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AN AGRO-ECONOMIC EVALUATION FOR SYNTHETICALLY MODIFIED UREA IN CLAYEY SOILS

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ABSTRACT: Ureaform (UF) has been synthesized by using urea as a primary compound to produce slow-release nitrogen fertilizer (SRNF). At attempt using such fertilizer as an alternative for urea under Egyptian conditions, some problems have arisen, such as the determination of its proper doses and optimum conditions to stimulate its breaking- down and its mineralization to produce NH_4^+ or NO_3^- accessible to plant. Therefore, an experiment has been conducted at El-Gemmeiza Agric. Res. Station to deal above-mentioned problems. Three successive crops, wheat (*T.aestivum* L.), maize (*Zea mays* L.) and wheat again have been fertilized by different rates of ureaform (90, 135 and 180 KgN/fed) frequently keeping with different combinations of urea and farmyard manure (only ureaform, ureaform +urea and ureaform + farmyard manure). Beside, urea fertilizer treatment at rate 135 Kg N/fed and control.

The results indicate: Regardless of the nature of treatment, highest yield quantity has been recorded for the first crop followed by the second then the third one.

As for treatments, urea treatment has given higher yield than others only with the first crop. Distinct superiority for yield quantity of ureaform treatments to that of urea one at the second crop has been noticed. At all treatments, marked reduction for third yield quantity has been found.

As for N, P and K plant content ,there is gradual decline for N% , P% and K% contents for studied cropping succession. Urea treatment, in general, has given highest N% value comparing to its corresponding of ureaform treatments at first crop while at the second crop, it has given lowest one, besides, approximate similarity among the effect of urea and ureaform treatments on N% values at the third crop has been noticed.

No trend has been determined concerning P% at first, second or third crop, however, high rates of UF-nitrogen have sometimes recorded some superiority with K%.

As for N-uptake and N-recovery, urea treatment has recorded the highest value only at the first crop while at second and third crop, it has given the lowest ones. Ureaform treatments have given uniformed rational values at first and second crop with marked decrease at the third crop.

Total N- recovery of ureaform treatments have ranged from 1.3 to 1.5 times as much as that of urea treatment.

Under the condition of this experiment, investment factor of ureaform treatments has almost been inferior to that of urea, however, treatments of low nitrogen rates of ureaform have recorded rational values for such factor.

Key words: Urea, ureaform , nitrogen, wheat, maize, nitrogen recovery, NR, UF, SRNF, agro-economic, I.F. invest. factor

INTRODUCTION

The farmers in the developing countries are custommed to applying urea as a nitrogen fertilizer for different crops because of its high nitrogen content and its low price.

Numerous investigators mentioned several harmful effects due to the use of urea fertilizer either in soil or in plant Menon *et al.* (1989), Yerokun and christenson, (1989), Knowles *et al.* 1991, Poerster *et al.* 1990 a,b, Bremner, (1995)and Abbady *et al.* (1999).

One of the most important alternatives of urea application is the using ureaform (condensates of urea molecules) which had the long history in use as a slow release nitrogen fertilizer for many types of growing media and plants (Mahmoud *et al.* 1991, Tindall and Detrick, 1999, Habashy (2001), Halvorson *et al.* 2002 and Abbady *et al.* (2003)

Many trials showed that with the use of ureaform fertilizer, N-leaching can be minimized comparing with urea, even though N-application rates obviously exceeded those usual in practice Mahajan and Tripathi, 1991 and Abbady *et al.* (1991). Minimum N-leaching would have reflected on the nitrate amounts in surface and ground water in turn which would have also reflected on human health. Also, number of trials proved that Ureaform had a far

greater residual effect than other nitrogen fertilizers Hegazy *et al.* 1998, Abbady *et al.* (2003) and Awaad *et al.* (2003).The objective of this paper is to identify the optimum rate of ureaform nitrogen must be added to 3 successive crops (wheat, maize and wheat) as well as conditions of practice at which ureaform can be successfully used as a nitrogen fertilizer to obtain optimum yield and economic return.

MATERIALS AND METHODS

A field experiment has been conducted at El-Gemmeiza Agric, Res. Station (vertisols, Typic Torrents, clayey, montmorillonitic, thermic and slightly calcareous). To determine the optimum nitrogen rate of ureaform fertilizer as well as best conditions of application which guarantee proper nitrogen release rate which would be reflected upon the productivity of suggested cropping succession, wheat (Sakha 69, variety), maize (Giza,2 variety) and wheat again. Physical and chemical properties of soil have presented in Table 1.

