IMPACT OF DIFFERENT NITROGEN FORMS AND K ADDED ON N AND K LOSSES INTO DRAINAGE WATER UNDER COTTON CULTIVATION IN CLAY SOIL OF NORTH DELTA.

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ABSTRACT

A field experiment was conducted to study the effect of applied fertilizer forms from nitrogen on N and K^+ leaching through a clay soil into subsurface drains under cotton cultivation in north Delta (Egypt). The N-fertilizers forms (ammonium nitrate; ammonium sulphate and urea) were added to the soil with and without potassium sulphate fertilizer in recommended doses (70 and 48 unit/fed for N and K_2O, respectively) in two equal doses after the first irrigation and the second one, respectively.

Data showed that, total cumulative drain discharge throughout the five irrigation cycles under cotton cultivation were nearly the same in all treatments. The losses of NH^+_4-N in drainage water was less than the NO^-_3-N. The total losses of NH^+_4-N were 28.19, 23.33, 23.12, 21.13, 17.82 and 27.63 g N/fed for NH_4NO_3+K_2SO_4, NH_4NO_3, $(NH_4)_2SO_4$+K_2SO_4, $(NH_4)_2SO_4$, $CO(NH_2)_2$+K_2SO_4 and $CO(NH_2)_2$, respectively. Results indicated also that the losses amount of N-Nitrate in drainage water decreased by successive days of irrigation. Total losses of NO_3-N under NH_4NO_3+K_2SO_4 and $(NH_4)_2SO_4$+K_2SO_4 were higher than NH_4NO_3 and $(NH_4)_2SO_4$ by 9.72 % and 6.47%, respectively. While, total NO_3^--N loss under $CO(NH_2)_2$+K_2SO_4 was lower than $CO(NH_2)_2$ by 6.16%. The highest total losses of NO_3-N were found under NH_4NO_3+K_2SO_4 and NH_4NO_3 comparing with the other treatments. The results revealed that, by the end of season the total nitrogen losses were 4.67, 4.25, 4.05, 3.80, 3.78 and 4.02 kg N/fed for fertilizer treatments of ammonium nitrate +K-sulphate, ammonium nitrate, ammonium sulphate + K-sulphate, ammonium sulphate, urea + K-sulphate and urea, respectively. The total nitrogen fertilizer losses were 14.15, 12.89, 15.27, 14.34, 8.14 and 8.64 kg fertilizer /fed for the corresponding treatments. These losses represented 6.67, 6.08, 5.78, 5.43, 5.41 and 5.74% of the added N at the corresponding treatments, respectively.

Total potassium losses were 1.15, 1.10, 1.18, 1.11, 0.96 and 1.06 kg K_2O /fed for fertilizer treatments of ammonium nitrate + K-

sulphate, ammonium nitrate, ammonium sulphate + K-sulphate, ammonium sulphate, urea + K-sulphate and urea, respectively whereas, total fertilizer losses were 2.39, 2.29, 2.46, 2.32, 2.01 and 2.21 kg fertilizer /fed for the corresponding treatments.

The obtained results indicated that combination of N and K-fertilizers added to the soil, except urea, slightly increased losses of N in both NH^+_4 and NO^-_3 forms and K in the drainage water under cotton cultivation. So, the irrigation after the addition of such fertilizes must be controlled, to minimize nutrients losses into drainage water.

Keywords: NH^+_4-N, NO_3^--N, K_2O, losses, tile drainage, fertilizer forms, clay soil, cotton.

INTRODUCTION

Nitrate concentration of surface runoff and tile drainage water from intensive agricultural production system has become a serious environmental and economic concern. Nitrate transport, however, occurs throughout the season, and the major mass losses occur when the majority of the water flow occurs (Ibrahim et al. 2003). Contaminated waters contribute to eutrophication of lakes and streams. In addition, since some municipalities use surface waters for human consumption, the NO^-_3 concentration in these waters must be <10mg N/L. Nitrate can be readily converted to NO^-_2 in the human body, and has been implicated in two major health problems: Blue-baby syndrome (methaemoglobinaemi) and stomach cancer (Drury et al.,1993).

The considerable variation in NO^-_3 concentration in drainage water may be ascribed to several factors including soil properties, amount of irrigation water, temperature of the air and evaporation rates, drainage system and forms of applied fertilizers, uptake by growing cotton plants and adsorption and fixation of NH^+_4 on the 2: 1 type clay minerals (Nasseem, 1991 and Dinnes et al., 2002). Several researchers have monitored tile drainflows to study nutrients losses from different agricultural management practices (Drury et al., 1993 and 1996; Ramadan and El-Leithi, 1999; Bakhsh et al., 2002; Ibrahim et al., 2003; Ramadan et al., 2004 and Antar 2005 and 2007).

