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MAXIMIZING CORN PRODUCTIVITY THROUGH SOME MODERN FARMING SYSTEMS

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ABSTRACT

Two field experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station, Agricultural Research Center Egypt, during the two successive summer seasons of 2011 and 2012. The main objectives of this study were to determine the effect of tillage treatments, plant distribution patterns and sources of nitrogen fertilizer on growth, yield and its components of corn hybrid S.C. 128. Each tillage treatment was performed in separate experiment. Every experiment of tillage treatment was carried out in split plot design with four replications. The main plots were occupied with plant distribution patterns. The sub-plots were assigned to sources of nitrogen fertilizer. The most important results could be summarized as follaws:

All studied characters were significantly affected by different studied tillage treatments in the two seasons. Using chisel plow twice gave the highest values of studied characters in both seasons. Using chisel plow once in addition to Stiller plow once was accompanied with the least values of these characters in both seasons.

There was significant effect on all studied characters due to plant distribution patterns in the two seasons. Planting maize in ridges 80 cm apart, 22 cm between hills and one plant per hill produced the highest values of all studied characters in both seasons. Planting corn or maize in ridges 70 cm apart, 50 cm between hills and two plants per hill gave the lowest values of these characters in both seasons.

Sources of nitrogen fertilizer had a significant effect on all studied characters in the two seasons. Using Urea fertilizer resulted in the highest means of all studied characters followed by using Ammonium Nitrate then Ammonium Sulphate fertilizers in both seasons.

It can be concluded that tillage corn soil by using chisel plow twice and planting in ridges 80 cm apart, 22 cm between hills and one plant per hill in addition using Urea as a source of nitrogen fertilizer in order to maximize corn hybrid S.C.128 growth and its productivity under the environmental conditions of Sakha district,Kafr El-Shikh Governorate Egypt.

INTRODUCTION

Corn or maize (*Zea mays* L.) is considered as a one of the most important strategic cereal food crops in the world as well as in Egypt. Corn is used as a feed for livestock whether fresh, silage or grains. Furthermore, it is used in several important industries such as starch and fructose sugar and corn oil as by product Therefore, it is necessary to increase corn yield to face the wide gap between production and consumption. Increasing corn productivity can be through culture prodices agronomists are continually looking for the best ways that help farmers to increase grain yield and net return of the crop, such as tillage system, plant distribution patterns (ridge and hill spacings and number of plants/hill) and sources of nitrogen fertilizer.

Tillage has been an important aspect of technological development in the evolution of agriculture, in particular in food production. The objectives of tilling the soil include seedbed preparation, water and soil conservation and weed control. Tillage has various physical, chemical and biological effects on the soil both beneficial and degrading, depending on the appropriateness or otherwise of the methods used. The physical effects such as aggregate-stability, infiltration rate, soil and water conservation, in particular, have direct influence on soil productivity and sustainability, which lead to an enhanced nutrient uptake and better yield of crops (Arif *et al.*, 2007). Modupe and Idowu (2007) studied the effects of four tillage systems (TS): (plow + harrow, plow, chisel + harrow and chisel) and three fertilisers NPK 15:15:15 rates; 0, 40 and 80 kg/ha on corn grain and stover yields. They reported that grain yield and hundred seed weight were significantly affected by tillage systems. Agbede *et al.* (2008) found that compared with zero tillage methods (ZT) and manual clearing (MC) mechanized tillage methods caused reduction in plant height, leaf area, dry matter and grain yield. Growth and yield parameters reduced with increased implement pass; hence, ploughing plus two passes of harrow (PLHH) gave least values of these parameters and nutrient content. Grain yield was reduced by 11 to 25% as a result of mechanized tillage which was not favourable to performance of sorghum. Ahmad *et al.* (2010) pointed out that tillage operation with the same implement over several years may lead to compacted layer in field soil. Plowing at the same depth year after year reinforce the plow pan development, so use of different tillage implement may be the only solution to breakup this pan. Tillage implements are used to weaken the soil strength, reduce compaction and allow the free movement of air and water in order to promote plant growth. Tillage operation is carried with the objective of changing the soil physical properties and to enable the plant to show their full potential. Ozpinar (2010) found that shallow tillage (ST) produced grain yield as much as mouldboard plough (MT) in 2006 season, while the differences among tillage systems were non-significant in 2007 season. Khaliq *et al.* (2012) studied the effect of deep and shallow tillage and fertilizer treatments *i.e.* recommended dose of fertilizer (RF), farm yard manure (FYM) and recommended dose of fertilizer plus farmyard manure (RF+FYM) on corn fodder yield. They stated that the effect of deep tillage on corn fodder yield was non-significant.

