J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 6(2): 295 - 307 , 2015

RESPONSE OF MAIZE VARIETIES TO N-FERTILIZER RATES UNDER DRAINAGE CONDITIONS IN CLAY SOIL.

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ABSTRACT

A field experiment was conducted at the Experimental Farm of Sakha Agric. Res. Station during the two summer growing seasons (2012 and 2013), to evaluate the effect of distance from drain line (1/4 and 1/2 distance from drain line) and applied N-fertilizer rate (90, 120 and 150 kg N/fed) on yield and yield components as well as N-content of two maize hybrids (single pioneer hybrid No. 10 (V2) and ternary hybrid No 329 (V1)) in clay soils. The tile lines were spaced to simulate a 20 m spacing and 1.2 m depth with a slope of 0.1%.

Data showed that:

Water table depths were increased with increasing time after irrigation. Water table depth near the drains was higher than in midway between drains. Soil bulk density was lower near the drain and gradually increased towards the midway between drains.

Decreasing distance from drain line from L/2 to L/4 resulted in a significant increase in yield and yield components of maize crop as well as N-content (kg/fed.) and protein percentage in both seasons.

Maize grains yield, 100 grains weight, ear diameter and Plant height increased with increasing rate of N-fertilization. The values of maize grain yield were 25.71, 27.66 and 29.68 ardab/fed in the first season and 26.23, 28.62 and 30.72 ardab/fed in the second season for 90, 120 and 150 kgN/fed., respectively. The corresponding values of protein percentage were 6.01, 11.68 and 15. 55 % in the first season and 5.94, 11.54 and 15.52 % in the second season, respectively. Data showed that V2 resulted in a significant increase in the grain yield, 100 grain weight and Plant height of maize crop.

The combination between distance from drain line and 150 kgN/fed resulted in a high yield and yield components as well as N-content of maize crop. Maize varieties resulted in somewhat differences in the grain yield, 100 grains weight, ear diameter and Plant height as well as N-content and protein percentage of maize crop in both seasons with every N-fertilization. The highest values of grains yield, 100 grains weight, Ear diameter and Plant height as well as N-content and protein percentage of maize crop were obtained with combination between L/4, 150 kgN/fed and V2 while, the lowest values were obtained with interaction of L/2, 90 kgN/fed and V1 in both studied seasons.

The obtained results revealed also, that 20 m drains spacing in clay soils is not the proper but may be economic. In addition, distance from drain line must be taken into consideration when distributing fertilizer treatments and their replicates in fertilization experiments to obtain reliable results.

Keywords: Drain line, nitrogen fertilizer, maize crop, clay soil.

INTRODUCTION

Drainage is generally required to increase soil productivity by facing the twin problems of water logging, soil salinity and subsequently offer the suitable environments for plant growth and also for humanbeing. The tile drainage also causes very important changes in nutrients movement which make these nutrients more available for plant growth, (Abd El-Khalek, 2000 and Antar, 2005 and 2007). In clay soil at North Delta, Ramadan et al., (2006) found that 1000 grains weight, grain and straw yield significantly increased as the distance from drain line decreased, from L/2 to L/4.

Maize (Zea mays, L.) has always been and still as one of the real star of cereal crops in Egypt. It has assumed it's importance in Egypt because of its being one of the main sources of food for people and animals. Every part of the maize plant has economic value. The grain, leaves, stalk, tassel and cob, it's used for several industrials such as starch, fructose, corn flaks, alcohol, corn oil, corn fiber, ethanol, animals feed and fodder. In Egypt, it is necessary to increase maize yield to face the wide gab between the production (5.5 million ton) and consumption (13.5 million tons). The main goal of the Egyptian national maize program is to develop new hybrids with high yielding.

Maize yield is affected by many factors such as drainage conditions and nitrogen fertilizer. Nitrogen is the most important nutrients required for all plants to obtain improving yield and its quality (Rees et al., 1995). Maize needs high rates of N-mineral application, reached 300kg urea/fed. in normal soils (Nofal and Hinar, 2003). Several researchers have monitored yields and N-content of maize under different N-fertilizer rates, maize hybrids and drainage conditions (Ibrahim et al., 2003; Antar 2005 Peng Yan, et al., 2014 and Cavigliaa, et al,. 2014). Nitrogen uptake is a parameter expresses the value resulted from increasing both dry matter production and nitrogen concentration in any plant part. Ibrahim et al., (2003) and Antar, (2005) found that, yields and N-content of corn grains and straw were highly significant near the drain and decreased far from the drains.