Nitrogen losses in drainage water are mainly in the form of nitrate, but may also in the form of ammonium because although ammonium readily adsorbed by the colloids it is rapidly oxidized into nitrates. Duxbury and Peverly (1978); Ibrahim (1990) and Antar (2005) reported that the concentration of NH^+_4-N in drainage water was less than the NO^-_3-N. Bjorneberg et al. (1998) and Bakhsh et al.

(2002) showed a high correlation (R^2 =0.89) between annual subsurface drainage flow volume and the annual NO^-_3-N leaching losses with subsurface drainage water.

Potassium losses into drainage water are influenced by several factors such as, soil texture, growing plants (plant cover), irrigation rate and fertilizer and manure application. Johnston and Goulding (1992) applied 90 kg K as K_2SO_4 and 220 kg K as farmyard manure and obtained K concentration in drainage water of 2.7 and 4.5 mgL^{-1} respectively, (comesponding to 7 to 11 kg K lost/ha) as compared with 1.5 mgL^{-1} in the non-fertilized soil (i.e. 4 kg K/ha). Ceccon et al.(1993) reported leaching losses of K^+ between 1 and 1.5 kg K ha^{-1} yr^{-1}. Through cotton growing season in clay soil, Ramadan and El-Leithi (1999) found that total N and K_2O losses in drainage water were 3.49 kg N/fed and 0.96 kg K_2O/fed, respectively. These losses were 5.01 and 2.01 % of added nitrogen and potassium fertilizers, respectively. Drainage studies can therefore be useful in assessing the impact of agricultural management practices on surface and groundwater quality.

The objectives of the present work were to evaluate the impact of applied N-fertilizer forms with and without K-sulphate fertilization on N and K^+ losses into drainage water under cotton cultivation in clay soil at north Delta, Egypt.

MATERIALS AND METHODS

A field experiment was carried out during summer season (2007) in an area of about twelve feddan at Experimental Farm of Sakha Agricultural Research Station, Kafr El-Shiek Governorate, north Delta of Egypt, in order to study the effect of applied fertilizer forms on NH^+_4-N, NO^-_3-N and K^+ losses into drainage water under cotton cultivation. The field is provided by tile drains network spaced at 20 m with 1.4 m depth. The experiments design was a randomized complete block with three replicates and six fertilizer treatments.

The N-fertilizers forms (70 kg N/fed.) were added to the soil in two equal doses (before the first and the second irrigations) with and without potassium sulphate fertilizer (48kg K_2O/fed) as follows:

1- Ammonium nitrate + potassium sulphate (NH_4 NO_3+K_2SO_4).
2- Ammonium nitrate (NH_4 NO_3).
3- Ammonium sulphate + potassium sulphate ($(NH_4)_2SO_4$+K_2SO_4).
4- Ammonium sulphate ($(NH_4)_2SO_4$).
5- Urea + potassium sulphate (CO $(NH_2)_2$ +K_2SO_4).
6- Urea (CO $(NH_2)_2$).

The different agricultural practices were done as recommended through the growing season. The soil samples were collected in 30cm increments to 120cm depth, before cotton cultivation, for analysis (Table, 1).

Drain discharge rates were manually measured two times every day when drain flow occurred, by measuring the amount of water running from tile line during a short interval and converting to m^3/fed. The average daily discharge rates were used in this study (Dieleman and Trafford, 1976). Several water samples from tile effluent (as drainage water) were collected at different times of the day and composite daily samples were taken for analysis. Ammonium and nitrate were daily determined in the drainage water using selective ion electrodes (Accument model 25 pH/ ion, Fisher Scientific) according to Milham et al. (1970). Potassium concentration was determined using Flame Photometer.

Table (1): The initial of some soil properties for the experimental field

Soil depth (cm)	Particle size distribution			Textural grade	EC (dS/m)	OM %	ESP	Available N, P, K (mg/kg soil)		
	Sand %	Silt %	Clay %					N	P	K
0-30	22.30	30.47	47.23	Clay	2.03	1.92	11.83	35.2	3.9	341.9
30-60	20.89	29.03	50.08	Clay	2.52	1.41	19.65	33.6	2.0	249.2
60-90	19.51	23.70	56.79	Clay	2.82	0.84	25.25	33.6	4.2	188.8
90-120	18.62	21.82	59.56	Clay	3.42	0. 54	26.88	8.4	5.0	188.8
Mean	20.33	26.26	53.41	Clay	2.7	1.18	20.90	25.2	3.78	292.2

RESULTS AND DISCUSSION

Discharge rate:

Data presented in Fig (1) shows that, the drain discharge was decreased with time especially in the first few days after all irrigation cycles. Drain discharge rates varied from 5.0 to 9.96 m^3/fed./day after one day from irrigations and from 0.15 to 0.92 m^3/fed./day before the next irrigation. Data in Table (2) showed that the cumulative discharge (m^3/fed.) were higher in the first irrigations than the others irrigations. Total cumulative drain discharge throughout the five irrigation cycles nearly the same in all treatments and were 134.37, 131.43, 131.80, 131.03, 132.00 and 131.52 m^3/fed. for NH_4 NO_3+K_2SO_4, NH_4 NO_3, $(NH_4)_2SO_4$+K_2SO_4, $(NH_4)_2SO_4$, CO $(NH_2)_2$ +K_2SO_4 and CO $(NH_2)_2$, respectively. Moustafa (1984) and Antar (2005 and 2007) found that in clay soil, the majority of discharge water is from water movement through soil cracks and macro pores.

