Minufiya J. Agric. Res. Vol.37 No. 2:397 - 407 (2012) **"http://www.mujar.net"**

تأثير نظام الصرف المغطى على استجابة نبات البطاطس للتسميد النيتروجيني

عبد الجليل عبد النبي العربي ، منال فتحي طنطاوي ، محمد عباس الشريف

معهد بحوث الأراضي و المياه و البيئة – مركز البحوث الزراعية – الجيزة

الملخص العربي

أجريت دراسة حقلية خلال موسمي شتاء متتاليين (٢٠١٠ /٢٠١١ و٢٠١١/ ٢٠١٢) على الأرض الطينية بمنطقة كفر الزيات بمحافظة الغربية وذلك لتقييم كفاءة التسميد النيتروجيني و استجابة نباتات البطاطس له وذلك تحت ظروف الصرف المغطى ولقد تم كذلك دراسة توزيع صور النيتروجين (النيتروجين الأمونيومي والنيتروجين النتراتي) فيما بين أعماق الأرض المختلفة و كذلك الماء الأرضي وماء الصرف. كانت المسافة بين كل حقليين ٢٠متر و بعمق ١٥٠سم. وكان السماد النيتروجيني المستخدم نترات الأمونيوم (٣٣٪ ن) ومعدل إضافة صفر و ٥٠٠ كجم/فدان. و تم تقدير عمق الماء الأرضي و كذلك النيتروجين في أعماق الأرض المختلفة و الماء الأرضي وماء الصرف وايضا محصول البطاطس. و قد أجريت هذه التقديرات عند فترات نمو مختلفة و مسافات مختلفة من الحقليات.

ولقد أوضحت نتائج الدراسة انخفاض مستوى الماء الأرضي بزيادة الفترة الزمنية بعد الري و خاصة بعد الرية الأولى و كان أكثر انخفاضا في عمق الماء الأرضي الموجود فوق الحقليات. كما انخفض المحتوي من النيتروجين الأمونيومي وكذلك النتراتي (مجم/كجم) بزيادة العمق بعد كل من الرية الأولى و الثانية و كذلك عند الحصاد بينما ازداد هذا المحتوى بزيادة المسافة عن الحقليات و كان أقل محتوى للنيتروجين بالتربة هو ما قدر عند مرحلة الحصاد مع جميع معاملات الدراسة وكان محتوى التربة من النيتروجين الأمونيومي أعلى من محتواها من النيتروجين النتراتي. و من ناحية أخرى فإن محتوى الماء الأرضي و ماء الصرف من النيتروجين النتراتي (مجم/لتر) كان أكثر من محتواها من النيتروجين الأمونيومي مع جميع معاملات الدراسة. وكان اعلي محصول من البطاطس موجودا في التربة المسمدة أعلي الحقليات. كما كان أعلي محتوي من صورتي النيتروجين (٪) في كل من القش و الدرنات موجودا في النباتات النامية عند منتصف المسافة بين الحقليات.

وتوصي هذه الدراسة بضرورة الإهتمام بالصرف المغطي حيث أنه يؤدي إلي زيادة كفاءة التسميد النيتروجيني و تزداد هذه الكفاءة بتقليل المسافة بين الحقليات كما توصي أيضا بضرورة الاهتمام بالتسميد النيتروجيني لنبات البطاطس حيث أنه يؤثر في زيادة الإنتاجية.

EFFECT OF TILE DRAINAGE SYSTEM ON POTATOES PLANT RESPONSE TO NITROGEN FERTILIZATION

A.A. El-Araby, Manal F. Tantawy and M.A. El-Sherif
Soils, Water and Environmental Inst. Res., Agric. Res. Center, Giza

(Received: Jan. 22, 2012)

ABSTRACT: *A field study was carried out through two successive winter seasons of 2010 / 2011 and 2011 / 2012 on clay soil of Kafr El-Zayat area, Gharbiya Governorate to study nitrogen fertilization efficiency and its effect on potatoes plant growth under tile drainage system conditions. Nitrogen forms (NH_4-N and NO_3-N) distribution through different soil depths, ground water and drainage water were studied. The distance between each two laterals was 20 m and its depth was 150 cm. In this study, nitrogen fertilization was added as ammonium nitrate (33% N) at rates of 0 and 500 kg/fed. The following determinations i.e. ground water level, nitrogen forms and its content in different soil depths , ground water , drainage water , potatoes yield and its content of nitrogen were carried out at different growth stages and at different distances from laterals.*

The obtained data show that , ground water table depth was increased with the increasing the period after irrigation especially after the first irrigation. The greatest increase of ground water depth was found above the laterals. After the first and second irrigation and harvesting stage, the soil content (mg/kg) of available NH_4-N and NO_3-N was decreased with the increase of soil depth, but it increased when the distance increase from the lateral .The lowest contents of the determined N forms were found at harvesting stage. With different treatments, the soil content of NH_4-N was higher than of NO_3-N. On the other hand, ground and drainage water content (mg/l) of NO_3-N were higher than those of NH_4-N with all treatments under study. The highest yield of potato plants was found in the fertilized soil above the laterals. The high contents (%) of two N forms in both straw and tubers were found in the plants grown at middle distance between the laterals .