In fertilization experiment, researches usually distribute the fertilizer treatments randomly in soil despite of its position between tile drains. The objectives of the present work were to study the effect of distance from drain line and applied N-fertilizer rate on yield and yield components as well as N-content of two maize hybrids in clay soils.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm of Sakha Agric. Res. Station during the two summer growing seasons (2012 and 2013), to evaluate the effect of distance from drain line (1/4 and 1/2 distance from drain line) and applied N-fertilizer rate (90, 120 and 150 kg N/fed) on yield and yield components as well as N-content of two maize hybrids (single pioneer hybrid No. 10 and ternary hybrid No 329.) in clay soils. The location is situated at 31°07′ 13″ N latitude and 30°57′ 43″ E longitude. The tile lines were spaced to simulate a 20 m spacing and 1.2 m depth with a slope of 0.1%. The field was plowed with moldboard plow to a depth of 20 cm. Maize (*Zea mays*, L.) was planted on May 15, 2012 and May 17, 2013. All plots received a total of 100 Kg Ca-superphosphate/fed. (15.5% P_2O_5) and 50 Kg k-sulfate/fed. (48% K_2O) during tillage operation. Nitrogen fertilizer in the form of urea was added in two doses (before the first and the second irrigations).

The different agricultural practices were done as recommended through the two growing seasons. Soil samples were taken to a depth of 0.9 m, before cultivation for analysis. The main chemical and physical properties of the soil are presented in Table (1).

The experiments were conducted in a split-split-plot design with three replicates. The main plots were distances from drain line, the sub-plots maize hybrids and the sub-sub-plots were nitrogen rates as follows:

Main plots (distances form drain line):

L/2: Distances of 1/2 from drain line.
L/4: Distances of 1/4 from drain line.

Sub-plots (hybrids):

V2: Single pioneer hybrid No. 10.
V1: Ternary hybrid No 329.

Sub-Sub-plots (nitrogen application rate):

N_1: Nitrogen application at rate 90 kg N/fed.
N_2: Nitrogen application at rate 120 kg N/fed.
N_3: Nitrogen application at rate 150 kg N/fed.

Table(1): Some soil chemical and physical properties of the experimental field.

Soil depth (cm)	Particle size distribution			Texture grade	EC (dS/m)	OM %	Available N, P, K (ppm) (mg/kg soil)		
	Sand%	Silt%	Clay%				N	P	K
0-30	19.50	23.43	57.07	Clayey	1.77	1.50	28.0	7.0	388
30-60	20.00	24.00	56.00	Clayey	2.06	0.96	26.0	5.0	321
60-90	19.60	24.95	55.45	Clayey	2.25	0.61	25.0	4.6	298

EC-soil salinity (in soil paste extract), OM-Organic matter,

To monitor water table fluctuation, observation wells were installed midway between drains at 1/2 and 1/4 distances from tile drain as recommended by Dieleman and Trafford (1976). Soil bulk density and total porosity of the different layers of soil profile were measured using the core sampling technique as described by Campbell (1994). The Maize crop was harvested on 5^{th} October in 2012 (first season) and 7^{th} October in 2013 (second season) to determine yield (grain,) and yield components (100 grains weight, ear diameter and plant height). Maize grains samples were taken and dried at 70^oC, grounded with a mill, wet digested according to Jackson (1967) and its total N content was determined using micro Kjeldahl (Cottenie *et al.,* 1982). N-content by maize grains (kg/fed) was calculated by multiplying dry yield of maize grains (kg/fed) by N %. Also, protein percentage was calculated by multiplying N % of maize grains by 5.7.

Statistical analysis: Data are subjected to statistical analysis according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Water table levels and hydraulic head:

As shown in fig (1) water table depths in both studied seasons were increased with increasing time after irrigation. The lowest values of water table depth were found after one day from irrigation. While the highest values were found before the next irrigation. Water table depth near the drains (L/4) was higher than in midway between drains (L/2). This may be due to the improved drainage near the drains than midway between it which, in return, gave the top soil chance to dry and permitted for shrinkage and formation of water passage ways and allowed a rather easier movement of water into drain pipes. Similar results were obtained by Antar, (2005), Gendy, et al, (2009) and Paulo Castanheira (2010).

