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Telefax:+2 050220226, 0502202253
E-mail: agrjournal_mansuniv@hotmail.com

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Nitrate and Ammonium Balance in Fertilizing Wheat Grown on Sand Soil

Abdel Wahab , M.A.S ; Manal, A. Attia ; Amira, H.M.Hassan and Amira, A. A.Salem.
Soils ,Water and Environment Res. Institute, Agric. Res. Center. Egypt.

ABSTRACT

A field experiment was carried out on sandy soil of Agric. Res. Station, at Ismailia Governorate, Egypt lat. 30° 35' 41.9"N, long. 32° 16' 45.83" E. during two successive winter seasons of 2013/2014 and 2014/2015 to studied the response of wheat plant (Sakha 93) to nitrogen fertilization in two forms *i.e.*, ammonium-N and nitrate-N in different ratios at the rate of (100 Kg N fed^{-1}) as ammonium nitrate (AN) as a source of NH_4-N and NO_3-N and anhydrous ammonia (AA) as a source of (NH_4-N).The obtained results showed that the most effective balance which gave the highest significant increases in all yield parameters was (12.5 Kg NO_3-N+ 87.5Kg NH_4-N) comparing with Applying AN (50 Kg NO_3-N+ 50 Kg NH_4-N) alone and the average of improvements were 11.6% , 52.3% , 42.2 and 72.9 % for 1000 grain weight , grain yield , harvest index and yield efficiency, respectively.In addition, Applying (100 kg N/fed as AA) resulted in slightly increase in straw and biological yields compared with (12.5 Kg NO_3-N + 87.5 Kg NH_4-N) but it was not significant and recorded increase about 35.5% and 39.8% ,respectively. The results indicated that application of AN in combination with AA (12.5 Kg NO_3-N / 87.5 Kg NH_4-N) exhibited the best treatment in enhancing the uptake of N,P, K and protein yield in wheat grains as it achieved 82.3% ,104.8%,84.9% and 82.3% increase ,respectively. Furthermore, increasing rate of NH_4-N as anhydrous ammonia (100 kg N fed^{-1}) in the absence of NO_3-N gave the highest N and P uptake in straw by 99.8% and 72.6% increase for both elements. While, the highest value of K uptake in straw had increased by 53.7% with combined treatments of 75Kg AN+90 Kg AA /fed (12.5 Kg NO_3-N + 87.5 Kg NH_4-N) and significantly surpassed the single AA alone.However, usage of ammonium nitrate fertilizer in combination with anhydrous ammonia fertilizer had noticeable effect for lowering the quantity of ammonium nitrate fertilizer and improvement the yield quantity and quality of wheat plant.

Key words: Ammonium nitrate, anhydrous ammonia, wheat and sand soil.

INTRODUCTION

Wheat (*Triticumaestivum*, L.) is one of the most important crops used in human food and animal feed in Egypt. Recently, a great attention of several investigations has been directed to increase the productivity of wheat to minimize the gap between the Egyptian production and consumption by increasing the cultivated area and wheat yield per unit area and reducing production costs, especially nitrogen mineral fertilizers and find other alternatives (Kowsar *et al.*, 2015). In Egypt total production of wheat ranged 8.407 million tons in 2011, produced from an area of 3.058 million fed, (FAO, 2011).

Today's agriculture faces two major challenges: (a) satisfying the growing food demand of the ever-expanding world population, while (b) stabilizing or lowering the associated production risks and environmental pollution.

As an essential constituent of proteins, nucleic acids, chlorophylls and many secondary metabolites, nitrogen (N) is one of the major elements required for plant growth. Nitrogen is the most important element for wheat. It also has a clear impact on increasing the amount of yield and protein content of grain (Seadh 2014).Its essential role may be attributed to one or all of these reasons: 1) N is constituent of all proteins and nucleic acids and hence of all protoplasm (Russell *et al.* 2006), 2) N enhanced the meristematic activities consequently, increasing the cell size that manifested in internodes elongation, (Osman *et al.*, 2000) and 3) El-Masry, 2001 indicated that the increase of N led to the nutrient uptake, capacity of photosynthesis assimilation in building metabolites, its translocation and accumulation in the sink ().