Key words: *Tile drainage, Nitrogen fertilization, Potatoes plant, Chemical composition, Ground and drainage water*

INTRODUCTION

Installation of subsurface drainage system in soils results in indirect effects on improving soil physical, chemical and hydrological properties, such as lowering water table, which lead to better structure of top soil, higher infiltration and porosity (Antar, 2000). Also it leads to increase soil aeration, drainable porosity, hydraulic conductivity, and reduce bulk density (Naguib, 1987). The application of subsurface drainage system in soil leads to disposing of the excess water and provides suitable salt balance (Wesseling, 1983) and reduces soil salinity (EC), soil sodicity (ESP) and pH (Sadik *et al*., 1988).

Potato (Solanum tuberosum L.) is considered one of the world major staple food crops as it produces more dry matter and protein per hectare than the major central crops (Burton,1989). Potatoes tubers are eaten in more countries than any other crop . Potatoes tubers in the global economy are the fourth important crop after the three cereals namely maize, rice and wheat (Vreugdenhil *et al*., 2007) . The main production areas of potatoes are in Europe and in the Russia, which account for nearly 56% of the output. In Egypt, potato is one of the most important vegetable crops grown under Egyptian conditions. According to the recorded data obtained from the department of Agricultural Economics and Statistics, Ministry of Agriculture and land Reclamation, the cultivated area of potato in 2009 reached about 329.721 feddans, which yielded 3659284 tons of tubers with an average of about 11.098 tons per feddan.

On the other hand , potato plants has high nutrients requirements , especially N-fertilizers , largely due to its shallow root system and short growth duration (Acland, 1980), but its recovery of fertilizer-N is often quite low. The low efficiency is partly due to a shallow root system that is usually confined to top 60cm of soil, with 90% of the root length in the surface 25cm of the soil profile (Tanner *et al*., 1982).Therefore , the liberal application of mineral N-fertilizers to maintain adequate level of N in the rhizosphere, leads to the accumulation of excessive levels of NO_3-N in the plant (Maynard *et al*.,1976 and Taha , 2011) as well as contribute to high NO_3-N content of ground water .

This work was carried out to study the response of potatoes plants to nitrogen fertilization under tile drainage system conditions. Nitrogen forms (NH_4-N and NO_3-N) distribution among different soil depths and both ground water table and drainage water were studied .

MATERIALS AND METHODS

A field experiment was carried out in alluvial clay soil of Kafr El-Zayat, Gharbiya Governorate, Egypt on potatoes through two successive winter seasons of 2010 / 2011 and 2011 / 2012 to study its response to nitrogen fertilization under tile drainage system. The space between each two laterals was 20m and the lateral depth was 150cm. Before planting, representing soil samples of the tested were collected soil at depths of 0-20, 20-40 and 40-60cm at the distance of 0 (above lateral), 25 % (5 m) and 50% (10 m) from the lateral. Each soil sample was air-dried, ground, good mixed and sieved through a 2 mm sieve. The prepared samples were analyzed for some physical and chemical properties and also for its content of available NH_4-N and NO_3-N according to the methods described by Black *et al*. (1965), Cottenie *et al*. (1982) and Page *et al*. (1982) and the obtained data were recorded in Table (1). At the same time, samples of both ground water table and drainage water were taken from observation wells and from the collector drain . Samples of ground water and drainage water were analyzed for pH, EC (dS/m) and the content of (mg/l) NO_3-N and NH_4-N according to the methods described by Cottenie *et al*. (1982) and Page *et al*. (1982) . The obtained data were recorded in Table (2).

Table (1): Some physical and chemical properties of the studied soil at different distances from the lateral before potatoes planting.

properties and units	Distance from the lateral								
	A (0 m)			B (5 m)			C (10 m)		
	0-20 (cm)	20-40 (cm)	40-60 (cm)	0-20 (cm)	20-40 (cm)	40-60 (cm)	0-20 (cm)	20-40 (cm)	40-60 (cm)
Particles size distribution(%)									
Sand	18.5	14.9	14.2	18.5	14.9	14.2	18.5	14.9	14.2
Silt	33.5	32.5	32.1	33.5	32.5	32.1	33.5	32.5	32.1
Clay	48.0	52.6	53.7	48.0	52.6	53.7	48.0	52.6	53.7
Texture grade	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
pH 1:2.5(soil:water) susp	7.45	7.50	7.52	7.52	7.60	7.63	7.60	7.65	7.66

EC in soil paste (dS/m)	1.35	1.52	2.11	1.48	1.65	2.25	1.60	1.70	2.32
Organic matter (%)	1.80	0.88	0.65	1.95	0.95	0.65	2.11	1.05	0.70
Calcium carbonate (%)	2.05	3.14	1.80	2.03	3.09	1.80	2.00	1.97	1.80
Total nitrogen (%)	0.155	0.087	0.075	0.162	0.090	0.080	0.175	0.095	0.080
Available nitrogen (mg/kg)	134	118	104	143	124	116	150	130	118
Available NH4-N (mg/kg)	108	95	82	111	97	90	115	100	92
Available NO3-N (mg/kg)	26	23	22	32	27	26	35	30	26

Table (2): Chemical analysis of ground water and drainage water in the used soil before potatoes planting.

