EFFECT OF NITROGENOUS FERTILIZERS FACTORY (TALKHA FERTILIZERS FACTORY) ON NITRATE STATUS IN THE AGRICULTURAL ENVIRONMENT.

Tantawy, Manal F.[1]; S. A. Abou Elnaga[2]; E. A. Abou Hussien[2] and M. S. Abou Alfotoh[1]
1- Soil, Water and Environment, Inst, Res. Agric. Rrs. Center, Giza, Egypt
2- Soil Sci.Dep. Fac. of Agric Minoufia Univ. Egypt

ABSTRACT

This research work was carried out to evaluate nitrogenous fertilizers factory (Talkha fertilizers factory) as a source of nitrate pollution and its content in the soil, irrigation and drainage water and cultivated plants in its Talkha area, Dakahlia Governorate, Egypt. Soil samples were taken at soil depths of 0-15, 15-30, 30-60 and 60-90 cm at five distances of the factory .i.e. at before 500m of the factory (as control), 0, 500, 1000 and 1500 m after them. These soil samples were analyzed for some physical and chemical properties and also for its content of different N-forms .i.e. total – N, NH_4-N, NO_3-N, NO_2-N and organic- N (O-N). At the soil sampling sites, samples of both irrigation and drainage water were taken and analyzed for their pH, EC and the content of both NH_4-N and NO_3-N. At the same sites, samples of cultivated plants were taken and analyzed for the content of total - N, NH_4-N and NO_3-N. After that, the relationships between some soil properties and its content of different N- forms were calculated. From theses relations and predication equations the predict soil content of NO_3-N was calculated.

The obtained data show that, the soil content (mg/kg) of different N forms was decreased with the increase of soil depth, except NO_3-N was increased with the soil depth up to 60 cm. Also, the content of these forms was decreased with the distance increase of the factory. The relationships between soil properties and the content of different N- forms varied depending on the studied soil property and N-forms. Generally, the prediction values of NO_3-N were higher than those of determined NO_3-N. Also both irrigation and drainage water and plant samples content of both NH_4-N and NO_3-N was decreased with the distance of the factory increase.

Keywords: Pollution, Nitrate, Nitrogenous fertilizers, Prediction equations and Soil properties.

INTRODUCTION

Berrow and Reaves (1984) reported that soils have became polluted if contents of a metal exceed the upper end of an accepted normal range. They also added that the continuous accumulation of harmfull metals and their persistence in soil makes soil pollution a far more serious matter than either air or water pollution. Al-Othman *et al.* (2011) pointed out that heavy metals accumulation is one of the most serious environmental concerns of the present day, not only because many of these metals are toxic to the crops themselves, but also because of their potential harm to animals and humans. Found metals are non-biodegradable and are considered major environmental pollutants resulting in cyto toxic, mutagenic and carcinogenic effects in animals. WHO (2004) found that biogeochemical processes are

known to modify nitrate concentrations such the different forms of nitrogen (NO_2^-, NH_4^+, NH_3) can potentially be transformed into nitrate. The objective of Garizabal *et al.* (2012) investigation was to analyze the evolution of nitrate contamination in relation to agronomic and management changes within a traditionally irrigated soil. That specifically, the impact of changes in irrigation allowance assignment, changes in irrigation method from rotation to on-demand flood irrigation, and creation of water consumption accounts were analyzed. That to this end, nitrogen monitoring and annual balances were carried out in a small irrigated hydrological basin (95 ha) located in Northeastern Spain throughout the years of 2001 and 2005–2008.That the evolution of the nitrate contamination index was also analyzed, which relates the mass of nitrates exported to the fertilization necessities of a specific irrigated area. Found that the results demonstrated that although changes in crop pattern caused a 33% reduction in the nitrogen required through fertilization, the fertilization rates applied are still double the necessities. Yang *et al.* (2006) found accumulation and distribution of NO_3-N in soil was significantly affected by annual fertilizations. Mineral fertilizers (NP and NPK) led to NO_3-N accumulation in most subsoil layers, with major impact in the 20-140 cm depth. Found the combination of mineral fertilizers and farmyard manure (MNP and MNPK) reduced soil NO_3-N accumulation in comparison to mineral fertilizers. Sapek (2005) pointed that agriculture is probably the largest contributor of nitrogen pollution to ground water, as nitrate originates both from soil N-mineralization and nitrification and from excessive use of N-fertilizers and manure on arable crops in order to increase yields and product quality. Cemek *et al.* (2007) found that nitrate and nitrite levels in our natural water supplies are important indicators of water quality. The increasing levels of nitrate and nitrite concentrations are becoming an important problem for public health. Nitrates are of great toxicological concern as they are involved in the origin of nitrites and nitrosamines and the development of metahaemoglobinaemia in infants. It is well known that high level nitrite is toxic to alga. Laboratory studies carried out by Katerji et al. (2001) have shown that soil salinity reduces nitrogen content and salinity affecting the nitrification. The salinity effect on bacterial activity with respect to nitrogen fixation is one of the hypo theses for explaining its salt sensitivity. Bertrand et al. (2007) found that positive correlations between the amounts of NO_3^- immobilized and soil pH changes by the release of hydroxyl ions by the soil microbial biomass which served to balance the charge in response to anion uptake (NO_3^-). Barrett and Burke (2000) observed that soils with higher organic matter content and wide soil C/N ratios may immobilize more N than soils with less soil OM because of a limitation of reduced C substrate to microbial metabolism. Organic substrates with wide C/N ratios often support microbial communities that are N limited and generally exhibit higher rates of N immobilization presumably because microbes require additional mineral N to metabolize material with high C content relative to N. In a field experiment, Eltilib *et al.* (2005) found that $CaCO_3$ caused a substantial reduction in nitrogen availability and, hence, in maize yield in Al-Marj soil. It was not clear from that experiment whether the negative effect of $CaCO_3$ was due to poor

nitrogen transformation or due to leaching. Gami *et al.* (2009) reported that positive relationships between total N and silt + clay content were found for both forested and cultivated soils for all of the soil depths 0-15 cm and 15-30 cm. El-Melegy (2007) reported that the relationships between the soil profiles content of available-N and the soil content of clay and OM and values of CEC were positive and its were negative with soil pH. Also, the trend of relative decrease values of total available-N with soil depth was unclear. Jagessar and Alleyne (2011) showed that soil bacteria derive their energy by oxidizing ammonia to nitrite (NO_2^-) and ultimately to nitrate, NO_3^-. These bacteria are abundant and active that all ammonia reaching the soil is oxidized to nitrate. This process is known as nitrification. Plants and many bacteria take up and readily reduce nitrate and nitrite through the action of nitrate and nitrite reductases. The ammonia that is formed is incorporated into amino acids by plants.