Wheat is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization (Metwally 2009). Ammonium (NH_4^+) and nitrate (NO_3^-) are two common forms of inorganic N that can serve as limiting factors for plant growth and are often used as wheat fertilizers to maximize crop yields. (Luo, *et al.* 2013).

Anhydrous ammonia (82 % N) and ammonium nitrate (33.5% N) are the common N fertilizers and these sources are similarly effective when properly applied to wheat .They vary in their susceptibility to volatilization or gaseous loss as ammonia to the atmosphere and they can pollute soils and groundwater as nitrate. Therefore, management of N fertilizers are very important for soil fertility and productivity (Siam *el al.*, 2012and Seadh ,2014) .

Ammonium nitrate fertilizer (33.5% N) is important for plant nutrition. In recent years, ammonium nitrate use has declined for the following causes 1) high expensive , (2) difficulty of store and maintain under the right conditions,(3) a potential source of environmental pollution .and (4) It is also, considered to be a hazardous material because of its combustible and explosive properties (Dana *el al.*, ,2013).

Anhydrous ammonia (NH_4) is the most concentrated N source (82% N) and is one of the most widely applied N fertilizer in the last few decades due primarily to its lower cost per unit of N relative to other N sources. In soil, ammonia reacts with water to form the ammonium (NH_4) ion, which is held on organic matter.

Moreover, Berry (2011) reported that AA has lower lab our requirements for application and is less prone to volatilization. It has also been shown that ammonia has nematicidal properties. Metwally (2009) found that injection of anhydrous ammonia into the

soil before sowing gradually increase soil pH then gradual decrease in soil pH took place. The anhydrous ammonia injected before sowing was gave higher yield and, minerals uptake than other nitrogen sources, (Wyckoff 2012)

Ismail *el al.*,(2013) found that the application of anhydrous ammonia high rate led to increase of plant characters in wheat .

Sandy soils represent about 90% of the Egyptian soils. These soils are characterized by their poor physical, chemical properties and fertility as well as their low capacity to retain water and their low supplying power for nutrients which losses by leaching and volatilization. It is therefore necessary to apply different sources of organic fertilizers for this soil besides the usual fertilizers (Abdel-Rahman ,2012 and Abdel-Fattah *el al.*,2015).

The current study aims to study the effect of ammonium nitrate and anhydrous ammonia as sources for NO_3-N and NH_4-N on yield and chemical composition of wheat variety (Sakha 93) in balanced amounts under sandy soil conditions.

MATERIALS AND METHODS

A field experiment was conducted on a sandy soil at the Experimental Farm of Ismailia Agriculture Research Station during two winter seasons 2013/2014 and 2014/2015, to investigated study the response of wheat plant (cultivar Sakha 93) to application of nitrogen fertilizer in two forms *i.e.*, Ammonium Nitrate (AN) and Anhydrous Ammonia (AA) on wheat productivity and macronutrient contents .

A representative soil sample of the field was taken from 0 – 30 cm layer and used for determining some physical and chemical properties of studied soil whose results are presented in Table (1) according to Page *et al.* (1982) and Klute(1986) .

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

Course Sand	Fine sand (%)	Silt (%)	Clay (%)	Texture	O.M (%)	$CaCO_3$ (%)
6.48	88.24	3.70	11.33	Sandy	0.53	2.93

pH (1:2.5)	EC (dS/m)	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}
8.05	1.78	5.62	3.89	7.44	0.85	1.38	5.98	10.44

Available macronutrients($mgKg^{-1}$)		
N	P	K
36.95	3.49	182

During soil preparations for planting, the compost manure was mixed thoroughly with the soil one month before sowing at a rate of 10 Mg fed^{-1}. for improving structure ,fertility , colloids of soil for increasing water holding capacity and not lost of anhydrous ammonia through leaching or volatilizatoin (Kaur *el al.*, 2008 and Abdel-Rahman ,2012). The Chemical composition of compost used in the experiment is shown in Table (2) according to Brunner and Wasmer (1978).