Water source	EC (dS/m)	pH	Nitrogen content (mg/l)		
			NO_3-N	NH_4-N	Total – N
Ground	5.50	8.35	4.80	1.98	6.78
Drainage	3.56	7.80	2.50	1.15	3.65

*** Mean values at two seasons**

Two weeks before planting, certified potato seed tuber of the Scotland cv . Nieta were subjected to chitting process in order to promote green sprouting by exposing them to an indirect light under high relative humidity conditions. Seed tubers ranging from 35-55 mm in size with 2-3 sprouts were sown on 2 October and 24 September in 2010 and 2011 in the first and second seasons, respectively. Potato seed pieces were set at 20 cm between each other, on rows and in depth of about 15 cm in rows. The distance between rows is 60 cm. All farming processes for potatoes were carried out according to the recommendations of Egyptian Ministry of Agriculture. Before planting the tested area which was one feddan (4200 m^2) was fertilized with ordinary super phosphate (15.5% P_2O_5) with soil preparation at application rate of 75 kg P_2O_5/fed. After planting, the cultivated area was divided into two equal areas. The first area was left without nitrogen fertilization, while the second area was fertilized with ammonium nitrate (NH_4NO_3) containing 33% N with application rate of 500 kg/fed. (165 kg N/fed). Also the cultivated area was fertilized with potassium sulphate (K_2SO_4) containing 48% K_2O at application rate of 90 kg K_2O/fed . Both potassium and nitrogen fertilizers were added on two equal doses directly before the first and second irrigations. At the distances of 0 (A), 5 (B) and 10m (C) from the lateral, the ground water table depth was recorded by daily reading of observation wells after the first and second irrigations to the next irrigation.

Samples of ground water were taken through observation wells after 1,4,7,10,13,16,19 and 21 days of both first and second irrigations at the distance of A, B and C in fertilized and unfertilized soil and analyzed for its content of nitrogen (NO_3-N + NH_4-N) as mg/l according to the method described by Cottenie *et al*. (1982) and recorded based on the mean values at the three distances. Also, at 1,4,7,10 and 13 days after the same irrigations, samples of drainage water were taken from the collectors and analyzed for its content (mg/l) of NH_4-N and NO_3-N. Before second and third irrigations and at harvesting stage, soil samples were taken at soil depth of 0-20, 20-40 and 40-60cm at the distance of A, B and C of fertilized and unfertilized soils. The collected soil samples were prepared and analyzed for its content (mg/kg) of available nitrogen (NO_3-N + NH_4-N) according to the method described by Cottenie *et al*. (1982) . Vegetative samples of potatoes of each treatment were taken directly before the second and the third irrigations. At harvest stage, potato plants were harvested and the yields of tubers were weighed as ton / fed. Tubers samples were taken at the distances of A, B and C in the fertilized and unfertilized soils. All plant samples were air-dried, oven-dried at 70°C until the weights become constant and kept for chemical analysis. A

0.2 gm of each dried sample was digested by 5 ml of mixture of conc. H_2SO_4 + conc. $HClO_4$ (at ratio of 3:1) according to the method described by Chapman and Pratt (1961). The final digest was diluted up to 50ml using distilled water. The digest content of total N, NO_3-N and NH_4-N was determined according to the methods described by Cottenie *et al*. (1982) and Page *et al*. (1982).

The experimental design was a split plot design with three replicates. The main factor was the nitrogen fertilization (without and with nitrogen fertilization) and the sub factor was the distance from the lateral which was above lateral , 25 % and 50% (0 ,5 and 10 m) from the lateral. The obtained data of tubers yield were statistically analyzed according to Snedecor and Cochran (1980) .

RESULTS AND DISCUSSION .

Ground Water Table Level .

The data of water table level (cm) with time after the first and second irrigations (I1 and I2) at different distances of lateral (0 , 5 , and 10 m) is presented in Table (3). Data show that , in both unfertilized and fertilized soil and at different distances of laterals there are no clear differences between ground water table at the same day after the first and second irrigation. At the same day , the level of ground water table after the first irrigation was more down after the first irrigation compared with that measured after the second irrigation . This trend was found in both unfertilized and fertilized soils at the three studied distances of lateral . Also , this trend was resulted from the positive effect of farming practices such as tillage on the increase of soil porosity and draw down of water movement (El-Sanat , 2003). Generally, with different treatments under study, the depth of ground water was increased with the decrease in the distance from the laterals. These findings means that, water table level above laterals dropped faster than that in midway between laterals . Abd El-Dayem (1982) ; Ibrahim *et al.* (1999) and Antar (2000) 0btained on similar results.

Table (3): Average* water table depth (cm) after first (I 1) and second (I 2) irrigation at different distances (A , B and C) of lateral.