Ureaform (40%N) with dissolution characteristics presented in Table 2 ,prepared according to Abbady *et al.* 1992, has been used in 3 groups of treatments as shown in Table 3.

Table 1. Some physical* and chemical properties of studied soil**

Physical properties	Value	Chemical properties	Value
		pH (1:2.5)	7.57
Coarse sand ,%	0.51		
Fine sand ,%	16.18	EC (dsm-1)	0.88
Silt ,%	37.63	Cations, meq/100g soil	0.16
Clay, %	45.67	Ca^{++}	
Textural class	Clayey	Na^{+}	0.29
		K^{+}	0.01
		Anions, meq/100g soil	
		HCO^{-}_{3}	0.25
		$CO^{=}_{3}$	-
		Cl^{-}	0.07
		$SO4^{--}$	0.31
		O.M.%	1.88
		Available N ppm	51.78
		Available K ppm	690

* Particale size distribution was determined according to pipette method (USSL Staff, 1954) .

** Chemical analyses were performed on the extract of soil paste(Jackson,1967)

Besides, urea treatments with a rate of 135 Kg N/fed. which has been suggested for comparison. Moreover, the non-fertilized treatment (control) has been also included. The whole dose of ureaform fertilizer has been broadcasted, as a single application, just before the first irrigation of the first crop while in case of urea, the amount has been splitted into two doses and broadcasted ahead planting of the first and second crop. Recommended doses of both calcium super phosphate and potassium sulphate have been applied.

Table 2. Dissolution characteristics of ureaform

Character	Value
CWSN	21.17
HWSN	30.91
CWS % of total nitrogen	54.49%
Activity index	55.09%

CWSN: Cold Water Soluble Nitrogen
HWSN: Hot Water Soluble Nitrogen
Activity index = {CW IN N% - HW IN N% / CW IN N%} x100

Table 3. Applied treatments

Treatment	Nitrogen rate Kg N/fed
1- Control	0.0
2- Urea (U)	135
(UF)	
3- Ureaform	90
4- Ureaform	135
5- Ureaform	180
(UFU)	
6- Ureaform + Urea	60 (UF) + 30 N (Urea)
7- Ureaform + Urea	90 (UF) + 45 N (Urea)
8- Ureaform + Urea	120 (UF) + 60 N (Urea)
(UFF)	
9- Ureaform + farmyard	90 (UF) + 15 m^3 FYM
10- Ureaform + farmyard	135 (UF) + 15 m^3 FYM
11- Ureaform + farmyard	180 (UF) + 15 m^3 FYM

The experiment has been started by the first crop, wheat (winter crop) which has been planted manually in rows 20 cm apart, followed by maize (summer crop) which has been planted in the same plots of preceding wheat. In order to study any other residual effect of N-fertilizer once again, wheat has been planted.

The experiment has been laid out in complete randomized blocks design with four replications consisting of 11 treatments Snedecor and Cochran, (1967).

Plant samples (grain, straw and stover) have been taken, oven -dried at 70°C, weighed, ground and chemical analysis was performed according to Klute (1986).

RESULTS AND DISCUSSION

The study has included the effect of the different nitrogenous fertilization treatments on yield, percentage concentration of N, P and K and nitrogen recovery for each of the studied successive crops as well as calculation of economic return.

Yield of the Three Successive Crops

As for first crop, wheat (*T. aestivum*, L.), data given in Table 4 illustrate that the different treatments showed insignificant effect on grain yield, however, it is observed that such treatments have significantly effect on the straw and total yield; the group of (UF), has given straw yield less than that of other treatments. Urea treatment (U), UF + urea (UFU) and UF + farmyard manure (UFF) treatments have given marked amounts of straw yield. The values of harvest index (H.I.) have confirmed these results. It seems that the straw yield has been increased as the soluble nitrogen form increased and vise versa. Here, it would be mentioned that urea treatment has considered soluble nitrogen form, (UFU) treatments has contained free urea and (UFF) treatments has been certainly enriched with soluble nitrogen form as a result of farmyard manure effect on acceleration of ureaform breaking-down process and subsequently the fast release of its nitrogen must be done. This results has been in agreement with that of Hegazy *et al.* (1998).