Table 2. Some physical and chemical properties of compost.

Moisture %	pH (1:10)	EC (dSm^{-1})	O.M (%)	Macronutrients (%)				C/N ratio
				C	N	P	K	
25- 30	7.44	3.64	72.18	36	1.98	2.96	3.98	18.20

In both seasons, the treatments were arranged in a randomized complete block design with three replicates. The plot area was $500m^2$ (50 m length and 10 m width). Seeds were sown of wheat cultivar (*Triticumaestivum*cv. Sakha 93) on the 2nd and 5th of November 2013 and 2014, and harvested on the 21th and 25th of April 2014 and 2015, respectively.

The experiment pilot unit was fertilized with the recommended rates of P and K as follows: 31 kg P_2O_5 $fed.^{-1}$ as calcium superphosphate (15% P_2O_5) and potassium was added at 75 kg K $fed.^{-1}$ as potassium sulphate (48 % K2O) before planting.

Nitrogen (N) fertilizer was added at the rate of 100Kg N in form of ammonium nitrate (33.5%N) as a source of both NO_3-N alone or combined with anhydrous ammonia (82 % N) as a source of NH_4-N in three equal splits after 20, 35 and 55 days of sowing. The experiment plot was divided into four divisions and injected with anhydrous ammonia (82 % N) at rates (25; 50, 75 and 100 kg N /fed). Injected directly of anhydrous ammonia (82 % N) was into the soil at 15 cm depth with 30 cm spacing between the points of injection. Injection ammonium anhydrous before 5 days from planting according to the injection technique previously used by **(Farrag *et al.*, (2011).** Agricultural practices for growing wheat were carried out as recommended by the Ministry of Agriculture.

The treatments were as follows:

1-100 Kg N/fed as AN (50 Kg NO_3-N/ 50 Kg NH_4-N).
2- 75 Kg N/fed as AN +25 Kg N as AA (37.5 Kg NO_3-N/ 62.5 Kg NH4-N).
3-50Kg N/ fed as AN +50 kg N fed^{-1} as AA (25 Kg NO_3-N / 75 Kg NH_4-N).
4-25Kg N/ fed as AN +75 kg N fed^{-1} as AA (12.5 KgNO_3-N / 87.5 Kg NH_4-N).
5-100 kg N/ fed as AA(0 Kg NO_3-N / 100 Kg NH_4-N).

At harvest, ten plants were taken randomly from each plot to measure the following parameters:

A- Yield and its components:

1- 1000 – grain weight (g).
2- Grain yield (Mg/fed).
3- Straw yield (Mg/fed).
4- Biological yield = grain yield + straw yield.
5- Harvest Index (HI) = (grain yield / biological yield)
6- Yield efficiency = (grain yield / straw yield) x 100

B- Plant analysis:

Grain and straw samples from each treatment were taken for chemical analysis since they were

digested using H_2SO_4 and $HClO_4$ acid mixture (1:1). (Ryan *et al.* 1996). The digest was then used to determine N, P and K concentration in grains and straw as described by Chapman and Pratt (1961) and uptake was calculated. Crude protein content was also calculated by multiplying N% by 5.75.

All obtained results in both seasons were statistically analyzed as mean values for both seasons. Least significant difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1-Effect of the different treatments on yield parameters of wheat plants (mean of two seasons)

As illustrated in Table (3), the obtained results show that application of AN in combination with AA significantly affected on yield and its components. The results clarified that the progressive elevating in the rate of NH_4-N with simultaneous reduction in NO_3-N caused average increase in wheat yield by about 11.6% , 52.3% , 42.2 and 72.9% for 1000 grain weight , grain yield , harvest index and yield efficiency of wheat ,respectively in the plants treated with (12.5 Kg NO_3-N / 87.5 Kg NH_4-N) comparing with Applying AN (50 Kg NO_3-N/ 50 Kg NH_4-N) alone . Also, Applying AA at the rate (100 Kg NH_4-N) resulted in significant increase in straw and biological yields compared with(50 Kg NO_3-N/ 50 Kg NH_4-N) and recorded relative increase by about 35.5% and 39.8% ,respectively , with no significant different between this treatment and 100 Kg N as AA .

