Misr J. Ag. Eng. 19 (3): 585 – 596

FACTORS AFFECTING ON THE PNEUMATIC PLANTER FOR CORN PLANTING EFFICIENCY AND ACCURACY

El-Iraqi, M. E.; Z. M. Emara; and M. I. Egela[1]

ABSTRACT

The present study was carried out at the research farm of the Rice Mechanization Center, Meet El-Dyba, Kafr El-Sheikh Governorate through summer seasons of 2000 and 2001. The objective of this work is to study the factors affecting on the efficiency and accuracy of corn mechanical planting using pneumatic planter under two different planting conditions, namely Afeer "mechanical planting of dry seeds in the soil" and Heraty " mechanical planting of soaked seeds in the soil". The variables of this study were: 1- five forward planting speeds, (2.93, 3.94, 4.68, 6.82 and 9.17km/h); 2- five planting depths; (2, 3, 4, 5 and 6 cm); 3- two planting conditions (Afeer and Heraty); 4- two physical properties of corn seeds (one way–cross 10 and three way-cross 310) 5- five soaking periods in the water (0, 6, 12, 18 and 24 hours).

From the laboratory tests it could be concluded that, the effect of the rotational speed of seed distributor disk and the physical properties of socked corn seeds on the patching efficiency of seeds in the holes of distributor disk was found to be not significantly. Therefore, it could be obtained regular planting even the planting speed reached to about 10 km/h without significantly effect under the physical properties of used corn seeds. However, the obtained results from field tests cleared that, using pneumatic planter under Heraty condition instead of Affer condition results in an increment in planting accuracy, field capacity (fed./h) and efficiency (%)and saving the power consumption (kW) and energy required (kW.h/fed.) by about 16.5 -17.5 % and 23-33%, respectively. Also, using pneumatic planter at 4 cm planting depth under Heraty conditions with soaked seeds for a period of 12h gave the best results of germination ratio and lateral scattering and consequently highest grain yield.

INTRODUCTION

Corn crop is considered as one of the most important grain crops in Egypt. In 2001 the planted area of corn was 1.770 million feddan, ***(ARCNC. 2001).*** Recently, the government tends to enlarge the growing area of corn to satisfy the shortage of producing the wheat and try to make the self sufficiency for tread by mixing corn with wheat with a rate of 20% ***(Matouk et al., 1999).*** However, increasing the productivity of corn per a unit area needs more advances techniques to achieve better circumstances for planting, growing, harvesting and processing.

Abd Alla (1999) reported that the sowing process is considered one of the most important agricultural operations. The art of placing seeds in the soil to obtain high germination ratio and healthy plants is most important objective to achieve highest yield. However, applying mechanization in planting crops by Egyptian farmers still limited because of the little number of available planters. ***Staut et. al. (1961)*** found that planters should be designed to apply higher pressures on soil at seed level, but should place relatively loose soil above the seed. However, ***Erbach (1981)*** described the major planter requirements for conservation planting as a) more seeds contact with soil, b) consistently cut plant residue, c) uniformly penetrate the soil, d) uniform of seed depth, and e) adequately seed cover. ***El- Nakib (1975)*** reported that, the

[1]Researcher, Agricultural Engineering Research Institute, Dokki, Giza.

f[illegible]g and missing percentages of the feeding cells were related to seed position on t[illegible]e sucked holes, suction and speed of the feed plate rotation. The frequency of pick-up (f) of each seed position was described to the suction "p", feed hole area "a", seed weight "w", seed length protruding into the hole "l", main seed dimension "L" and an imperial constant. The frequency of pick-up was found to be increase with the groups "pa/w" and "l/L" in the following form: $f = 9.5\ (pa/w) + 52\ (l/L) - 6.5$. for 100%filling of the feed holes, suction more than 30 H2o was found necessary at a feed-plate speed of 10 rpm. Less suction required at higher speeds. The average planting depth for corn seeds ranged from 3 to 5 cm according to field conditions as reported by ***Awady and Ghoniem (1985) ; El-Sayed (1994) and Swan and Higgs (1994)***. However, ***Wurr et. al. (1985)*** indicated that, sowing depth had a considerable effect on percentage of seedlings emergence and the spread of emergence time. Corn should be planted deep enough to place the seed in contact with worm moist soil sufficient cover for protection against birds, rodents and surface drying ***(Leonard and Martin, 1986).***

Free (1970), reported that the grain yield of corn was greatly affected by the planting methods. However, the success or the failure a crop production system often depends on seed-bed condition, previous tillage operations, planting methods and tillage. This fact was corporations by ***Cannel and Ellis (1978)*** they reported that the different cultivation methods have an effect on soil conditions and plant root growth.