The water flow decreases sharply when the clay swells after a few days of irrigation.

Table (2): Cumulative discharge (m^3/fed.) of drainage water for five irrigation cycles under different treatments

Fertilizer treatments	Cumulative discharge (m^3/fed.) of drainage water					
	First irrigation	Second irrigation	Third irrigation	Fourth irrigation	Fifth irrigation	Total
$NH_4NO_3 + K_2SO_4$	44.04	28.54	24.93	16.18	20.68	134.37
NH_4NO_3	45.77	22.97	25.81	17.97	18.91	131.43
$(NH_4)_2SO_4 + K_2SO_4$	42.55	23.04	29.04	16.99	20.18	131.80
$(NH_4)_2SO_4$	38.00	24.92	26.45	19.41	22.25	131.03
$CO(NH_2)_2 + K_2SO_4$	35.71	24.50	29.15	22.00	20.64	132.00
$CO(NH_2)_2$ (urea)	37.29	27.76	23.22	20.68	22.57	131.52

Nitrogen losses:

NH^+_4-N losses:

Nitrogen (ammonium and nitrate) losses in drainage water were measured with different fertilization forms under cotton cultivation. Data in Table 3 showed that, the losses of NH^+_4-N in drainage water was less than the NO^-_3-N. Duxbury and Peverly (1978); Ibrahim (1990) and Antar (2005) reported that the concentration of NH^+_4-N in drainage water was less than the NO^-_3-N. The values of NH^+_4-N losses through five consecutive irrigation cycles under all studied treatments varied from 0.49 to 16.47 g/fed. The high losses of NH^+_4-N values were found in the first irrigation under all fertilizers treatments. The total losses of NH^+_4-N were 28.19, 23.33, 23.12, 21.13, 17.82 and 27.63 g/fed for NH_4NO_3+K_2SO_4, NH_4NO_3, $(NH_4)_2SO_4$+K_2SO_4, $(NH_4)_2SO_4$, $CO(NH_2)_2$+K_2SO_4 and $CO(NH_2)_2$, respectively.

It is clearly show that total losses of NH^+_4-N were higher under NH_4NO_3+K_2SO_4 followed by $CO(NH_2)_2$. Ammonium ions might be lost throw volatile as NH_3 gas or may be leached out as an NH^+_4 salt. The ions may be retained through a reaction with the soil colloids, or may act as a biological substrate to living organisms in soils. As such, NH^+_4 could be taken up by growing plants or oxidized in a two-step reaction to nitrate (Tahaun et al., 1988).