On the other hand, the lowest values of 1000 grain weight , grain yield, straw yield and biological yield were obtained with Applying AN only (50 Kg NO_3-N/ 50 Kg NH_4-N)and recorded 43.36 (g) ,1.49 (Mg/fed), 2.45 (Mg/fed) ,3.94 (Mg/fed) for 1000 grain weight , grain yield, straw yield and biological yield respectively, as well as ,0.38 for harvest index and 60.77% for yield efficiency

Table 3. .Effect of the different treatments on wheat yield . (mean of two seasons)

Treatments N-source Kg N Fed^{-1}	NO_3-N kgFed^{-1}	NH_4-N kgFed^{-1}	1000-grain weight (g)	Grain yield (MgFed^{-1})	Straw yield (MgFed^{-1})	Biological Yield (MgFed^{-1})	Harvest index	Yield Efficiency %
100(KgN)AN	50	50	43.36	1.49	2.45	3.94	0.38	60.77
75(KgN) AN + 25(KgN)AA	37.5	62.5	45.27	1.65	2.58	4.23	0.39	63.94
50 (KgN)AN+ 50(KgN) AA	25	75	47.2	1.91	2.78	4.69	0.41	68.59
25(KgN)AN + 75(KgN) AA	12.5	87.5	48.39	2.27	3.12	5.39	0.42	72.87
100 (KgN)AA	0	100	47.94	2.19	3.32	5.51	0.40	65.97
L.S.D			0.92***	0.11***	0.23***	0.31***	0.014**	4.12**

(AN)Ammonium Nitrate , (AA)Anhydrous Ammonia

These results referred to the most pronounced treatment which gave the highest significant increases in all yield parameters namely (12.5 Kg NO_3-N / 87.5 Kg NH_4-N) by increasing the rate of NH_4-N and decreasing the rate of NO_3-N. The enhancement effect of using NO_3-N combined with NH_4-N may be due to improving N uptake which reflected on yield parameters. Also, the differences in the above parameters increase the different N sources were mainly due to their variations in the availability of N and other nutrients. Moreover, wheat can assimilate ammonium more readily than nitrate, possibly because the plants lack a completely functional nitrate- redacted system. Silberbuh and Lips (1992) reported that grain production is greatly affected by NH^+_4 and NO_3^- nutrition .They concluded that plant receiving high NH^+_4 concentrations is stimulated to invest most of their carbohydrate reserves on new tiller formation. On the other hand, plants treated with nitrate invest the bulk of the carbohydrate in grain production.

These results are in agreements by Ashoub *et al.* (2005) reported that the rate of 60 kg N fed^{-1} and 80 kg N fed^{-1} for anhydrous ammonia as a source of NH_4^+ led to the increase of grain yield , 1000 grains and number of spike while the applied of 80 kg N $fed.^{-1}$ increased straw yield (kg $fed.^{-1}$).

In addition, the increase in N fertilizer which resulted from the increase in AA rate was increase metabolic processes and physiological activities rate and thus, increased yield with good quality of grains (Sugar and Berzsenyi, 2012).

Furthermore , in sandy soil under moist condition AA moves more and can be applied at high rates with little or no loss from volatilization or denitrification comparing with AN which more readily leaches from the soil (Teal *et al.* 2008). Conversely, the lack of the yield parameters when applied AN solely possibly may be due to the ammonium N quickly converts to nitrate and as water moves through the soil, the nitrate(NO_3^-) that is in soil solution moves along with the water resulted in limited sink of plant available N in the soil. The current results were confirmed by those obtained by Ehab, *et al.*, (1998) who showed that the highest values of the yield were recorded due to the application of ammonia gas, while the application of ammonium nitrate gave the lowest values with significant differences between the application of ammonia gas and the other nitrogen sources.

