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Efficiency of Different Nitrogen Fertilizer Sources on Soil Productivity, Fertility and Economically of Wheat Followed by Maize Crops Grown under Calcareous Soil Conditions.

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ABSTRACT

A field experiment was carried out at the farm of Nubaria Agriculture Research Station (Calcareous soil), in two successive winter 2013/2014 & 2014/2015 and summer 2014 & 2015 seasons to evaluate the efficiency of two different sources of nitrogen fertilizers, gas fertilizer ammonia gas 82 %N (AG) and ammonium nitrate 33.5 %N (AN) to enhance soil fertility and get highest economical production of two cereal crops (wheat and maize) grown under calcareous soil conditions. Nitrogen fertilizers doses were 240 kgNha^{-1} and 288 N ha^{-1} for AG and AN fertilizers compared to zero nitrogen fertilizer rate as control for wheat and maize plants, respectively. The acquired data showed that the injection of ammonia gas fertilizer (82%N) was more efficiency than the ammonium nitrate (33.5%N) for both wheat and maize crops during two winter and summer seasons. The data revealed that, the average of mean values for two winter and summer seasons of grains weight (g), grains yield, stover yield, biological yield tonha^{-1} and relative increasing yield (RIY%) for both wheat and maize plants were superiority by injection ammonia gas (AG) fertilizer compared to control and ammonium nitrate (AN) fertilizer applied. It was noticed that there is a significant difference between the obtained data of harvest index % due to AG injection or AN fertilizer applying during two winter or summer seasons for wheat and maize plants, respectively. On other hand, the mean values of (R.I.Y%) due to AG injection was greater than applying AN fertilizer for wheat and maize plants, respectively. Moreover, the mean values of N, P, K concentration (%), as well as their uptake and protein (%) in grains of wheat and maize plants were a significantly increased by AG injection than AN applying for wheat and maize winter and summer seasons, respectively. From the stand point of nitrogen efficiency, the fertilizing by injection AG fertilizer was more efficiency in terms of productivity factor (P.F) and apparent recovery (AR) compared to AN fertilizer for wheat and maize, respectively. Also, it was noticed that injection AG to fertilization wheat and maize crop remarkably positively effect on mean values of N, P and K available than the application of AN fertilizer at harvesting stage, respectively. Regarding to the farm profitability, the highest net income24691.6 and 13159.8L.E ha^{-1} and investment ratio 13.55 and 6.68 were achieved by injection of AG fertilizer for wheat and maize crops as an average of two seasons, respectively. Data also, revealed that the approximate profitably of each added N unit ha^{-1} were 102.9 and 45.69L.E with the AG injection for wheat and maize crops respectively, under the experiment conditions.

Keywords: nitrogen fertilizers, ammonia gas, productivity, fertility, nitrogen efficiency,

INTRODUCTION

Chemical fertilizers are one of the expensive inputs used by agriculture staff to obtain desired crop yields. Recovery of macronutrients and micronutrients by plants is low in many soils. These lower efficiencies are due to significant losses of nutrients by leaching, run-off, gaseous emission and fixation by soil. These losses can potentially contribute to degradation of soil, and water quality and eventually lead to overall environmental degradation.

Among chemical fertilizers, nitrogen fertilizer is unique lead to increase the most by human activity (Jürg *et al*. 2008). Therefore, selecting the correct dose, source and timing of nitrogen fertilizer application is an important aspect of successful crops production. (LI Yan *et al*. 2016).

In Egypt, numerous of nitrogenous fertilizers, ammonium sulphate, ammonium nitrate and urea were used. As well as, ammonia gas by injected in the soil before planting using especial apparatus was applied. The influence of inorganic nitrogen fertilizer sources either mineral or gas on plant growth is mainly due to its effect on soil reaction and nutrients availability. (Abd El-Hafeez, *et al*. 2013).

The superiority of ammonia gas fertilizer than the traditional nitrogen fertilizers is the addition of ammonia under the surface of the soil to the depths save the fertilizer of the loss, increase the efficiency of nitrogen fertilization and thus producing abundant crops. Moreover, the proper source of ammonia gas up to 140 kg N/fed augmented soil nutrition, its uptake, N use efficiency, maize growth and production (quantity and quality), (Siam, *et al*. 2008).

Both of wheat and maize crops are considered as main economical crops. They play a fundamental role in human and animal feeding (Sanjay *et al*. 2016). In Egypt, wheat crop production is estimated about 9.107 million ton, from planting about 1.26 million hectare on the years 2012 to 2016. In season of 2017, the production of wheat crop diminished about -2 million tonnes (F.A.O. 2017). On the other hand, maize output is also in prospect at a lower level than in previous years, FAO expecting that maize production in 2017 will not exceed 4 million tonnes, as last year's record level of 5 million tonnes (F.A.O. 2017). With increasing human demand for food more efforts had been done to expand wheat and maize cultivation area e.g in calcareous and sandy soils.

The major problems of soil under calcareous conditions are poor in physical properties, deficient in organic matter and characterized by relative high pH, thus their content of N was limited and availability of phosphorus and micronutrients were low.

The main objectives of this work were to study the efficiency of two different sources of nitrogen fertilizers (ammonia gas 82%N and ammonium nitrate 33.5%N) to enhance soil fertility and get highest economical production of two cereal crops (wheat and maize) grown under calcareous soil conditions. Also a cost benefit analysis would be undertaken to ascertain if the application of treatments is conducive to sustainability.