The main objective of this work is to study the factors affecting on the efficiency and accuracy of corn mechanical planting under two different planting conditions, namely Heraty " mechanical planting for wet (soaked) seeds in the soil" and Afeer "mechanical planting for dry seeds in the soil" to realize the flowing specific objectives:

1. Increasing field capacity and efficiency of the pneumatic planter;
2. Studying the effect of physical properties of corn seeds and rotational speed of seed distributor disk on the mechanical planting accuracy;
3. Decreasing the growing rate of weeds and consequently, increasing grain yield

MATERIAL AND METHODS

The field experiments were carried out during 2000 and 2001 corn growing seasons at " research farm of the Rice Mechanization Center (RMC), Meet El-Dyba, Kafr El-Sheikh" Agric. Eng. Res. Institute.

Experimental procedure

To carry out this study, two stages of work and tests has been done as follows:

First stage: Laboratory tests and experiments:

The laboratory work was carried out to:

1- measure the corn seeds physical properties (length, width, thickness and specific weight) of dray and soaked corn seeds at different soaking periods.
2- study the effect of the change in rotational speed of distributor disk of the pneumatic planter and physical properties of corn seeds on the seed patching efficiency in cells of distributor disk.
3- adjust and calibrate the pneumatic planter.

Second stage: Field experiments:

The field experiments were carried out to:

1- study the effect of different planting conditions on the capacity and efficiency of pneumatic planter, total power consumption and Energy requirement.
2- study the effect of using "Heraty" planting condition on the mechanical planting accuracy of corn comparing with traditional "Afeer" planting condition

Experimental field

The experimental field was plowed two times using chisel plow and leveled by scrapper. The experimental field was divided into two plots, the first plot was irrigated (Heraty plot) and the other plot left as it is (Afeer plot). The Heraty plot was cultivated one pass by using rotary cultivator when the soil moisture content became suitable for using machinery (about 27 %) and the planting process was done in both plots at the same planting date.

The experiments were conducted in a clay soil and the soil mechanical analysis of the experimental field was done in Soil, Water and Environment Research Institute. The average soil moisture content and the data of soil mechanical analysis are shown in Table (1).

Table (1): Soil moisture content and soil mechanical analysis of the experimental field.

Clay %	Slit %	(Clay + Slit) %	Sand %	$Caco_3$ %	Organic matter %	Soil type
53.32	17.63	70.95	29.05	1.3	1.71	Clay
Average soil moisture content			Afeer = 19.34%		Heraty = 27.61%	

Equipment

The mounted pneumatic planter "GAMMA 90" was used with a 55.6 kW (75hp) Yanmar tractor in this study. The pneumatic planter consists of four planting units (4 rows). The main parts of the planter unit are shown in Fig. (1). The feeding mechanism has two groups of feeding gears. Various combinations could be obtained to select the most appropriate feeding speed. The planter was adjusted at 12 kg /fed., 20 cm hill spacing within row and 75 cm row spacing, using a seed distributor disk of 26 holes (4.5 mm hole diameter), and a speed ratio of 1:1.14 between planter wheel and distributor disk gear of the planter. The technical specifications of the planter are as follows: -

Type and model	GAMMA, 90
Source of manufacture	Italy
No. of rows	4
Row spacing (mm)	500-800
Working width (mm)	2000-3200
Weight (kg)	600

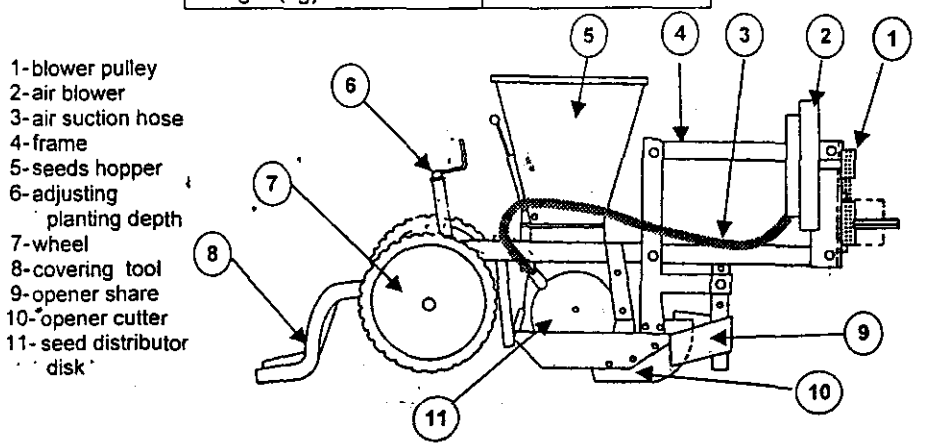

Fig. (1): The components of the pneumatic planter unit.