Days after irrigation	Unfertilized soil						Fertilized soil					
	11			12			11			12		
	A	B	C	A	B	C	A	B	C	A	B	C
1	60	38	31	42	31	30	62	40	35	47	35	33
2	71	45	39	50	40	36	74	48	43	59	45	41
3	82	48	46	61	45	42	85	57	52	70	54	48
4	90	56	51	66	56	48	90	64	58	80	61	54
5	91	64	59	70	60	53	92	69	64	84	68	62
6	92	70	62	79	62	65	94	74	67	88	74	70
7	94	77	70	83	68	68	96	76	71	90	78	74
8	99	81	72	89	73	70	99	80	76	91	81	78
9	100	82	79	90	80	75	101	84	80	92	84	81
10	104	87	81	91	83	82	103	88	84	94	86	83
11	105	90	82	94	86	82	106	91	88	96	90	86
12	106	91	89	95	90	85	107	93	90	98	91	88
13	107	92	90	96	91	86	108	95	92	100	92	89
14	109	93	92	98	92	87	109	96	94	101	93	90
15	110	95	93	100	94	88	110	97	95	102	95	92
16	110	97	93	102	95	90	111	98	96	103	97	94

17	111	100	94	103	96	91	112	99	97	104	98	95
18	112	100	96	104	98	93	113	100	98	105	99	96
19	113	101	98	105	99	95	114	101	99	106	100	97
20	114	102	99	106	100	97	115	102	100	107	101	98
21	115	102	100	107	101	99	115	103	100	108	102	99

* Measured during two growing seasons at A, B and C .

Nitrogen In Soil

The soil content (mg/kg) of available N which measured as NH_4-N and NO_3-N among different soil depths after three growth periods with the studied treatments were recorded in Table (4). These data show that , with all treatments , the soil content of either of NH_4-N or NO_3-N was decreased with the increase of soil depth. These findings may be resulted from the high content of soil fine fractions and organic matter in the surface layers compared to the subsurface layer (El- Sherif , 2005 and El-Mleegy , 2007). At the same depth and with different treatments under study, the soil content of NH_4-N was higher than the content of NO_3-N. This trend was resulted from the high ability of NH_4 adsorption by negative charges presented on the surface of soil compounds especially clay and organic matter. Also, NO_3 is characterized by more solubility and leaching with irrigation water to down depths and ground water (Abd El-Galil , 2006 and El-Mleegy , 2007) .

Table (4):Unfertilized and fertilized soils content of total – N (T-N), NH_4-N , NO_3-N (mg/kg) at different soil depths , distance from lateral after first (I 1) and second (I 2) irrigation and at harvest stage.

Nitrogen fertilization	Distance from laterals (m)	Soil depth (cm)	After I 1			After I 2			At harvest		
			NH_4-N (mg/kg)	NO_3-N (mg/kg)	T-N (mg/kg)	NH_4-N (mg/kg)	NO_3-N (mg/kg)	T-N (mg/kg)	NH_4-N (mg/kg)	NO_3-N (mg/kg)	T-N (mg/kg)
Unfertilized soil	A (0m)	0-20	92.5	26.5	119.0	85.0	25.0	110.0	75.5	22.5	98.0
		20-40	86.0	22.0	110.5	81.0	21.0	102.0	72.5	21.0	93.5
		40-60	82.5	21.0	103.5	80.0	21.0	101.0	70.0	20.0	90.0
		Mean	87.0	23.2	110.2	82.0	22.4	104.4	72.7	21.2	93.9
	B (5 m)	0-20	97.5	26.5	124.0	93.5	25.5	119.0	85.0	23.5	108.5
		20-40	94.0	22.5	116.5	90.0	21.5	111.5	81.0	21.0	102.0
		40-60	85.0	22.0	107.0	82.0	21.0	103.0	78.5	20.0	98.5
		Mean	92.2	23.7	115.9	88.5	22.7	111.3	81.5	21.5	103.0
	C (10m)	0-20	103.0	27.5	130.5	96.0	26.5	122.5	90.0	25.0	115.0
		20-40	97.5	22.5	120.0	92.5	22.0	114.5	85.0	21.5	106.5
		40-60	88.0	22.0	110.0	85.0	21.0	106.0	81.0	20.0	101.0
		Mean	96.2	24.0	120.2	91.2	23.2	114.4	85.4	22.2	107.5
Fertilized soil	A (0 m)	0-20	115.0	40.0	155.0	125.0	30.0	155.0	105.0	35.0	140.0
		20-40	105.0	40.0	145.0	90.0	40.0	130.0	95.0	35.0	130.0
		40-60	100.0	35.0	135.0	90.0	35.0	125.0	90.0	30.0	120.0
		Mean	106.7	38.4	145.0	101.7	35.0	136.7	96.7	33.4	130.0
	B (5 m)	0-20	110.0	50.0	160.0	110.0	50.0	160.0	110.0	35.0	145.0
		20-40	130.0	45.0	175.0	110.0	35.0	145.0	105.0	30.0	135.0

		40-60	120.0	35.0	155.0	95.0	35.0	130.0	90.0	25.0	115.0
		Mean	120.0	43.4	163.4	105.0	40.0	145.0	101.7	30.0	131.7
	C (10 m)	0-20	135.0	60.0	195.0	125.0	50.0	175.0	120.0	45.0	165.0
		20-40	130.0	55.0	185.0	110.0	55.0	165.0	115.0	40.0	155.0
		40-60	130.0	35.0	165.0	115.0	40.0	155.0	95.0	40.0	135.0
		Mean	131.7	50.0	181.7	116.7	48.4	165.1	110.0	41.7	151.7

Regarding to the effect of drainage treatments under study, the obtained data in Table (4) show that, the soil content (mg / kg) of total nitrogen , NH_4-N and NO_3-N among different soil depths was increased with the increase of the distance from the lateral. This finding was resulted from the faster and large amounts of irrigation water removed above the lateral compared with those occurred at far from the distances of the lateral associated with high leaching amounts of different N forms (Antar, 2000) . Also , this trend may be resulted from the high absorbed amounts of nitrogen by plants grown above lateral associated with the greater plant growth compared with other locations .These findings were found at different soil depths in unfertilized and fertilized soils in two growing seasons . Under different drainage treatments, the contents of determined N forms in the fertilized soil were higher than those determined in the unfertilized soil (Antar, 2000 and El- Sanat, 2003) .