This work was carried out to study the effect of mineral nitrogen fertilizers on the soil content of different N- form especially that of nitrate form and found the relationships between these forms and soil physical and chemical properties. Also, irrigation and drainage water and plants content of the determined N-forms were determined.

MATERIALS AND METHODS

Soil Locations and Its Sampling

The studied area in this investigation is represent the alluvial soil of Meet Anter Village around at Talkha fertilizer factory, Talkha, Dakahlia Governorate (Fig 1). The selected area was carried out based their production polluted by nitrate. Soil samples were collected at different distances of factory (nitrate source) .i.e. -500 m before factory (which represent the control), 0, 500, 1000 and 1500 m (Fig 2). At each distance, the sampling process was conducted at four soil depth .i.e. 0 - 15, 15 – 30, 30 – 60 and 60 – 90 cm. Each soil sample was air-dried separately, ground, good mixed, sived through a 2mm sieve and kept into plastic bottles. Some physical and chemical properties for these samples were determined according to the methods described by Page *et al.* (1982), Cottenie *et al.* (1982) and Kim (1996). The obtained data were listed in Tables (1 to 3).

Irrigation and Drainage Water Samples

At each distance of premonitioned soil sampling process, samples of both irrigation and drainage water were taken. Irrigation water resources in the studied area was Nile River water. On the other hand the drainage water samples were taken from the collector hole of tile drains. The samples of both irrigation and drainage water were taken according to APHA (1995) method, and analyzed for its pH and EC according to the methods described by Cottenie *et al.* (1982).

Total nitrogen was determined in all soil samples digestion by mixture of conc $HClO_4$ and H_2SO_4 (1 : 3 ratio) using method of Kjeldahl as described by

Page *et al.* (1982). Nitrate and ammonium – nitrogen were extracted and determined by Kjeldahl distillation according to the method described by Page *et al.* (1982). Also, nitrite content was determined using as spectrophotometer described by Bremner and Keeney (1966). Finally organic nitrogen (ON): was calculated by subtracting Total nitrogen (T-N) – sumation (NO_3-N + NH_4-N + NO_2-N). Nitrate and ammonium were determined by Kjeldahl distillation as described by Cottenie *et al.* (1982). Statical Analysis was calculated by mtb12 Program.

Plant Samples and Its Analysis

At each distance of soil sampling, samples, of grown plant (Corn, Rice, Clover and Vridity) was taken and divided into shoots and roots, air-dried at 70 ^{0}C, ground and kept into plastic bags. 0.2 gram of the oven dried plant sample was digested with 5 ml of concentrated percholoric acids ($HClO_4$) + sulfuric acid (H_2SO_4) at mixed ratio mixture of 1:3 on a hot-plate until the digest become clear and uncolored. The digest was diluted to 100 ml with distilled water according to Chapman and Pratt (1961) and determined the plant content of total nitrogen. The NH_4-N and NO_3-N were determined. Nitrogen content in plant samples digestion was determined as a percentage (Total-N %) using conventional method of Kjeldahl as described by Page *et al.* (1982). Determination of nitrate and ammonia were carried out by Kjeldahl distillation (Cottenie *et al.,* 1982).

RESULTS AND DISCUSSION

The Soil Content Of Different Nitrogen Forms

Total nitrogen (T-N).

The recorded data in Table (4) show a wide variations in the soil content (mg/kg) of T-N in the studied area. For example, this content ranged from 515 mg/kg in 60-90 cm of profile 1 to 9300 mg/kg in the surface 0-15 cm layer of profile 2. In addition, this content was decreased with dis0tance increase of the factory as well as with the increase of soil depth (except the control profile). Generally, the soil in the studied area may be characterized by high content of T-N. This trend show fertilizers factory resulted in an increase of soil content of T-N, where the found increase resulted from the outline products of this factory. Such this effect was reported by WHO (2004); Mahvi *et al.* (2005); Angelopoulos *et al.* (2009); Nettleton and Peterson (2010); Hongmei *et al.* (2011) and Garizabal *et al.* (2012).
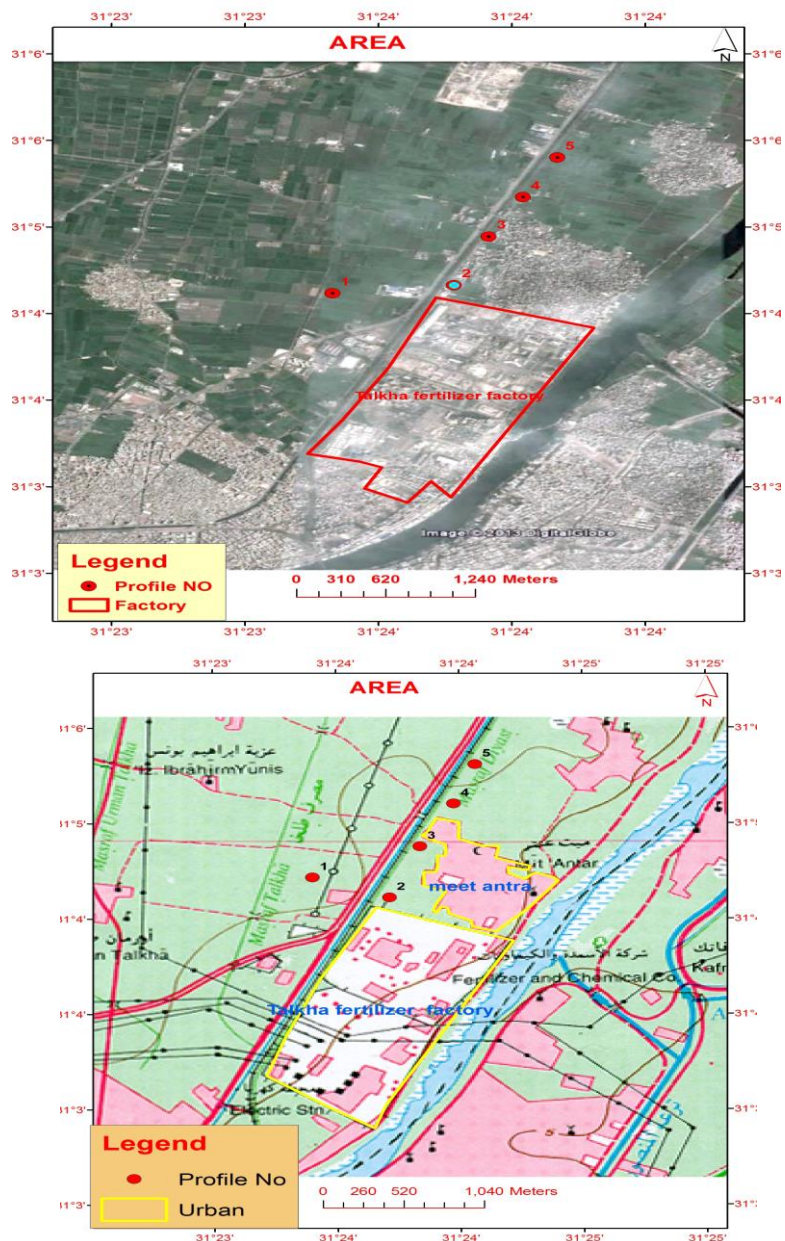
Figs (1 and 2): Map location and sites of the studied soil profiles of Talkha area Dakahlia Governorate, Egypt.