Scope of variables

To realize the purpose from this study, the following different variables (factors) taken under consideration, which may be affecting on the performance of the pneumatic planter:

1- Planting speed: five different forward planting speeds, namely 2.93, 3.94, 4.68, 6.82 and 9.17km/h (at rated engine speed of 2500 rpm);
2- Planting depth: five different planting depths, namely; 2, 3, 4, 5 and 6 cm;
3- Planting conditions: (two different planting conditions were used, namely; Afeer (corn seeds without soaking planted in Afeer plot "traditional method") and Heraty (soaked corn seeds planted in the Heraty plot);
4- Seeds physical properties of two different corn varieties, namely; one way –cross 10 and three way-cross 310 under five soaking periods in the water for 0, 6, 12, 18 and 24 hours

Measurements

To evaluate efficiency and accuracy of corn mechanical planting under the previous scope of variables (factors) and actual field conditions, the following measurements and measuring tools were taken into consideration:

1-Machine measurements to evaluate the factors affecting on the planter efficiency

To evaluate the field capacity and efficiency for pneumatic planter the following items were measured during planting operation: -

a- Actual forward speed , rotational speed of distributor disk and total time

The forward speed of planting during actual operation was calculated by measuring the time required for tractor + planter to pass between 2 sight poles, 20 m spacing. A multi-range hand tachometer was used to measure the actual rotational speed of the seed distributor disk and power take off of the tractor at 2500 rpm tractor engine speed. Also the total planting time was measured during planting operation to calculate the field capacity and efficiency of the pneumatic planter under study treatments.

b- Fuel and power consumption

The fuel consumed by the tractor was measured during seedbed preparation and planting operations under Afeer and Heraty planting conditions. A measured volume of fuel was put into the fuel tank of the tractor before operating in the field for a specific period. After the work was over, the volume left in the fuel tank was measured using a measuring jar. Form these observations the volume of fuel consumed was determined and the rate of fuel/ hour consumption was calculated.

The total power consumed by the tractor during seedbed preparation and planting operations was calculated by using the measured fuel consumption. The following formula was used to estimate power consumption by the tractors according to ***Embaby (1985).***

$$EP = \left(F_c \times \frac{1}{60 \times 60} \right) \rho_f \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36} \ (kW) \ \ldots\ldots\ldots\ (1)$$

Where: F_c = fuel consumption, *l/h;*
ρ_f = density of the fuel *(0.85 kg/l for diesel fuel);*
L.C.V. = lower calorific value of fuel *(10000 k cal/kg for diesel fuel);*
427 = thermo-mechanical equivalent, *kg.m/k cal;*
η_{th} = thermal efficiency of engine *(40% for diesel engine);*
η_m = mechanical efficiency of engine *(80 % for diesel engine).*

Estimation of the energy required for seed beed preparation and operating the planter was carried out using the following equation:-

$$Energy\ requirements\ (kW.h/\ fed.) = \frac{Power\ Consumption\ (kW)}{Effective\ field\ efficiency\ (fed/h)} \quad \ldots\ldots (2)$$

c. physical properties

The physical properties such as length (mm), width (mm) and thickness (mm) were measured using digital vernier calipers for corn seeds of one-way cross 10 and three–way cross 310 without soaking and after soaking in the water for a period of 6,12,18 and 24 hours. However, the specific weight (g/cm^3) was measured using scaling jar contain 500 mm^3 water. The samples were weighted and putted in the jar to measure the volume of the water increased than 500 mm^3 on the scale of the jar. Then the specific weight was calculated by dividing the sample weight (g) on its volume cm^3.

d. patching efficiency

The patching efficiency of corn seeds was measured under different speeds of seed distributor disk and soaking periods, using the following equation:

$$Patching\ efficiency, \% = \frac{actual\ No.\ of\ seeds\ collected\ at\ any\ speed\ of\ distributor\ disk\ ,\ rpm}{theoretical\ No.\ of\ seeds\ at\ the\ same\ rpm\ of\ distributor\ disk} \times 100 \quad \ldots\ldots (3)$$

Where: theoretical No. of seeds = No. of cells on the distributor disk * rpm of disk

It should be cleared that, the tests were conducted at PTO rate of 540 rpm (56 rad/s) to operate air blower using a distributor seed disk 26 with ϕ 4.5 mm holes under the disk rotation speeds from 15.7 to 24.5 rpm (from 1.6 to 2.6 rad/s).

2-Crop measurements to evaluate the factors affecting on the planting accuracy

a- Germination ratio

The germination ratio *(G.R)* was calculated after ten days from planting and irrigation date by using the following formula:

$$GR\ (\%) = \frac{PN}{SN} \times 100 \quad \ldots\ldots (4)$$

Where: *PN* = Average plant number per twenty meters along the sowing row;
SN = Average number of delivered seeds per twenty meters along the rows;

The value of (SN) No. of theoretical hills/20m was calculated during planter calibration.

b- Scattering of seeds

After germination the plants dispersion around the row center was measured through 20 meters along the row in order to determine the lateral scattering of seeds.

c- Actual planting depth

The actual planting depth was measured after ten days from planting date in 1 m length along the row (three replicates) for each treatment. The actual planting depth was measured by measuring the vertical distance from soil surface to seed place in soil after removing the soil cover of seed.

d- Dry weight of growing weeds

A wooden frame (1 m x 1m) was used to determine the quantity of standing weeds before and after cultivation under Afeer and Heraty planting conditions. The *dry weight of weeds in grams was determined by electric oven drying at 60° c for 18* hours.

e- Grain yield

The grain yield was taken under consideration in this work as a function of different treatments under study. The yield for all treatments was determined by weighing the ears of corn per two square meters with 3 replication. After that, the grain moisture content and shelling percentage was calculated to determined the average grain yield of corn crop in t/fed. on the basis of 15.5 % (w.b.) grain moisture content at the harvesting time.