About maize (*Zea mays* L.) as the second crop, the data show that the grain, stover and total yield have been significantly affected by different treatments comparing to control. Also, the values of such yields of UF – groups treatments have slightly been superior to those of urea treatment. This tendency indicated the presence of rational residual

Table 4. Yield of the three successive crops (wheat, maize and wheat), harves index* and % relative change of yield for each as affected by fertilization treatments

Treatment	First crop (ton/fed)				Second crop (ton/fed)				Third crop (ton/fed)				Yield summation of 3 crops (ton/fed)			% Relative change of yield calculated of urea treatment yield		
	Grain	Straw	Total	H.I	Grain	Straw	Total	H.I	Grain	Straw	Total	H.I	Grain	Straw	Total	Grain	Straw	Total
Control	2.07	5.99	8.06	0.26	1.76	5.74	7.50	0.23	1.23	1.77	3.00	0.41	5.06	13.50	18.60	-28.93	13.01	-17.84
Urea, 135	3.41	7.62	11.03	0.31	2.46	6.20	8.66	0.28	1.25	1.70	2.95	0.42	7.12	15.52	22.64	-	-	-
(UF)																		
UF, 90	3.24	6.16	9.40	0.34	2.63	7.87	10.50	0.25	1.46	2.04	3.50	0.42	7.33	16.07	23.40	2.94	3.54	3.36
UF, 135	3.44	6.45	9.89	0.35	3.22	7.37	10.59	0.30	1.55	2.13	3.68	0.42	8.21	15.95	24.16	15.31	2.70	6.71
UF, 180	3.44	6.95	9.89	0.35	3.32	6.80	10.12	0.33	1.56	2.16	3.72	0.40	8.32	15.41	23.73	16.85	0.71	4.81
Mean	3.37	6.35	9.73	0.35	3.06	7.35	10.40	0.29	1.52	2.11	3.63	0.41	7.95	15.81	23.76	11.70	2.31	4.96
UFU)																		
	3.71	6.80	10.51	0.35	2.90	7.68	10.58	0.27	1.42	1.95	3.37	0.42	8.03	16.43	24.46	12.78	5.86	8.04
FU+Urea, 90	3.15	7.21	10.36	0.30	2.69	6.90	9.59	0.28	1.41	2.00	3.41	0.41	7.25	16.11	23.36	1.83	3.80	3.18
UF+Urea, 135	3.53	7.21	10.74	0.33	3.07	7.31	10.38	0.30	1.52	2.10	3.62	0.42	8.12	16.62	24.74	14.05	7.09	9.28
UF+Urea, 180	3.46	7.07	10.53	0.33	2.86	7.62	10.18	0.28	1.45	2.02	3.47	0.42	7.80	16.39	24.19	9.55	5.58	6.83
(UFF)																		
UF,90+fym	3.44	6.83	10.27	0.33	2.68	7.58	10.26	0.26	1.52	2.04	3.56	0.43	7.64	16.45	24.09	7.30	5.99	6.41
UF,135+fym	3.18	7.73	10.91	0.29	3.08	7.78	10.86	0.28	1.83	2.60	4.43	0.41	7.87	17.45	25.32	10.53	12.43	11.84
UF, 180+fym	3.09	7.71	10.80	0.29	3.08	7.78	10.86	0.28	1.83	2.60	4.43	0.41	8.00	18.09	26.09	12.36	16.56	5.24
Mean	3.24	7.42	10.52	0.30	2.98	7.63	10.94	0.28	1.62	2.27	3.90	0.42	7.84	17.33	25.17	10.06	11.16	11.16
L.S.D 5 %	NS	1.24	1.28	-	0.66	2.13	2.13	-	NS	NS	NS	-						

nitrogen amounts from UF-nitrogen, which have been enough to give such results. Such presence has been expected, accordingly, its nature, but in case of urea treatment, it is thought that the soil under study has high capability for nitrogen retention due to soil properties Table 1.

Regarding the third crop, obvious reduction in values of grain, straw and total yield has been occurred. Such reduction may be attributed to no fertilization has been carried out for urea treatment at planting the third crop. On the other hand, there has been marked depletion for UF-nitrogen through the growth periods of studied cropping succession, since the ureaform fertilizer has been applied as a single application at the beginning of the experiment.

No difference for the values of H.I. has been noticed between UF-groups treatments and that of urea treatment at either second or third crop.