MATERIALS AND METHODS

A field experiment was conducted in two successive winter 2013/2014 and 2014/2015 also summer 2014, 2015 seasons at the farm of Nubaria Agriculture at Research Station (calcareous soil conditions), to study the efficiency of two different sources of nitrogen fertilizers (ammonia gas 82% N and ammonium nitrate 33.5%N) to enhance soil fertility and get highest economical

production of two cereal crops (wheat and maize) grown under calcareous soil conditions.

Sampling procedure:

Composite surface soil samples (0-30cm) at each season were collected before treatments application for soil physical and chemical analyses according to (Black, 1983) (Tables 1&2). Also, organic manure analysis of two seasons 2013/ 2014 and 2014 / 2015 were done and recorded in Table (3) whereas, it was added at rate of 12 ton ha-1 for all treatments and thoroughly mixed with the soil surface during its preparing for planting.

Table 1. Some soil physical analysis of the investigated sit for two experimental winter and summer Seasons.

Experimental year	Mechanical analysis			Soil texture	K_h $cmhr^{-1}$	B.d gcm^{-3}
	Sand %	Silt %	Clay %			
Winter2013/2014	55.19	23.11	21.70	S.L	1.89	1.22
Winter 2014/2015	55.94	21.93	22.13	S.L	1.94	1.24
Summer 2014	56.13	21.03	22.84	S.L	2.00	1.29
Summer 2015	55.99	22.52	21.49	S.L	1.96	1.27

S.L= sandy loam K.h= hydraulic conductivity B.d = Bulk density

Table 2. Some soil chemical analysis of the investigated sit for two experimental winter and summer seasons.

Experimental year	Soil pH (1:2.5)	E.C (dSm^{-1})	Available macronutrients (ppm) $mgkg^{-1}$			Total N%	OM %	$CaCO_3$ %
			N	P	K			
2013/2014	8.23	2.29	39.7	2.52	76.3	0.16	0.32	22.51
2014/2015	8.21	2.27	41.3	2.71	79.2	0.18	0.27	23.11
Summer 2014	8.24	2.19	43.6	2.60	84.22	0.12	0.28	22.30
Summer 2015	8.21	2.09	41.90	2.58	82.39	0.13	0.30	23.09

Table 3. Chemical analysis of used farmyard manure samples for two winter experimental seasons.

Experimental year	PH 1:10	E.C (dSm^{-1})	OM %	OC%	Total N %	Total P%	Total K%	C/N ratio
2013/2014	7.23	2.9	39.6	23.02	1.34	0.5	1,68	17.18
22014/2015	7.30	3.1	40.3	23.43	1.38	0.62	1.70	16.97

Experimental design and treatments application:

Randomize Complete Block Design R.C.B.D was used with three replicates in each treatment. Nitrogen fertilizer sources were added in two sources, injection of ammonium gas (AG) 82%N and application of ammonium nitrate (AN) 33.5%N for each crop, wheat (Giza 168 variety) and Maize (single cross 162 maize hybrid).

Winter field experiment:

Grains of wheat, (Giza 168 variety) were planted at the rate of 144 Kg ha-1 in the third week of November for each winter season. The experimental field was prepared, homogeneously mixed with the topsoil to approximate 30cm depth before cultivation. Nitrogen fertilizers at the rate of 240 kg N ha-1 were added in two sources ammonia gas (AG) 82% N which was injected directly into the moderately moisted soil at 15 cm depth with 30 cm spacing between points of injection before planting according to the injection technique previously used by (Eid 1972) and (Farrag *et al*., 2011). Ammonium nitrate (AN) 33.5%N was applied in three equal doses at 15, 45 and 75 days from sowing. The total area of the experimental plot was 15m2 (3m* 5m). Phosphorus fertilizer in the form of mono-superphosphate (15.5%P2O5) at the rate of 108 Kg P2O5 ha-1 was added during soil preparation. Potassium fertilizer in the form of potassium sulphate (48% K2O) at the rate of 57.6 Kg K2O ha-1 was added with the second dose of N fertilizers.

Summer field experiment:

Seeds of maize (single cross 162 maize hybrid) were planted at the rate of 28.8 Kg ha-1 during the third week of May 2014 and 2015. Nitrogen fertilizer was added in the two sources as mentioned above in two summer seasons at the rate of 288 Nha-1. Each experimental plot consisted of 4 rows (5m long and 0.70 m apart) with a total area 15m2 and received the recommended dose of phosphorus mineral fertilizer 108 kg P2O5 ha-1in the form of mono-superphosphate (15.5%P2O5) and potassium fertilizer at the rate of 57.6 kgha-1 in the form of potassium sulphate 48% K2O.

At harvesting of each crop for each season, the central area of each plot was harvested and weighted as ton ha-1 to estimate the grain, stover and biological yield. Also, 1000 grain weight (g) for wheat crop and 100 grain weight (g) for maize crop were estimated. Total N content % in grains was estimated by using the standard method given by (Jackson 1973) and both of P and K content % determined by using the procedure described by (Ryan *et al*. 1996).

Moreover, after harvesting, soil samples were collected from each plot, air dried, crushed and passed through a 2-mm sieve for estimating soil available nitrogen mgkg-1 according to Mulvaney (1996). While soil available P and K mgkg-1 determined according to (Soltanpour and Schwab 1991).

The following different criteria were calculated:

- Protein% = N% * 6.25
- Harvest index = $\frac{\text{Grain yield (ton ha}^{-1})}{\text{Biological yield (ton ha}^{-1})}$
- Relative increasing yield

$$= \frac{\text{Grain yield of treatment tonha}^{-1} - \text{grain yield of control tonha}^{-1}}{\text{grain yield of control tonha}^{-1}} X100$$

- Uptake kg/ha^{-1} of (N, P and K) = (N, P, and K)% in grain* grain yield kg/ha^{-1} / 100.