Table (1). Particle size distribution of (%) texture class, and saturation percent (SP) of the selected samples taken from different soil profiles of Talkha, Dakahlia Governorate at different distances from Talkha Fertilizer factory.

Profile No	Distance from factory (M)	Soil depth (cm)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture class	SP %
1	-500	0 – 15	2.30	13.98	35.02	48.70	Clay	83.13
		15 – 30	2.15	20.17	32.45	45.23	Clay	82.25
		30 – 60	2.12	21.64	33.89	42.35	Clay	74.38
		60 – 90	2.00	21.68	30.45	45.87	Clay	73.50
2	000	0 – 15	2.02	16.65	34.49	46.84	Clay	70.00
		15 – 30	1.60	19.98	30.78	47.64	Clay	78.75
		30 – 60	1.21	25.88	30.45	42.46	Clay	78.75
		60 – 90	1.03	28.04	31.78	39.15	Clay - loam	74.38
3	500	0 – 15	1.53	19.12	35.78	43.57	Clay	74.38
		15 – 30	1.25	23.12	30.12	45.51	Clay	76.13
		30 – 60	1.01	23.85	29.82	45.32	Clay	65.63
		60 – 90	0.98	24.67	25.78	48.57	Clay	70.00
4	1000	0 – 15	1.75	19.84	35.74	42.67	Clay	70.00
		15 – 30	1.56	24.58	35.45	38.41	Clay - loam	70.00
		30 – 60	1.50	25.00	30.88	42.62	Clay	74.38
		60 – 90	1.34	26.09	30.12	42.45	Clay	78.75
5	1500	0 – 15	1.75	18.18	33.15	46.92	Clay	71.84
		15 – 30	1.60	21.25	32.50	44.65	Clay	70.44
		30 – 60	1.50	23.50	31.17	43.83	Clay	71.14
		60 – 90	1.28	24.12	30.10	44.50	Clay	70.44

Table (2). Soil EC (dSm^{-1}) and the content (meq/l) of soluble cations and anions in the selected soil profiles located around Talkha fertilizer factory of Talkha, Dakahlia Governorate.

Profile No	Distance from factory (M)	Soil depth (cm)	EC (dSm^{-1})	Soluble cations (meq/l)				Soluble anions (meq/l)			
				Na$^+$	K$^+$	Ca^{+2}	Mg^{+2}	Cl^{-1}	CO$_3^-$	HCO$_3^{-1}$	SO$_4^{-2}$
1	-500	0 – 15	2.05	13.15	0.20	3.65	3.50	15.13	000	2.53	2.84
		15 – 30	1.60	9.25	0.18	3.11	3.46	10.45	000	2.35	3.20
		30 – 60	1.40	8.35	0.14	2.90	2.61	9.50	000	2.01	2.49
		60 – 90	1.22	7.35	0.13	2.50	2.22	8.15	000	1.73	2.32
		Mean	1.56	9.53	0.16	3.04	2.95	10.81	000	2.16	2.71
2	000	0 – 15	4.15	30.88	1.33	6.15	3.14	25.30	000	3.30	12.90
		15 – 30	3.80	21.09	1.27	6.15	9.49	37.14	000	2.75	1.89
		30 – 60	3.50	20.78	1.22	4.92	8.08	21.84	000	2.75	10.41
		60 – 90	2.02	11.13	1.25	3.69	4.13	13.68	000	2.47	4.05
		Mean	3.67	20.97	1.27	5.23	6.21	24.49	000	2.82	7.31
3	500	0 – 15	3.19	20.10	1.27	5.56	4.97	24.84	000	3.03	4.03
		15 – 30	2.91	19.55	1.19	4.10	4.26	22.70	000	2.70	3.70
		30 – 60	2.62	18.11	1.27	3.69	3.13	21.05	000	2.65	2.50
		60 – 90	2.52	16.68	1.13	3.28	4.11	18.02	000	2.55	4.63
		Mean	2.81	18.61	1.22	4.16	4.12	21.66	000	2.73	3.72
4	1000	0 – 15	3.10	22.86	0.25	4.51	3.38	25.96	000	2.75	2.29
		15 – 30	2.50	16.90	0.22	4.10	3.78	17.32	000	2.75	4.93
		30 – 60	2.25	14.11	0.20	3.69	4.50	15.61	000	2.48	4.41
		60 – 90	1.90	13.50	0.17	3.69	1.64	15.80	000	1.93	1.27
		Mean	2.44	16.84	0.21	3.99	3.33	18.67	000	2.48	3.23
5	1500	0 – 15	2.38	15.34	0.27	4.92	3.27	13.88	000	2.75	7.17
		15 – 30	1.72	10.87	0.27	3.44	2.62	12.88	000	2.50	1.82
		30 – 60	1.70	10.44	0.20	3.28	3.08	11.64	000	2.33	3.03
		60 – 90	1.42	8.20	0.20	2.87	2.93	10.81	000	1.82	1.57
		Mean	1.81	11.21	0.24	3.63	2.98	12.30	000	2.35	3.39

Table (3): Some chemicals properties of the studied soil samples taken from soil profiles around Talkha fertilizer factory at Talkha, Dakahlia Governorate.