It would be pointed out that no-effect for additions of urea or farmyard manure (UFU and UFF) has been occurred on yield values of cropping succession, however, it is observed that the high rates of ureaform have given comparatively higher yield. Urea or farmyard manure have been added to ureaform as an activating agents to breaking-down ureaform complicated chains, however, such action has not been hinted where the three groups of ureaform treatments have mostly had the same behavior. This no-response has been inspired with the experiment soil properties.

Examination the data of yield summation of three crops shows that the obtained yield from UF-groups treatments, in general, has been superior to that of urea, increases in yields have ranged from 7.33 to 8.323 Ton/ fed, from 15.95 to 18.09 and from 23.4 to 26.09 ton/fed in the same order, against 7.12, 15.52 and 22.64 ton/ fed for the urea treatment.

Taking the yield summation of urea treatment as a standard level, the relative change of yield could be calculated for the other treatments in percentage values. They have ranged for grain yield from 1.83% to 14.05%, for straw + stover, from- 0.17% to 16.56% and for total yield, from 3.18% to 15.24% .

Nitrogen, Phosphorus and Potassium Content

Results of N, P and K plant content as percentage concentration values for studied cropping succession presented in Table 5 show clear decline for N%, P% and K% values has been along with yield decreasing of such

Table 5 . Concentration of nitrogen, phosphorus and potassium % for the studied crops

Treatment	First Crop						Second Crop						Third Crop					
	N%		P%		K%		N%		P%		K%		N%		P%		K%	
	grain	straw	grain	straw	grain	straw	grain	stover	grain	stover	grain	stover	grain	straw	grain	straw	grain	straw
Control	1.44	0.30	0.25	0.10	0.50	1.70	1.10	0.28	0.20	0.13	0.28	0.65	1.22	0.29	0.13	0.30	0.35	1.60
Urea,135 (U)	1.81	0.58	.33	0.14	0.53	1.29	1.34	0.35	0.30	0.15	0.31	0.86	1.24	0.29	0.24	0.32	0.38	1.43
(UF)																		
UF,90	1.64	0.57	0.12	0.26	0.48	1.96	1.51	0.24	0.36	0.14	0.28	0.89	1.19	0.29	0.31	0.33	0.40	1.60
UF,135	1.73	0.57	0.39	0.26	0.45	1.40	1.73	0.39	0.26	0.13	0.18	0.86	1.24	0.29	0.27	0.27	0.46	1.30
UF,180	1.80	0.66	0.28	0.11	0.68	1.93	1.66	0.66	0.37	0.13	0.18	0.80	1.43	0.33	0.34	0.34	0.48	1.70
	1.72	0.60	0.26	0.21	0.57	1.76	1.63	0.43	0.33	0.13	0.17	0.85	1.29	0.30	0.31	0.31	0.45	1.53
(UFU)																		
UF+Urea,90	1.63	0.51	0.35	0.13	0.68	2.04	1.35	0.30	0.35	0.16	0.25	1.32	1.19	0.25	0.35	0.30	0.53	1.50
UF+Urea,135	1.70	0.66	0.28	0.07	0.45	1.64	1.38	0.40	0.31	0.35	0.34	0.92	1.67	0.33	0.34	0.34	0.45	1.65
UF+Urea,180	1.81	0.68	0.20	0.03	0.45	1.86	1.69	0.55	0.26	0.30	0.30	1.54	1.78	0.34	0.35	0.32	0.45	1.70
	1.71	0.62	0.28	0.08	0.53	1.85	1.47	0.42	0.30	0.27	0.30	1.26	1.55	0.31	0.35	0.32	0.48	1.62
(UFF)																		
UF,90+fym	1.62	0.54	0.28	0.04	0.43	1.40	1.36	0.36	0.15	0.15	0.25	1.27	1.31	0.34	0.34	0.34	0.50	1.40
UF,135+fym	1.66	0.62	0.19	0.14	0.53	1.42	1.47	0.39	0.26	0.26	0.21	1.06	1.40	0.45	0.26	0.24	0.48	1.65
UF,180+fym	1.92	0.67	0.35	0.09	0.63	2.25	1.85	0.60	0.35	0.15	0.21	0.88	1.67	0.45	0.27	0.17	0.45	1.65
	1.73	0.61	0.27	0.09	0.53	1.69	1.56	0.45	0.25	0.19	0.22	1.22	1.46	0.41	0.29	0.25	0.48	1.57

succession where they have started with comparatively high values at first crop then they have gradually decreased till the third crop.