RESULTS AND DISCUSSION

1- Laboratory tests

1-1 Physical properties of corn seeds

The average values of measured physical properties are summarized in Table (1). The obtained results cleared that, the physical properties were greatly affected by the soaking period. The volume of corn seeds was increased by increasing soaking period, however, the increment percentage in the volume was higher at 6 and 12 soaking hours than that obtained at 18 and 24 soaking hours for seeds of both varieties under study. The opposite trend was obtained for specific weight at different soaking periods and for one-way cross 10 and three-way cross310 corn seeds. The corn seeds of three-way cross 310 recorded higher average values of measured physical properties than one way cross 10.

Table (1): Average values of physical properties of corn seeds.

Variety	Physical properties	Soaking period, h				
		0	6	12	18	24
One-way cross 10	Length, mm	10.92	11.58	11.84	11.99	12.07
	Width, mm	9.20	9.640	9.76	9.92	9.92
	Thickness, mm	4.68	5.00	5.13	5.14	5.16
	Specific weight, g/cm^3	1.2	1.18	1.15	1.14	1.13
Three-way cross 310	Length, mm	11.44	11.783	12.12	12.2	12.23
	Width, mm	9.69	10.12	10.36	10.43	10.44
	Thickness, mm	5.08	5.48	5.48	5.55	5.56
	Specific weight, g/cm^3	1.23	1.21	1.19	1.18	1.18

1-2 Seed patching efficiency

The effect of tip speeds of the distributor disk on seed patching efficiency (longitudinal planting regularity) is illustrated in Fig. (1). The results showed that, how patching seeds efficiency varies with the rate of the distributor disk speed and, consequently, with the forward speed. The patching efficiency value was more than 0.95 until a disk speed of about 50 rpm (5.2 rad/s). This corresponds to forward speeds of about 10 km/h. This means that planting is regular even at the highest speeds reached to 10 km/h on the field.

However, the effect of soaking corn seeds on the seed patching efficiency was observed. Increasing soaking period results in a decrement in the seed patching efficiency, however, this decrement not significant. The patching seed efficiency for one-way cross 10 corn seeds was higher than that obtained for three-way cross 310 corn seeds due to various physical properties.

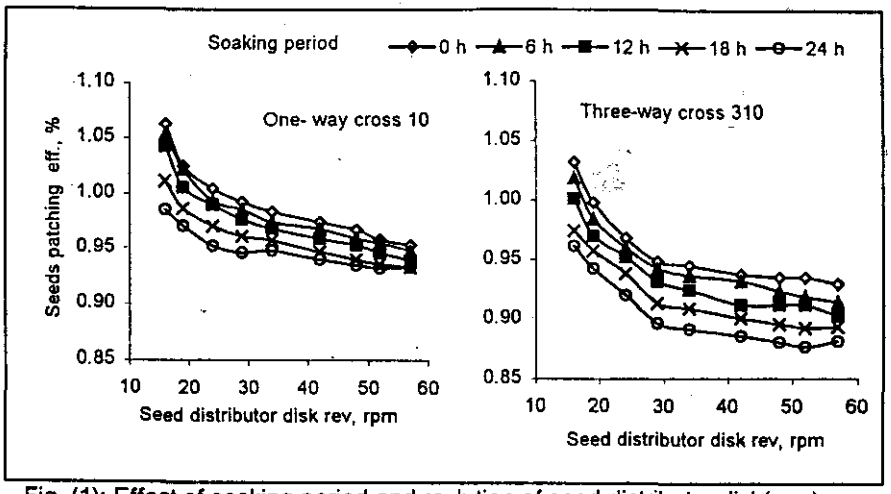

Fig. (1): Effect of soaking period and revlution of seed distributor disk(rpm) on the seed patching efficiency,%.

2- Field tests

2-1 Planting efficiency tests

2-1-1 Field capacity and efficiency

The effect of forward speed and planting conditions on the field capacity and efficiency of the pneumatic planter are shown in Tab. (2). The Heraty conditions increased the field capacity and efficiency of the planter compared with Afeer conditions. The results may be due to the various in land preparation (big clod diameters) in Affer, which increased slippage, consequently, decreasing the forward speed of the planter.

The maximum values of effective field capacity were 3.70 and 3.22 fed./h for Heraty and Afeer, respectively at forward speed of 9.17km/h (2.55 m/s). However, the maximum values of field efficiency were 72.60 and 69.23 % for Heraty and Afeer conditions, respectively at forward speed of 2.93 km/h (0.81 m/s).

Table (2): The effect of planting conditions and forward speed on field capacity, efficiency, fuel consumption, power consumption and energy requirement.