Profile No. Profile No	Distance from factory (M)	Soil depth (cm)	pH In (1:2.5) (soil : water) suspension	OM (g/100g)	CaCO$_3$ (g/ 100g)	CEC (meq /100g)	Available P (mg / kg)	Available K (mg / kg)
1	-500	0 – 15	8.61	1.90	3.80	46.15	8.15	1815.60
		15 – 30	8.65	1.15	2.75	45.55	6.72	1612.00
		30 – 60	8.80	0.50	2.63	44.10	6.15	1416.40
		60 – 90	8.85	0.35	1.40	43.50	5.10	1213.00
		Mean	8.73			44.83	6.53	1512.60
2	000	0 – 15	8.45	2.20	5.47	49.15	12.20	2418.00
		15 – 30	8.50	1.60	4.61	42.68	11.30	2011.00
		30 – 60	8.55	0.65	2.61	43.72	11.22	1815.60
		60 – 90	8.70	0.43	1.29	41.14	9.98	1612.00
		Mean	8.59			44.76	11.18	1862.80
3	500	0 – 15	8.50	2.15	3.02	53.06	11.31	2011.20
		15 – 30	8.55	1.60	2.54	51.11	11.01	2011.20
		30 – 60	8.55	0.60	1.68	50.81	11.00	1416.40
		60 – 90	8.55	0.40	1.38	42.78	9.69	1416.40
		Mean	8.61			49.62	10.72	1661.40
4	100	0 – 15	8.55	2.04	5.17	51.06	11.03	2011.20
		15 – 30	8.60	1.00	3.07	50.69	10.96	2011.20
		30 – 60	8.60	0.53	2.20	48.43	10.57	1408.60
		60 – 90	8.65	0.40	4.31	46.17	9.00	1001.60
		Mean	8.60			48.42	10.39	1659.40
5	1500	0 – 15	8.59	1.90	4.74	44.16	9.46	2001.00
		15 – 30	8.64	1.20	2.16	45.01	9.98	1803.60
		30 – 60	8.72	0.50	1.26	44.16	8.99	1418.00
		60 – 90	8.75	0.36	1.43	40.14	6.66	1206.60
		Mean	8.68			44.21	8.77	1607.20

Amonium nitrogen (NH$_4$-N).

The listed values of soil samples under study content (mg/kg) of available NH$_4$-N and its a percent of total – N were shown in Table (4) that reveals that in all soil profiles, the content of NH$_4$-N was decreased with the increase of soil depth. This trend was related positively with the soil content of both fine fraction and organic matter. Also, in the studied area this content was decreased with the distance increase from the factory, except the profile number1 located before the factory. So, the highest content of NH$_4$-N was found in the surface layer (0-15 cm) of profile 2. The studied soil samples of Talkha area are characterized by a high content of NH$_4$-N. This finding show the clear effect of fertilizer factory on the soil content of NH$_4$-N. For example, this content increase from 135.00 mg/kg in the deeper layer of profile 1 to 546.00 mg/kg in the surface 0-15 cm of profile 2.

Regarding the soil samples under study, content of NH$_4$-N as a percent of T-N, as percented in Table (4) show that NH$_4$-N represent the third fraction of T-N in the soil samples of Talkha area. The highest NH$_4$-N as a

percent of T-N were found in the different layers of profile 1, where the lowest values were found within profile 2.

Nitrate nitrogen (NO$_3$-N).

The recorded data in Table (4) show the effect of outline products of fertilizers factory on soil content of NO$_3$-N as mg/kg and as a percent of T-N. These data show, at different distance from the factory, the soil content of NO$_3$-N was increased with soil depth up to 30-60 cm depth and turned to decrease at the more depth. This means that, the high content of NO$_3$-N was found at soil depth of 30-60 cm. These findings attributed to NO$_3^-$ leaching with irrigation water. Also, the soils content of NO$_3$-N was decreased with the distance increased from factory, except profile 1. This trend cleared that outline products of the tested industrial activities resulted in a clear increase of the nearest soil content of NO$_3$-N. So, the mean content of NO$_3$-N in profile 1 was 321.25 mg/kg and was 525.00 mg/kg in profile 2.

Table (4): The studied soil samples content (mg / kg) of different N – forms and its percent (%) of T-N through different layers of soil profiles taken at different distance of Talkha fertilizer factory of Talkha, Dakahlia Governorate.

Profile No	Distance from factory (M)	Soil depth (cm)	* T– N mg / kg	* NH$_4$ – N mg / kg	%of T-N	* NO$_3$ – N mg/ kg	%of T-N	* NO$_2$ – N mg / kg	%of T-N	* O-N Mg / kg	%of T-N
1	-500	0 – 15	2030.00	370.00	18.22	285.00	14.04	1.22	0.06	1373.78	67.67
		15 – 30	1115.00	265.00	23.77	370.00	33.18	1.10	0.09	478.90	42.95
		30 – 60	790.00	175.00	22.15	385.00	48.73	0.96	0.12	229.04	28.99
		60 – 90	515.00	135.00	26.21	245.00	47.57	0.78	0.15	134.22	26.06
		Mean	1112.50	236.25		321.25		1.02		553.98	
2	000	0 – 15	9300.00	546.00	5.87	505.00	5.43	2.15	0.02	8246.85	88.68
		15 – 30	8600.00	473.00	5.50	595.00	6.91	2.05	0.02	7529.95	87.56
		30 – 60	5100.00	450.00	8.82	590.00	11.56	1.60	0.02	4058.40	79.58
		60 – 90	4680.00	410.00	8.77	410.00	8.76	1.38	0.03	3858.62	82.45
		Mean	6920.00	469.75		525.00		1.80		5923.46	
3	500	0 – 15	8300.00	493.00	5.94	478.00	5.76	2.15	0.03	7326.85	88.28
		15 – 30	7700.00	456.00	5.92	521.00	6.76	1.95	0.03	6721.05	87.29
		30 – 60	7600.00	425.00	5.59	552.00	7.26	1.50	0.02	6621.50	87.13
		60 – 90	3010.00	398.00	13.22	395.00	13.12	1.20	0.03	2215.80	73.61
		Mean	6652.50	443.00		486.50		1.70		5721.30	
4	1000	0 – 15	3700.00	483.00	13.05	460.00	12.43	1.90	0.05	2755.10	74.46
		15 – 30	2100.00	444.00	21.14	492.00	23.42	1.62	0.07	1162.38	55.35
		30 – 60	1300.00	392.00	30.15	520.00	40.00	1.41	0.12	386.59	29.74
		60 – 90	1150.00	315.00	27.39	360.00	31.30	1.12	0.09	473.88	41.21
		Mean	2062.50	408.50		458.00		1.51		1194.49	
5	1500	0 – 15	2750.00	464.00	16.87	390.00	14.18	1.75	0.06	1894.25	68.88
		15 – 30	1835.00	425.00	23.16	440.00	23.97	1.45	0.08	968.55	52.78
		30 – 60	970.00	370.00	38.14	470.00	48.45	1.32	0.14	128.68	13.27
		60 – 90	688.00	308.00	44.77	325.00	47.24	0.95	0.14	54.05	7.86
		Mean	1560.75	391.75		406.25		1.37		761.38	
		General mean	3661.65	389.85		439.40		1.48		2830.92	