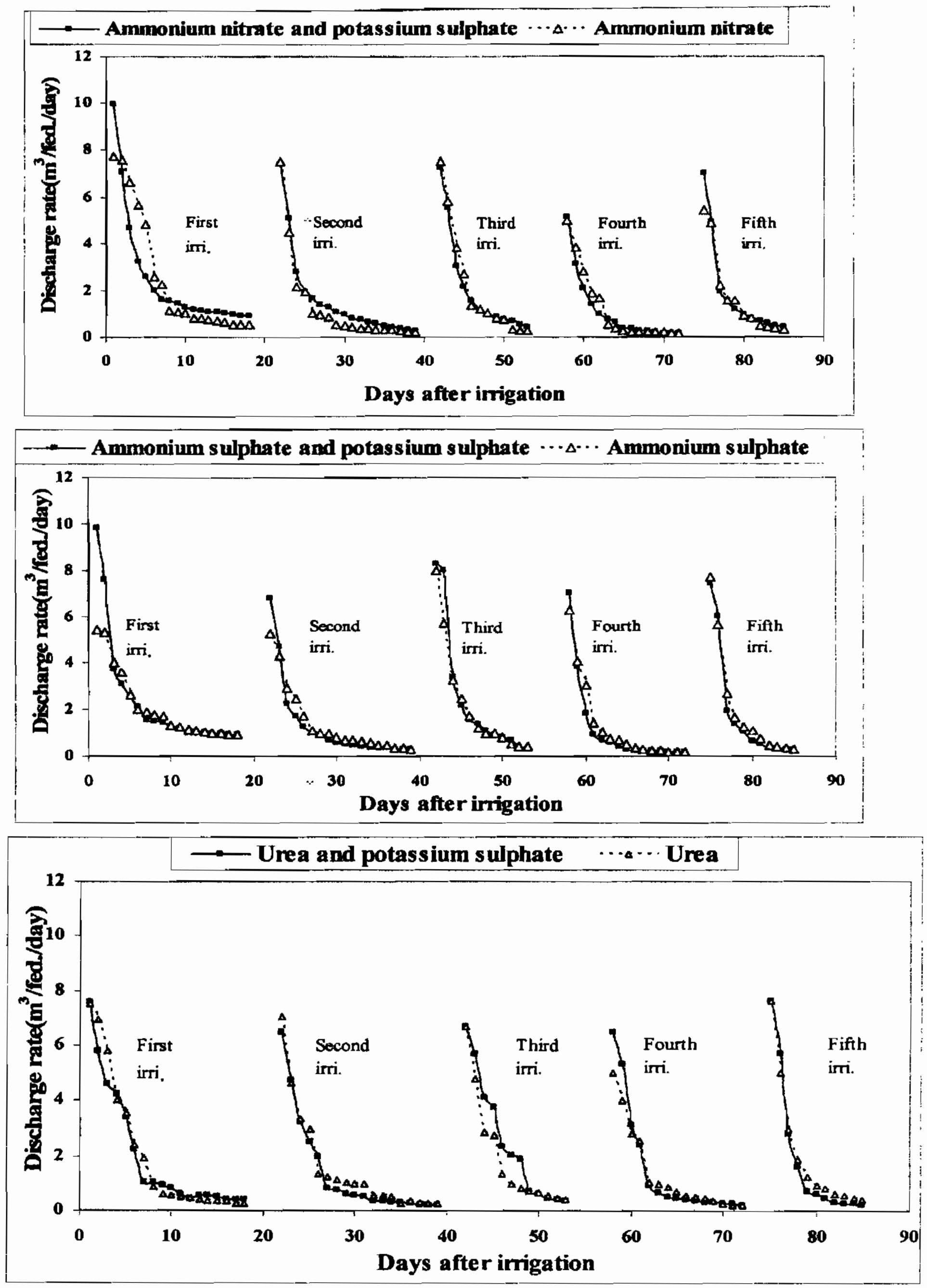

Fig (1): Drain discharge rate with time after five irrigation cycles under different treatments.

Table (3): Losses of NH^+_4-N (g/fed.) into drainage water through five irrigation cycles under different treatments.

Fertilizer treatments	Losses of NH_4-N (g/fed.) into drainage water					
	First irrigation	Second irrigation	Third irrigation	Fourth irrigation	Fifth irrigation	Total
$NH_4NO_3 + K_2SO_4$	14.47	6.62	5.48	0.49	1.13	28.19
NH_4NO_3	8.46	3.43	9.96	0.59	0.89	23.33
$(NH_4)_2SO_4 + K_2SO_4$	7.86	4.53	9.03	0.58	1.12	23.12
$(NH_4)_2SO_4$	6.22	5.04	8.43	0.55	0.89	21.13
$CO(NH_2)_2 + K_2SO_4$	5.03	4.74	5.67	0.68	1.70	17.82
$CO(NH_2)_2$ (urea)	16.47	4.02	4.38	1.06	1.70	27.63

NO^-_3-N losses via drainage water:

Data in figure (2) indicated that the amount of N-Nitrate in drainage water decreased by succession days of irrigation in all irrigation cycles. In general, results revealed that the amount of N-NO^-_3 was very high during the first few days after irrigation, then a gradual reduction occurred with further days. After fertilizers application, N-Nitrate losses in drainage water varied from 135.85 to 449.81 g/day/fed after one day from irrigations and from 3.93 to 37.39 g/day/fed before the next irrigation. The decrease in N-NO^-_3 leached with increasing the period after irrigation is attributed to the reduction of water moved downward to water table or groundwater. Similar results were obtained by Ibrahim et al., (2003) and Ramadan et al., (2004).

Results in Table 4 indicated that, NO_3-N losses through five consecutive irrigation cycles under different fertilization forms were paralleled to the cumulative discharge rate results (Table 2). The highest values of NO_3-N losses were found in the first irrigation under all fertilizers treatments. This is due to high rate of cumulative discharge in the first irrigations than the other ones (Bjorneberg et al. (1998) and Bakhsh et al. (2002)). In addition to, the relatively high level of N in the soil before cotton cultivation, since the soil was cultivated with maize in the previous summer season and was left fallow until cotton cultivation. This could be due to mineralization of soil organic matter during this period. Also, the decrease losses of NO_3-N under the latest irrigations with all fertilizers treatments, may be attributed either to the decrease of N concentration in the soil solution and/or to the increasing demand of cotton plant of N during this growth stage.