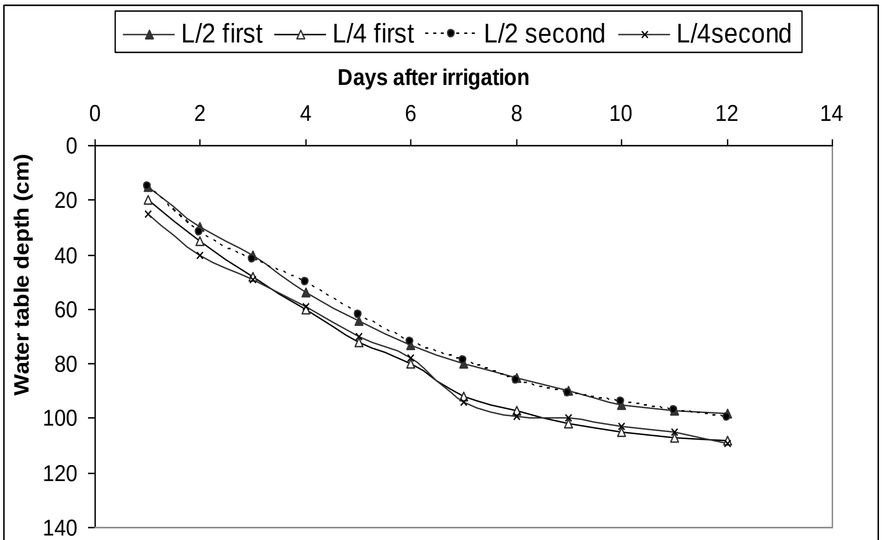

Fig (1) water table depth (cm) with time (day) after irrigation with different distance (L) from drain line

Soil bulk density and soil porosity

Soil bulk density is considered as one of the parameters which indicate the status of soil structure and consequently, soil water, air and heat regimes (Richards, 1954). Results in Table (2) show that soil bulk density increased with increasing soil depth for all tested profiles. This increase may be resulted from increasing soil compaction due to layers weight. Results in Table (2) show that, soil bulk density values were lower near the drain and gradually increased towards the midway between drains. Soil porosity values (Table, 2) had taken almost the opposite trend to that encountered with bulk density. This may be due to more effectiveness of drainage system near the drain line than far from the drain line. Similar results were obtained by Ibrahim *et al.* (1999) and Antar (2005).

Table (2): Soil bulk density (gcm^{-3}) and total porosity (%) with distance from drain line.

Treatments	Soil depth (cm)	The overall average of two seasons	
		Bulk density (gcm^{-3})	Total porosity (%)
1/4 Distances from drain line.	0-15	1.12	57.92
	15-30	1.26	52.64
	30-60	1.32	50.19
	60-90	1.42	46.42
	Mean	1.28	51.79
1/2 Distances from drain line.	0-15	1.15	56.60
	15-30	1.26	52.64
	30-60	1.37	48.49
	60-90	1.45	45.28
	Mean	1.31	50.75

Effect of distance from drain line on yield and its components:

Data in Table (3) showed that decreasing distance from drain line L/2 to L/4 resulted in a significant increase in the grains yield, 100 grains weight and plant height and insignificant in the ear diameter of maize crop in both seasons. The values of grains yield, 100 grains weight, ear diameter and Plant height near the drain (L/4) were higher than that far from it (L/2) by about 1.30 ardab/fed, 1.97gm, 7.9 cm and 0.05cm in the first season and about 0.87 ardab/fed, 1.33gm, 3.3 cm and 0.6 cm, in the second seasons, respectively. Data in Table, 3 clearly showed that the N-content (kg/fed.) and protein percentage by maize plant were parallel to the yield results in both seasons. Whereas, the high values of N-content and protein percentage were obtained near the drain (L/4). This is due to the effect of drainage on conditioning water-air relationship in the root zone and its effect on mobility and availability of nutrients to the plant roots which cause more vegetative growth and subsequently produce a higher yield. These results are in agreement with those obtained by Antar, (2005).

Table (3): Effect of distance from drain line on yield and yield components of maize crop.