* T-N: Total nitrogen, NH$_4$-N: Ammonium nitrogen, NO$_3$-N: Nitrate nitrogen, NO$_2$-N: Nitrite nitrogen and O-N: Organic nitrogen.

Regarding the studied soil samples content of NO_3-N as a percent of T-N which recorded in Table (4) may be noticed that, NO_3-N represent the second fraction of T-N in the soil samples of Talkha area. In the studied area, the highest content of NO_3-N as a percent of T-N was found in the profile 1, where the lowest one was recorded in profile 2 and increased with the distance increase from the factory. These results are in agreement with those obtained by Ju et al. (2006); Bordeleau et al. (2008); Graham et al. (2008); Zhao et al. (2011) and Garizabal et al. (2012).

Nitrite nitrogen (NO_2-N).

The studied soil samples content (mg/kg) of NO_2-N was very low, where its represent less than 2 % of T-N as shown in Table (4). The content of NO_2-N mg/kg was decreased with the depth of soil increase, but its as a percent of T-N appeared no clear relation with soil depth. The vertical distribution of NO_2-N in the studied area reveals that the main source of NO_2-N in the soil of this area resulted from the outline products for the tested factory. So that the mean values of soil content of NO_2-N in profile 1 was 1.02 mg/kg and its was 1.80 mg/kg in profile 2. The soil samples of Talkha area content of NO_2-N was slight high.

Organic nitrogen (O-N).

The data in Table (4) show that O-N represent the main N forms in the studied area, where this content was decreased with the increase of soil depth. The high content of O-N in the surface layer resulted from the high soil content (%) of OM in this layer. Also, the highest content of O-N was found in profile 2, where the lowest one was found in profile 1. This may be due to the highest content of T-N found in the profile 2 while the lowest one was recorded in profile 1.

Relationships Between Soil Properties and Its Content of Different Nitrogen Forms.

The presented data in Table (5) show the correlation coefficients "r" between the studied soil samples properties and the content of different N forms .i.e. total- N, NH_4-N, NO_3-N, NO_2-N, and O-N. The date show that the found values of "r" appeared wide variations from property to another as well as from N-forms to another. Concerning the correlation obtained for soluble cations, the data show higher values with K^+ and Na^+ and the lowest values were with Mg^{2+} and Ca^{2+} with

most N-forms under study. In addition, the high values of "r" were found with Cl^- compared with other soluble anions. On the other hand, the soil samples of Talkha area content of NO_3-N appeared affected by soil content of soluble cations and anions, where "r" values in the area were high.

Regarding the correlation between the studied soil chemical properties and its content of different N-forms as presented in Table (5) may noted that the high "r" values were found with total-N and NH_4-N and the lowest were found with NO_3-N and NO_2-N. Except with soil pH and its content of $CaCO_3$, all values of "r" for different soil properties and N-forms were positive. Most of

soil chemical properties in Talkha area grade low values of "r" with the determined N- forms.

Particle size distribution gave wide range for "r" varied from negative to positive with different N-forms (Table, 5). The soil contents of T-N, NH_4-N and OM were positively correlated with different soil particle fractions, where the content of NO_3-N and NO_2-N were correlated negatively with the studied soil particle fractions. In general, all soil properties (physical and chemical) have a greater and wide effects on the soil content of different N-forms and its transformation from form to another.

Table (5): Correlation coefficient (r) between the content of different N-forms and some soil properties in the selected soil profiles located around Talkha fertilizer factory at Talkha at, Dakahlia Governorate.

Soil properties		T-N-Ns	NH$_4$-Ns	NO$_3$-Ns	NO$_2$-Ns	ON-Ns
Soluble cations	Na$^+$	0.820 0.000	0.824 0.000	0.699 0.000	0.872 0.000	0.806 0.000
	K$^+$	0.911 0.000	0.606 0.001	0.633 0.001	0.631 0.001	0.913 0.000
	Ca^{+2}	0.798 0.000	0.808 0.000	0.674 0.000	0.909 0.000	0.785 0.000
	Mg^{+2}	0.564 0.003	0.458 0.021	0.671 0.000	0.520 0.008	0.552 0.004
Soluble anions	Cl$^-$	0.841 0.000	0.745 0.000	0.749 0.000	0.843 0.000	0.830 0.000
	HCO$_3^-$	0.781 0.000	0.898 0.000	0.701 0.000	0.909 0.000	0.763 0.000
	SO$_4^{-2}$	0.444 0.026	0.500 0.011	0.401 0.047	0.474 0.017	0.433 0.030
Chemical properties	EC	0.865 0.000	0.823 0.000	0.769 0.000	0.883 0.000	0.852 0.000
	pH	-0.791 0.000	-0.878 0.000	-0.616 0.001	-0.807 0.000	-0.776 0.000
	OM	0.722 0.000	0.854 .0000	0.689 0.000	0.915 0.000	0.702 0.000
	CaCO$_3$	-0.790 0.000	-0.720 0.000	-0.723 0.000	-0.752 0.000	-0.777 0.000
	CEC	0.447 0.025	0.613 0.001	0.398 0.049	0.673 0.000	0.433 0.031
	*AP	0.581 0.002	0.836 0.000	0.697 0.000	0.749 0.000	0.556 0.004
	*AK	0.771 0.000	0.778 0.000	0.720 0.000	0.887 0.000	0.757 0.000
particle size distribution	Clay	0.191 0.361	0.002 0.993	-0.191 0.360	0.025 0.905	0.203 0.330
	Silt	0.021 0.919	0.166 0.429	-0.049 0.815	0.315 0.125	0.016 0.939
	Silt+Clay	0.185 0.375	0.133 0.525	-0.208 0.319	0.273 0.187	0.192 0.358
	F-Sand	-0.135 0.519	-0.076 0.718	0.243 0.241	-0.228 0.273	-0.143 0.495
	C-Sand	-0.204 0.327	-0.346 0.091	-0.304 0.140	-0.257 0.215	-0.191 0.359

*AP: available P　　　　　　***AK: available K**

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Regression equations and also regression coefficients "R^2" considered a best way to discusse and explain the relationships between soil properties and its content of different nutrients . Data in Table (6) show these relations between soil properties and its content of N-forms. The found regression coefficient "R^2" were varied widely for each N-forms by the difference of soil properties. The found "R^2" values were high for all N-forms.