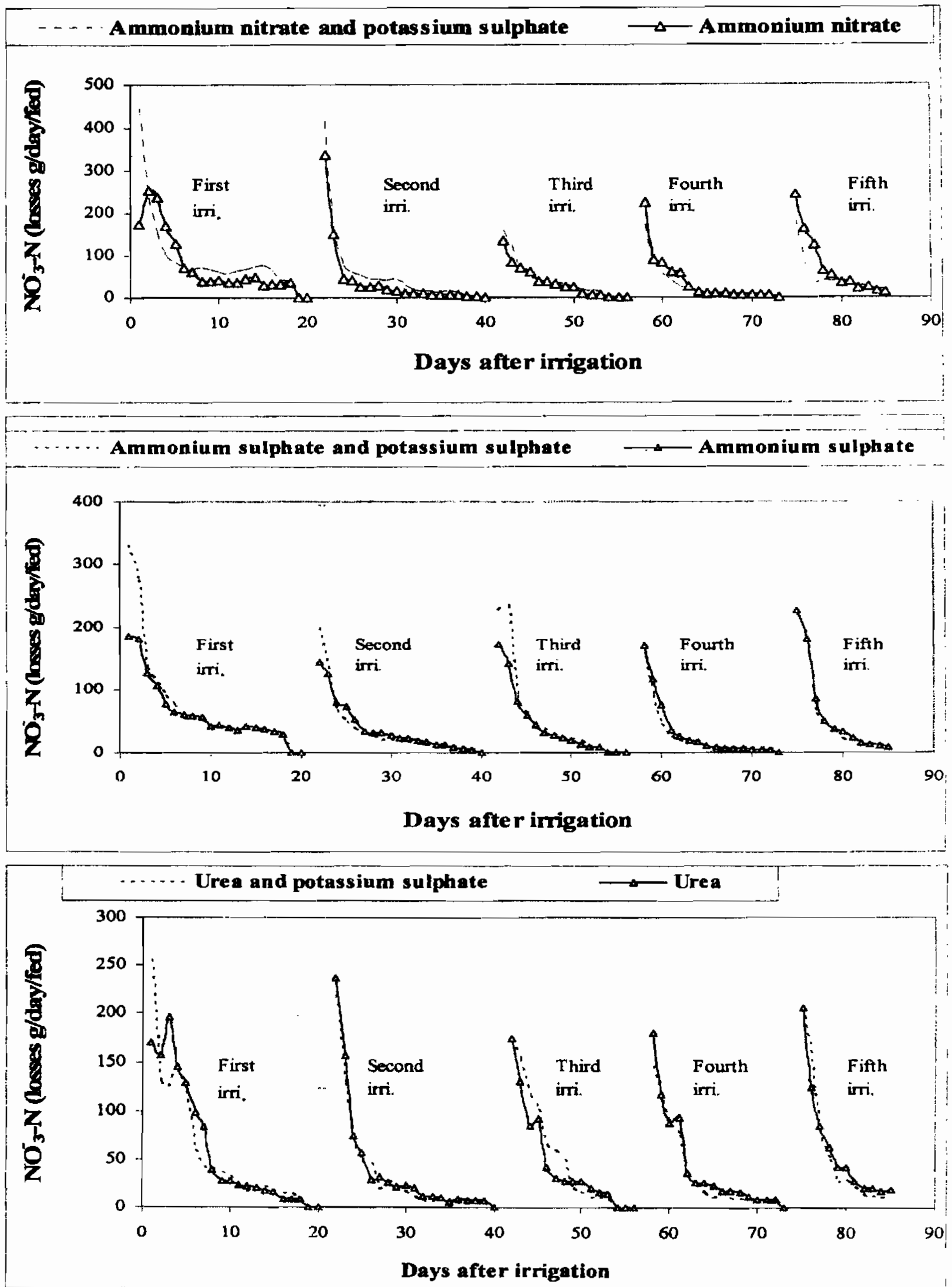

Fig (2): N-Nitrate losses in drainage water with time after five irrigation cycles under different treatments.

Total losses of NO_3-N under NH_4NO_3+K_2SO_4 and $(NH_4)_2SO_4$+K_2SO_4 treatments were higher than NH_4NO_3 and