Corn hybrids response differently to plant distribution patterns. Many investigators studied the effect of plant distribution patterns as ridge and hill spacings and number of plants/hill on growth, yield and its attributes of corn , in this regard; Riahinia and Dehdashti (2008) observed that grain yield significantly decreased as row spacing increased from 35 to 100 cm. Darwich (2009) showed that the effect of row spacing on ear length, ear diameter, number of kernels/row and number of rows/ear was not significant. Overall, the obtained results indicated that increasing distance between rows from 60 to 70 and 80 cm lead to a significant increase in growth characters, grain and its components due to better interception and utilization of solar radiations and the increase in photosynthetic processes. Onyango (2009) concluded that with good nutrition and favorable weather conditions, decreased corn row spacing can maximize corn production per unit land area by increasing plant

population density, optimal light interception and nutrient uptake. Babaji *et al.* (2012) found that stand density did not affect number of leaves but influenced plant height with tallest plants at 3 plants per hill. Heavier cobs were produced at 1 plant per hill, while cob and grain yield were highest at 2 – 3 plants per hill. The interaction of 25 cm and 2 or 3 plants per hill has the highest cob and gain yield. Moraditochaee *et al.* (2012) showed that effect of row spacing on grain yield and 1000 grain weight was significant. But on plant height, ear length and number of rows/ear was non-significant.

Providing adequate nitrogen fertilizer is a major factor in building a successful corn production program. Research has shown little if any difference in corn yield as a result of using different nitrogen sources in conventional tillage production systems if soils are well drained. The reason seems due to achieving quick contact between soil and fertilizer. On wet soils there is less chance of loss from ammonium than nitrate forms of nitrogen. Powel (2005) reported that significant differences in growth and yield of corn among various nitrogen fertilizer sources. Osundare (2009) found that there were significant differences between N - sources in growth and yield parameters of maize. N - sources significantly increased corn leaf area from 0.52 m^2/plant for control to 0.74, 0.91 and 1.04 m^2/plant for urea, CAN, and NPK, respectively. Also, N – sources significantly increased corn grain yield from 1.94 t/ha for control to 3.78, 5.27, and 6.47 t/ha for urea appling, CAN and NPK fertilizers, respectively. Halvorson *et al.* (2011) stated that nitrogen application to crops generally results in increased nitrous oxide (NO) emissions. Thus, selection of nitrogen fertilizer source can be a mitigation practice for reducing NO emissions in irrigated corn in semiarid areas.

Therefore, this investigation was established to study the effect of tillage treatments, plant distribution patterns and sources of nitrogen fertilizer on growth, yield and its components of corn (*Zea mays* L.) hybrid S.C. 128. under the environmental conditions of Sakha district, Kafr El-Sheikh Governorate Epypt.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station, Agricultural Research Center Egypt during the two successive summer seasons of 2011 and 2012. The main objectives of this study were to determine the effect of tillage treatments, plant distribution patterns and sources of nitrogen fertilizer on growth, yield and its components of corn hybrid S.C. 128.

Each tillage treatment was performed in separate experiment. Every experiment of tillage treatment was carried out in split plot design with four replications. The studied tillage experiments were as follows; 1- Using chisel plow once. 2- Using chisel plow twice. 3- Using tiller plow once. 4- Using chisel plow once beside tiller plow once.

The main plots were occupied with the following four plant distribution patterns *i.e.* ridge width, hill spacings and number of plants per hill with stable of plant density (24000 plant/fed); 1- 70 cm between ridges, 25 cm between hills and one plant per hill. 2- 70 cm between ridges, 50 cm between hills and

two plants per hill. 3- 80 cm between ridges, 22 cm between hills and one plant per hill. 4- 80 cm between ridges, 44 cm between hills and two plants per hill.

The sub-plots were assigned to three sources of nitrogen fertilizer as follows; 1- Ammonium sulphate (20.6 N). 2- Ammonium nitrate (33.5 % N). 3- Urea (46.0 % N). Nitrogen fertilizer in the previously mentioned forms was added at the rate of 120 kg N/fed in two equal portions, one half after thinning (before the first irrigation)(21 days from sowing) and the other half before the second irrigation(36 days from sowing). Each experimental basic unit (sub – plot) included eight ridges, each of 3.0 m length, in case of 70 cm between ridges and seven ridges, each of 3.0 m length, in case of 80 cm between ridges, resulted an area of 16.8 m^2 (1/250 fed). The preceding winter crop was sugar beet in the first season and barley in the second season.

Soil samples were taken at random from the experimental sites before sowing and after harvesting at a depth of 0 - 15 cm and 15-30 cm from soil surface during the growing seasons to measure the physical and chemical soil properties as shown in Table 1.

Table 1:Mechanical and chemical soil characteristics* at the experimental sites during the two growing seasons of 2011 and 2012.