Table (6): Regression equations and regression coefficients (R^2) between the soil content of different N-forms and some soil properties in the selected soil profiles located around Talkha fertilizer factory at Talkha at, Dakahlia Governorate.

Soil properties	Regression equation	R^2
Soluble cations	T-N-Ns = - 2983 + 49.1 Na$^+$ + 3959 K$^+$ + 1083 Ca^{+2} - 230 Mg^{+2}	93.20
	NH$_4$-Ns = 106 + 7.42 Na$^+$ + 19.2 K$^+$ + 43.3 Ca^{+2} - 4.1 Mg^{+2}	71.90
	NO$_3$-Ns = 256 + 9.60 Na$^+$ + 10.90 K$^+$ + 17.20 Ca^{+2} + 25.00 mg^{+2}	65.00
	NO$_2$-Ns = 0.163 + 0.0179 Na$^+$ + 0.0569 K$^+$ + 0.270 Ca^{+2} - 0.0207 Mg^{+2}	86.00
	ON-Ns = - 3350 + 31.70 Na$^+$ + 3938 K$^+$ + 1058 Ca^{+2} - 252 Mg^{+2}	92.50
Soluble anions	T-N-Ns = - 6881 + 266 Cl^{-1} + 2172 HCO3$^-$ + 101 SO4^{-2}	77.30
	NH$_4$-Ns = - 207 + 2.45 Cl^{-1} + 225 HCO$_3^-$ - 2.78 SO$_4^{-2}$	82.70
	NO$_3$-Ns = 143 + 7.29 Cl^{-1} + 62.50 HCO$_3^-$ - 2.86 SO$_4^{-2}$	61.60
	NO$_2$-Ns = - 0.671 + 0.0203 Cl^{-1} + 0.732 HCO$_3^-$ - 0.0104 SO$_4^{-2}$	89.90
	ON-Ns = - 6790 + 257 Cl^{-1} + 1863 HCO$_3^-$ + 103 SO$_4^{-2}$	74.40
Chemical properties	T-N-Ns = - 48069 + 4151 EC + 5249 pH + 2676 OM - 1115 CaCO$_3$ + 24CEC + 24 AP - 2.71 AK	84.20
	NH$_4$-Ns =1031 - 25.0 EC - 92 pH + 71.8 OM - 8.64 CaCO$_3$ - 7.26 CEC + 54.2 AP - 0.0141 AK	97.00
	NO$_3$-Ns = - 372 + 45.5 EC + 31 pH - 76.0 OM - 4.8 CaCO$_3$ + 3.18 CEC + 24.6 AP + 0.0872 AK	81.20
	NO$_2$-Ns = - 10.4 + 0.160 EC + 1.16 pH + 0.322 OM - 0.0291 CaCO$_3$ +0.00085 CEC + 0.129 AP +0.000001 AK	95.70
	ON-Ns = - 49537 + 4138 EC + 5390 pH + 2655 OM - 1100 CaCO$_3$ + 29 CEC - 53 AP - 2.77 AK	82.60
Particle size distribution	T-N-Ns = - 10784 + 140 clay + 108 clay+silt	4.30
	NH$_4$-Ns = 41 - 5.8 clay + 7.92 clay + silt	3.00
	NO$_3$-Ns= 943 - 3.49clay - 4.57 clay+silt	4.90
	NO$_2$-Ns = - 1.28 - 0.0397 clay + 0.0592 clay + silt	11.40
	ON-Ns = - 11491 + 149 clay + 101 clay+silt	4.80
General	T-N-Ns = - 25860 - 1064 Na$^+$ + 3891 K$^+$ - 903 Ca^{+2} - 1295 Mg^{+2} + 1084 Cl^{-1} - 2552 HCO$_3^{-1}$ + 1273 SO$_4^{-2}$ - 370 EC + 1171 pH + 1115 OM - 148 CaCO$_3$ + 230 CEC + 397 AP + 0.38 AK - 78 Clay + 168 clay+silt	98.90
	NH$_4$-Ns = 1584 + 28.4 Na$^+$ - 14.8 K$^+$ + 64.0 Ca^{+2} + 20.6 Mg^{+2} - 30.1 Cl^{-1} + 13.0 HCO$_3^{-1}$ - 38.7 SO$_4^{-2}$ + 43.4 EC - 133 pH + 43.9 OM - 19.6 CaCO$_3$ - 10.7 CEC + 38.3 AP + 0.024 AK + 3.31 Clay - 4.08clay+silt	98.40
	NO$_3$-Ns = - 3113 + 0.1 Na$^+$ - 22.2 K$^+$ + 42 Ca^{+2} + 19.7 Mg^{+2} - 1.5 Cl^{-1} + 62 HCO$_3^{-1}$ - 6 SO$_4^{-2}$- 8 EC + 256 pH - 141 OM + 6.5 CaCO$_3$ + 11.5 CEC + 24.0 AP+ 0.145 AK +10.0 Clay - 3.7 clay+silt	89.60
	NO$_2$-Ns= - 8.40 + 0.0463 Na$^+$ - 0.040 K$^+$ + 0.340 Ca^{+2} + 0.029 Mg^{+2} - 0.0304 Cl^{-1}+ 0.180 HCO$_3^{-1}$ - 0.061 SO$_4^{-2}$ - 0.093 EC + 1.14 pH + 0.216 OM - 0.0490 CaCO$_3$ + 0.0145 CEC + 0.0310 AP + 0.000318 AK + 0.0386 clay - 0.0636 clay+silt	99.20
	ON-Ns = - 24490 - 1081 Na$^+$ + 3903 K$^+$ - 943 Ca^{+2} - 1334 Mg^{+2} + 1105 Cl^{-1} - 2538 HCO$_3^{-1}$ + 1300 SO$_4^{-2}$ - 399 EC + 1139 pH + 1182 OM - 41 CaCO$_3$ + 230 CEC + 308 AP + 0.28 AK - 82 clay + 159 clay+silt	99.00

These findings show a greater effect of all soil properties under study on the soil content of properties and its different N- forms. The clear observation which may be noted from the data in Table (6) is that, the lowest "R^2" values for the different soil properties were found with NO_3-N. This means that the soil content of NO_3-N have low affected by soil properties compared with those found with other N-forms. In addition, these findings reveals that the soils content of NO_3-N is high related with external factors .i.e. fertilization, irrigation water, outline product of the presented industrial activities and others.