At first crop, obvious similarity among the nitrogen content of both grain and straw of urea treatment and those of high nitrogen rate of ureaform treatments at each (UF), (UFU) and (UFF) has been noticed. This has indicated its ability to release sufficient of nitrogen.

No clear trend has been observed concerning P% and K% values, however, K% values of high UF-nitrogen rates have been relatively higher, which were in agreement with those of Abbady *et al.* (2003).

At the second crop, N-content in grains was higher under urea treatments, while the ureaform treatments have given the highest N-content in stover, yield. This proved that the UF-residual nitrogen has been able to offer good meal of nitrogen to plant, in this respect, Koren' kov (1983) reported that the residual effect of ureaform fertilizer on the second and third crop was apparently higher than that of the conventional nitrogen fertilizers. As for P% and K%, the results show that UF-treatments were superior to those of urea and control treatments.

At third crop, the prevailing trend has nearly shown similarity among N% values of all-treatments with marked superiority being occurred for high UF-nitrogen rates, as well as P% and K% in grain.

Remarkably, the ureaform has been less effective within the first season than urea when applied at usual rates, however, at liberal rates, it has not increased the N soil solution concentration, their nitrogen is almost unleachable and its losses due to denitrification or volatilization are minimal, yet it is taken by plants over a longer period of time as this fertilizer gradually break-down. In this study, a part from adequate nitrogen nutrition of the first crop, considerable after effect on subsequent crops has been observed.

Nitrogen Uptake and Its Recovery:

Data of N-uptake and nitrogen recovery (NR) corrected for control which presented in Table 6 show that at first crop, the highest N-uptake and NR values has been obtained from urea treatment. The effect of the different treatments on NR values can be ordered on average as follows:

$$U > (UFU) > (UFF) \cong (UF)$$

These results have been coincided with most studies which

Table 6. N-uptake and N- recovery (NR) for First, Second and Third Crop as affected by fertilization treatments

Treatment	First Crop				Second Crop				Third Crop				Total	
	N-uptake (kg/fed)			NR%	N-uptake (kg/fed)			NR%	N-uptake (kg/fed)			NR	N-uptake (kg/fed)	NR%
	grain	straw	Total		grain	Stover	Total		grain	straw	Total			
Control	29.80	17.97	47.77	-	19.36	16.07	35.43	-	15.01	5.13	20.14	-	99.82	-
Urea,135(U)	61.70	44.20	105.90	43.06	32.96	21.70	54.66	14.24	15.50	4.93	20.43	0.21	171.73	57.51
(UF)														
UF,90	53.10	35.11	88.21	44.93	39.71	18.89	58.60	25.74	17.37	5.92	23.29	3.50	170.10	74.17
UF,135	59.50	36.76	96.26	35.92	55.71	28.74	84.45	36.31	19.22	6.18	25.40	3.90	206.11	76.13
UF,180	61.92	45.87	107.42	33.34	55.11	44.88	99.99	35.87	22.31	7.13	29.44	5.17	273.22	74.38
	58.17	39.25	97.42	38.06	50.18	30.84	81.01	32.64	19.63	6.41	26.04	4.19	204.47	74.89
(UFU)														
UF+Urea,90	60.47	34.68	95.15	52.64	39.15	23.04	62.19	29.73	16.90	4.88	21.78	1.82	179.12	84.19
UF+Urea,135	53.55	47.59	101.14	39.53	36.32	27.60	63.92	21.10	23.55	6.60	30.15	7.41	195.21	68.04
UF+Urea,180	63.89	49.03	112.92	36.19	51.88	40.21	92.09	31.48	27.06	7.14	34.20	7.81	239.21	75.48
	59.30	43.77		42.79	42.45	30.28	72.73	27.44	22.50	6.21	28.71	5.68	204.51	75.91
(UFF)														
UF,90+fym	55.73	36.88	92.61	49.82	36.45	27.29	63.74	31.46	19.91	6.94	26.85	7.45	183.20	88.73
UF,135+fym	52.79	47.93	100.72	39.22	46.60	29.41	76.01	30.06	21.28	9.81	31.09	8.11	207.82	77.39
UF,180+fym	59.33	51.66	110.99	35.12	56.98	46.68	103.66	37.91	30.56	11.70	42.26	12.29	256.91	85.32
	55.95	45.49	101.44	41.39	46.68	34.46	81.14	33.14	23.92	9.48	33.40	9.28	215.98	83.81

NR: Nitrogen recovery % = [Total N uptake for the treatment (kg/fed) - Total N uptake for the control kg/fed) / N added]×100

achieved in this field, for example, Hegazy *et al.* (1998), Habashy, (2001) and Abbady (2003).