Soil analysis		2011 season				2012 season			
		Before sowing		After harvesting		Before sowing		After harvesting	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
A: Mechanical analysis									
Sand %		12.44	5.92	12.44	5.92	12.44	5.92	12.44	5.92
Silt %		23.95	34.77	23.95	34.77	23.95	34.77	23.95	34.77
Clay %		60.52	59.48	60.52	59.48	60.52	59.48	60.52	59.48
Texture		Clayey	Clayey	Clayey	Clayey	Clayey	Clayey	Clayey	Clayey
B: Chemical analysis									
Organic matter %		1. 16	1.03	1.00	0.94	1.28	1.10	1.23	0.96
Total N %		0.101	0.091	0.120	0.11	0.105	0.093	0.130	0.11
Total carbonate %		3.95	3.90	3.95	3.90	4.01	3.98	4.01	3.98
CEC meq/100 g soil		32.00	30.00	33.20	32.10	31.60	29.80	31.70	30.90
SP %		78.00	79.00	78.00	79.00	77.50	78.30	77.80	78.90
SAR		3.19	3.51	4.32	4.80	3.86	3.85	3.38	6.17
Available mg/kg	N	28.00	20.00	31.00	29.00	25.50	20.10	23.30	19.50
	P	8.00	6.00	10.00	9.50	8.80	7.30	7.75	7.15
	K	288.6	218.4	245.7	245.7	395.0	380.0	391.0	379.0
Soluble cations meq/L	Ca^{++}	7.70	6.25	7.97	6.94	4.29	1.47	9.51	2.68
	Mg^{++}	6.13	6.05	13.03	5.69	3.40	2.00	6.74	2.08
	Na^{+}	8.40	8.70	14.00	12.06	5.60	5.08	9.70	9.50
	K^{+}	0.21	0.20	0.34	0.27	0.32	0.78	0.42	0.42
Soluble anions meq/L	CO_3^{--}	-	-	-	-	-	-	-	-
	HCO_3^{-}	4.50	3.00	2.50	2.50	5.94	4.06	5.63	4.69
	Cl^{-}	9.12	8.16	10.08	11.04	3.15	1.15	7.80	7.20
	SO_4^{--}	8.82	10.04	22.76	11.42	3.52	4.12	12.94	2.80
pH		7.95	8.01	7.85	8.05	7.82	7.90	7.95	8.01
EC ds/m		2.24	2.12	3.53	2.50	1.26	0.93	2.64	1.47

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The experimental field well prepared by previously mentioned tillage experiments system, leveling, compaction, ridging (70 and 80 cm between ridges) and then divided into the experimental units.

Calcium superphosphate (15.5S % P_2O_5) was applied during soil preparation at the rate of 150 kg/fed. Potassium sulphate (48.0 % K_2O) at the rate of 50 kg/fed was applied with the first dose of nitrogen fertilizer.

Corn grains were hand sowing in hills at the rate of 3-4 grains/hill using dry sowing method (Afir) on one side of the ridge with the above mentioned hill spacings during the first week of June in 2011 and 2012 seasons. The plants were thinned to one or two plants per hill for previously mentioned treatments before the first irrigation. The first irrigation was applied after 21 days from sowing and the following irrigations were applied at 15 days intervals during the growing seasons. The other agricultural practices were kept the same as normally practiced in corn fields according to the recommendations of Ministry of Agriculture and Land Reclamation, except for the factors under study.

Studied Characters:

A- Growth Characters:

After 90 days from sowing, random samples of five guarded plants were taken at random from each sub – plot to determine the following characters:

1- Plant height (cm). 2- Ear height (cm). 3- Ear leaf area (cm^2).

B- Yield and its Attributes:

At harvest time (after 120 days from planting) random samples of five guarded plants were taken at random from each sub – plot to determine the following characters:

4- Ear length (cm). 5- Ear diameter (cm).
6- Number of rows/ear. 7- Number of grains/row.
8- Ear weight (g). 9- Ear grains weight (g).
10- 100-grain weight (g).
11- Grain yield (ardab/fed); it was determined by the weight of grains per kilograms adjusted to 15.5 % moisture content of each plot, then converted to ardab per feddan (ardab = 140 kg).

Statistical analysis

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split – plot design to each experiment (tillage treatments), then combined analysis was done between tillage treatment experiments as published by Gomez and Gomez (1984) by using “MSTAT-C ” computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 and 1% levels of probability as described by Snedcor and Cochran (1980).

RESULTS AND DISCUSSION

I- Effect of Tillage Treatments:

The statistical analysis of obtained results showed that all growth characters *i.e.* plant and ear height (cm) and ear leaf area (cm^2) exhibited

significant effect due to studied tillage treatments and that held true in the two growing seasons (Table 2).