Drainage	Grain yield (ardab/fed.)	100grain weight (g)	Plant height (cm)	Ear diameter (cm)	N-content (kg/fed)	Protein (%)
First season						
L/4	28.38	28.26	238.1	12.72	42.86	11.25
L/2	27.08	26.29	230.2	12.67	39.42	10.62
F-test	**	**	*	ns	*	*
Second season						
L/4	28.96	27.42	208.7	12.6	43.72	11.25
L/2	28.09	26.09	205.4	12.0	39.25	10.75
F-test	*	**	ns	ns	**	*

L/4 = 1/4 distance from drain line   L/2 = 1/2 distance from drain line ardab= 140 kg

As shown in Table (4) there were high significant differences in yield and yield components as well as N-content and protein percentage of maize crop.

Table (4): Effect of applied N-fertilizer rate on yield and yield components of maize crop.

N-fertilizer	Grain yield (ardab/fed.)	100grain weight (g)	Plant height (cm)	Ear diameter (cm)	N-content (kg/fed)	Protein (%)
First season						
N1	25.71c	25.15c	227.3c	12.08b	37.45c	6.01c
N2	27.66b	27.36b	235.5b	13.25a	41.47b	11.68b
N3	29.68a	29.30a	239.7a	12.75b	44.51a	15.55a
Second season						
N1	26.23c	24.29c	193.9	11.3c	38.00c	5.94
N2	28.62b	26.81b	207.0	12.6b	40.59b	11.54
N3	30.72a	29.07a	220.4	14.5a	45.88a	15.52

Data showed that, maize grains yield, 100 grains weight, ear diameter and plant height increased with increasing rate of N-fertilization (from 90 to 150 kg N/fed) in both studied seasons. The values of maize grains yield were 25.71, 27.66 and 29.68 ardab/fed in the first season and 26.23, 28.62 and 30.72 ardab/fed in the second season for 90, 120 and 150 kgN/fed., respectively. The corresponding values of protein percentage were 6.01, 11.68 and 15. 55 % in the first season and 5.94, 11.54 and 15.52 % in the second season, respectively. The increment in 100 grains weight as a result of increasing N-fertilization rate may be due to the role of nitrogen in increasing plant growth and grain filling. The increment in grain yield due to nitrogen fertilizer may be explained by the increase in most correlated yield components, which increase the final yield. The increase of protein percentage due to, high N-content by maize grains under high rates of N-fertilizer. This might be attributed firstly to the increases in the root surface and enrichment of soil solution with nitrogen which reflects its influence on N-concentration in plant tissues. This raising in N% in plant tissues may be contributed in building up metabolites and subsequently increasing dry matter production up to full growth stage and thin increases nutrients uptake by maize plant.

Data in Table (5) showed that Single pioneer hybrid No. 10 (V2) resulted in a significant increase in the grains yield, 100 grains weight and plant height and insignificant in the ear diameter of maize crop in both seasons. The values of grains yield, 100 grains weight, ear diameter and plant height withV2 were higher than that V1 by about 1.19 ardab/fed, 0.38 gm, 13.3 cm and 2.61cm in the first season and about 1.1 ardab/fed, 0.1gm, 12.5cm and 0.83 cm, in the second season, respectively. Data (Table 5) clearly showed that the N-content (kg/fed.) and protein percentage by maize plant were parallel to the yield results in both seasons. Whereas, the high values of N-content and protein percentage were obtained with V2.

Table (5): Effect of hybrids on yield and yield components of maize crop.

Varieties	Grain yield (ardab/fed.)	100grain weight (g)	Plant height (cm)	Ear diameter (cm)	Grain N-content (kg/fed)	Grain Protein (%)
First season						
V1	27.12	27.97	227.5	11.39	39.53	10.71
V2	28.31	28.35	240.8	14.00	42.76	11.15
F-test	**	**	*	ns	**	ns
Second season						
V1	27.97	26.86	200.8	12.4	40.82	10.78
V2	29.07	26.96	213.3	13.23	42.16	11.22
F-test	**	ns	*	ns	ns	ns

The interaction between distance from drain line and N-fertilizer:

Data in Table (6) showed that, in both studied seasons, grain yield, 100 grains weight, ear diameter and plant height as well as grain N-content and grain protein percentage of maize crop increased with increasing the N-fertilization (from 90 to 150 kgN/fed) under two distances from drain line (L/4 and L/2). On the other hand, increasing distance from drain line L/4 to L/2 resulted in decrease in the grain yield, 100 grains weight, ear diameter and plant height as well as grain N-content and grain protein percentage of maize crop in both seasons with every N-fertilization. The combination with 1/4 distance from drain line and 150 kgN/fed resulted in high yield and yield components as well as N-content of maize crop. On the other hand, the combined effect with 1/2 distance from drain line and 90 kgN/fed resulted in low yield and yield components as well as grain N-content of maize crop.