Items	Heraty planting condition					Afeer planting condition				
Forward speed, km/h	2.93	3.94	4.68	6.82	9.17	2.93	3.94	4.68	6.82	9.17
Forward speed, m/s	0.81	1.09	1.30	1.89	2.55	0.81	1.09	1.30	1.89	2.55
Effective field capacity, fed./h	1.51	1.93	2.23	2.99	3.70	1.44	1.71	2.02	2.63	3.22
Efficiency, %	72.60	68.91	66.77	61.52	56.45	69.23	61.07	60.48	54.12	49.16
Fuel consumption, l/h	32.3	32.8	33.3	33.8	34.3	38.0	38.5	39.0	39.5	40.0
Fuel consumption, l/fed.	21.39	16.99	14.93	11.30	9.27	26.39	22.51	19.31	15.02	12.42
Power consumption, kW (*)	102.16	103.75	105.33	106.91	108.49	120.19	121.77	123.36	124.94	126.52
Energy requirement, kWh/fed. (*)	67.66	53.75	47.23	35.76	29.32	83.47	71.21	61.07	47.50	39.29

(*):during land preparation and planting operation.

2-1-2 Fuel and power consumption

The effect of forward speed and planting conditions on fuel consumption, power consumption and energy requirement during seedbed preparation and planting operating are summarized in Table (2). The obtained results cleared that, the Afeer increased fuel and power consumption than that obtained under Heraty at any forward speed of the planter. The maximum values power 126.52 and 108.49 kW consumption of were obtained at 9.17 km/h (2.55m/s) forward speed under Afeer and Heraty planting conditions, respectively. Also, it could be cleared that, using pneumatic planter under the Heraty planting conditions saved about 16.5-17.5 % in power consumption and about 23-33% in energy requirement compared with Afeer planting conditions.

2-2 Planting accuracy tests

2-2-1 Planting depth

The planting depth was adjusted at 2, 3, 4, 5 and 6 cm, but under field conditions the actual planting depth was found to be different than that adjusted. It can be concluded that the actual planting depth was highly affected by the planting conditions. The values of actual planting depth were higher than adjusted under all different planting conditions except at the adjusted planting depth of 6 cm under Heraty planting condition the values of actual planting depth was lower than adjusted ones.

The rate of increment percentage in actual planting depth under Affer was higher than that obtained under Heraty. However increasing the planting depth under both Afeer and Heraty decreased the rate of increment percentage. The actual planting depth values were 2.5, 3.6, 4.8, 5.3 and 5.8 cm under Heraty compared with the adjusted planting depth on 2, 3, 4, 5 and 6 cm, respectively in case of using one-way cross 10 corn seeds. However the corresponding values of actual planting depth under Affer planting condition were 2.7, 3.8, 4.9, 5.6 and 6.3 cm. The maximum values 35 and 51% of increment percentage for actual planting depth were obtained at adjusted planting depth of 2 cm for one-way cross10 and three-way cross310, respectively.

2-2-2 Lateral scattering

The effect of planting depth and planting onditions on the lateral scattering of one-way cross 1c corn variety under different planting depths and planting conditions is shown in Fig. (2). It is observed that, the highest lateral scattering percentage was obtained at planting depth of 2 cm, however, the lowest lateral scattering percentage was obtained at planting depth of 6 cm for both varieties of corn seeds. The results also indicated that the lateral scattering percentage was highly affected with planting condition. Using Afeer results in higher lateral scattering percentage than that obtained when using Heraty at any soaking period of corn seeds for both varieties of. The reasons behind these results may be due to field preparation method of Affer planting condition where the soil was looser with bigger clod diameters.

In corresponding, the effect of physical properties of corn seeds on the lateral scattering percentage was found to be highly affected when using the one-way cross 10 corn seeds than using three-way cross 310 corn seeds due to higher volume of three-way cross 310 corn seeds.

The highest values of frequency percentage at range of lateral distance of 1-1 cm were 80 and 76.25 % obtained under Heraty planting condition at planting depth of 6 cm when using one-way cross 10 and three-way cross 310 corn varieties, respectively. However the corresponding values obtained under Afeer planting condition were 75.0 and 72.5 % under the same above-mentioned parameters of range of lateral distance, planting depth and varieties.

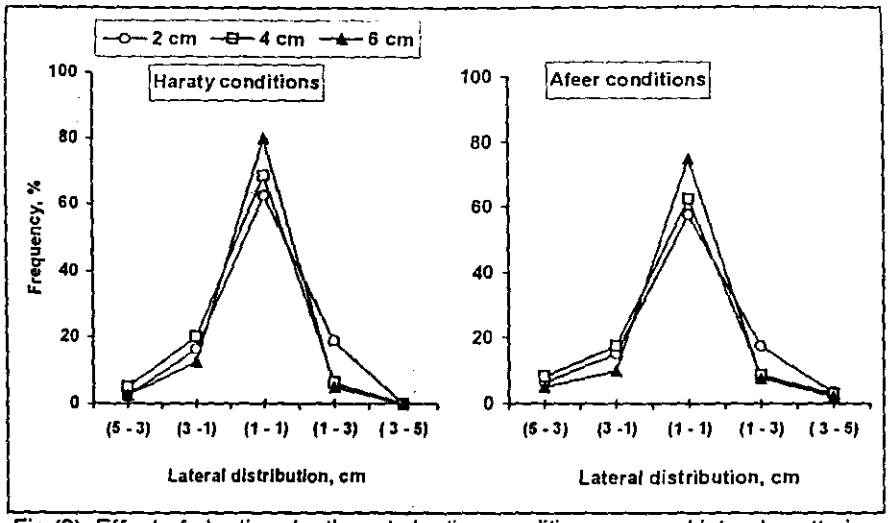

Fig.(2): Effect of planting depth and planting conditions on seed lateral scattering for one-way cross corn variety.