Nitrogen efficiency:

- Productivity factor (kg grain/kg N) = $\frac{\text{Grain yield kgha}^{-1}}{\text{Amount of N applied fertilizer}}$
- Apparent N recovery %

$$= \frac{\text{Total N-uptake (kgha}^{-1}) - \text{N-uptake from control (kgha}^{-1})}{\text{Amount of Napplied fertilizer (kg/ha}^{-1})} *100$$

(Fageria, *et al*., 1996)

Apparent net nutrient release in soil (Are):

It's defined as the percent of nutrient supplying power of N, P and K sources.

$$\text{Are (g-g}^{-1}) = \frac{AT - AC}{Na} \times 100$$ (Fageria , 2009).

Where: e nutrient, At available nutrient mgkg^{-1} treated soil, and AC available nutrient (mgkg^{-1}) in control and Na is the quantity of nutrient applied kgha^{-1}

Economic evaluation:

Evaluation of the farm profitability of all tested variability was considered and calculated as following:

- NI = TIO – TCI ……
- NI = Net income LE
- TCI =Total cost input,
- TIO = Total income outputs,
- I.R = Investment Ratio= $\frac{\text{Output, L.Eha}^{-1}}{\text{InputL.Eha}^{-1}}$
- F.P= NI/FA L.E/ N unit
- F.P fertilizer productivity
- FA = fertilizer amount applied kgha^{-1}.

Data were subjected to statistical analysis of variance and treatment means were compared according to the Least Significant Differences (L.S.D. at 0.05). The collected data were statistically analyzed according MSTAT Statistical Package (1990).

RESULTS AND DISCUSSION

Wheat yield and yield component:

Data in Table (4-a) shows a significant and positive effect of two different nitrogen fertilizers sources ammonia gas 82%N (AG) and ammonium nitrate 33.5% N (AN) on yield and yield components of wheat plant during two winter seasons 2013/2014 and 2014 /2015 over the control treatment. The mean values of two growing seasons 1000 grain weight(g), grain, straw and biological yield ton ha^{-1}, as well as harvest index % were increased with the application of (AG) and (AN) fertilizers by (35.19%, 34.4%), (46.75%, 40.25%), (30.07%, 27.81%), (35.29%, 31.22%) and (7.36, 7.32%) respectively, than the control treatment.

Also, data indicate that there is a positive significant effect between the application of AG and AN fertilizers on mean values of 1000 grain weight(g), grain, straw and biological yield ton ha^{-1} and harvest index %. Concerning, the RIY% for grain yield produced by application of AG since it was significantly increased by18.98% than application of AN fertilizer.

This results were harmony with Jasemi S. Sh. *et al*. (2014) and Azza R. Ahmed *et al.* (2012).

Table 4-a. Effect of treatments on mean values of 1000 grain weight (g), grain, straw and biological yield tonha^{-1}, harvestindex%, relative increasing yield (RIY) of wheat crop for two winter seasons (2013/2014 and 2014/2015).

Items	1000 grain weight /g		M.V	Grain yield ton/ha-1		M.V	Straw yield ton/ha-1		M.V
Exp. season	2013/2014	2014/2015		2013/2014	2014/2015		2013/2014	2014/2015	
Control	39.17	39.55	39.36	4.73	4.80	4.77	9.66	9.76	9.71
AG	53.11	53.31	53.21	6.89	7.11	7.00	12.98	12.28	12.63
AN	52.89	52.91	52.9	6.68	6.69	6.69	12.46	12.36	12.41
L.S.D at 0.05	0.0188	0.0266		0.2147	0.1883		0.1684	0.5954	
Items	Biological yield ton/ha^{-1}		M.V	Harvest index %		M.V	RIY %		M.V
Exp. season	2013/2014	2014/2015		2013/2014	2014/2015		2013/2014	2014/2015	
Control	14.39	14.56	14.48	32.87	32.63	32.75	-	-	-
AG	19.87	19.31	19.59	34.67	35.64	35.16	45..67	48.13	46.75
AN	19.14	18.87	19.00	34.84	35.46	35.15	41.23	39.38	40.25
L.S.D at 0.05	0.1975	0.5489		0.342	0.3859		-	-	-

AG= ammonia gas AN= ammonium nitrate M.V= mean value R.E.Y= relative increasing yield

Macronutrients N, P , Kcocentration %, their uptake kgha^{-1}and protein % in wheat grain:

Data in Table (4-b) reveal that the mean values of N, P, K%, N,P ,K uptake kgha^{-1}and protein % of wheat crop for two winter seasons of 2013/2014 and 2014 /2015 were significantly increased than the control for both applied AG and AN fertilizers. The increment rate of mean of N, P, K concentration% than the control for the two season were about (33.68%, 20.73%), (42.2%, 26.67%) and (23.0%, 18.03%) with applying AG and AN fertilizers, respectively. As well as, the increasing percentage of N, P, K uptake in both AG and AN fertilizers for two winter seasons than the control were by (97.9%, 69.4%) uptake N, (110.54, 77.75) uptake P as well as (81.8%, 67.8%) uptake K, respectively. Moreover, the mean values for two winter seasons of protein% Fig (1) in both applying AG or AN fertilizers were significantly increased than the control treatment by 33.72% and 20.76%, respectively. On the other hand, the mean values of total N, P K%; N, P, K uptake kgha^{-1}and protein % obtained by applying AG fertilizer were the superiority. The values as an average of two winter seasons due to applying AG fertilizer were about (2.58 N%, 0.64%P and 0.75%K) (181.55 N, 45.14 P, 52.9 K kgha^{-1} uptake) and (16.1% protein), respectively.