Regarding to the data of soil content of the determined N forms which recorded in Table (4), it may be noted that , among different soil depths at different distances of laterals in both unfertilized and fertilized soils , the high content (mg/kg) of the determined N forms was found after the first irrigation and the lowest one was found after plant harvest . These findings were resulted from the increase in the amounts of N absorbed by plants with the increase of plant age and also was resulted from the increase of the leached amounts of N with irrigation water to ground water and drainage water with the time increase through growing season. In this respect, Oosterbaan (1994) and Bol'shakov *et al*. (1996) obtained similar results.

Ground Water Content of Nitrogen

Ground water content of total nitrogen , NH_4-N and NO_3-N (mg/l) which recorded in Table (5) show that, with different treatments under study the concentration of both NH_4-N and NO_3-N in ground water was decreased with the increase of time after either of first and second irrigation . This means that , most of leached nitrogen was occurred directly after irrigation and at short time of N fertilizer application. At different days of irrigation , the concentration of NH_4-N and NO_3-N in ground water measured after the first irrigation was lower than that determined after the second irrigation . These findings were resulted from the faster movements and greater amounts of irrigation water resulted in a greater amounts of N leaching after the first irrigation compared with that occurred after the second irrigation (Table, 3). This trend was found in unfertilized and fertilized soils in two growing seasons. The data of concentration of NH_4-N and NO_3-N in ground weter also show that , with all treatments under study, the concentration of NO_3-N in ground water was higher than that measured for NH_4-N . This finding was resulted from high solubility of NO_3-N form and its movement with leaching water (Bol'shakov *et al*., 1996 and Ibrahim *et al*., 1999) . Generally , with different drainage treatments , the concentration of NH_4-N and NO_3-N in ground water in fertilized soil was higher than that measured in the ground water in unfertilized soil .

Drainage Water Content of Nitrogen

The data of drainage water concentration (mg/l) of NH_4-N and NO_3-N as presented in Table (6) illustrated that, the high concentration of either of NH_4-N or NO_3-N was found at the first days of irrigation and decreased at the later days . These findings were in good relations with the large amounts of irrigation water moved from soil to drains which characterized by high content of leached NH_4-N and NO_3-N, where these amounts were decreased with increasing time after irrigation (Ibrahim *et al*., 1999 and Antar, 2000) . This trend was found in both unfertilized and fertilized soils in the two growing seasons . At different days after irrigation , the concentration of NH_4-N and NO_3-N in drainage water after the first irrigation was lower than that found after the second irrigation . These findings were resulted from the high amounts of irrigation water and nitrogen leached and removed to drains after the first irrigation compared with that occurred after the second one. The obtained data also show that, at the same day after the first and second irrigation, the concentration of NO_3-N in drainage water was higher than that of NH_4-N in the two growing seasons with unfertilized and fertilized soils. These findings were resulted from the high solubility and leaching rate of NO_3-N form compared with NH_4-N form. Generally , with all the studied treatments , the concentration (mg/l) of NH_4-N and NO_3-N in drainage water in the soil fertilized with nitrogen was higher than those found in the unfertilized soil . Abu-Sinna (1991) obtained similar results .

Table (5): Ground water content of total N (T-N), NH_4-N and NO_3-N (mg/l) in unfertilized and fertilized soil after different days of first and second irrigation (I1 and I2) .

Days after irrigation	Unfertilized soil						Fertilized soil					
	After I 1			After I 2			After I 1			After I 2		
	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)
1	2.10	5.80	7.90	2.30	5.95	8.25	2.65	7.10	9.75	3.00	7.40	10.40
4	1.98	5.60	7.58	2.18	5.90	8.08	2.50	7.00	9.50	2.80	7.25	10.05
7	1.90	5.52	7.42	2.10	5.75	7.85	2.38	6.88	9.26	2.65	7.12	9.77
10	1.78	5.25	7.03	1.98	5.50	7.48	2.30	6.80	9.10	2.51	6.98	9.49
13	1.60	4.90	6.50	1.82	5.15	6.97	2.25	6.65	8.90	2.40	6.85	9.25
16	1.52	4.80	6.32	1.65	4.92	6.57	2.15	6.48	8.63	2.30	6.77	9.07
19	1.45	4.70	6.15	1.55	4.80	6.35	2.10	6.40	8.50	2.23	6.65	8.88
21	1.40	4.65	6.05	1.44	4.68	6.12	2.07	6.35	8.42	2.15	6.45	8.60
Mean	1.72	5.15	6.87	1.88	5.33	7.21	2.30	6.71	9.01	2.51	6.93	9.44

***Mean values at two growing seasons .**

Table (6) : Drainage water content of total soluble N (T-N), NH_4-N and NO_3-N (mg/l) at different days of first (I 1) and second (I 2) irrigation in unfertilized and fertilized soils.