2-2-3 Germination ratio

The effect of planting depth and planting conditions on the germination ratio is illustrated in Fig. (3). The figure indicated that, the germination ratio was gradually increased from Afeer to Heraty (12h) planting condition then decreased again from Heraty (12h) to Heraty (24h) planting conditions for any planting depth and variety of corn seeds under study. This result may be due to increasing the absorbed water by seeds, which results in bad conditions for emergence of seeds.

The germination ratio was decreased under Afeer by 14.0 and 13.4 % compared with Heraty (12h) for one-way cross 10 and three-way cross 310, respectively. Also, it can be noted that the highest values of germination ratio of 89.7 and 86.6 % were obtained under Heraty (12h) at 4 cm planting depth for one-way cross 10 and three-way 310 corn varieties, respectively. Therefore, it could be stated that, the best soaking period for corn seeds is 12h.

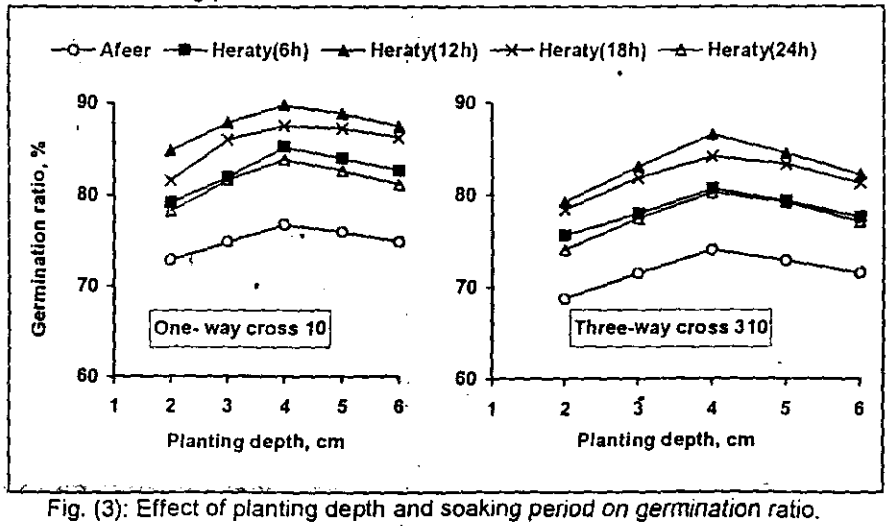

Fig. (3): Effect of planting depth and soaking period on germination ratio.

On the other side, the germination ratio was highly affected by planting depth at any given planting conditions. Decreasing the planting depth or increasing it than 4 cm results in decrement percentage in germination ratio. These results may be due to covering soil, which was not sufficient for protection against birds, rodents and surface drying before emergence at shallow depths (<3cm). However, at deep depths (>5cm) the reason behind these results may be due to a lot of covering soil above seeds, consequently the corn seeds could not be able to emergence, specially in Afeer planting conditions. The best results for germination ratio was obtained under the planting depth of 4 cm.

2-2-4 Rate of growing weeds

The average values of dry weight of growing weeds before first and second cultivation operations were 252.4 g and 118.7 g under Afeer planting conditions, respectively. While the corresponding values under Heraty were 59.3 g and 31.6 g, respectively. These results revealed that, the growing rate of weeds was highly affected by planting condition. Therefore it can be cleared that, using Heraty reduces the growing rate of weeds by 76.5 and 35.5 % at the first and the second cultivation operations instead of Afeer.

2-2-5 Corn grain yield.

The average of grain yield as affected by different planting conditions and depths is shown in Table. (4). It can be noticed that, Heraty at any soaking period generally improved plant growth and increased yields than Afeer. However, the effect differed according to soaking periods were used and corn seeds variety.

Also, under the Heraty, the grain yield was increased when increasing the soaking period for corn seeds from 6 to 12 hours. Moreover, when increasing soaking period from 12 to 18 or from 18 to 24 hours the grain yield was decreased. The maximum values of corn grain yield were 3.643 and 3.403 t/fed. obtained under Heraty-12h planting condition and planting depth of 4 cm for one-way cross 10 and three-way cross 310 corn varieties, respectively. The minimum values were 3.307 and 2.212 t/fed; obtained under Afeer and planting depth of 2 cm for one-way cross 10 and three-way cross 310 corn varieties, respectively. Therefor, it can be noted that, the planting depth of 4 cm and soaking of 12h gave the highest results of grain yield.