Maize yield and yield components:

Data presented in Table (5-a) show that the mean values of 100 seed weight (g), grain, stover and biological yield (ton ha^{-1}), and harvest index% were significantly increased with the application of (AG) and (AN) fertilizers over the control. Increment percentage in mean values due to applying of both AG and AN fertilizers treatments were (57.8, 45.7) (62.02%, 54.38%), (44.91%, 36.39%), (50.56%, 42.33%) and (7.64 , 7.7%) over the control for average two summer seasons, respectively . Moreover, there is insignificant increase between the mean values of harvest index by applying of AG and AN as the maximum mean value was about 35.53 remarkable by applying AN fertilizer. While, the difference between the mean values of 100 seed weight, grain, stover and biological yield with applying of AG were higher than applying AN for two summer seasons by 8.29 %, 4.95%, 6.24, 5.78 %, respectively. On the other hand, mean comparison results showed that AG treatment produced the highest mean values for 100 seed weight (g), grain, stover and biological yield (ton ha^{-1}) as well as R.I.Y.

Table 4-b. Effect of treatments on N, P, K (%) and their uptake kgha^{-1} on wheat grains during winter seasons (2013/2014) and (2014/2015).

Items	N%		M.V	P%		M.V	K%		M.V
Exp. year	2013/2014	2014/2015		2013/2014	2014/2015		2013/2014	2014/2015	
Control	1.90	1.95	1.93	0.44	0.46	0.45	0.60	0.62	0.61
AG	2.55	2.60	2.58	0.61	0.67	0.64	0.73	0.77	0.75
AN	2.30	2.35	2.33	0.55	0.59	0.57	0.70	0.73	0.72
L.S.Dat0.05	0.228	0.1883		0.103	0.084		0.0831	0.0821	
Items	N uptakekgha^{-1}		M.V	P uptakekgha^{-1}		M.V	K uptakekgha^{-1}		M.V
Exp. Year	2013/2014	2014/2015		2013/2014	2014/2015		2013/2014	2014/2015	
Control	89.87	93.60	91.74	20.80	22.08	21.44	28.38	29.79	29.09
AG	178.20	184.90	181.55	42.64	47.64	45.14	51.03	54.75	52.89
AN	153.60	157.20	155.4	36.74	39.47	38.11	48.79	48.83	48.81
L.S.Dat0.05	1.957	1.698		0.909	0.867		1.033	1.016	

AG= ammonia gas AN= ammonium nitrate M.V= mean value

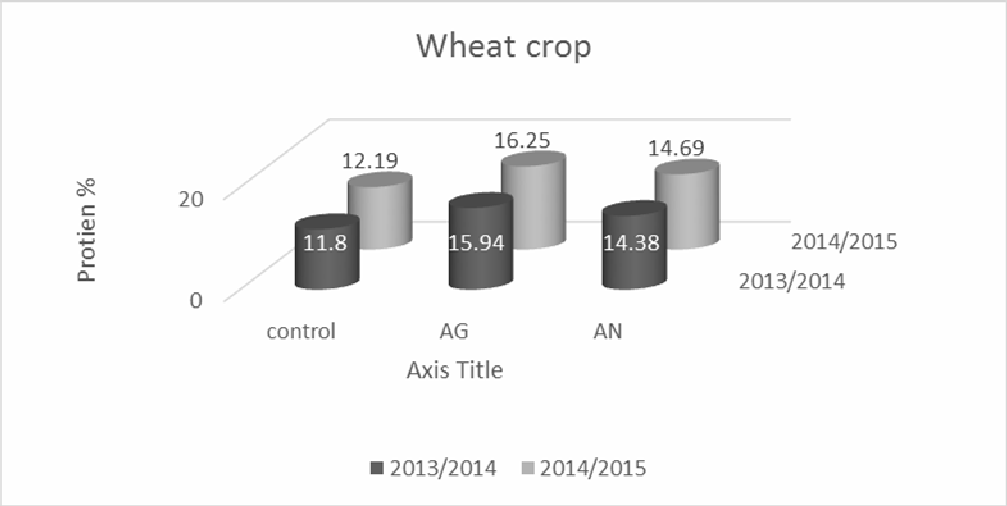

Fig. 1. Effect of two different fertilizers ammonia gas AG and ammonium nitrate AN on protein %of wheat grain crop 2013/2014 and 2014/2015.

Table 5-a. Effect of treatments on mean values of 100 seeds weight (g), grain, stover and biological yield ton ha^{-1}, harvest index% and relative increasing yield (RIY%) of Maize crop for two summer seasons 2014 and 2015.