The presented data in Table (7) show the predicted soil content (mg/kg)of NO_3-N using the regression equations listed in Table (6). Also, the content of predicted NO_3-N (NO_3-N) as a percent of determined NO_3-N (D NO_3-N) in the same soil was calculated by (NO_3-N) / (D NO_3-N)*100. These data show that more than 90% of the studied soil samples have P NO3-N more than D NO_3-N.

These findings are clear in the soil profiles located after the studied nitrate source. Also, these findings become clear at the soil depth of 0-15 and 15-30 cm compared with that at the depths of 30-60 and 60-90 cm. The lowest percent of P NO_3-N in the deeper soil layers in relation with different soil properties under study reveals and approved that the soilsof the studied area content of NO_3-N was related with external factory such as fertilization, quality of irrigation water, pollution source...etc., more than those with soil properties. Regarding the calculated values of P NO_3-N as well it' a percent of D NO_3-N may be also noted that the high values of P NO_3-N were found using the regression equation between soil chemical properties and the soil content of NO_3-N, except the soil profile located before the factory. On the other hand, the lowest percent was found using the regression equation of soluble anions(95.61)%.

Irrigation and Drainage Water Chemical Composition.

The presented data in Table (8) show EC (dSm^{-1}) for both irrigation and drainage water in the studied area. In general, EC values were decreased with the distance increase from the factory compared with that in location 1.These findings reveals that, outline products of nitrogenous fertilizers resulted in an increase salinity level in both irrigation and drainage water. Irrigation water in Talkha area characterized by relative low EC values. On the other hand, drainage water in the same area have a high EC values. These results reveals that outline products reached to the soils and drains from fertilizers factory have a high content of soluble salts.

Regarding irrigation and drainage water pH presented in Table (8) may be noticed that, in both irrigation and drainage water in the studied area pH values were increased with the distance increase of the factory. At the same distance of the factory, pH was low in irrigation water than that in drainage water. These findings reveals that outline products of fertilizers factory have large amounts of acidic compounds.

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Regarding the content (mg/l) of NH_4-N and NO_3-N in both irrigation and drainage water, the data in Table (8) show that in both irrigation and drainage water at different distance of the factory, the water content of NO_3-N was higher than that of NH_4-N. Also, at the same distance of the factory the content of NH_4-N and NO_3-N in drainage water was higher than found in irrigation water. These results are attributed to the large amounts of NO_3-N reached directly from the final outline products of this factory to drainage water in addition with reached by leaching with irrigation water from different soil layers to drains.

Table (8):Some chemical analysis for both irrigation and drainage water taken at different distance of Talkha fertilizer factory at Talkha , Dakahlia Governorate.

Location No.	Distance from factory (M)	Irrigation water				Drainage water			
		pH	EC (dSm⁻¹)	NH_4- N mg /l	NO_3- N mg /l	Ph	EC (dSm⁻¹)	NH_4-N mg /l	NO_3 – N mg /l
1	-500	7.70	0.49	20.80	31.10	8.05	0.83	20.09	55.13
2	000	7.50	0.99	28.70	38.50	7.75	1.98	92.40	130.20
3	500	7.50	0.59	25.50	56.00	7.80	1.90	79.80	88.20
4	1000	7.55	0.57	25.00	33.60	7.80	1.75	48.65	71.40
5	1500	7.65	0.55	25.05	32.60	7.88	1.05	37.80	64.40

Plant Content of Nitrogen.

The presented data in Table (9) show the content (%) of NH_4-N and NO_3-N in both shoots and roots of plants cultivated in the studied area, at different distances of the factory. The content of both NH_4-N and NO_3-N in plant shoots was higher than that found in the plant roots. The content of NO_3-N was higher than that found with NH_4-N. Also, the plant content of both NH_4-N and NO_3-N was decreased with the distance increase from factory. This trend was in harmony with the soil content of both NH_4-N and NO_3-N content in both soils and irrigation water. These results are in agreement with those obtained by Rahmani (2006); Tamme et al. (2006); Prasad and Avinesh (2008); Chen *et al.* (2010) and Huang *et al.* (2010).

Table (9): Plants content (mg / kg) of different N – Forms at different distances of Talkha fertilizer factory of Talkha at of Dakahlia Governorate.

Location No.	Distance from factory (M)	Plant type	Shoots			Roots		
			T – N (%)	NH_4-N (%)	NO_3 – N (%)	T – N (%)	NH_4-N (%)	NO_3 – N (%)
1	-500	Corn	1.17	0.12	0.32	0.85	0.10	0.53
2	000	Rice	1.50	0.17	0.71	1.25	0.17	0.71
3	500	Rice	1.49	0.17	0.72	1.05	0.17	0.72
4	1000	Clover	2.32	0.50	1.18	2.35	0.50	1.18
5	1500	Vridity	2.44	0.67	1.51	2.12	0.67	1.51

Thus it can be concluded that:-

1- The wastes of various industrial activities containing some hazard products.

   So, such these products must be treated before dumping into the soil and water.

2- The products of the industrial activities must be analyzed.

3- The environment effects of industrial activities wastes must be evaluated according to environment protection law.

4- Designed program to prevent soil pollution.

5- Contentions evaluate to pollution status and development.

6- Account the needs of the crop of nitrogenous fertilizers.

7- Rationalization of the use of mineral fertilizers and raise its efficiency of use in agriculture.

8- The use of good agricultural practices

9- Management of irrigation water and agricultural drainage

10- Non-wasteful use as agricultural fertilizers

11- Not cultivate eny food crops specially that eating fresh in the polluted soil.

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تأثير مصنع الأسمدة النيتروجينية (مصنع سماد طلخا) على حالة النترات فى البيئة الزراعية

منـــال فتحـــى طنطـــاوى¹ وصـــلاح علـــى أبوالنجـــا² والحسـينى عبـدالغفار أبوحسـين²   و محمد سمير أبوالفتوح.¹

١- معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر.