At second crop, the lowest N-uptake and NR values has been obtained from urea treatment and highest value has been for (UFF) treatment (on average). The rank of the effect of these treatments on the RN or NUE can be come as follow:

(UFF) > (UF) > (group) > (U).

At third crop, although N-uptake and NR values of all treatments have been considerably low, UF treatment have still been superior to urea one. Also, it is interested to indicate that the high rates of ureaform treatment have frequently given the highest values. Thus, this fertilizer can be applied at high rates once a season or every two or three seasons without any danger of nitrogen lost or adverse effect on plant growth.

For more elucidation, Fig (1) shows sharp decline for curve of urea NR progressing with the time process of the experiment.

On the other hand, curves pattern of ureaform treatments, in general, has revealed a state of somewhat uniformity for NR, particularly, at the first and second crop comparing to urea. Total NR data in Table, 6 illustrate poor performance for urea treatment comparing to that of UF treatments although its rate has split 2 times at application. Nitrogen recovery (NR) value represented 57.51% for urea treatment whereas it for UF treatment has ranged from 74.89% to 83.81% (on average, 78.2 %). Here, ureaform fertilizer has had a far greater distinction than urea, where its relative increase of NR proportionally to that of urea reached about 35.98 %.

For more confirmation on previous mentioned concept, Fig. (2) shows the part of depleted-nitrogen by plant for urea and ureaform treatments (on average) against the undetected-part and which has probably represented the remained and/or lost nitrogen. It has been 42.49 % for urea whereas it has ranged from 16.19 to 25.11 for ureaform treatments. This is related to the fact that ureaform compound is a condensates of urea molecules which need more time to break-down into single urea molecules and then converts to ammonium ions (Abbady *et al* 1999), i.e. no nitrogen loss has been occurred from ureaform compound, even if it was so, it would be very neglected.

Economic Return

Economic reasons have essentially played a decisive role in whether (SRNF) would remain restricted to a few special crops

Table 7. Yield increase, gross return, net return and investment factor (I.F.) produced from N-fertilization for the successive three crops under study

Treatment	Norm of applied nitrogen, kg/fed	Yield increase, Ton/fed		Gross return at market rate, L.E			Invested in N.Fert, L.E.	Net return, L.E.	I.F.
		Wheat	Maize	Wheat	Maize	Total			
Urea,135 (U)	135	1.36	0.70	1450.67	388.50	1839.17	179.00	1660.17	9.27
(UF)									
UF,90	90	1.40	0.87	1493.34	282.85	1976.19	200.00	1776.19	9.88
UF,135	135	1.69	1.50	1802.67	832.50	2635.17	300.00	2335.17	8.78
UF,180	180	1.70	1.56	1813.34	865.80	2679.14	400.00	2279.14	6.70
(UFU)									
UF+Urea,90	60+30	1.83	1.14	1952.01	632.70	2584.71	173.49	2411.22	14.90
UF+Urea,135	90+45	1.26	0.93	1344.01	516.15	1860.16	260.27	1599.73	7.15
UF+Urea,180	120+60	1.75	1.31	1866.67	727.05	2593.72	346.98	2246.74	7.48
(UFF)									
UF +fym90	90	1.67	0.92	1781.34	510.60	2291.60	250.00	2041.60	9.17
UF +fym135	135	1.40	1.41	1493.34	782.55	2275.89	350.00	1925.89	5.50
UF +fym180	180	1.67	1.32	1781.34	732.60	2513.94	450.00	2063.94	5.59

Gross return = value of yield increase (in terms of money).
Net return = Gross return - Invested in N-Fertilizer.
Investment factor (I.F.) = Gross return, L.E. / Invested, L.E. (FAO, 2000)
Yield increase = The difference between yield of the treatment and the yield of the control