Items	1000 grain weight /g		M.V	Grain yield ton/ha^{-1}		M.V	Stover yield ton/ha^{-1}		M.V
Exp. year	2014	2015		2014	2015		2014	2015	
Control	24.88	25.92	25.4	4.39	4.51	4.45	9.11	8.97	9.04
AG	39.65	40.51	40.08	7.16	7.26	7.21	12.99	13.20	13.1
AN	36.11	37.91	37.01	6.80	6.94	6.87	12.27	12.39	12.33
L.S.D at 0.05	0.7268	0.7717		0.2306	0.2063		0.0231	0.0246	
Items	Biological yield ton/ha^{-1}		M.V	Harvest index %			RIY %		M.V
Exp. Year	2014	2015		2014	2015		2014	2015	
Control	13.50	13.48	13.49	32.51	33.48	32.99			
AG	20.15	20.46	20.31	35.53	35.48	35.51	63.10	61.0	62.05
AN	19.07	19.33	19.2	35.64	35.41	35.53	54.90	53.88	54.39
L.S.D at 0.05	0.2097	0.2163		0.2729	0.2595		-	-	

AG= ammonia gas AN= ammonium nitrate M.V= mean value R.E.Y= relative increasing yield

Macronutrients N, P, K%; N, P , K uptake kgha^{-1} and protein % in maize grains:

Data presented in Table (5-b) and fig. (2) indicate that the application of nitrogen fertilizers either AG or AN led to a significant increasing of N, P and K concentration%, N-uptake yield ton ha^{-1} and protein (%) in grain during two summer seasons compared to the control treatment. In the same Table, it was noticed that the injection of AG fertilizer recorded the higher significant difference in N, P, K % and its uptake kgha^{-1} and protein% compared to AN fertilizer. Those results were concert with (Jasemi *et al* 2014). The mean values percentage of two summer seasons for N, P, K %; N, P, K, uptake kgha^{-1} and protein % were increased with applying AG than AN by 8.5 N%, 15.4 P% and 10.9 K% and 13.56%N uptake, 22.5% P and 16.2% K uptake and as well as 8.21% protein, respectively. From the above mentioned results cleared that the ammonia gas AG fertilizer was effective more than the ammonium nitrate AN fertilizer for either wheat crop or maize crop during two winter 2013/2014 and 2014 /2015 and two summer seasons 2014 and 2015. This data agree with the result of (Siam *et al* 2008), (Abdel-Aziz, *et al*.2010) and (EL–Masry, *et al* 2006).

Nitrogen efficiency:

Nitrogen efficiency in terms of productivity factor and apparent N recovery in Fig (1a&b) showed that application of AG fertilizer caused a higher mean values of nitrogen efficiency for both apparent recovery or productivity factor than the AN fertilizer for produce wheat

grain yields during two winter seasons. At the same time, it noticed that there is insignificant difference for productivity factor between the two different fertilizers AG or AN to produce maize grain yield. On the other hand, the AG fertilizer was ascertained highest mean values for apparent N recovery for both summer seasons to get maize grain yield. These results may be due to ammonia gas fertilizer is the nitrogen form easy-to-use of the plant and in the mid of the agricultural season, it is converted into nitrate and is used at high rates to feed the plant. As well as, ammonia gas react with the soil water produce hydroxyl ions which it caused dissolve a part of the organic matter which applied lead to increase available nutrients. (Siam, *et al*. 2012) and (Ismail, *et al* 2006).

Table 5-b. Effect of treatments on N, P, K%, their uptake kgha^{-1} and protein% of maize grain yield during summer seasons (2014) and (2015).

Items	N%		M.V	P%		M.V	K%		M.V
Exp. year	2014	2015		2014	2015		2014	2015	
Control	1.45	1.50	1.48	0.23	0.26	0.25	1.01	1.05	1.03
AG	1.90	1.95	1.925	0.44	0.46	0.45	1.47	1.58	1.53
AN	1.75	1.80	1.775	0.38	0.39	0.39	1.35	1.40	1.38
L.S.D at 0.05	0.197	0.266		0.203	0.0595		0.206	0.245	
Items	N uptake ekgha^{-1}		M.V	P uptake kgha^{-1}		M.V	K uptake kgha^{-1}		M.V
Exp. Year	2014	2015		2014	2015		2014	2015	
Control	65.10	67.70	66.4	10.30	11.70	11.00	45.30	47.40	46.35
AG	136.00	141.60	138.8	31.50	33.40	32.45	105.30	114.70	110.0
AN	119.53	124.92	122.23	25.90	27.10		92.20	97.16	94.68
L.S.D at 0.05	1.977	2.148		2.476	2.099		2.919	1.886	

AG= ammonia gas AN= ammonium nitrate M.V= mean value R.E.Y= relative increasing yield

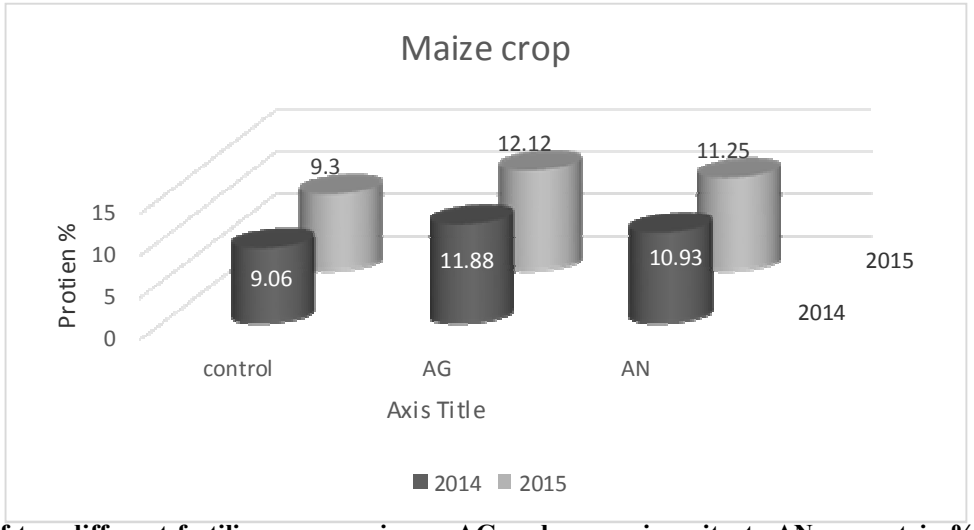

Fig. 2. Effect of two different fertilizers ammonia gas AG and ammoniumnitrate AN on protein %of maize grain crop 2013/2014 and 2014/2015.