$(NH_4)_2SO_4$ ones by 9.72 % and 6.47%, respectively. This could be explained by the competition between NH^+_4 and K^+ ions on the exchange and fixation sites of the exchange complex, in case of ammonium nitrate + potassium sulphate and ammonium sulphate + potassium sulphate application, which may increase the mobility of both NH^+_4 ions in the soil solution and out to the drainage water. On the other hand, total NO_3-N loss under $CO(NH_2)_2+K_2SO_4$ was lower than $CO(NH_2)_2$ by 6.16%. This may be due to high values of ESP (Table 1) which may incomplete the hydrolysis of urea in the soil, hence, reduces N losses from soil by leaching. Tahoun et al. (1988) found that the hydrolysis of urea in the clayey and loamy sand fertile soils was fast with a rate constant of 0.32 ± 0.04 day^{-1} for either soil. Whereas, in the saline-alkali soils, the hydrolysis was incomplete as some urea persisted for 28 days. When the ESP was reduced, the hydrolysis proceeded with a faster rate at 0.39 day^{-1} which is comparable with the fertile soils. The hydrolysis of urea as follows:

$$CO(NH_2)_2 + H_2O \xrightarrow{\text{Urease}} NH_4CO_2.NH_2$$

$$NH_4CO_2.NH_2 + H_2O \longrightarrow (NH_4)_2CO_3$$

$$(NH_4)_2CO_3 + H_2O \longrightarrow CO_2 + 2NH_4OH \longrightarrow 2NH_3 + 2H_2O$$

Data in Table 4 revealed also that, the highest total losses of NO_3-N were found under $NH_4NO_3+K_2SO_4$ and NH_4NO_3 fertilizer treatments comparing with others treatments. Whereas NO_3-N losses were increased by 15.37, 22.83, 23.25 and 16.37 % under $NH_4NO_3+K_2SO_4$ than $(NH_4)_2SO_4+K_2SO_4$, $(NH_4)_2SO_4$, $CO(NH_2)_2+K_2SO_4$ and $CO(NH_2)_2$, respectively. The corresponding percentage were 5.14, 11.95, 12.33 and 6.06 % with NH_4NO_3 than the above mentioned treatments, respectively. Also, the total losses of NO^-_3-N were higher under $(NH_4)_2SO_4+K_2SO_4$ than $CO(NH_2)_2+K_2SO_4$ and $CO(NH_2)_2$ by about 6.83 and 0.86 %, respectively. While, total losses of NO^-_3-N were lower under $(NH_4)_2SO_4$ than $CO(NH_2)_2$ by about 5.56 % and nearly equal to $(NH_4)_2SO_4+K_2SO_4$ (Table 4). In this concern Balba et al. (1969) had shown that the collected amount of N from urea (U), ammonium sulphate (AS) and calcium nitrate (CN) applied on soil columns surfaces and using 3 soils differing in texture, were in order: CN>AS>U. The leached N was mainly in the form of NO^-_3. Leached N from the clay loam soil were 41, 10 and 4.5 percent of the added amount of N in the forms of NO^-_3, NH^+_4 and urea, respectively. Similar results were obtained by Ramadan and El-Leithi, (1999).

Table (4): Losses of NO_3-N (g/fed.) into drainage water through five irrigation cycle under different treatments

Fertilizer treatments	Losses of NO_3-N (g/fed.) into drainage water					
	First irrigation	Second irrigation	Third irrigation	Fourth irrigation	Fifth irrigation	Total
$NH_4NO_3 + K_2SO_4$	1862.95	1097.78	621.81	486.39	572.50	4641.43
NH_4NO_3	1510.26	760.49	535.18	618.98	805.20	4230.12
$(NH_4)_2SO_4 + K_2SO_4$	1498.67	682.91	796.05	417.65	627.98	4023.24
$(NH_4)_2SO_4$	1252.32	715.20	625.92	508.10	677.09	3778.63
$CO(NH_2)_2 + K_2SO_4$	1125.76	656.02	787.45	578.2	618.43	3765.87
$CO(NH_2)_2$ (urea)	1197.45	751.86	690.37	680.04	668.85	3988.57

Potassium losses via drainage water:

Potassium concentration in this study showed a remarkable reduction in the last days of the different irrigation cycles, i.e. K^+ ion concentrations in the drainage water tend to decrease with lowering groundwater level and decreasing soil moisture content. Generally, potassium concentration (K_2O) in drainage water varied in a relatively narrow range (between 1.17 and 5.56 ppm) and was slightly decreased as the lowering in the groundwater level increased. According to International Potash Institute (1977) the decrease of K^+ concentration in the drainage water with lowering groundwater level may be ascribed to decrease in K^+ diffusion as a result of decrease in soil moisture content. The low K^+ concentration in the drainage water in all treatments is due to the high clay content of soil with less K^+ saturation.

Data in Table 5 showed that the values of potassium losses were in the order: first irrigation > second irrigation > third irrigation > fourth irrigation < fifth irrigation in all tested fertilizer treatments. The high losses of K from soils via the drainage water throughout the first and second irrigations cycles may due to either the low need of plants to K^+ or the high K^+ content in the soil during this period. Where, the soil was cultivated with maize in the previous summer season and was left fallow until cotton cultivation. This could be due to mineralization of soil organic matter during this period.