٢- قسم علوم الأراضى – كلية الزراعة – جامعة المنوفية - مصر.

أجريت هذه الدراسة بغرض تقييم مصنع الأسمدة النتروجينية (مصنع سماد طلخا) كمصدر تلوث بالنترات وكذلك المحتوى من النترات فى كل من التربة وماء الرى وماء الصرف وكذلك النباتات المنزرعة بمنطقة طلخا محافظة الدقهلية مصر. أخذت عينات أرض من منطقة الدراسة على أعماق صفر – ١٥ و ١٥ – ٣٠ و ٣٠ – ٦٠ و ٦٠ – ٩٠ سم من على مسافات ٥٠٠ متر قبل المصنع (للمقارنة) وصفر و ٥٠٠ و ١٠٠٠ و ١٥٠٠ متر بعد المصنع. تم تقدير بعض الخواص الطبيعية والكيميائية لعينات التربة تحت الدراسة. كمـا تـم تقديرمحتوى هذه العينات من الصور المختلفة للنيتروجين (الكلى والأمونيومى والنتراتى والنتريتى والعضوى). عند نفس مواقع عينات التربة أخذت عينات من ماء الرى وكذلك مـاء الصرف وقدر فيها رقم الحموضة ودرجة التوصيل الكهربى وكذلك محتواها من كل من النيتروجين الأمونيومى والنتراتى وعند نفس المواقع كذلك أخذت عينات من النباتات المنزرعة وقدر محتواها من كل من النيتروجين الكلى والأمونيومى والنتراتى. بعد ذلك تم حساب العلاقات بين بعض خواص التربة ومحتواها من صور النيتروجين المختلفة. ومن هذه العلاقات وكذلك معادلات التوقع تم حساب القيم المتوقعة لمحتوى التربة من النترات.

أظهرت النتائج المتحصل عليها أن محتوى التربة من الصور المختلفة للنيتروجين يتناقص بزيادة العمق وذلك فيما عدا النيتروجين النتراتى الذى إزداد المحتوى منه حتى عمق ٦٠ سم. وقد لوحظ كذلك أن المحتوى من جميع هذه الصور يتناقص بزيادة المسافة من المصنع ولقد أظهرت العلاقات بين بعض صفات التربة والمحتوى من صور النيتروجين المختلفة إختلافا كبيرة معتمدة على الصفة وكذلك صورة النيتروجين المقدرة. وكانت القيم المقدرة للنيتروجين النتراتى أعلـى مـن تلـك المحسوبة للنترات. وكـذلك فإن محتـوى كـل مـن النيتروجين النتراتى والأمونيومى فى ماء الرى وماء الصرف وكذلك العينات النباتية يتنـاقص بزيـادة المسافة عن المصنع.

تأثير مصنع الأسمدة النيتروجينية (مصنع سماد طلخا) على حالة النترات فى البيئـة الزراعية

Table (7): Predicted Values of soil content (mg/kg) of nitrate (P-NO$_3^-$) and it's a percent (%) of the determined nitrate (D –NO$_3^-$) in relation with soil properties in the soil profile selected around Talkha fertilizer factory of Talkha, Dakahlia Governorate.

Profile (No)	Distance from factory (M)	Soil depth (cm)	Soluble cations		Soluble anions		Chemical properties		partical size distribution		General	
			P-No$_3^-$ (mg/kg)	% of D-No$_3^-$	P-No$_3^-$ (mg/kg)	%of D-No$_3^-$	P-No$_3^-$ (mg/kg)	% of D-No$_3^-$	P-No$_3^-$ (mg/kg)	% of D-No$_3^-$	P-No$_3^-$ (mg/kg)	% of D-No$_3^-$
1	-500	0-15	534.70	187.61	403.30	141.51	331.12	116.18	390.44	136.99	334.63	117.42
		15-30	486.75	131.56	356.90	96.46	319.08	86.24	430.15	116.26	334.59	90.43
		30-60	452.81	117.61	330.76	85.91	328.91	85.43	446.78	116.05	343.11	89.12
		60-90	426.48	174.07	303.90	124.04	294.13	120.04	434.13	177.19	305.14	124.55
		Mean	475.27		349.05		317.51		425.37		329.67	
2	0	0-15	751.22	148.76	496.79	98.37	552.59	109.42	407.85	80.76	501.44	99.29
		15-30	815.34	137.03	580.22	97.52	509.73	85.67	418.36	70.31	599.44	100.75
		30-60	755.41	128.04	444.32	75.31	563.73	95.55	461.62	78.24	579.36	98.19
		60-90	543.19	132.49	385.52	94.03	467.64	114.06	482.22	117.61	439.25	107.13
		Mean	716.36		476.88		532.22		442.69		531.78	
3	500	0-15	682.69	142.82	501.93	105.01	481.08	100.64	428.31	89.60	500.98	104.81
		15-30	633.67	121.63	466.65	89.57	500.42	96.05	438.54	84.17	505.14	96.96
		30-60	585.42	106.05	454.93	82.41	514.28	93.17	441.44	79.97	518.02	93.84
		60-90	587.61	148.76	420.49	106.46	468.61	118.64	433.71	109.80	447.32	113.25
		Mean	622.51		460.89		488.34		437.99		502.66	
4	1000	0-15	640.25	139.19	497.57	108.17	463.33	100.73	435.75	94.73	447.64	97.31
		15-30	585.66	119.04	427.04	86.79	523.80	106.46	471.41	95.81	554.38	112.77
		30-60	569.60	109.54	399.18	76.77	482.99	92.88	458.36	88.15	523.78	100.73
		60-90	491.92	136.64	375.17	104.22	387.07	107.52	463.20	128.67	379.19	105.33
		Mean	571.83		424.87		470.44		457.19		471.57	
5	1500	0-15	572.58	146.82	395.55	101.42	383.06	98.22	413.33	105.98	401.14	102.86
		15-30	487.96	110.90	387.94	88.17	418.45	95.10	434.59	98.77	425.57	96.72
		30-60	491.82	104.64	364.81	77.62	416.85	88.69	447.28	95.17	437.28	93.04
		60-90	459.5	141.39	331.06	101.87	327.09	100.64	446.77	137.47	302.82	93.17
		Mean	503.17		369.85		389.20		435.46		402.33	
		General mean	577.83		416.31		439.54		439.74		447.60	