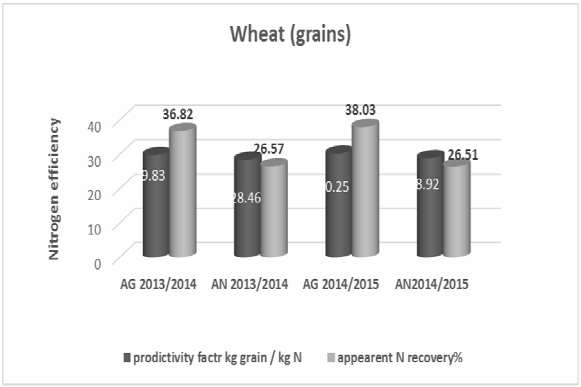

Fig. 3a. Effect of two different fertilizers ammonia gas AG and ammonium nitrate N on N efficiency for wheat grain crop 2013/2014 and 2014/2015.

Effect of AG and AN fertilizers on soil available nutrients N, P and K mgkg^{-1} at wheat and maize harvesting stage:

Available nitrogen, phosphorus and potassium in soil after wheat and maize crops harvesting were presented in Tables 6 (a&b).

Data showed that the average values for soil available nitrogen, phosphorus and potassium due to application of AG were 87.5 N, 14.9 P and 338.2 K mg kg^{-1}soil after wheat crop harvesting and 89.5, 15.95 and 322.5 mgkg^{-1} soil after maize crop harvest, respectively. It is clear, that the mean values of soil available nitrogen, phosphorus and potassium mgkg^{-1} due to application of AG fertilizer was the superiority values than the control and the application of AN fertilizer for the two wheat and maize crops.

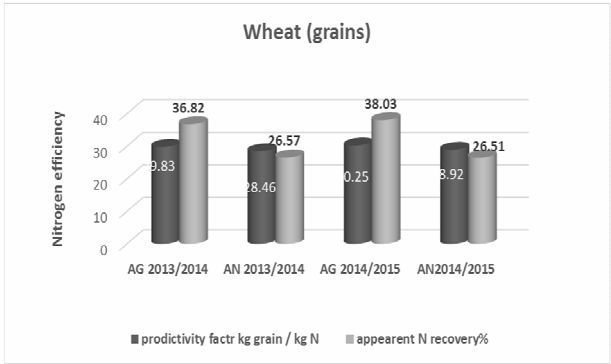

Fig. 3-b. Effect of two different fertilizers ammonia gas AG and ammonium nitrate AN on N efficiency for maize grain crop 2014 and 2015.

Table 6-a. Effect of treatments on soil available N, P and K (mg/kg) at harvesting stage of wheat (2013/2014 and (2014/2015) seasons.

Items	available N		M.V	Available P		M.V	Available K		M.V
Treatments	2013/2014	2014/2015		2013/2014	2014/2015		2013/2014	2014/2015	
Control	45.45	48.77	47.11	10.50	10.70	10.6	293.30	294.50	293.9
Ammonia gas	84.00	91.00	87.5	14.80	15.00	14.9	336.90	339.50	338.2
Ammonium Nitrate	70.00	81.00	75.5	13.40	13.90	13.65	324.50	327.70	326.1
L.S.D at 0.05	1.398	1.21		1.145	1.099		0.967	1.002	

Table 6-b. Effect of treatments on soil available N, P and K ($mgkg^{-1}$) at harvesting stage of maize 2014 and 2015 seasons.

Items	available N		M.V	Available P		M.V	Available K		M.V
Treatments	2014	2015		2014	2015		2014	2015	
Control	49.50	54.50	52.00	11.90	12.20	12.05	290.00	290.50	290.25
Ammonia gas	88.00	91.00	89.5	15.80	16.10	15.95	320.00	325.00	322.50
Ammonium Nitrate	73.00	84.00	78.5	14.90	15.20	15.05	317.00	320.00	318.5
L.S.D at 0.05	1.349	1.472		1.314	1.047		2.555	2.674	

Effect of the treatments on apparent net nutrients available N, P and K% at harvesting stage of wheat and maize plants:

Data in Fig (4 a&b) revealed that the main values percentage of apparent net available nitrogen release (AR-N%) in soil after wheat crop harvesting for both winter seasons were superiority by application AG fertilizer whereas saved about 38.5% to 42.2% available nitrogen for the two growing seasons, respectively. Moreover, mean value of AR-N% in soil after maize crop harvesting by applying AG fertilizer were also ascertained the highest mean values and saved about 32.08% and 30.42% for the two growing seasons, respectively. This data concerted with (Nor eldein *et al*. 2016). It should be also noted that in the same Fig (4a&b the mean values of $AR\text{-}_P$ and $AR\text{-}_K$ in soil were increasing due to applying AG than AN fertilizer after harvesting of both wheat and maize plants.

