .
7- The highest machine productivity values(11.22 and 10.55 t. / fed. under ridging after emergence and ridging with planting respectively) were found at forward speed of 2.0 km / h, plating depth of 14 cm and spacing between potato seeds of 25 cm
8- The lowest power requirements of 32.64 kW was found at forward speed of 2 km/h and planting depth of 14 cm. Meanwhile the lowest energy requirement was 47.87 kW.h/ fed. Found at forward speed of 3.6 km / h and planting depth of 14 cm.

REFERENCES

Abdou, F.M. (1985) .Effect of mechanical planting on potato yield . M. Sc. Th, Fac. of Agric. Cairo Univ.

Abdou, F.M. (1995) Design of combination unit for mechanical potato planting with belt and chain , Misr J. of Agric. Eng ., 12 (4) : 912-930.

Bernaki, J. H. and C. Z. Kanafojski (1972) Agricultural machine, theory and construction . Vol. (1) No (1): 738-765.

El-haddad, Z. A. and E. A. Ahmed (1983). A semi-automatic potato planter. The Second. I. Conf. of prod. Eng. Dept, Univ. of Alex. .

El. Shal, M. S. and M. S. Shehata . (1987). Study on the performance of Nard potato planter under Egyptian condition, Misr J. of Agric. Eng. , 4 (1 0) : 93-98.

Glukou, A. P.(1994).Potato varieties of the Belousovskoe Experimental farm "Kartofel-Ovoshchi. No.3,23 (c.f Abd El-galiel 2002,Ph. D. Th. Mansura unvi..

Ismail, Z. E. (1989) Evaluation of some engineering parameters affecting uniformity of distribution of potato planter. Misr J. of Agric. Eng., 6 (1): 78-90.

Ismail, Z. E. and A. Abo El-magd (1994) . Evaluation of mechanical potato planting . Misr J. of Agric. Eng., 11 (1): 3 18.
Khalifa,ELS. M. A.(1988).Efficiency of some hills planting machines (planters). unpup M.Sc.. Th. Fac. of Agric., Tanta Univ..
Misener, G.C. (1982). Potato uniformity spacing. Trans. of ASAE., 25 (6):1504 -1505.
Siepman, IR A. M. (1983) Mechanization of potato growing. I. course on potato, Inst of Agric, Eng., Wageningen, Netherland.

بعض العوامل الهندسية المؤثره على انتظامية التوزيع في الخط والانتاجية لآلة زراعة البطاطس .

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يعتبر محصول البطاطس من أهم محاصيل الخضر في مصر حيث يستخدم كغذاء أساسي للإنسان وحيث أن زراعة البطاطس مازالت تجرى يدويا في مصر مما يترتب عليه عدم انتظامية التوزيع في الخط و قلة الانتاجيه. أجري هذا البحث لدراسة تأثر بعض العوامل الهندسية لآلة زراعة البطاطس الموترة على انتظامية التوزيع و الإنتاجية لمحصول البطاطس . وقد أجرى هذا البحث في أحد الحقول الخاصة بأحد المزارعين بمحافظة الدقهلية٢٠٠٢ و كانت أهم النتائج المتحصل عليها كآلاتي:-

١. زيادة السرعة الأمامية أدت إلى زيادة النسبة المئوية للازدواج في الدرنات و الفاقد كما أدت إلى نقص نسبة الإنبات و التشتت العرضي للدرنات و كذلك الإنتاجية.
٢. زيادة عمق الزراعة أدي إلى زيادة التشتت العرضي للدرنات و القدرة المتطلبة كما أدي ألي نقص في نسبة الإنبات و الإنتاجية .
٣. إقامة الخطوط بعد الإنبات أدي آلة زيادة الإنتاجية بمقدار ٥ – ١٠ %.
٤. أنسب مسافة بين تقاوي البطاطس في الخط أثناء الزراعة كانت تتراوح بين ٢٥ – ٣٠ سم حيث زودت من شبه الانبات و الانتاجية .
٥. أعلى قيم لنسبة الإنبات كانت ٩٨,٦ ، ٩٤,٣ % مع التخطيط بعد الإنبات و التخطيط مع الزراعة على التوالي عند السرعة الأمامية ٢كم / ساعة و عمق الزراعة ١٤ سم و المسافة بين تقاوى البطاطس في الخط ٣٠ سم.
٦. اقل نسبة مئوية للازدواج في الدرنات و الفقد في الدرنات كانت ٣,٣ % ، ٢,٩ % على التوالي عند السرعة الأمامية ٢ كم / ساعة
٧. أعلى قيم للإنتاجية كانت ١١,٢٢ ، ١٠,٥٥ طن / فدان مع التخطيط بعد الانبات و التخطيط مع الزراعة على التوالى عند السرعة الامامية ٢كم / ساعة وعمق الزراعة ١٤سم و المسافة بين تقاوى البطاطس فى الخط ٢٥ سم.
٨. اقل قدرة متطلبة كانت ٢٤,١٣ كيلوات عند السرعة الأمامية ٢كم / ساعة وعمق الزراعة ١٤ سم بينما كانت اقل طاقة متطلبة كانت ٣١,٦٩ كيلوات . ساعة / فدان عند السرعة الأمامية ٣,٦ كم / ساعة وعمق الزراعة ١٤ سم .