Table 2: Plant and ear height and ear leaf area of corn as affected by tillage treatments, plant distribution patterns and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Characters / Treatments	Plant height (cm)		Ear height (cm)		Ear leaf area (cm^2)	
	2011	2012	2011	2012	2011	2012
A- Tillage treatments:						
Using chisel plow once	222.8	212.7	123.2	113.1	756.2	652.8
Using chisel plow twice	232.1	217.2	127.6	115.2	846.1	696.1
Using tiller plow once	216.4	211.4	120.8	110.8	708.5	632.8
Using chisel + tiller	209.1	204.0	116.6	106.7	668.5	617.6
F. test	*	*	*	*	*	*
LSD (5 %)	1.1	2.5	1.7	1.8	6.3	7.1
LSD (1 %)	1.3	2.8	1.9	2.0	7.7	8.4
B- Plant distribution patterns:						
70 cm between ridges + 1 plant/hill	220.1	211.3	121.8	112.1	760.6	663.8
70 cm between ridges + 2 plants/hill	215.6	206.9	118.9	109.0	683.7	589.3
80 cm between ridges + 1 plant/hill	225.3	216.5	127.3	114.6	809.1	716.6
80 cm between ridges + 2 plants/hill	219.3	210.6	120.2	110.2	725.8	629.5
F. test	*	*	*	*	*	*
LSD (5 %)	0.8	1.5	0.4	1.2	3.6	3.7
LSD (1 %)	1.0	1.7	0.6	1.4	4.9	5.0
C- Sources of nitrogen fertilizer:						
Ammonium Sulphate	214.9	206.0	118.7	108.1	713.6	619.8
Ammonium Nitrate	220.1	211.4	122.2	111.4	739.7	644.4
Urea	225.3	216.6	125.3	114.8	781.2	685.3
F. test	*	*	*	*	*	*
LSD (5 %)	0.5	1.3	0.4	0.8	3.6	3.4
LSD (1 %)	0.6	1.5	0.5	0.9	4.8	4.7
D- Interactions:						
A X B	*	NS	*	*	*	NS
A X C	*	NS	*	*	NS	NS
B X C	*	NS	NS	NS	*	NS
A X B X C	*	NS	NS	NS	*	NS

There were substantial differences in all studied growth characters among various studied tillage treatments (using chisel plow once, chisel plow twice, tiller plow once and chisel + tiller plows once of each) in both seasons. Since, using chisel plow twice for tillage corn soil produced the highest values of the previously mentioned characters. On the other wise, using chisel plow once in addition to tiller plow once in order to preparation corn soil gave the lowest values of these characters. However, using chisel plow once only came in the second rank after using chisel plow twice in both seasons. The increases in growth characters due to using chisel plow twice may be ascribed to weaken the soil strength, reduce compaction and allow the free movement of air and water. Also, this tillage treatment was carried with the objective of changing the soil physical properties and to enable the plant to show their full potential

in order to promote plant growth. These results are in coincidence with those reported by Agbede *et al.* (2008)

From obtained data, yield and its attributes; ear length (cm), ear diameter (cm), number of rows/ear, number of grains/row, ear weight (g), ear grains weight (g), 100-grain weight (g) and grain yield (ardab/fed) were significantly affected by different studied tillage treatments in the two seasons (Table 3 and 4). Using chisel plow twice to till corn soil gave the highest values of yield and its attributes under study.

Table 3: Ear length and diameter, number of rows/ear and number of grains/row of corn as affected by tillage treatments, plant distribution patterns and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Characters / Treatments	Ear length (cm)		Ear diameter (cm)		Number of rows/ear		Number of grains/row	
	2011	2012	2011	2012	2011	2012	2011	2012
A- Tillage treatments:								
Using chisel plow once	21.9	20.3	5.1	4.7	13.2	13.4	41.3	39.5
Using chisel plow twice	23.4	21.1	5.2	4.9	13.9	13.9	43.5	41.6
Using tiller plow once	21.2	19.8	4.9	4.6	13.0	13.2	39.7	38.4
Using chisel + tiller	20.5	19.6	4.8	4.3	12.8	13.0	38.3	37.0
F. test	*	*	*	*	*	*	*	*
LSD (5 %)	0.32	0.25	0.08	0.06	0.3	0.18	0.7	0.5
LSD (1 %)	0.35	0.28	0.10	0.08	0.4	0.27	0.8	0.6
B- Plant distribution patterns:								
70 cm between ridges + 1 plant/hill	21.8	20.5	5.1	4.6	13.4	13.6	41.0	40.0
70 cm between ridges + 2 plants/hill	20.7	19.4	4.9	4.5	12.6	12.8	38.5	36.8
80 cm between ridges + 1 plant/hill	23.2	21.1	5.2	4.8	13.9	14.0	43.8	41.6
80 cm between ridges + 2 plants/hill	21.2	19.8	4.9	4.5	12.9	13.0	39.5	37.8
F. test	*	*	*	*	*	*	*	*
LSD (5 %)	0.11	0.20	0.03	0.04	0.2	0.2	0.7	0.4
LSD (1 %)	0.14	0.23	0.04	0.06	0.3	0.3	0.8	0.5
C- Sources of nitrogen fertilizer:								
Ammonium Sulphate	20.8	19.4	4.8	4.5	12.8	13.0	38.5	37.1
Ammonium Nitrate	21.9	20.1	5.0	4.6	13.2	13.3	40.9	39.1
Urea	22.5	21.0	5.2	4.8	13.6	13.8	42.7	41.0
F. test	*	*	*	*	*	*	*	*
LSD (5 %)	0.07	0.11	0.02	0.05	0.1	0.1	0.2	0.2
LSD (1 %)	0.10	0.13	0.03	0.07	0.2	0.2	0.3	0.3
D- Interactions:								
A X B	*	NS	*	NS	NS	*	NS	NS
A X C	*	*	*	NS	NS	NS	*	NS
B X C	*	NS	NS	NS	NS	*	*	NS
A X B X C	*	NS	NS	NS	NS	NS	*	NS