Metwally (2009) found that a positive effect of N-fertilization on growth characters and yield parameters of wheat plant could be arranged in the order: Ammonia gas < ammonium sulfate < ammonium nitrate < urea. Also, he found that increasing anhydrous ammonia level from 60 to 100 kg N /fed caused a significant increase in 1000 grain weight in wheat. Duan *et al.* (2007) reported that yield maximization in a mixed N supply (NO_3-N / NH_4-N) could be attributed to an up regulation of N uptake and metabolism by NO_3^-inriceand soybean.

Furthermore , Daneshmand *et al.* (2012) suggested that the addition of N fertilization was significantly increased straw weight , number of spikes/m^2, number of spiklets/ spikes, 1000 grain weight and grain yield.

1- Effect of the different treatmentsonN, P and K uptake and protein content of wheat grain (mean of two seasons)

It can be seen from the results presented in Table (4) as the fertilization rate of NH_4^+ increased and NO_3^- decreased the N, P, K uptake and protein yield in wheat grains increased but it was noticeable in the case of the combined treatments. The highest values were obtained with the combined treatments of (12.5 kg NO_3-N / 87.5 kg NH_4-N) and gave39.87, 12.72, 42.21 and 229.2Kg fed^{-1} for N,P ,K and protein yield, respectively as it increased by 82.3% ,104.8%,84.9% and 82.3% ,respectively ,compared with 50 kg NO_3-N/ 50 kg NH_4-N .

On the other hand, applying AN (50 kg NO_3-N/ 50 kg NH_4-N) alone gave the lowest values and recorded (21.87, 6.21, 22.83 and 125.7 Kg/fed), respectively for the same nutrients. Based on the above values of the results, applying (12.5 kg NO_3-N / 87.5 kg NH_4-N) would still be preferred to improve the uptake of N,P , K and protein yield when compared with applying 100 kg NH_4-N as AA with no significant difference . Application of N in the form of AA as a source for NH_4-N invariably increases protein concentration and this would seem it's the chief advantage for applying the two forms of N fertilizers.

Table 4. Effect of the different treatments on the uptake of NPK and protein content of wheat grain (mean two seasons)

Treatments N-source Kg $NFed^{-1}$	NO_3N ($kg_{1)}fed^-$	NH_4-N (kg $fed^{-1)}$	Nitrogen Uptake$_1$ (Kg fed)	Phosphorus uptake$_1$ (Kg fed)	Potassium Uptake$_1$ (Kg fed)	Protein Yield$_{-1}$ (Kg fed)
100(kg N)AN	50	50	21.87	6.21	22.83	125.7
75 (kg N) AN+ 25(kg N) AA	37.5	62.5	25.86	8.04	27.33	148.7
50 (kg N)AN + 50(kg N) AA	25	75	31.62	9.91	33.55	181.8
25 (kg N)AN+75 (kg N) AA	12.5	87.5	39.87	12.72	42.21	229.2
100 (kg N) AA	0	100	39.24	12.56	41.87	225.6
L.S.D			2.26***	0.39***	2.91***	13.03***

(AN)Ammonium Nitrate - (AA) Anhydrous Ammonia

It is interesting to mention that the high increased uptake of the studied nutrients in wheat grains accompanied with this treatment could be explained as a result of the remarkable increase in availability of nutrients and consequently increasing plant growth and grain weight of the yield. As well as, this may be attributed to the important role of N in plant metabolism processes, roots growth and proliferation of plants which increase nutrients uptake. Moreover, the improvement of the uptake of such nutrients is in accordance with the differing responses of these two sources. On the other hand, the response of wheat to added N fertilizer could be attributed to the poor soil-fertility level of available N in the experimental field as shown in Table 1.