Days after irrigation	Unfertilized soil		Fertilized soil	
	I 1	I 2	I 1	I 2

	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N mg / l)(	T-N (mg / l)	NH_4-N (mg / l)	NO_3-N (mg / l)	T-N (mg / l)
1	1.4	3.5	4.9	1.5	3.8	5.3	1.6	5.1	6.7	1.8	5.5	7.3
4	1.3	3.1	4.4	1.5	3.6	5.1	1.6	4.7	6.3	1.7	5.3	7.0
7	1.3	2.5	3.8	1.4	2.8	4.2	1.4	4.1	5.5	1.5	4.5	6.0
10	1.1	2.2	3.3	1.3	2.4	3.7	1.2	3.8	5.0	1.5	4.0	5.5
13	0.9	2.2	3.1	1.1	2.4	3.5	1.2	3.8	5.0	1.2	3.4	4.6
Mean	1.2	2.7	3.9	1.4	3.0	4.4	1.4	4.3	5.7	1.5	4.5	6.1

*Mean values at two growing seasons .

Potatoes Yield

Yield of potatoes tubers (ton/fed.) as affected by nitrogen fertilization and drainage distance from the lateral was recorded in Table (7) . These data show high response of potatoes plants to N fertilization where the obtained yield of tubers in the fertilized soil was high significant increase than that obtained from the unfertilized soil at the three distances of laterals . These findings show the nitrogen fertilization importance for potatoes plants growth (Marschner, 1998 and Darwish *et al*., 2003). These results are in agreement with those obtained by Chen and Hutchinson (2008 and 2009) and Taha (2011). In both unfertilized and fertilized soils, the tubers yields of potatoes plants grown above the laterals significant increase than those of plants grown between the laterals. These results may be attributed to the more improved effects of tile drainage on soil physical and chemical properties especially above the laterals (Antar, 2000 and Agbede, 2010). The efficiency use of nitrogen fertilization on potatoes plants may be supported by the calculated relative change values (RC,%) of the yield produced from fertilized soil compared with that produced from unfertilized soil as recorded in Table (7) . At different distances (A , B and C) from the laterals, the calculated values of RC were positive in the two growing seasons. These results were in agreement with those obtained by Rodrigues *et al*. (2008) and Taha (2011).

Potatoes Content of Nitrogen

The presented data in Table (8) show the nitrogen (NH_4-N and NO_3-N) content (%) of straw and tubers of potatoes plants as affected by the studied treatments. These data show that , with different treatments , both straw and tubers content of NH_4-N and NO_3-N was decreased with distance increase from the laterals , where the lowest content was found in the plants grown in the middle distance between laterals . This trend may be resulted from the high plant growth above the lateral which associated with greater yield compared with other distances. This trend may be explained based on the dilution effect as mentioned by Marschner (1998) and Basak (2005). This trend was found in both unfertilized and fertilized soils in the two growing seasons. At different distances , straw content of N after the second irrigation was lower than that found after the first irrigation. This trend may be also explained based on the dilution effect (Basak , 2005) .Tubers and straw content (%) of NH_4-N in unfertilized and fertilized soils was higher than the content (%) of NO_3-N at the three studied distances . Generally , tubers and straw content of either NH_4-N or NO_3-N in the fertilized soil was higher than those in the unfertilized soil. This trend was found in the two growing seasons, Mauromicale *et al*. (2006) and Taha (2011) obtained similar results.

Table (7): Tubers yield (ton/fed) of potato at different distances (A , B and C) of lateral in unfertilized and fertilized soils

Growing seasons	Unfertilized soil			Fertilized soil			RC (%)		
	A (0 m)	B (5 m)	C (10 m)	A (0 m)	B (5 m)	C (10 m)	A (0 m)	B (5 m)	C (10 m)
First	9.10	8.35	7.99	16.02	14.22	13.55	76.04	70.30	69.59
Second	9.15	8.05	7.85	16.75	14.30	13.60	83.06	77.64	73.25

L. S. D. at 0.05 level : Fertilization = 0.3448
Distances = 0.4223
Interaction = 0.3878

Table (8) : Straw and tubers of potato plants content (%) of total N (T-N) , NH_4-N and NO_3-N at growth stage and different distance at lateral in unfertilized and fertilized soils (Mean value in two growing seasons).

Nitrogen fertilization	Distance from laterals (m)	Straw						Tubers		
		Before I 2			Before I 3			At harvesting stage		
		NH_4-N (%)	NO_3-N (%)	T-N (%)	NH_4-N (%)	NO_3-N (%)	T-N (%)	NH_4-N (%)	NO_3-N (%)	T-N (%)
Without	A	1.050	0.450	01.50	0.980	0.420	1.400	1.710	0.020	1.730
	B	1.000	0.400	1.400	0.900	0.380	1.280	1.650	0.017	1.667
	C	0.900	0.320	1.220	0.830	0.320	1.150	1.610	0.016	1.626
With	A	1.820	0.830	2.650	1.750	0.600	2.350	2.250	0.030	2.280
	B	1.700	0.700	2.400	1.550	0.550	2.100	2.010	0.025	2.035
	C	1.600	0.650	2.250	1.420	0.500	1.920	1.950	0.022	1.972

I3 = Third irrigation .