It was followed by using chisel plow once only in the two growing seasons. However, using chisel plow once in addition tiller plow once was accompanied with the least values of yield and its attributes in the first and second seasons. Such superiority of using chisel plow twice in increasing

grain yield and its attributes may be due to the improving physical, chemical and biological soil properties as well as long-term productivity of soils and consequently enhanced plant growth and development as well as grain yield. The scope of these findings is generally according to those obtained by Arif *et al*. (2007), Agbede *et al*. (2008) and Ozpinar (2010).

Table 4: Ear weight, ear grains weight, 100-grain weight and grain yield/fed of corn as affected by tillage treatments, plant distribution patterns of corn affected by tillage treatments, plant distribution patterns and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Characters / Treatments	Ear weight (g)		Ear grains weight (g)		100-grain weight (g)		Grain yield (ardab/fed)	
	2011	2012	2011	2012	2011	2012	2011	2012
A- Tillage treatments:								
Using chisel plow once	202.4	191.0	170.7	161.5	39.9	39.1	24.534	23.109
Using chisel plow twice	208.0	195.4	176.7	167.2	40.8	39.8	25.739	24.582
Using tiller plow once	196.5	186.2	166.4	157.3	39.0	38.2	22.469	21.365
Using chisel + tiller	189.8	179.4	160.5	152.4	38.1	37.3	21.244	20.069
F. test	*	*	*	*	*	*	*	*
LSD (5 %)	1.4	1.0	1.2	1.4	0.9	0.4	0.730	0.330
LSD (1 %)	2.1	1.8	1.8	2.0	1.4	1.0	0.841	0.500
B- Plant distribution patterns:								
70 cm between ridges + 1 plant/hill	202.4	190.7	169.4	160.3	39.8	39.1	24.139	22.770
70 cm between ridges + 2 plants/hill	189.6	179.2	161.4	152.7	38.5	37.5	21.536	20.187
80 cm between ridges + 1 plant/hill	209.7	197.8	177.8	168.1	40.7	39.7	25.791	24.689
80 cm between ridges + 2 plants/hill	194.8	184.2	165.8	157.4	39.0	38.2	22.521	21.480
F. test	*	*	*	*	*	*	*	*
LSD (5 %)	1.5	1.0	1.2	1.3	0.1	0.4	0.317	0.438
LSD (1 %)	2.1	1.7	1.6	1.7	0.2	0.5	0.429	0.594
C- Sources of nitrogen fertilizer:								
Ammonium Sulphate	189.5	178.7	160.5	152.2	38.3	37.3	22.095	20.392
Ammonium Nitrate	200.3	189.5	168.9	159.8	39.5	38.6	23.458	22.340
Urea	207.7	195.7	176.4	166.8	40.7	39.9	24.937	24.112
F. test	*	*	*	*	*		*	*
LSD (5 %)	1.3	0.9	0.8	0.9	0.1	0.2	0.135	0.224
LSD (1 %)	2.0	1.6	1.1	1.2	0.2	0.3	0.179	0.298
D- Interactions:								
A X B	*	*	*	*	*	*	*	*
A X C	*	*	*	*	*	*	*	*
B X C	NS	NS	*	*	*	*	*	*
A X B X C	*	*	*	*	*	*	*	*

II- Effect of plant Distribution Patterns:

The effect of plant distribution patterns on corn growth characteristics *i.e.* plant and ear height (cm) and ear leaf area (cm^2) was significant in both seasons as its showan in (Table 2). From obtained results, it could be recommend that planting corn plants in ridges 80 cm apart, 22 cm between hills and one plant per hill significantly surpassed other plant distribution and

produced the highest values of plant and ear height, and ear leaf area in both seasons under the environmental conditions of this study. Whereas, planting corn plants in ridges 70 cm apart, 25 cm between hills and one plant per hill gave the best values of all studied characters after aforementioned treatment. On the other wise, planting corn plants in ridges 70 cm apart, 50 cm between hills and two plants per hill resulted in the lowest values of these characters in both seasons. This increase in growth characters when planting corn plants in ridges 80 cm apart, 22 cm between hills and one plant per hill may be due to competition and mutual shading between the adjacent plants. These results were parallel with those reported by Darwich (2009) and Babaji *et al.* (2012).

There was significant effect on yield and its attributes (ear length, ear diameter, number of rows/ear, number of grains/row, ear weight, ear grains weight, 100-grain weight and grain yield/fed) due to plant distribution patterns in the two seasons (Table 3 and 4). The best plant distribution pattern that produced the highest values of grain yield and its attributes was 80 cm between ridges, 22 cm between hills and one plant per hill in the first and second seasons under the environmental conditions of this study. Plants were planted in ridges 70 cm apart, 25 cm between hills and one plant per hill came in the second rank after previously mentioned plant distribution pattern in both seasons. On the other side, planting in ridges 70 cm apart, 50 cm between hills and two plants per hill gave the lowest values of grain yield and its attributes in the first and second seasons of this investigation. Such these effects might have been due to better interception and utilization of solar radiations and the increase in photosynthetic processes, improvement in early corn growth and stimulated the building of metabolic products accompanying with best plant distribution pattern. These findings are coincidence with those Srecorded by Darwich (2009) and Moraditochaee *et al.* (2012).

