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EFFECT OF TRADITIONAL SOLUBLE AND SLOW RELEASE N-FERTILIZERS ON WHEAT & THEIR RESIDUAL EFFECT ON SORGHUM AND BARLEY IN SOME SOILS OF EGYPT

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ABSTRACT: *A pot experiment was conducted under greenhouse conditions using pots (perforated at the bottom), with 12 kg soil capacity of each. Pots were seeded with wheat (Triticum aestivum c.v. Sakha 8), to study the effects of traditional soluble-N and slow release-N fertilizers. The soil of each pot was thoroughly mixed with P at a rate of 12 mg P/kg soil. Soil K was in sufficient amount. The experimental pots were contained 288 pots, which arranged in a complete randomized block design with three replicate in four factors of three forms of soil , four N-fertilizers (two traditional soluble-N and the other two slow release-N fertilizers) , three rates of N-fertilizers as well as two rates of moisture regimes of 70 and 100 WHC . At wheat maturity after 24 weeks-growth, plants in each pot were cut 2-cm above soil surface, carefully washed, dried and weighted. After wheat harvested and in the same pots, in order to study the N-fertilizes residual effect, two successive crops of Sorghum vulgar "c.v. Giza 15" and then barley "Hordium, vulgar c.v. Giza 121" were planted and harvested after 9 and 16 weeks , respectively. The obtained results may be summarized as follows:*

- *The traditional soluble forms of N-fertilizers produced higher dry matter (gm./pot) of wheat crop compared with the slow release forms of N-fertilizers.*
- *Dry weights (gm/pot) of both sorghum and barley were more under fertilization with slow release forms of N-fertilizers, than under fertilization with the traditional soluble forms, with approximately equal to two fold and threefold, respectively.*
- *Slow release forms resulted in less N-uptake by wheat than the traditional soluble forms. While the slow release forms of N-fertilizers affected positively on N-uptake by both of sorghum and barley, with increases approximately equal to twice threefold more than the traditional soluble ones.*
- *Residues of slow release N- fertilizers have appropriate supply of sorghum and barley, at the two successive with amounts of (N), because their ability to continuous supply (N) for long periods of time.*

Key word: *Traditional soluble N-fertilizers - Slow releases N- fertilizers - Water holding capacity - Field crops - Soils.*

INTRODUCTION

Wheat is one of the most ancient crops of the world. It was cultivated as long as 6500 years ago on the territory of present-day Iraq, 600 years B.C. in Egypt, and 2500-3000 years B.C. in India and China. Wheat is the leading food crop in world farming. It occupies over 30% (238 million hectares) of the crop area under all grain cultures (760 million hectares). Wheat is the main food crop for the nations living in the temperate zone, (Ustimenko-Bakumovsky 1983).

Sorghum has a number of features which make it a drought-resistant crop. The crop does well on most soils but better so in light to medium textured soil, (Doorenbos *et al.* 1986). The main crop areas under sorghum are concentrated in the countries of a hot dry climate, (Ustimenko-Bakumovsky 1983).

Barley crop areas are mainly situated in the regions of the temperate zone, but it is also raised on large territories in the subtropics and even in the mountain regions of the tropical belt, (Ustimenko-Bakumovsky 1983).

Nitrogen-release from sulphur coated urea (SCU) particles is directly affected by the thickness and quality of the coating. The dissolution of urea into the soil solution follows microbial and hydrolytic degradation of the protective sulphur coating and the presence of micro pores and imperfection, *i.e.* cracks and complete sulphur coverage. Typically, there are three forms of coatings: damaged coating with cracks, damaged coating with cracks sealed with wax, and perfect coating. SCU-fertilizers may contain more than one third of granules with damaged coating and about one third of perfectly coated granules. Therefore, one third or even more of the urea may be released immediately after contact with water (so-called 'burst'), and one third may be released long after it is required by the plant (so-called 'lock-off' effect) (Shaviv, 2001 and 2005). Urea has 46%N and after coating with sulphur, (SCU) still contain about 30-40% N, (Trenkel, 2010).