REFERENCES

Abd El- Dayem, M. S. (1982). Testing of spacing between drains and validity of drain spacing equations. ASAE.Winter meeting , ST Joseph ,Mich. Paper No. (82-256). (C.F. Antar , 2000)

Abd El-Galil, A. (2006). Fertilizer – N dynamics in the soil and yield response of potatoes as affected by methods of N – application . J . Appl. Sci. Res. 9: 613 – 623 .

Abu-Sinna, M. A. (1991). Efficiency of tile drainage for providing good air - water balance in soil . Ph.D. Thesis , Fac. of Agric. Cairo University , Egypt.

Acland, J. D. (1980). “ East African Crops “. pp. 146-150. FAO, London: Longman (1980 ed.) .

Agbede, T. M. (2010). Tillage and fertilizer effects on some soil properties , leaf nutrient concentration, growth and sweet potato yield on an Alfisol in southwestern Nigeria .Soil and Tillage Res. 110: 25 – 32 .

Antar, A. Sh. (2000). Effect of drainage system on some hydrological , physical and chemical properties of soil in Northern Delta (Egypt).M. Sc. Thesis , Fac. of Agric. Minufiya Univ. , Egypt .

Basak, R.K. (2005). "Fertilization". Kalyani

Publishers , Ludhiana – New Delhi – Noida (U. P.) , Hyderabad –Chennai – Calcutta – Cuttack .

Black , C. A., D. D. Evans, J. L. While, L . E. Ensimenger and F. E. Clarke (1965). ”Methods of Analysis”. Part 1, Amer. Soc. of Agronomy, Inc. Publisher Wisconsin, USA.

Bol'shakov, V. A., L.P. Orlova, M. S. Simakova, N. A. Muromzev, Z. N. Kakhnovich and I. V. Reznikov (1996). Influence of drainage and field management on chemical properties of sod-podzolic weakly gleyic soils, of drainage and soil waters . Euvasion Soil Sci. , 28 (6) ; 67-77.

Burton, W. G. (1989). “The Potato” , 3rd Ed. Longman , London , pp. 742.

Chapman, H. D. and P. F. Pratt (1961). "Methods of Analysis for Soils", Plants and Waters, Agric. Pub. Univ. of California Division of Agric. Sci. , USA, Chapter 2 , pp. 56- 64 .

Chen, Z. and C. M. Hutchinson (2008). Controlled release nitrogen fertilizers application on Atlantic northeast Florida potato production . Am. J. Pot. Res. 85: 1- 59 .

Chen, Z. and C. M. Hutchinson (2009). Evaluation of alternative fertilizer programs and potato varieties in seepage irrigated potato production. Am. J. Pot. Res. 86: 135 – 164.

Cottenie, A., M. Verloo, L. Kikus, G. Velghe and R. Camerlynck (1982). "Chemical Analysis of Plants and Soils". Lab. Anal. and Agrochem. State Univ., Gent Belgum.

Darwish, T., T. Atallah, S. Hajhasan and A. Chranek (2003). Management of nitrogen by fertigation of potato in Lebanon. Nutr. Cycling in Agroecosys. 67: 1-11.

El-Mleegy, H. A. (2007). Effect of soil chemical and physical properties on nitrogen forms and distribution in soils of Minufiya Governorate . M. Sc. Thesis , Fac. of Agric. Minufiya Univ., Egypt .

El-Sanat, G. M. (2003). Effect of amelioration processes on nutrients status in salt affected soils . M.Sc. Thesis, Fac. of Agric. Minufiya Univ. , Egypt .

El-Sherif, M.A.B. (2005). Impact of agricultural practices on environmental pollution in North Sinai with special references to transformation of N-fertilizers in soil .Department of Agricultural Science , Institute of Environmental Studies & Research , Ain Shams University , Egypt

Ibrahim, S. M., S.A. Gaheen, M. M. Saffan and A. A. I. El-Araby (1999). Hydrological properties of tile drained clay soils under flood and drip irrigation system , J. Agric. Res. Tanta University , Egypt .

Marschner, H. (1998). " Mineral Nutrition in Higher Plants". Academic Press, Harcount Brace Jovanovisch Publischer.

Mauromicale, G., A. Ierna and M. Marchese (2006). Chlorophyll fluorescence and chlorophyll content in field grown potato as affected by nitrogen supply, genotype, and plant age. Photosynthetica. 44 : 76-82.

Maynard, D. N., A. V. Barker, P. L. Minotti and N. H. Peck (1976). Nitrate accumulation in vegetables. Advance in Agronomy . 28 :71-118.

Naguib, B. H. (1987). Tile drainage in relation to soil characteristics and plant growth . Ph. D. Thesis , Fac. of Agric. Moushtoher , Zagazig Univ., (Banha Branch) , Egypt .