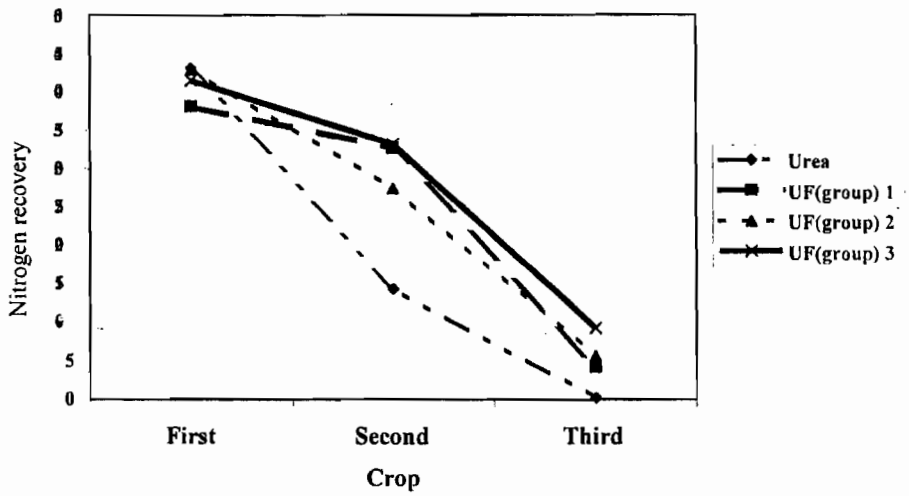

Fig. 1. Nitrogen Recovery as affected by N-treatments at first, second and third crop

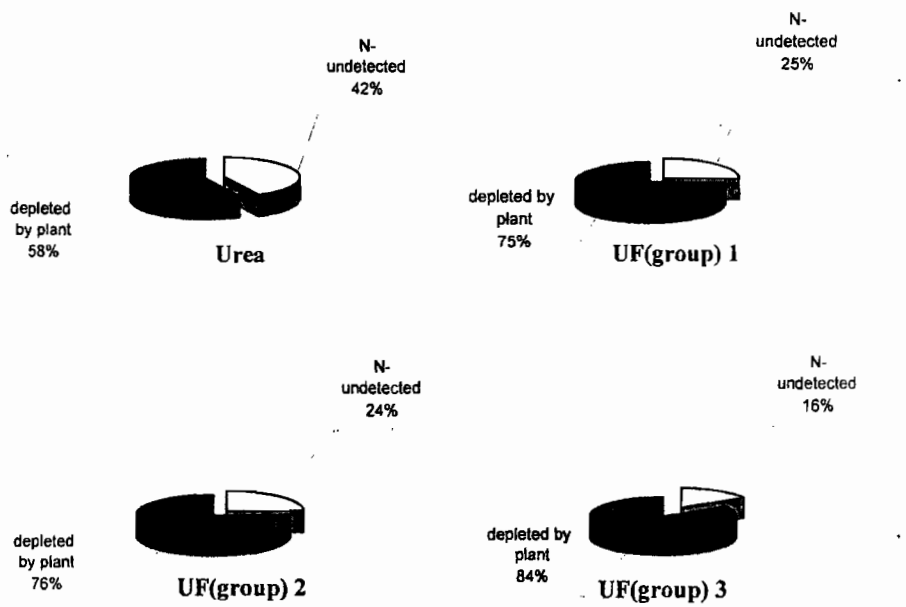

Fig. 2. The final position of the nitrogen of both urea and urea-form fertilizers

which find wide agricultural acceptance because of their high cash return. Currently, SRNF application potentiality has controversially evoked several questions. Data in Table 7 give some light on such questions. In start, it is taken into consideration that the amount of increase in yield has been only referred to the effect of the nitrogen fertilizers application and also, cost of the known other agriculture operations (seed, pesticides, fuel, repairs, labor...Etc) has not been included as well as the calculation Table 7 have been based on the official wholesale price of nitrogen fertilizers and yield which have come as follow:

Urea, 46.5 % nitrogen, L.E. 620 (One American dollar = 6.5 L.E) for 1 ton , Ureaform 40 % nitrogen, L.E. 890 for 1 ton. Ureaform fertilizer has not had credible price, L.E. 890 for one ton represented urea price for 1 ton + price of some other chemicals which are necessity to prepare 1 ton of it.

Wheat, L.E. 1066.67 for 1ton

Maize, L.E. 555 for 1 ton

In general, the data indicate that the fertilizer application has been profitable where the investment factor (I.F.) values have been more than 1. Ureaform treatments have mostly given gross and net return values greater than urea treatment, whoever, depending on the cost of applied nitrogen, their I.F. values have approached or equated with that of urea treatment and they have sometimes been inferior to it. This means that the highest I.F. value has not always given highest net return. In other words, the highest yield/fed does not necessarily means the highest return.