The release pattern of nitrogen from urea-formaldehyde (UF) (38% N) fertilizers is multi-step process (dissolution and decomposition). In general, some proportion of the N is released slowly (Fraction I); this is followed by a more gradual release over a period of several (3-4) months (Fraction II) depending on the product form. However, the release pattern is also influenced by the soil temperature and moisture, as well as by soil organisms and their activity. UF fertilizers show a significant slow release of nitrogen with a good compatibility with most crops. Because of its low solubility it will not scorch vegetation of impair germination. Because it is more effective at higher temperatures, it is widely used in warmer climates, (Trenkel 2010).

Nitrogen availability depends on amount and form of applied-N, soil available-N, soil type & condition, crop rotation and cultivation history of the field, as well as on temperature and precipitation during the growing season (Aucklah *et al.,* 1991, Poutala 1998, Przulj and Momcilovic 2001, Muurnen 2007).

Management strategies to reduce soil N-loss include improved timing of N- fertilizer applications, better use of soil and plants testing procedures to determine N availability, application of nitrification or urease inhibitors, and use of N-fertilizer sources that are suitable for local environmental conditions (Dinnes *et al.,* 2002). The optimum growth of plants there must be a balance between the rate of photosynthetic production and the rate of N-assimilation. Also under conditions of high photosynthetic activity, N-nutrition must be high and vice versa (Slack and Hatch, 1967).

The release of N by the slow-release fertilizer tested in this trial was too slow for the cool growing conditions. Slow release of N-fertilizer in coated treatments had an apparent effect on plant N status throughout the growing cycle. Lower N availability reduced plant N-content at heading stage. Lower grain and straw N-content and lower plant N-uptake indicate lower N-availability also at grain filling period, (Rajala and Peltonen-Sainio (2013).

This research aims to study the effect of slow release N-fertilizers "*i.e.* sulphur-coated urea "SCU" and urea formaldehyde "UF" as well as traditional soluble forms of N-fertilizers of calcium nitrate "CaN" and ammonium sulphate "NH" on dry weighs of wheat, sorghum and barley cultivated in some soils of Egypt under two moisture regimes of 70 %WHC and 100% WHC. Also, N uptake by the cultivated plants was studied.

MATERIALS AND METHODS

A pot experiment was conducted under green house conditions using pots (perforated at the bottom), with 12 kg capacity of each. The soil of each pot was supplied, through mixed thoroughly, with P at a rate of 12 mg P/kg soil. Soil-K was in sufficient amount. The experimental pots were contained 288 pots representing, i.e. "3 soils" x "4 N-fertilizer forms" x "4 N-rates" x "2 moisture of WHC" x "3 replicates" which arranged randomized in a complete block design with three replicate in four factors of:

(1) Soils: surface (0-20 cm) soil samples were taken separately from three different locations of Egypt. These locations were Experimental Farm of Soil, Water and Environment Research Institutes (ARC) Giza (Giza Governorate), and Experimental Farm of El-Nobaria and El-Tahreer station ARC, of Nobaria and El-Tahreer (Behaira Governorate) respresinting alluvial, calcareous and sandy soils respectively. The collected soil samples were air-dried, ground, sieved through a 2 mm sieve. Their textures were clay loam, sandy clay loam and sandy loam, respectively.

(2) N-Fertilizers: They were two traditional soluble N-fertilizers of calcium nitrate (15.5% N,"**CaN**") and ammonium sulphate (21%N,"**NH**"). As well as two slow release N-fertilizers of sulphur-coated urea (28%N, "**SCU**"), and urea formaldehyde (31%N, "**UF**").

(3) Rates of N-fertilizers: They were 0.0, 2.4, 3.6 and 5.4 (gm N/pot).

(4) Moisture regimes: Represented with **70%** and **100%** of Water Holding Capacity **(WHC)**.

Pot were seeded with wheat (Triticum aestivum *c.v. Sakha 8*), at the winter season of 2015/2016 , at a rate of 15 seeds/pot and thinned to 10 seedlings/pot after emergence. At maturity (24 weeks-growth), plants in each pot were cut 2-cm above soil surface, carefully washed, dried and weighed, ground digested and analyzed for (N) as mentioned by Black *et al.,* (1965).