Oosterbaan, R. J. (1994). "Agricultural Drainage Criteria. In: drainage principles and applications pub. 16. second edition . (edited by Ritzema, H.P.)ILRI, Wagningen,The Netherlands

Page, A. L., R. H. Miller and D. R. Keeney (1982). " Methods of Soil Analysis ". II. Chemical and Microbiological Properties, 2nd Ed. Madison, Wisconsin , U. S. A.

Rodrigues, M. A., A. Pereira, J. E. Cabanas, L. Dias, J. Pires and M. Arrobas (2008) . Crops use – efficiency of nitrogen from manures permitted in organic farming . Europ. J. Agron. 25 : 328 - 335 .

Sadik, M. K., A. A. Salam, H. H. Abbas and B. H. Naguib (1988). Evaluation changes in soil salinity and sodicity following laying sub-soil drains (designed and installed by the Ministry of irrigation) in a clay soil in Giza . Proceedings of the 2nd Conference of the Agricultural Development Research, Cairo,17-19. Dec., 1988. Vol. IV.

Snedecor, G. W. and W. G. Cochran (1980). "Statistical Methods" . Oxford and J. B. H. Publishing Com. 7 Edition.

Taha, M. A.E. (2011). Rationalizing the use of mineral nitrogenous fertilization through adding some organic fertilizers to potato plants. M. Sc. Thesis, Fac. of Agric Minufiya Univ., Egypt .

Tanner, C. B., G. G. Weis and D. Curwen (1982). Russet Burbank rooting in sandy soils with pans following deep lowing . Am. Pot. J. 59: 107-112.

Vreugdenhil, D., J. Bradshawand and C. Gebhardt (2007). " Potato Biology and Biotechnology – Advances and Perspectives". Oxford : Elsevier.

Wesseling, J. V. (1983). Crop growth and wet soils . In. J. Van Schilfgaarde (Ed.) "Drainage for Agriculture" No. 17, Amer.Soc. of Agronomy. Inc. Madison, Wisconsin , U.S.A.

تأثير نظام الصرف المغطى على استجابة نبات البطاطس للتسميد النيتروجيني

عبد الجليل عبد النبي العربي ، منال فتحي طنطاوي ، محمد عباس الشريف

معهد بحوث الأراضي و المياه و البيئة – مركز البحوث الزراعية – الجيزة

الملخص العربي

أجريت دراسة حقلية خلال موسمي شتاء متتاليين (٢٠١٠ /٢٠١١ و٢٠١١/ ٢٠١٢) على الأرض الطينية بمنطقة كفر الزيات بمحافظة الغربية وذلك لتقييم كفاءة التسميد النيتروجيني و استجابة نباتات البطاطس له وذلك تحت ظروف الصرف المغطى ولقد تم كذلك دراسة توزيع صور النيتروجين (النيتروجين الأمونيومي والنيتروجين النتراتي) فيما بين أعماق الأرض المختلفة و كذلك الماء الأرضي وماء الصرف. كانت المسافة بين كل حقليين ٢٠متر و بعمق ١٥٠سم. وكان السماد النيتروجيني المستخدم نترات الأمونيوم (٣٣٪ ن) ومعدل إضافة صفر و ٥٠٠ كجم/فدان. و تم تقدير عمق الماء الأرضي و كذلك النيتروجين في أعماق الأرض المختلفة و الماء الأرضي وماء الصرف وايضا محصول البطاطس. و قد أجريت هذه التقديرات عند فترات نمو مختلفة و مسافات مختلفة من الحقليات.

ولقد أوضحت نتائج الدراسة انخفاض مستوى الماء الأرضي بزيادة الفترة الزمنية بعد الري و خاصة بعد الرية الأولى و كان أكثر انخفاضا في عمق الماء الأرضي الموجود فوق الحقليات. كما انخفض المحتوي من النيتروجين الأمونيومي وكذلك النتراتي (مجم/كجم) بزيادة العمق بعد كل من الرية الأولى و الثانية و كذلك عند الحصاد بينما ازداد هذا المحتوى بزيادة المسافة عن الحقليات و كان أقل محتوى للنيتروجين بالتربة هو ما قدر عند مرحلة الحصاد مع جميع معاملات الدراسة وكان محتوى التربة من النيتروجين الأمونيومي أعلى من محتواها من

النيتروجين النتراتي. و من ناحية أخرى فإن محتوى الماء الأرضي و ماء الصرف من النيتروجين النتراتي (مجم/لتر) كان أكثر من محتواها من النيتروجين الأمونيومي مع جميع معاملات الدراسة. وكان اعلي محصول من البطاطس موجودا في التربة المسمدة أعلي الحقليات. كما كان أعلي محتوي من صورتي النيتروجين (٪) في كل من القش و الدرنات موجودا في النباتات النامية عند منتصف المسافة بين الحقليات.

وتوصي هذه الدراسة بضرورة الإهتمام بالصرف المغطي حيث أنه يؤدي إلي زيادة كفاءة التسميد النيتروجيني و تزداد هذه الكفاءة بتقليل المسافة بين الحقليات كما توصي أيضا بضرورة الاهتمام بالتسميد النيتروجيني لنبات البطاطس حيث أنه يؤثر في زيادة الإنتاجية.