Table (4): Effect of planting conditions and corn varieties on the corn grain yield.

	One-way cross 10					Three- way cross 310				
	2 cm	3 cm	4 cm	5 cm	6 cm	2 cm	3 cm	4 cm	5 cm	6 cm
Afeer	2.307	2.360	2.422	2.470	2.338	2.212	2.280	2.355	2.300	2.268
Heraty (6h)	2.717	2.840	2.954	2.850	2.786	2.597	2.700	2.810	2.740	2.666
Heraty (12h)	2.294	3.480	3.643	3.580	3.556	3.192	3.300	3.403	3.350	3.301
Heraty (18h)	3.195	3.350	3.562	3.480	3.412	3.020	3.200	3.332	3.280	3.206
Heraty (24h)	2.964	3.100	3.303	3.210	3.100	2.758	2.890	3.024	2.960	2.870

Conclusion and Recommendations

From the pervious results and discussion it can be derived the following conclusion:

- The seed patching efficiency in cells of seed distributor disk was not significantly affected by the rotational speed of distributor disk and soaking period of seeds.
- The field capacity and efficiency of the planter was increased under the Heraty planting conditions, in addition of saving about 16.5-17.5 % in power

consumption and about 23-33% in energy requirement compared with Afeer planting conditions.

- Using pneumatic planter under Afeer planting condition decreased the germination ratio by about 13.6 % and results in higher lateral scattering percentage than that obtained under Heraty planting conditions for both corn varieties.
- Using pneumatic planter at 4 cm planting depth under Heraty conditions with soaked seeds for a period of 12h gave the best results of germination ratio and lateral scattering and consequently highest grain yield. The maximum values of corn grain yield obtained under this condition were 3.643 and 3.403 t/fed. for one-way cross 10 and three-way cross 310 corn varieties, respectively.
- Using Mechanical planting under Heraty planting conditions reduces the growing rate of weeds compared with Afeer planting conditions by 76.5 and 35.54% at the first and the second cultivation operations, respectively.
- This study recommend to use using the pneumatic planter for corn mechanical planting under Heraty planting conditions with 12 h soaking period for corn seeds in the water and planting depth of 4 cm at forward speed up to 10 km/h with high efficiency and planting accuracy.

REFERENCES

Abd Alla, H. (1999). Performance evaluation of a developed planter furrow opener. Misr J. Ag. Eng., 16 (2): 176-192, Egypt.

Awady, M.N. and Y. E. Ghoniem (1985). Design characteristics of a push-type maize planter. Misr J. Ag. Eng. , 2(1): 38-49, Egypt.

Cannell, R.G. and F. B. Ellis, (1978). Simplified cultivation effect on soil conditions and crop yield. Letcombe Laboratory, Letcombe regis Wantage, Oxan. 129 J.T. : 55-59.

EL-Nakib, A. A. (1975). Study on mechanization of maize planting. Unpubl. M. Sc. Thesis. (Agric. Eng.), Faculty of Agric., Al-Azhar Univ, Egypt.

El-Sayed A.S., (1994). Some Characteristics of seed drill suitable for corn planter, Misr J. Ag. Eng. 11(4): 917-928, Egypt.

Embaby, A. T., (1985). A comparison of the different mechanization systems for cereal crop production. Unpubl. M. Sc. Thesis. (Agric. Eng.), Cairo Univ.

Erbach, D. C. (1981). Planting for crop production with conservation. In proceedings of the A.S.A.E. Conference or crop production in the 80, A.S.A.E. pub., 7-81 : 50-65, A.S.A.E. Joseph Mi 49085 .

Free, G. R. (1970). Minimum tillage for corn production. Bull. 1030 N. Y. Agric. Exp. Sta. Field crop Abst. 24: 3245, 1971.

Leonard, W. H. and J. H. Martin (1986). Cereal crops (Corn cultural practice), Third edition. 173-191.

Matouk, A. M.; Khourshied, A. M. ; EL-Hadidi, Y. M.; and Hegazy, K. S. (1999). Mix-milling of wheat and maize grain mixiture and its effects on energy requirement. Misr J. of Agric. Eng. Vol. 16 No. (1): 83-99, Egypt.

Staut, B. A.; W. F. Buchel and F. W. Snyder (1961). Effect of soil compaction on seeding emergence under simulated field conditions. Agric. Eng.; Feb. 1961; 68-71.

Steel and Torrie (1980). Principles and Procedures of Statistics. McGraw-Hill Company N. Y.

Swan, J.B. and R. L. Higgs (1994). Surface residue and in-row treatment effects on long-term no-tillage continuous corn. Agron. J. (86): 771-718.

Wurr, D. C. ; R. Jave and R. Fellows (1985). The influence of sowing depth and seed process wheel weighting on seedling emergence of crisp lettuce. J. Agric. Sci.; Camb. 104, 631-636.