III- Effect of Sources of Nitrogen Fertilizer:

The obtained data revealed that the effect of sources of nitrogen fertilizer on all studied characters *i.e.* growth characters, yield and its attributes was significant in the two growing seasons as its shown in (Table 2, 3 and 4). It can be stated that corn plants fertilized Urea as a source of nitrogen fertilizer resulted in the highest means of plant and ear height, ear position, stem diameter, ear leaf area, ear length and diameter, number of rows/ear, number of grains/row, ear weight, ear grains weight, shelling percentage, 100-grain weight and grain yield/fed followed by fertilized it by Ammonium Nitrate then Ammonium Sulphate in the first and second seasons. The increase in plant height as a result of using Urea as a source of nitrogen fertilizer may be attributed to increase soil pH in the short run and lead to increased leaching of metals and biocides associated with dispersible organic colloids. In the longer run, the soil acidification resulting from nitrification of fertilizer nitrogen can result in leaching of some heavy metal cations as well as urea inhanced plant growth such as leaf number and leaf area wchich resulted in improve plant growth and plant grain yield. These results are in harmony with those recorded by Powel (2005) and Osundare (2009).

IV- Effect of Interactions:

Many significant interactions effects among studied factors were detected on all studied characters in both seasons. We have reported enough the significant interactions on grain yield/fed only.

The effect first order of interaction between tillage treatments and plant distribution patterns on grain yield (ardab/fed) was significant in the two growing seasons. The optimum treatment that produced the highest values of grain yield was utilization of chisel plow twice beside planting in ridges 80 cm apart, 22 cm between hills and one plant per hill, where its results were 28.03 and 26.94 ardab/fed in the first and second seasons, respectively as illustrated in Table 5. It was followed by the treatment of using chisel plow once only besides planting in ridges 80 cm apart, 22 cm between hills and one plant per hill in both seasons. The lowest means of grain yield (19.60 and 18.02 ardab/fed) were resulted from using chisel and tiller plows once of each and planting in ridges with 70 cm distance between them, 50 cm between hills and two plants per hill in the first and second seasons, respectively.

Table 5: Grain yield (ardab/fed) of corn as affected by the interaction between tillage treatments and plant distribution patterns during 2011 and 2012 seasons.

Tillage treatments	Plant distribution patterns			
	70 cm between ridges + 1 plant/hill	70 cm between ridges + 2 plants/hill	80 cm between ridges + 1 plant/hill	80 cm between ridges + 2 plants/hill
2011 season				
Using chisel plow once	25.180	22.467	27.040	23.450
Using chisel plow twice	26.556	23.611	28.033	24.756
Using tiller plow once	23.222	20.467	24.811	21.378
Using chisel plow once + tiller plow once	21.600	19.600	23.278	20.500
F. test	*			
LSD (5 %)	0.633			
LSD (1 %)	0.858			
2012 season				
Using chisel plow once	23.490	21.322	25.474	22.151
Using chisel plow twice	24.979	22.224	26.941	24.182
Using tiller plow once	22.062	19.177	23.881	20.340
Using chisel plow once + tiller plow once	20.548	18.024	22.459	19.247
F. test	*			
LSD (5 %)	0.876			
LSD (1 %)	1.187			

Data presented in Table 6 indicated that the interaction between tillage treatments and sources of nitrogen fertilizer had a significant effect on grain yield (ardab/fed) during the first and second seasons. Moreover, the highest means of grain yield were produced with using chisel plow twice + Urea as nitrogen fertilizer soures, which gave 27.25 and 26.36 ardab/fed in the first and second seasons, respectively. On the other hand the lowest means of grain yield/fed were obtained from using chisel and tiller plows once of each + Ammonium Sulphate, which findings were 19.85 and 18.15 ardab/fed in the first and second seasons, respectively.

Table 6: Grain yield (ardab/fed) of corn as affected by the interaction between tillage treatments and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Tillage treatments	Sources of nitrogen fertilizer		
	Ammonium Sulphate	Ammonium Nitrate	Urea
2011 season			
Using chisel plow once	23.098	24.650	25.855
Using chisel plow twice	24.417	25.550	27.250
Using tiller plow once	21.017	22.483	23.908
Using chisel plow once + tiller plow once	19.850	21.150	22.733
F. test	*		
LSD (5 %)	0.270		
LSD (1 %)	0.359		
2012 season			
Using chisel plow once	21.113	23.203	25.012
Using chisel plow twice	22.609	24.773	26.363
Using tiller plow once	19.690	21.241	23.164
Using chisel plow once + tiller plow once	18.157	20.142	21.910
F. test	*		
LSD (5 %)	0.449		
LSD (1 %)	0.597		

The effect first order of the interaction between plant distribution patterns and sources of nitrogen fertilizer on grain yield (ardab/fed) was significant in both seasons as shown in Table 7. Maximum values of grain yield were obtained from planting in ridges 80 cm apart, 22 cm between hills and one plant per hill in addition mineral fertilizer with Urea, which the results were 27.36 and 26.62 ardab/fed in the first and second seasons, respectively.