Table (6): The interaction between distance from drain line and applied N-fertilizer rate on yield and yield components as well as grain N-content of maize crop.

Parameters	LxN	First season		F-test	Second season		F-test
		L/4	L/2		L/4	L/2	
Grain yield (ardab/fed.)	N1	26.50c	24.92c	ns	26.68c	25.78c	ns
	N2	28.35b	26.97b	ns	29.12b	28.12b	ns
	N3	30.25a	29.31a	ns	31.07a	30.37a	ns
100grain weight (g)	N1	26.17c	24.13c	ns	25.25c	23.53c	ns
	N2	28.45b	26.27b	ns	27.35b	26.27b	ns
	N3	30.17a	28.43a	ns	29.65a	28.48a	ns
Plant height (cm)	N1	231.2c	223.3c	ns	195.0c	192.7c	ns
	N2	239.5b	231.5b	ns	208.1b	205.9b	ns
	N3	243.5a	235.8a	ns	223.0a	217.7a	ns
Ear diameter (cm)	N1	12.17c	12.0c	ns	11.7c	11.0b	ns
	N2	13.5b	13.0b	ns	13.7b	11.5b	ns
	N3	12.5a	13.0a	ns	15.5a	13.5a	ns
Grain N-content (kg/fed)	N1	39.6c	35.2c	ns	40.4c	35.7c	ns
	N2	43.5b	39.4b	ns	42.9b	38.3b	ns
	N3	45.5a	43.6a	ns	47.9a	43.8a	ns
Grain Protein (%)	N1	6.12	5.89	ns	6.20c	5.67c	ns
	N2	12.32	11.05	ns	11.85b	11.23b	ns
	N3	15.19	14.92	ns	15.72a	15.33a	ns

The interaction between maize hybrids and N-fertilizer:

Data in Table (7) showed that, in both studied seasons, grains yield, 100 grains weight, ear diameter and plant height as well as grain N-content and grain protein percentage of maize crop increased with increasing the N-fertilization (from 90 to 150 kgN/fed) with both two maize hybrids (V1 and V2). On the other hand, maize hybrids resulted in somewhat differences in the grains yield, 100 grains weight, ear diameter and plant height as well as grain N-content and grain protein percentage of maize crop in both seasons with every N-fertilization.

Table (7): The interaction between two maize hybrids and applied N-fertilizer rate on yield and yield components as well as N-content of maize crop.

Parameters	VxN	First season		F-test	Second season		F-test
		V1	V2		V1	V2	
Grain yield (ardab/fed.)	N1	24.98c	26.45c	ns	25.73c	26.73c	ns
	N2	26.97b	28.35b	ns	28.07b	29.17b	ns
	N3	29.43a	30.13a	ns	30.12a	31.32a	ns
100grain weight (g)	N1	25.72c	24.58b	*	24.75c	24.03b	*
	N2	27.80b	26.92a	*	26.80b	26.82a	*
	N3	29.87a	28.73a	ns	29.02a	29.12a	ns
Plant height (cm)	N1	218.7b	235.8c	*	185.8c	201.9c	*
	N2	229.2a	241.8b	*	199.5b	214.4b	*
	N3	234.7a	244.7a	ns	217.1a	223.6a	ns
Ear diameter (cm)	N1	10.2b	14.0ab	ns	10.7c	12.0b	*
	N2	11.5ab	15.0a	ns	12.0b	13.2ba	ns
	N3	12.5a	13.0b	*	14.5a	14.5a	ns
Grain N-content (kg/fed)	N1	35.1c	39.8c	ns	36.4c	39.6b	ns
	N2	39.6b	43.3b	ns	40.3b	40.9b	ns
	N3	43.9a	45.2a	ns	45.8a	46.0a	ns
Grain Protein (%)	N1	5.78c	6.23c	ns	5.65c	6.22c	ns
	N2	11.70b	11.68b	ns	11.43b	11.65b	ns
	N3	14.67a	15.55a	ns	15.26a	15.79a	ns

The interaction between distance from drain line and maize hybrids:

Data in Table (8) showed that, in both studied seasons, grains yield, 100 grains weight, ear diameter and plant height as well as N-content and protein percentage of maize crop decreased with increasing the distance from drain line (from L/4 to L/2) with both two maize hybrids (V1 and V2). Also, V2 cultivation resulted in an increase in the grains yield, ear diameter and plant height as well as grain N-content and grain protein percentage of maize crop in both seasons.