التقرير السنوى للحملة القومية للنهوض بمحصول الذرة الشامية (٢٠٠١). وزارة الزراعة - مركز البحوث الزراعية *(ARCNC)* .

الملخص العربى

"العوامل المؤثرة على كفاءة ودقة أداء آلة الزراعة الهوائية للزراعة الميكانيكية للذرة الشامية "

د/محمود السيد العراقى ، د/ زكريا محمد عمارة ، د/محسن إبراهيم عجيلة[٢]

أجريت الدراسة بالمزرعة البحثية لمركز ميكنة الأرز بميت الديبة - كفر الشيخ (معهد بحوث الهندسة الزراعية) خلال موسمى ٢٠٠٠ ، ٢٠٠١م ، بغرض دراسة العوامل المؤثرة على كفاءة ودقة أداء آلة الزراعة الهوائية (التى تعمل بشفط الهواء) للزراعة الميكانيكية للذرة الشامية تحت ظروف الزراعة العفير (بذرة جافة فى ارض جافة) وظروف الزراعة الحراتى (بذرة منقوعة فى الماء لفترة معينة فى ارض مستحرثة) بهدف التوصل إلى الأهداف الخاصة التالية: ١) زيادة السعة والكفاءة الحقلية لآلة الزراعة النيوماتك ، ٢) زيادة دقة الزراعة وذلك بزيادة نسبة الإنبات وتقليل نسبة الجور الغائبة وتقليل نسبة نمو الحشائش وبالتالى زيادة الإنتاجية . ولتحقيق هذه الأهداف كانت متغيرات الدراسة كالتالى:

١- سرعة الزراعة (خمس سرعات أمامية هى ٢,٩٣ ، ٣,٩٤ ، ٤,٦٨ ، ٦,٨٢ ، ٩,١٧ كم/ساعة)
٢- عمق الزراعة (خمس أعماق زراعة هى ٢ ،٣ ، ٤ ، ٥ ، ٦ سم)
٣- ظروف الزراعة (زراعة عفير و زراعة حراتى).
٤- الخواص الطبيعية لتقاوى صنفان من الذرة الشامية هما هجين فردى ١٠ ، هجين ثلاثى ٣١٠.
٥- مدة نقع البذور (خمس فترات نقع هى صفر ، ٦ ، ١٢ ، ١٨ ، ٢٤ ساعة).

وقد أظهرت النتائج ما يلى:

- لم تتأثر كفاءة مسك الحبوب فى قرص توزيع البذور لآلة الزراعة بشكل معنوى بالسرعة الدورانية لقرص البذور ولا بمدة النقع فى الماء رغم مدة النقع أثرت بشكل معنوى على الصفات الطبيعية لتقاوى الذرة .
- أدى استخدام آلة الزراعة تحت ظروف الزراعة الحراتى إلى زيادة السعة الحقلية والكفاءة لها بالإضافة إلى توفير حوالى ١٦,٥-١٧,٥ % فى القدرة المستهلكة وحوالى ٢٣-٣٣% من احتياجات الطاقة للفدان مقارنة بالزراعة العفير
- أدى استخدام آلة الزراعة الهوائية التى تعمل بشفط الهواء تحت ظروف الزراعة العفير إلى تناقص نسبة الإنبات بالإضافة إلى زيادة نسبة التشتت الطولى مقارنة بالزراعة الحراتى عند أى مدة نقع ولأى صنف ذرة تحت الدراسة. وكانت أعلى نسبة تشتت طولى تم الحصول عليها عند عمق زراعة ٢ سم فى حين كانت أقل نسبة عند عمق زراعة ٦ سم.
- أدى استخدام الزراعة الميكانيكية تحت ظروف الحراتى إلى انخفاض معدل نمو الحشائش مقارنة بالزراعة العفير بمعدل ٧٦,٥ % عند العزقة الأولى و ٣٥,٥٤ % عند العزقة الثانية.
- أعطى استخدام آلة الزراعة الهوائية التى تعمل بشفط الهواء على عمق زراعة ٤ سم تحت ظروف الزراعة الحراتى عند مدة نقع ١٢ ساعة للحبوب ، افضل النتائج لنسبة الإنبات ولنسبة التشتت الطولى وبالتالى الإنتاجية العالية. وكانت أعلى إنتاجية تم الحصول عليها هى ٣,٦٤٣ ، ٣,٤٠٣ طن/فدان باستخدام الزراعة الحراتى لصنفى الذرة هجين فردى ١٠ وهجين ثلاثى ٣١٠ على التوالى.
- هذا وتوصى الدراسة بإمكانية استخدام آلة الزراعة الهوائية التى تعمل بشفط الهواء بكفاءة عالية للزراعة الميكانيكية لمحصول الذرة تحت ظروف الزراعة الحراتى عند مدة نقع ١٢ ساعة فى الماء لتقاوى الذرة وعمق زراعة ٤سم وسرعة أمامية حتى ١٠ كم/س.

---

[٢] باحث - معهد بحوث الهندسة الزراعية – الدقى - الجيزة