Fortunately, ureaform treatments of low nitrogen rates have given the highest I.F. values which would promisingly reflect in favor of ureaform application. Furthermore, the positive effect of SRNF on environment would not be omitted.

In conclusion, In spite of a good performance of ureaform as a slow release fertilizer all period of experiment long, the authors think that no need to use such fertilizer for high fertile clayey soil, where such soil is able, to rational extent, to catch the ammonium produced from urea hydrolysis. Even if this fertilizer was in use with such as soil, the need to add an activating conditioner to encourage the breaking-down operation for ureaform compound would not have been required.

Calculation of N-recovery for ureaform against the urea and economic return have confirmed the importance of ureaform application

as a nitrogenous fertilizer for future, however, the further studied in this field would be needed.

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التقييم الأجرو اقتصادي لاستخدام اليوريا المعدله تركيبيا فى الأراضي الطينية

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عند استخدام اليوريافورم (سماد نتروجيني بطيء الذوبان) المصنع باستخدام اليوريا كمادة أولية كبديل لليوريا تحت الظروف المصرية. تبرز بعض المشاكل مثل تحديد المعدلات السمادية المناسبة وتهيئة أحسن الظروف البيولوجية لضمان أفضل فرص لإطلاق نتروجينه بالكمية المناسبة وفى الصورة الميسرة القابلة للامتصاص. وعلى ذلك أجريت هذه التجربة الحقلية في محطة بحوث الجميزة خلال ٣ مواسم زراعية متعاقبة وباستخدام التعاقب المحصولي (قمح-ذرة-قمح) لتقييم تأثير معدلات مختلفة من اليوريافورم (٩٠ ، ١٣٥ ، ١٨٠ كجم نتروجين / فدان) والتى تكررت باستخدام توليفة من اليوريا : اليوريافورم بنسبة ١:٢ لكل معدل كمجموعة ثانية من المعاملات. وفى مجموعة ثالثة وأخيرة بإضافة ١٥م^{3} سماد بلدى لكل معدل ، بالإضافة لمعاملة اليوريا ، ١٣٥ كجم / فدان ومعاملة الكونترول.

أوضحت النتائج الآتي :

بصفة عامة تأثرت الإنتاجية المحصولية بترتيب التتابع المحصولي تحت الدراسة فكانت أكبر إنتاجية للمحصول الأول واقلها للمحصول الثالث بصرف النظر عن طبيعة المعاملة.

أدت اليوريا إلى زيادة إنتاجية المحصول الأول (القمح) فقط بينما لوحظ تفوق مميز لمعاملات اليوريافورم في زيادة إنتاجية المحصول الثاني (الذرة). جاءت إنتاجية المحصول الثالث (قمح) منخفضة جدا لكل من اليوريا واليوريافورم.

فيما يتعلق بمحتوى المحاصيل المتعاقبة من العناصر الكبرى (نتروجين-فوسفور-بوتاسيوم).فقد لوحظ انخفاض تدريجي لتركيز العناصر الثلاث متسق مع ترتيب المحاصيل الثلاث حيث كان محتوى المحصول الأول > محتوى المحصول الثاني > محتوى المحصول الثالث. كما يجب التنويه الى أن المعدلات العالية من اليوريافورم أدت – على نحو متكرر – إلى زيادة المحتوى النيتروجيني.

لم يلاحظ اتجاه معين لمحتوى النباتات من الفوسفور إلا انه لوحظ ان محتوى نباتات معاملات المعدلات العالية من اليوريافورم كان أعلى نسبيا فى البوتاسيوم.

لوحظ تفوق ملحوظ لليوريافورم فيما يتعلق بالنتروجين المسترد حيث بلغت تقريبا ١,٥ مرة اكبر من اليوريا.

فيما يخص العائد الاقتصادي تحت ظروف هذه التجربة. فقد لوحظ بصفة عامة تدنى معامل الاستثمار لليوريافورم مقارنة باليوريا. إلا انه كان مرتفعا بالنسبة لمعاملات معدلات اليوريافورم المنخفضة مما يعطى مؤشرا جيدا لاستخدام هذه النوعية من الأسمدة رغم إغفال العائد البيئى اقتصاديا.