The potassium (K^+) losses, were slightly increased in the N-fertilizer treatments (except urea) fertilized with potassium sulphate than the without it. K^+ lossed in the drainage water under ammonium nitrate and ammonium sulphate fertilizer application recorded low values as compared to the ammonium nitrate + potassium sulphate and ammonium sulphate + potassium sulphate fertilizer treatments in the successive five irrigation cycles (Table 5). This could be explained by the competition between NH^+_4 and K^+ ions on the exchange and fixation sites of the exchange complex, which may increase the mobility of both NH^+_4 and K^+ ions in the soil solution and out to the discharge drainage water (Mengel, 1985). On the other hand, total K_2O loss under $CO(NH_2)_2$+K_2SO_4 was lower than $CO(NH_2)_2$ by 10.06%.

Table (5): Losses of K_2O (g/fed.) into drainage water through five irrigation cycle under different treatments

Treatments	K^+-Losses into drainage water (g K_2O /fed.)					
	First irrigation	Second irrigation	Third irrigation	Fourth irrigation	Fifth irrigation	Total
$NH_4NO_3 + K_2SO_4$	449.71	239.09	180.51	109.55	170.48	1149.34
NH_4NO_3	408.43	223.98	170.51	114.20	181.00	1098.12
$(NH_4)_2SO_4$+ K_2SO_4	390.34	238.72	232.36	137.34	180.88	1179.94
$(NH_4)_2SO_4$	297.26	278.65	204.11	142.52	192.3	1114.84
$CO(NH_2)_2 + K_2SO_4$	250.42	217.01	158.06	154.83	182.97	963.29
$CO(NH_2)_2$ (urea)	359.88	236.38	151.82	114.48	197.68	1060.24

Total losses of nitrogen and potassium via drainage water:

Data in table 6 show the total estimated amount of nitrogen losses as influenced by N-fertilizers forms with and without K^+ fertilizer under tile drainage system. The results revealed that, by the end of growing season (cotton) the total nitrogen losses were 4.67, 4.25, 4.05, 3.80, 3.78 and 4.02 kg/fed for fertilizer treatments of ammonium nitrate +K^+, ammonium nitrate, ammonium sulphate +K^+, ammonium sulphate, urea + K^+ and urea, respectively. The total fertilizer losses were 14.15, 12.89, 15.27, 14.34, 8.14 and 8.64 kg/fed for the corresponding treatments. The losses percentages from the used nitrogen fertilizer were 6.67, 6.08, 5.78, 5.43, 5.41 and 5.74 at the corresponding treatments.

The total potassium losses were 1.15, 1.10, 1.18, 1.11, 0.96 and 1.06 kgK_2O/fed for fertilizer treatments of ammonium nitrate +K^+, ammonium nitrate, ammonium sulphate +K^+, ammonium sulphate, urea + K^+ and urea, respectively. The total fertilizer losses were 2.39, 2.29, 2.46, 2.32, 2.01 and 2.21 kg/fed for the corresponding treatments, respectively. The losses percentages from the added potassium fertilizer were 2.39, 2.46 and 2.01 for the treatments of ammonium nitrate $+K^+$, ammonium sulphate $+K^+$ and urea + K^+, respectively. Kladivko et al. (1991) reported losses of 2.6 kgK/ha from low organic matter and poorly structured silt loam soil.

Table (6): Nitrogen and potassium losses into drainage water through five irrigation cycle under different treatments.

Treatments	Nitrogen losses			Potassium losses		
	Total N Losses (kg/fed)	Total fertilizer Losses (kg/fed)	Fertilizer losses (%)	Total K2O losses (kg/fed)	Total fertilizer losses (kg/fed)	Fertilizer losses (%)
NH4 NO3 + K2SO4	4.670	14.150	6.671	1.15	2.39	2.39
NH4 NO3	4.253	12.889	6.076	1.10	2.29	-
(NH4)2SO4+ K2SO4	4.046	15.269	5.781	1.18	2.46	2.46
(NH4)2SO4	3.800	14.339	5.428	1.11	2.32	-
CO (NH2)2 + K2SO4	3.784	8.137	5.405	0.96	2.01	2.01
CO (NH2)2 (urea)	4.016	8.637	5.737	1.06	2.21	-

Conclusion:

From the above-mentioned discussion, it could be concluded that combination of N and K-fertilizers added to the soil, except urea, slightly increased losses of N in both NH^+_4 and NO^-_3 forms and K in the drainage water under cotton cultivation. So, the irrigation after the addition of such fertilizes must be controlled, to minimize nutrients losses into drainage water.