Table (8): The interaction between distance from drain line and two maize hybrids on yield and yield components as well as N-content of maize crop.

Parameters	LxV	First season		F-test	Second season		F-test
		L/4	L/2		L/4	L/2	
Grain yield (ardab/fed.)	V1	27.59	26.66	ns	28.40	27.54	ns
	V2	29.15	27.48	ns	29.51	28.63	ns
	F-test	ns	ns		ns	ns	
100grain weight (g)	V1	28.21	27.38	ns	27.52	26.19	ns
	V2	28.31	25.18	ns	27.31	26.00	ns
	F-test	ns	ns		ns	ns	
Plant height (cm)	V1	231.3	223.7	ns	202.1	199.6	ns
	V2	244.8	136.8	ns	215.3	211.3	ns
	F-test	ns	ns		ns	ns	
Ear diameter (cm)	V1	11.8	11.0	ns	12.8	12.0	ns
	V2	13.7	14.3	ns	14.4	12.0	*
	F-test	ns	ns		ns	ns	
Grain N-content (kg/fed)	V1	40.9	38.2	ns	42.3	45.2	ns
	V2	44.9	40.7	ns	39.4	39.1	ns
	F-test	ns	ns		ns	ns	
Grain Protein (%)	V1	10.96	10.47	ns	11.01	10.55	ns
	V2	11.53	10.78	ns	11.50	10.94	ns
	F-test	ns	ns		ns	ns	

The interaction between distance from drain line, maize hybrids and N-fertilizer:

Data in Table (9) showed that, the highest values of grains yield, 100 grains weight, ear diameter and plant height as well as N-content and protein percentage of maize crop were obtained with interaction between L/4, 150 kgN/fed and V2 while, the lowest values were obtained with interaction of L/2, 90 kgN/fed and V1 in both studied seasons.

Nitrogen use efficiency = grain yield, kg/fed./nitrogen applied, kg/fed.:

Nitrogen use efficiency in terms of productivity factor clearly showed that application of nitrogen with low rates caused a higher value of nitrogen use efficiency. Data also, showed that the combination between L/4 and nitrogen rates resulted in higher value of nitrogen use efficiency especially with single pioneer hybrid No. 10 (V2). This is due to the effect of detraining distance from drain line (L/4) on conditioning water-air relationships in the root zone and its effect on mobility of nutrients to the plant root.

Table (9): The interaction between distance from drain line, two maize hybrids and applied N-fertilizer rate on yield and yield components as well as grain N-content of maize crop.

Parameters	LxVxN		First season V1	First season V2	Second season V1	Second season V2
Grain yield (ardab/fed.)	L/4	N1	25.63c	27.37b	26.30c	27.07b
		N2	27.43b	29.27ab	28.40b	29.83a
		N3	29.70a	30.80a	30.50a	31.63a
	L/2	N1	24.30c	25.53b	25.17c	26.40b
		N2	26.50b	27.43ab	27.73b	28.50b
		N3	29.17a	29.47a	29.73a	31.00a
100grain weight (g)	L/4	N1	26.07c	26.27b	25.40c	25.10b
		N2	28.40b	28.50a	27.53b	27.17b
		N3	30.17a	30.17a	29.63a	29.67a
	L/2	N1	25.38c	22.90b	24.10c	22.97b
		N2	27.20b	25.33a	26.07b	26.47a
		N3	29.57a	27.30a	28.40a	28.57a
Plant height (cm)	L/4	N1	223.3b	239.0c	186.4	203.6
		N2	232.7a	246.3b	200.5	215.7
		N3	238.0a	249.0a	219.3	226.7
	L/2	N1	214.0b	232.7c	185.3	200.1
		N2	225.7a	237.3b	198.6	213.2
		N3	231.3a	240.3a	214.9	220.5
Ear diameter (cm)	L/4	N1	10.33b	14.00ab	10.3c	13.0b
		N2	12.00ab	15.00a	13.0b	14.3ab
		N3	13.00a	12.00b	15.0a	16.0a
	L/2	N1	10.00a	14.00a	11.0b	11.0a
		N2	11.00a	15.00a	11.0b	12.0a
		N3	12.00a	14.00a	14.0a	13.0a
Grain N-content (kg/fed)	L/4	N1	36.85c	42.43b	38.10c	42.60b
		N2	41.40b	45.60a	41.33b	44.50b
		N3	44.33a	46.57a	47.40a	48.43a
	L/2	N1	33.35c	37.15c	34.64c	36.67b
		N2	37.82b	41.06b	39.34b	37.20b
		N3	43.40a	43.73a	44.10a	43.57a
Grain Protein (%)	L/4	N1	5.87c	6.38c	5.78c	6.62c
		N2	12.11b	12.54b	11.77b	11.92b
		N3	14.62a	15.66a	15.47a	15.96a
	L/2	N1	5.7c	6.07c	5.52c	5.83c
		N2	11.28b	10.82b	11.09b	11.38b
		N3	14.41a	15.43a	15.05a	15.61a