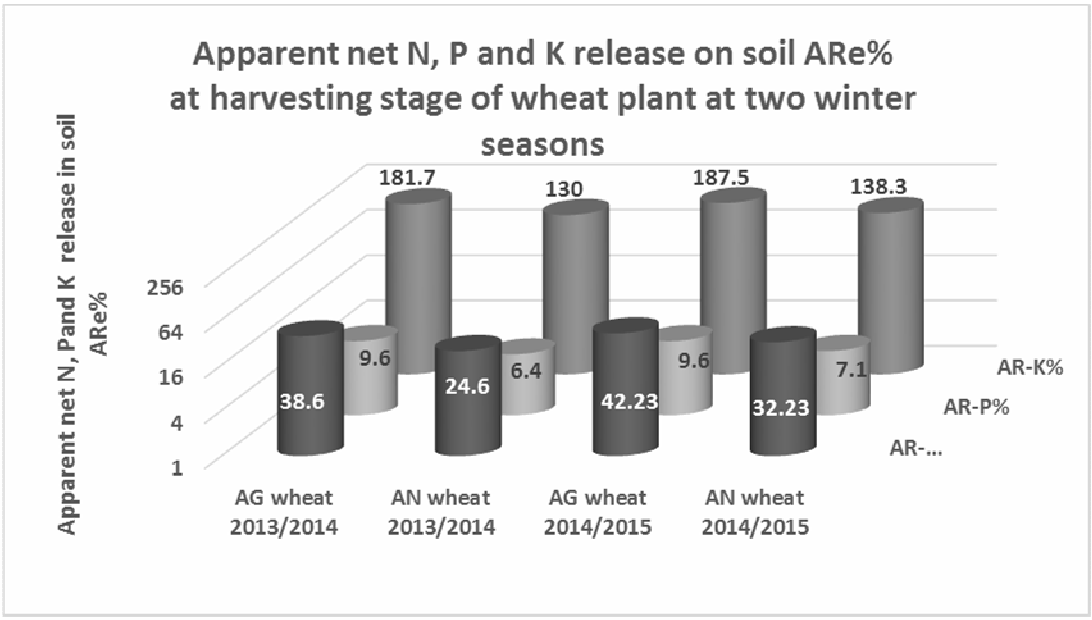

Fig. 4-a. Effect of treatments on apparent net N, P and K release in soil ARe % at harvesting stage of wheat plant at two winter seasons 2013/2014 and 2014/ 2015.

This obtained results may be due to ammonia gas react with the soil water produce hydroxyl ions which it caused dissolve a part of soil organic matter lead to increase available nutrients. The similar results confirmed with that obtained by (Tisdal *et al*. 1999).

Economical Assessment

Data in Tables (7a&b) show profitability calculations for applying AG fertilizer versus AN under this study. Input cost, outputs, net income and investment ratio for the tested treatments are presented in the same tables for both wheat and maize crops. The obtained results revealed that the highest net income was ascertained by applying AG fertilizer for the two winter seasons.

As the investment ratio values increased due to applied AG by 43.02% and 72.17% than the investment ratio values by applying AN fertilizer during the two winter seasons.

As well as, the same results were achieved in two summer seasons 2014&2015, thus the investment ratio values of applying AG fertilizer were incremented by 41.18% and 70.57% than investment ratio values by applying AN fertilizer for two seasons. It was noticed that, the difference of investment ratio values between the two years for both two winter and summer seasons may be due to the change of the price of the fertilizers and the worker wages of each year.

Fertilizer productivity F.P:

Fig. (5) revealed that the application of AG fertilizer for wheat or maize plants during two winter 013/2014 and 2014/ 2015 and summer 2014and 2015seasons were

ascertained the highest mean values of fertilizer productivity F.P than AN fertilizer.

Applying ammonia gas fertilizer to planting wheat or maize crop which grown on calcareous soil was approximate profitability by about 102.9 L.E and 45.69 L.E as an average of two seasons for each applied N unite for farmer.

Table 7-a. Total inputs for both ammonia gas and ammonium nitrate fertilizers for wheat and maize during two winter 2013/2014 and 2014/2015 and summer 2014 and 2015 seasons.

Items	N unit price L.E	N fertilizer sources unit N ha^{-1}	Cost N fertilizer for one ha^{-1} L.E	Cost of wages of workers L.E.h^{-1}	Total input
Crop			Wheat		
AG 2013/2014	7.2	240	1728	240	1968
AN 2013/2014	8.95	240	2148	540	2688
AG 2014/2015	7.2	240	1728	240	1968
AN 2014/2015	10.4	240	2496	720	3216
Crop			Maize		
AG 2014	7.2	288	2073.6	240	2313.6
AN2014	8.95	288	2577.6	540	3117.6
AG 2015	7.2	288	2073.6	240	2313.6
AN 2015	10.4	288	3024	720	3744

Table 7-b. Economical assessment for the two different sources of nitrogen fertilizers AG and AN for two winter 2013/2014 and 2014/2015 and two summer 2014and 2015 seasons.

Treatments	Yield ton ha^{-1}		The price of	The price of one	Output L.Eha^{-1}		Total output	Net income	IR
	grains	Straw	one ton grain L.E	ton straw L.E	Grains	Straw	L.Eha-1	L.E ha^{-1}	
Crop					Wheat				
AG 2013/2014	6.99	12.98	2564	560	17922.4	7268.8	25191.2	23223.2	12.8
AN 2013/2014	6.68	12.36	2564	560	17127.5	6921.6	24049.1	21361.1	8.95
AG 2014/2015	7.11	12.82	2730	680	19410.3	8717.6	28127.9	26159.9	14.29
AN 2014/2015	6.69	12.38	2730	680	18263.7	8418.4	26682.1	23466.1	8.3
Crop					Maize				
AG 2014	7.16	12.99	1800	120	12888	1558.8	14446.8	12133.2	6.20
AN2014	6.83	12.27	1800	120	12294	1472.4	13766.4	10648.8	4.42
AG 2015	7.26	13.2	2000	150	14520	1980	16500.0	14186.4	7.13
AN2015	6.89	12.39	2000	150	13780	1858.5	15638.5	11894.5	4.18