Table 7: Grain yield (ardab/fed) of corn as affected by the interaction between plant distribution patterns and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Plant distribution patterns	Sources of nitrogen fertilizer		
	Ammonium Sulphate	Ammonium Nitrate	Urea
2011 season			
70 cm between ridges + 1 plant/hill	22.585	24.225	25.608
70 cm between ridges + 2 plants/hill	20.433	21.433	22.742
80 cm between ridges + 1 plant/hill	24.133	25.875	27.363
80 cm between ridges + 2 plants/hill	21.229	22.300	24.033
F. test	*		
LSD (5 %)	0.270		
LSD (1 %)	0.359		
2012 season			
70 cm between ridges + 1 plant/hill	20.988	22.830	24.492
70 cm between ridges + 2 plants/hill	18.204	20.220	22.137
80 cm between ridges + 1 plant/hill	22.785	24.660	26.622
80 cm between ridges + 2 plants/hill	19.592	21.649	23.198
F. test	*		
LSD (5 %)	0.449		
LSD (1 %)	0.597		

Planting in ridges 80 cm apart, 22 cm between hills and one plant per hill in addition mineral fertilizer with Ammonium Nitrate came in the second rank. Whereas, planting in ridges with 70 cm distance between them, 50 cm between hills + Ammonium Sulphate tended to produce the lowest values of grain yield (20.43 and 18.20 ardab/fed) in the first and second seasons, respectively.

The effect of second order interaction among tillage treatments, plant distribution patterns and sources of nitrogen fertilizer on grain yield (ardab/fed) was significant in the first and second seasons as presented in Table 8.

Table 8: Grain yield (ardab/fed) of corn as affected by the interaction among tillage treatments, plant distribution patterns and sources of nitrogen fertilizer during 2011 and 2012 seasons.

Tillage treatments	Plant distribution patterns	Sources of nitrogen fertilizer		
		Ammonium Sulphate	Ammonium Nitrate	Urea
2011 season				
Using chisel plow once	70 cm between ridges 1 plant/hill	23.440	25.600	26.500
	70 cm between ridges 2 plants/hill	21.500	22.300	23.600
	80 cm between ridge 1 plant/hill	25.300	27.400	28.420
	80 cm between ridge 2 plants/hill	22.150	23.300	24.900
Using chisel plow twice	70 cm between ridges 1 plant/hill	25.400	26.800	27.467
	70 cm between ridges 2 plants/hill	22.133	23.400	25.300
	80 cm between ridge 1 plant/hill	26.800	27.600	29.700
	80 cm between ridge 2 plants/hill	23.333	24.400	26.533
Using tiller plow once	70 cm between ridges 1 plant/hill	21.400	23.200	25.067
	70 cm between ridges 2 plants/hill	19.400	20.533	21.467
	80 cm between ridge 1 plant/hill	23.133	25.100	26.200
	80 cm between ridge 2 plants/hill	20.133	21.100	22.900
Using chisel plow once + tiller plow once	70 cm between ridges 1 plant/hill	20.100	21.300	23.400
	70 cm between ridges 2 plants/hill	18.700	19.500	20.600
	80 cm between ridge 1 plant/hill	21.300	23.400	25.133
	80 cm between ridge 2 plants/hill	19.300	20.400	21.800
F. test		*		
LSD (5 %)		0.539		
LSD (1 %)		0.717		
2012 season				
Using chisel plow once	70 cm between ridges 1 plant/hill	21.537	23.567	25.367
	70 cm between ridges 2 plants/hill	19.400	21.350	23.217
	80 cm between ridge 1 plant/hill	23.293	25.510	27.620
	80 cm between ridge 2 plants/hill	20.223	22.387	23.843
Using chisel plow twice	70 cm between ridges 1 plant/hill	23.293	24.933	26.710
	70 cm between ridges 2 plants/hill	19.897	22.423	24.353
	80 cm between ridge 1 plant/hill	24.960	26.937	28.927
	80 cm between ridge 2 plants/hill	22.287	24.800	25.460
Using tiller plow once	70 cm between ridges 1 plant/hill	20.403	22.070	23.713
	70 cm between ridges 2 plants/hill	17.303	19.083	21.143
	80 cm between ridge 1 plant/hill	22.193	23.780	25.670
	80 cm between ridge 2 plants/hill	18.860	20.030	22.130
Using chisel plow once + tiller plow once	70 cm between ridges 1 plant/hill	18.717	20.750	22.177
	70 cm between ridges 2 plants/hill	16.217	18.023	19.833
	80 cm between ridge 1 plant/hill	20.693	22.413	24.270
	80 cm between ridge 2 plants/hill	17.000	19.380	21.360
F. test		*		
LSD (5 %)		0.897		
LSD (1 %)		1.193		