The obtained results revealed also, that 20 m spacing in clay soils is not the proper but may be economic. In addition, distance from drain line must be taken into consideration when distributing fertilizer treatments and their replicates in fertilization experiments to obtain reliable results

Table (10): The overall average of nitrogen use efficiency as affected by different treatments.

Treatments			Grain yield (kg / fed.)	Nitrogen applied (kg/fed.)	Nitrogen use efficiency
L/4	V1	N1	4933.35	90	54.82
		N2	5303.85	120	44.20
		N3	5719.0	150	38.13
	V2	N1	5162.3	90	57.36
		N2	5614.5	120	46.79
		N3	5930.85	150	39.54
L/2	V1	N1	4699.65	90	52.22
		N2	5151.85	120	42.93
		N3	5595.5	150	37.30
	V2	N1	4933.35	90	54.82
		N2	5313.35	120	44.28
		N3	5744.65	150	38.30

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REFERENCES

Abd El-khalek, M.I.I.(2000). Nitrogen loss and uptake as affected by nitrogen application and tile drainage. Ph.D.Thesis. Fac. Of Agric. Mansoura University, Egypt.

Antar, A. S. (2007). Nitrate transport in clay soils and its losses into field drains tiles from urea applied for sugar beet. J. Agric. Sci. Mansoura Univ., 32 (6): 4987- 4998.

Antar, A. S. (2005). Movement of some nitrogen forms, atrazine and malathion in clay soil as affected by drain spacings. Ph. D. Thesis, Fac. Agric. Tanta Univ., Egypt.

Campbell, D.J. (1994). Determination and use of bulk density in relation to soil compaction. In Soane and Ouwerk (Eds). Soil Compaction in Crop Production. Elsever, London and Amsterdam.

Cavigliaa O. P., R.J.M. Melchioria, V.O. Sadrasc (2014). Nitrogen utilization efficiency in maize as affected by hybrid and N rate in late-sown crops. Field Crops Research, Volume 168, P. 27-37.

Cottenie, A.; M. Ver Loo; L. Mjkiekens; G. Velghe and R. Comertynck (1982). Chemical Analysis of Plant and Soil. Lab. Anal. And Agrochem. State Univ., Gent., Belgium, Chapter 2 and 3, pp. 14-54.

Dieleman, P. J. and B. D. Trafford (1976). Drainage testing. Irrigation and Drainage Paper No. 28. FAO, Rome.

Gendy,A.A.S.; I. E. Nasr El-Din and A.S. Antar (2009). Effect of irrigation, potassium application and distance from drain line on wheat crop in clay soil. J. Agric. Res. Kafr El-Sheikh Univ., 35 (3): 897 – 908.

Ibrahim, S. H.; S. A. Gaheen; M. A. Koriem and A. S. Antar (2003). Atrazine and nitrate transport through a clay soil into subsurface tile drains of different spacings. J. Agric. Res. Tanta Univ., 29 (2), 335-353.

Ibrahim, S.M.; J. Blankenburg and H. Kuntze (1999). Drainage effects in marsh soil. II. Effects on soil properties and grain yield. Z.F. Kutturtech and Landentwick, 40(2):72-76.

Jackson M. L. (1967). Soil Chemical Analyses. Prinice-Hall of India, New Delhi.

Nofal,F.and A.Hinar(2003). Growth and chemical properties of maize grow of some single crosses as affected by nitrogen and manure fertilization under sprinkler irrigation in a sandy soil.Egypt .J.Appl.Sci.18(5B), 583.

Paulo Castanheira (2010). Empty drain and the water level at midway between the drains. aspects regarding management. CSBE11372 – Presented at ASABE's 9th International Drainage Symposium (IDS), Québec City, Canada June 13-17, 2010.