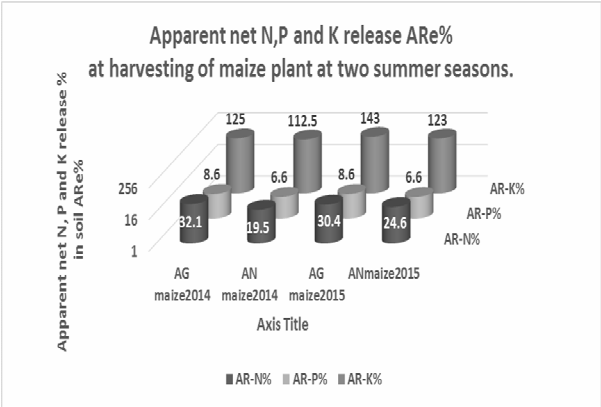

Fig. 4-b. Effect of treatments on apparent net N, P and K release in soil ARe % at harvesting stage of maize plant at two summer seasons 2014 and 2015.

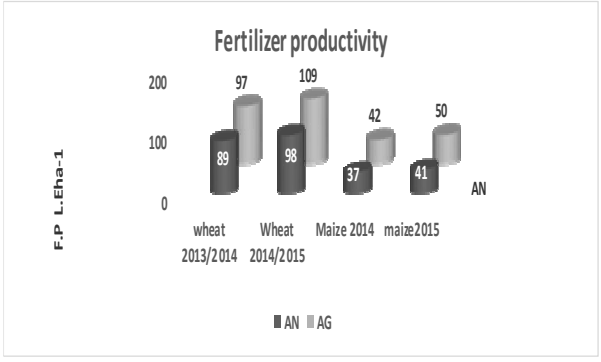

Fig. 5. Effect of two different fertilizers ammonia gas AG and ammonium nitrate AN Fertilizer productivity of wheat and maize plants during two winter 2013/2014 and 2014/2015 and summer 2014and 2015 seasons.

CONCLUSION

The present data concluded that under the same condition of this study the application of ammonia gas AG fertilizer 240 kg ha^{-1} for wheat and 288 kg ha^{-1} for maize plant was more efficient than the application of ammonia nitrate at the same doses. Whereas this treatment not only for enhance yield productivity for wheat and maize plants but also increasing their N, P and K kgh^{-1} uptake and nitrogen efficiency as well as soil nutrition. Data also, contribute significantly to produce the highest net income 24691.55 L.Eha-1 and 13159.8 L.Eha^{-1} as well as investment ratio13.55and 6.68 for wheat and maize crops, respectively as a mean values of two seasons.

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كفاءة مصادر مختلفة من الأسمدة النتروجينية على انتاجية و خصوبة التربة واقتصاديات كلا من محصولى القمح والذرة تحت ظروف الاراضى الجيرية

عزة رشاد أحمد ، منى كمال مصطفى عبد الراق ، محمد سعيد عواد و محمد عبد العزيز بيومى

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

أقيمت تجربة حقلية بمحطة بحوث النوبارية خلال موسمى شتاء 2014/2013 و 2015/2014 وأيضا موسمى صيف 2014و 2015على التوالى. وذلك بهدف دراسة كفاءة مصدرين مختلفين من الاسمدة النتروجينية (الحقن بالأمونيا الغازية 82%ن ونترات الامونيوم 33.5%ن) على انتاجية محصولى القمح والذرة وخصوبة التربة مع مراعاة أرباح المزرعة تحت ظروف الأراضي الجيرية وأضيفت الأسمدة بمعدل 240 و 288 كجم ن للهكتار لكل من نبات القمح والذرة خلال موسمى الشتاء 2014/2013 و2015/2014والصيف2014و2015على التوالى. وقد أوضحت النتائج ما يلى : * الحقن بالأمونيا الغازية أدت الى الحصول على أعلى قيم لتقدير وزن 1000 حبة والمحصول الكلى والزيادة النسبية للمحصول مقارنة بالكنترول والتسميد بنترات الأمونيوم لكل من نبات القمح والذرة خلال موسمى الشتاء 2014/2013 و2015/2014والصيف2014 و2015 على التوالى. *كذلك الحقن بالأمونيا الغازية أدت الى رفع كفاءة استخدام التسميد النتروجينى وزيادة كل من النتروجين و الفوسفور و البوتاسيوم الممتص زيادة ايجابية عن التسميد بنترات الامونيوم لكل من نبات القمح والذرة خلال موسمى الشتاء 2014/2013 و2015/2014والصيف2014و2015على التوالى.* قد أعطى الحقن بالأمونيا الغازية أعلى قيم للنتروجين الميسر ولها تأثير ايجابى على تيسر كل من الفوسفور والبوتاسيوم فى التربة عند مقارنتها بالتسميد بنترات الأمونيوم لكل من نبات القمح والذرة خلال موسمى الشتاء 2014/2013 و2015/2014 و الصيف2014و 2015على التوالى* .وأثبتت النتائج أن الحقن بالأمونيا الغازية أدى الى زيادة معنوية فى أرباح المزرعة بالمقارنة بالتسميد بنترات الامونيوم و كذلك أعطت أعلى ناتج لوحدة النتروجين لكل من نبات القمح والذرة خلال موسمى الشتاء 2014/2013 و2015/2014والصيف2014و2015 على التوالى.