There are several potential explanations for the observed preference for NH_4^+compared with NO_3^- . One reason may involve root morphology because different root tissues require different amounts of NH_4^+ and NO_3^-, and the meristem zone needs a higher concentration of NH_4^+ for protein synthesis is. In most species, NH_4^+ taken up by the roots is directly converted to amino acids within the roots, which cost less energy for both transport and assimilation (Zhang *et al.*2014)

Increasing anhydrous ammonia (NH_4^+) level from 80 to 100 or 120 kg N/fed. led to a continuous increase in macro- (N, P and K) uptake by wheat. El-Beltagy (2004) stated that the grain yield of wheat plant and its content of nitrogen were increased significantly by increasing the rate of applied anhydrous ammonia up to 90 kg N/fed. Zahran (2007) found that anhydrous ammonia fertilizer gave a significant increase in N, P and K content at 70 and 90 days from sowing as well as its content in grain of wheat plant. The same results were obtained by Siam *el al.*, (2012) for maize plants. Metwally, (2009) found that in wheat at all stages of growth; K uptake was increased with increasing N-rate from 60 to 80 to 100 kg N/fed. except with anhydrous ammonia and ammonium sulfate the highest uptake of grain and straw were obtained with 80 kg N/fed.

Effect of the different treatments on N, P and K uptake of wheat straw (mean of two seasons):

Data presented in Table (5) showed that the uptake of N and P in straw was significantly increased by increasing the rate of AA (100 kg NH_4-N). The results cleared that; N and P uptake of straw were the highest in the absence of AN and recorded16.92 and 4.97 (Kg fed^{-1}) ,respectively with 99.8% and 72.6% increase for both element over control (100 kg N as AA) . On the other hand, the highest value of K uptake in wheat straw recorded 45.84(Kg fed^{-1}) and had increased by 53.7% with the combined treatments (12.5 kg NO_3-N / 87.5 kg NH4-N). While, the lowest values for N, P and K were 8.4, 2.88 and 29.83 (Kg fed^{-1}) respectively, were obtained with applying (50 kg NO_3-N/ 50 kg NH_4-

N) as ammonium nitrate fertilizer alone. These results may be due to that the increasing rate of AA could improved physical and chemical properties of the soil and increased such nutrients more available for plants. Furthermore ,N application in the form AA as a source of NH_4-N was more effective in increasing the quantity of N uptake in grains and generally more effective in increasing the quantity in straw . These results are in harmony with those obtained by Metwally, (2009) who reported that N and P uptake of straw in wheat were increased with increasing anhydrous ammonia rate from 60 to 80 to 100 kg N/fed, except K uptake which was the highest with 80 kg N/fed.

It can be concluded that ,when wheat plants were fertilized with a mixture of (12.5 kg NO_3-N / 87.5 kg NH_4-N) compared with either of the two N sources applied alone improves the yield parameters and nutrients uptake of wheat plants .So ,the balance between NO_3 and NH_4 could increase the number of ammonium transporters ;and NH_4 is taken up by plant roots,(Duan *et al.*,2007) .

Table (5) . Effect of the different treatments onN P K uptake of wheat straw.(mean of two seasons)

Treatments Kg Nfed^{-1}	NO_3N (kg fed^{-1})	NH_4-N (kg fed^{-1})	Nitrogen uptake (Kg fed^{-1})	Phosphorus uptake (Kg fed^{-1})	Potassium uptake (Kg fed^{-1})
100 (kg N)AA	50 NO_3-N	50 NH_4-N	8.47	2.88	29.83
75(kgN) AN+25(kg N) AA	37.5 NO_3-N	62.5 NH_4-N	10.24	3.18	33.32
50 (kg N) AN+50(kg N) AA	25 NO_3-N	75 NH_4-N	12	3.78	38.64
25(kg N) AN+75(kg N) AA	12.5 NO_3-N	87.5 NH_4-N	14.78	4.41	45.84
100(kg N) AA	0-NO_3-N	100 NH_4-N	16.92	4.97	45.23
L.S.D			1.11***	0.31***	2.21***