Peng Yan, Shanchao Yue, Menglong Qiu, Xinping Chen, Zhenling Cui, , Fanjun Chen (2014). Using maize hybrids and in-season nitrogen management to improve grain yield and grain nitrogen concentrations. Field Crops Research, Volume 166, P. 38-45.

Ramadan. S. A., A.A.S. Gendy, N. I. Talha and A. A. El-Leithi (2006). Effect of distance from drain line on wheat crop under different rates of nitrogen fertlization in clay soil. J. Agric. Sci. Mansoura Univ., 31 (4): 2583- 2591.

Rees R. M., M. Roelcke, X. O. Wang and J. Richter (1996). The effect of fertilizer placement on nitrogen uptake and yields of wheat and maize in chinese losses soil. Nutrient cycling in agroecosystems. 47 (1): 81-91.

Richards, L.A. (1954). "Diagnosis and Improvement of Saline and Alkali Soils" U.S.D.A. Hand Book No. 60.

Snedercor, G. W. and W. G. Cochran (1980). "Statistical Methods" 7^{th} ed., Iowa state Univ., Press., Ames., Iowa, USA. 225-330.

استجابة اصناف الذرة للتسميد بالنتروجين تحت ظروف الصرف في الأرض الطينية

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أجريت التجربة في مزرعة محطة البحوث الزراعية بسخا خلال موسمي الصيف 2012 ، 2013 وذلك لدراسة تأثير المسافة من خط المصرف وإضافة السماد النيتروجيني علي الانتاج ومكونات الانتاج ومحتوي الحبوب من النتروجين والبروتين لهجينين من الذرة هما هجين فردي 10 (V2)وهجين ثلاثي 329 (V1) في الارض الطينية. وصممت التجربة بنظام القطع المنشقة مرتين.

وقد أظهرت نتائج الدراسة ما يلي:-

زيادة عمق الماء الارضي مع مرور الزمن بعد الري وزاد عمق الماء الارضي بالقرب من المصرف عن المناطق البعيدة عن المصرف كما لوحظ قلة الكثافة الظاهرية في المناطق القريبة من المصرف عن المناطق البعيدة من المصرف.

وتوضح النتائج ان نقص المسافة من خط المصرف من 2/1 الي 4/1 نتج عنها زيادة معنوية لانتاج الذرة ومكوناتة وايضا محتوي الحبوب من النيتروجين البروتين في الموسمين.

وعن زياد معدلات التسميد النيتروجيني وجد زيادة انتاج الذرة من الحبوب ووزن المائه حبة وطول النبات وقطر الكوز مع زيادة معدل السماد النيتروجيني حيث كانت قيم انتاج الذرة من الحبوب بمقدار 25.71، 27.86، 29.68 اردب للفدان في الموسم الاول و 26.23 ، 28.26 ، 30.72 اردب للفدان في الموسم الثاني للمعدلات 90، 120، 150 كيلوجرام نيتروجين للفدان علي التوالي. النتائج توضح زيادة معنوية لانتاج الذرة من الحبوب ووزن المائه حبة وطول النبات للصنف V2 .

والنتائج توضح ان الانتاج الاعلي للمحصول ومكوناتة و محتوي الحبوب من النيتروجين والبروتين تحققت نتيجة للتفاعل بين المسافة من المصرف ومعدل السماد النيتروجين 150 كيلو جرام للفدان. وان التفاعل بين الاصناف ومعدل السماد النيتروجين أدي الي إختلافات قليلة.

والنتائج توضح ان القيم الاعلي من انتاج الذرة من الحبوب ووزن المأئة حبة وطول النبات وقطر الكوز وايضا النيتروجين الممتص والبروتين تحققت مع التفاعل بين 4/1 المسافة من المصرف و150 كيلوجرام نيتروجين للفدان والصنف V2 بينما القيم الاقل تحققت مع التفاعل بين 2/1 المسافة من المصرف و90 كيلوجرام نيتروجين للفدان والصنف V1 في كلا الموسمين.

وفي النهاية النتائج توضح ان مسافة الصرف 20 متر في الارض الطينية غير مناسبة ولكن قد تكون إقتصادية. بالاضافة الي انة يجب ان يؤخذ في الاعتبار المسافة من المصرف عند توزيع معاملات السماد والمكررات في تجارب التسميد لكي نحصل علي نتائج واقعية.