It can be observed that, the highest values of grain yield (29.70 and 28.92 ardab/fed) were resulted from tillage corn soil by using chisel plow twice and planting in ridges 80 cm apart, 22 cm between hills and one plant per hill in addition using Urea as a source of nitrogen fertilizer in the first and second seasons, respectively. Application of chisel and tiller plows once of each and planting in ridges with 70 cm distance between them, 50 cm between hills and two plants per hill in addition using Ammonium Sulphate as a source of nitrogen fertilizer resulted in the lowest values of grain yield (18.70 and 16.21 ardab/fed) in the first and second seasons, respectively.

From the above mentioned results it can be concluded that tillge corn soil by using chisel plow twice and planting ridges 80cm apart ,22cm between hill and one plant per hill as well as using urea fertilizer can be recommended to improve the productivity of corn hybrid S.C.128 under the conditions of this study at rate of 120 kg N/fad.

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تعظيم إنتاجية الذرة الشامية باستخدام بعض النظم المزرعية الحديثة

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يهدف هذا البحث إلى تعظيم إنتاجية محصول الذرة الشامية بإستخدام نظم مزرعية حديثة والتى تساهم فى زيادة إنتاجية وجودة محصول الذرة الشامية هجين فردى ١٢٨ مثل معاملات الحرث لإعداد الأرض للزراعة ، نماذج مختلفة للتوزيعات النباتية ومصادر السماد النيتروجينى و لتحقيق هذا الغرض أقيمت التجارب الحقلية بالمزرعة البحثية بمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ – مركز البحوث الزراعية الجيزة – مصر خلال موسمى ٢٠١١ و ٢٠١٢. أجريت كل معاملة من معاملات الحرث الأربعة فى تجربة مستقلة. ثم نفذت كل معاملة من معاملات الحرث فى تصميم القطع المنشقة مرة واحدة فى أربع مكررات. إشتملت القطع الرئيسية على أربع نماذج مختلفة للتوزيعات النباتية (عرض الخط ، مسافة الزراعة وعدد النباتات فى الجورة) بكثافة نباتية ثابتة (٢٤ ألف نبات/فدان). بينما إحتوت القطع الشقية على ثلاثة مصادر للسماد النيتروجينى بالمعدل الموصي به (١٢٠ كجم نيتروجين/فدان).

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

أوضحت النتائج المتحصل عليها أن جميع الصفات تحت الدراسة قد تأثرت معنوياً نتيجةً بمعاملات الحرث فى موسمى الدراسة. أدى استخدام المحراث الحفار مرتين لحرث التربة وإعدادها لزراعة الذرة الشامية للحصول على أعلى القيم لجميع الصفات تحت الدراسة في كلا الموسمين. فى حين أدى استخدام المحراث الحفار مرة واحدة بالإضافة إلى المحراث العميق مرة واحدة أيضاً للحصول على أقل القيم لتلك الصفات في كلا الموسمين.

تأثرت جميع الصفات تحت الدراسة بنماذج التوزيعات النباتية معنوياً فى كلا موسمى الدراسة. وجد أن أفضل نموذج للتوزيع النباتى والذى أعطى أعلى القيم لجميع الصفات تحت الدراسة

هو زراعة الذرة الشامية على خطوط بعرض ٨٠ سم ، ٢٢ سم بين الجور مع ترك نبات واحد بالجورة في الموسمين الأول والثاني. أدت زراعة الذرة الشامية على خطوط بعرض ٧٠ سم ، ٨٠ سم بين الجور مع ترك نباتين بالجورة للحصول على أقل القيم لتلك الصفات فى كلا الموسمين.

أدى استخدام مصادر مختلفة للسماد النيتروجينى إلى فروق معنوية فى جميع الصفات تحت الدراسة فى كلا الموسمين. أدى تسميد نباتات الذرة الشامية باليوريا كمصدر للسماد النيتروجينى للحصول على أعلى القيم لجميع الصفات تحت الدراسة تلاه استخدام نترات النشادر ثم سلفات النشادر فى كلا الموسمين.

عموماً من النتائج المتحصل عليها فى هذه الدراسة يمكن التوصية بالإعداد الجيد لأرض الذرة الشامية هجين فردى ١٢٨ من خلال الحرث مرتين بالمحراث الحفار والزراعة على خطوط بعرض ٨٠ سم والزراعة في جور على مسافة ٢٢ سم مع ترك نبات واحد بالجورة والتسميد المعدنى باليوريا بمعدل١٢٠كجم ن/ف كمصدر للسماد النيتروجينى للحصول على أعلى نمو وإنتاجية لوحدة المساحة تحت ظروف منطقة سخا - محافظة كفر الشيخ.

قام بتحكيم البحث

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