(AN)Ammonium Nitrate , (AA)Anhydrous Ammonia

CONCLUSION

From the previous discussion, it can be concluded that the best treatment which enhancement the yield and its quality was obtained by applying (12.5 kg NO_3-N / 87.5 kg NH_4-N) Thus, we can save the quantity of ammonium nitrate fertilizer used and reducing environmental pollution

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التوازن بين نترات الأمونيوم و الأمونيا اللامائية فى تسميد نبات القمح النامى فى أرض رملية

محمد عبد الهادى سيد عبد الوهاب ، منال عبد الحكم عطية، أميرة حسن محمد حسن و أميرة عشرى محمد سالم

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

أجريت تجربتان حقليتان في محطة البحوث الزراعية بمحافظة الإسماعيلية فى موسمين متتاليين٢٠١٣/٢٠١٤ و٢٠١٤/٢٠١٥ لدراسة استجابة نباتات القمح صنف سخا 93 لمصادر مختلفة من التسميد النيتروجيني وهي نترات الأمونيوم و الأمونيا اللامائية في أرض رملية وذلك لمعرفة أفضل المعدلات المتوازنة التى يمكن اضافتها من نترات الأمونيوم و الأمونيا اللامائية وتأثير ذلك على المحصول والتركيب الكيماوى لنبات القمحويمكن تلخيص النتائج المتحصل عليها كما يلي:تشير النتائج ان أفضل معاملة أدت الى حدوث زيادة معنوية فى جميع صفات المحصول لنبات القمح هى اضافة (١٢,٥كجم نيتروجين نتراتى/الفدان +٨٧,٥كجم نيتروجين امونيونى/فدان) مقارنة بالكنترول (١٠٠ كجم نيتروجين/الفدان فى صورة نترات أمونيوم) وكانت نسبة الزيادة ١١.٦% ,٥٢.٣% ,٤٢.١%,٧٢,٩% لكل من وزن الألف حبة, محصول الحبوب , دليل الحصاد وكذلك كفاءة محصول نبات القمح على التوالى وايضا أدت المعاملة (١٠٠ كجم نيتروجين/فدان من الامونيا اللامائية) الى حدوث زيادة معنوية فى محصول القش والمحصول البيولوجى وسجلت ٣٣.٥% و٣٩.٨% لكل منهم على التوالى مقارنة بالكنترول ولكنها غير معنوية بالمقارنة بالمعاملة (١٢,٥كجم نيتروجين نتراتى/الفدان +٨٧,٥كجم نيتروجين امونيونى/فدان) .كذلك يتضح من النتائج أن المعاملة (١٢,٥ كجم نيتروجين نتراتى/الفدان +٨٧,٥كجم نيتروجين امونيومى/فدان) أدت الى زيادة امتصاص النيتروجين والفوسفور والبوتاسيوم وكذلك محصول البروتين وكانت نسب الزيادة ٨٢,٣% ,١٠٤.٨ ,٨٤.٩ ,٨٢.٣% على التوالى مقارنة بالكنترول.بالأضافة الى ذلك تشير النتائج الى زيادة امتصاص النيتروجين والفوسفور لمحصول القش نتيجة المعاملة (١٠٠ كجم نيتروجين امونيومى/فدان) وحققت نسبة زيادة ٩٩.٨% و ٧٢.٦% لكل من العنصرين بينما كان أعلى معدل امتصاص للبوتاسيوم فى محصول القش ٥٣.٧% نتيجة المعاملة (١٢,٥ كجم نيتروجين نتراتى/الفدان +٨٧,٥كجم نيتروجين امونيومى/فدان)و يتضح أيضا ان هذه المعاملة هى أفضل معاملة حيث اعطت أعلى قيمة اقتصادية لمحصول القمح .وأخيرا فان اضافة السماد النيتروجينى بمعدل ١٠٠كجم/فدان فى معدلات متوازنة من نترات الأمونيوم والأمونيا اللامائية هو الافضل لتقليل استخدام سماد نترات الأمونيوم وبالتالى تقليل التلوث البيئى والوصول الى محصول عالى الجودة .

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