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الملخص العربي

تأثير إضافة صور مختلفة من النتروجين وإضافة البوتاسيوم على فقد النتروجين والبوتاسيوم في ماء الصرف تحت ظروف زراعة القطن في الأرض الطينية بشمال الدلتا

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تم إجراء تجربة حقلية بهدف دراسة تأثير إضافة صور مختلفة من الأسمدة علي فقد الأمونيا والنترات والبوتاسيوم في مياه الصرف تحت تأثير الصرف المغطى وزراعة القطن في الأراضي الطينية بشمال الدلتا بمصر. أضيفت صور الأسمدة النتروجينية (نترات الأمونيوم، سلفات الأمونيوم، اليوريا) للأرض مع وبدون إضافة سلفات البوتاسيوم. وتمت الإضافة بمعدل ٧٠ وحدة نيتروجين للفدان و ٤٨ وحده بوتاسيوم للفدان على دفعتين متساويتين بعد ألريه الأولى والثانية مباشرة على التوالي.

أشارت النتائج إلى أن تصرف المصارف التراكمي الكلي خلال خمسة دورات ري كانت متساوية تقريبا لكل المعاملات. ووجد أن فقد النيتروجين في ماء الصرف في صورة الأمونيوم قليل جدا عن الفقد في صورة النترات. وكان الفقد

الكلي للنيتروجين الأمونيومي في ماء الصرف ٢٨,١٩، ٢٣,٣٣، ٢٣,١٢، ٢١,١٣، ١٧,٨٢، ٢٧,٦٣ جرام نتروجين للفدان للمعاملات نترات الأمونيوم+ سلفات البوتاسيوم، نترات الأمونيوم، سلفات الأمونيوم+ سلفات البوتاسيوم، سلفات الأمونيوم ، اليوريا+ سلفات البوتاسيوم، اليوريا على التوالي.

أشارت النتائج أيضا إلى أن فقد النيتروجين النتراتي في ماء الصرف يقل مع مرور الأيام بعد الري. ولقد زاد الفقد الكلي للنيتروجين النتراتي في ماء الصرف للمعاملتين نترات الأمونيوم+ سلفات البوتاسيوم، سلفات الأمونيوم+ سلفات البوتاسيوم بمقدار ٩,٧٢ ٪ ، ٦,٤٧٪ عن المعاملتين نترات الأمونيوم، سلفات الأمونيوم علي التوالي. بينما انخفض الفقد الكلي للنيتروجين النتراتي بمقدار ٦,١٦ ٪ مع اليوريا+ سلفات البوتاسيوم مقارنة باليوريا. وأيضا وجد أن أعلى فقد للنيتروجين النتراتي في ماء الصرف كان مع نترات الأمونيوم+ سلفات البوتاسيوم، نترات الأمونيوم مقارنة بالمعاملات الأخرى.

كان الفقد الكلي للنيتروجين في ماء الصرف ٤,٦٧، ٤,٢٥، ٤,٠٥، ٣,٨٠، ٣,٧٨، ٤,٠٢ كيلوجرام نتروجين للفدان للمعاملات نترات الأمونيوم+ سلفات البوتاسيوم، نترات الأمونيوم، سلفات الأمونيوم+ سلفات البوتاسيوم، سلفات الأمونيوم ، اليوريا+ سلفات البوتاسيوم، اليوريا على التوالي. وكان مقدار الفقد من الأسمدة النتروجينية المضافة ١٤,١٥، ١٢,٨٩، ١٥,٢٧، ١٤,٣٤، ٨,١٤، ٨,٦٤ كيلوجرام سماد للفدان والتي تعادل ٦,٦٧، ٦,٠٨، ٥,٧٨، ٥,٤٣، ٥,٤١، ٥,٧٤٪ من السماد النتروجيني المضاف لنفس المعاملات السابقة علي الترتيب.

أشارة النتائج أيضا أن الفقد الكلي للبوتاسيوم في ماء الصرف كان مقداره ١,١٥، ١,١٠، ١,١٨، ١,١١، ٠,٩٦، ١,٠٦ كيلوجرام K_2O للفدان للمعاملات نترات الأمونيوم+ سلفات البوتاسيوم، نترات الأمونيوم، سلفات الأمونيوم+ سلفات البوتاسيوم، سلفات الأمونيوم ، اليوريا+ سلفات البوتاسيوم، اليوريا على التوالي. بينما كانت كمية السماد المفقودة ٢,٣٩، ٢,٢٩، ٢,٤٦، ٢,٣٢، ٢,٠١، ٢,٢١ كيلوجرام سماد بوتاسي للفدان لنفس المعاملات السابقة علي الترتيب.

وعموما أظهرت النتائج أن إضافة السماد النتروجيني و البوتاسي معا للأرض فيما عدا اليوريا أدي إلى زيادة قليلة في فقد كلا صورتي النتروجين الأمونيومي والنتراتي وأيضا البوتاسيوم في ماء الصرف لزراعات القطن. لذلك ينصح بالتحكم في عملية الري في الريات التالية لإضافة الأسمدة مباشرة لضمان عدم فقدها في ماء الصرف.