To study the response of successive crops to the residual effects of N-fertilizers, 2 successive crops were planted. They were sorghum "Sorghum vulgare *c.v. Giza 15*" which planted at the following summer season of 2016 and harvested after 9 weeks, then barley "Hordium, vulgare *c.v. Giza 121"* which planted at the next winter season of 2016/2017 and harvested after 16 weeks. Plants in each pot were cut as an all plant at 2-cm above soil surface, carefully washed, dried and weighed, ground digested and analyzed for (N) as described by Black *et al.,* (1965).

Soil samples were analyzed for some physical and chemical properties according to the methods described by (Piper, 1950) and (Black *et al,* 1965). The obtained data are recorded in Table (1). Data were statistically analyzed as Sndecor and Coechran (1971) using computer M. Stat. program.

RESULTS AND DISCUSSION

Sulphur-coated urea (SCU) is broken down by microorganisms, chemical and mechanical action. The nitrogen in (SCU) is released more readily in warm temperatures and dry soil. SCU appears to be more effective when applied to the soil surface, rather than mixed into the soil.

The conversion of urea formaldehyde (UF) reaction products to plant-available N is a multi-step process, involving first dissolution, and microbial decomposition. Once in the soil solution, UF reaction products are converted to plant-available N through either microbial decomposition or hydrolysis. Microbial decomposition is the primary mechanism of N release. Environmental factors such as soil temperature, moisture, pH and aeration affect microbial activity and, therefore, the rate of N release.

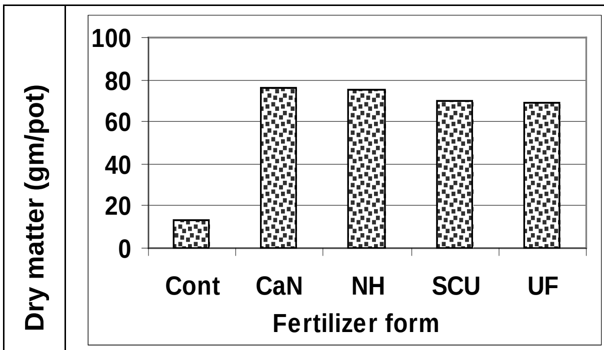
Effects N-fertilizers on wheat growth

Wheat dry matter yield (gm. /pot)

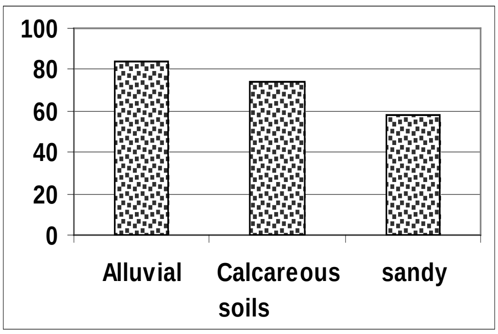
Collected graphs in Fig. (1), declared the individual mean effects of N-fertilizers form, N-fertilizers rates, soil type and soil moisture regimes on dry weights (gm. /pot) of wheat.

Table (1) : Analysis of the experimental soils.

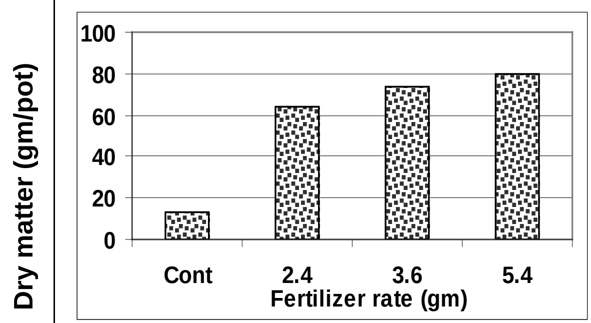
Soil Locations / Characteristics	*Giza*	*El-Noubria*	*El -Tahreer*
And units	*Alluvial*	*Calcareous*	*Sandy*
EC (dS/m) (past extract)	1.74	1.47	0.98
pH (1.2.5 soil:water)	8.0	8.2	7.8
O.M. %	1.93	1.43	1.18
$CaCO_3$ %	2.94	31.7	3.15
Total N %	0.1	0.04	0.03
Available P (mg/kg)	23.8	6.2	5.4
Available K (mg/kg)	390.0	151.0	112.0
Clay %	40.1	14.9	8.2
Silt %	28.5	22.5	16.6
Sand %	31.4	62.6	75.2
Soil Texture	*Clay Loam*	*Sandy Clay Loam*	*Sandy Loam*



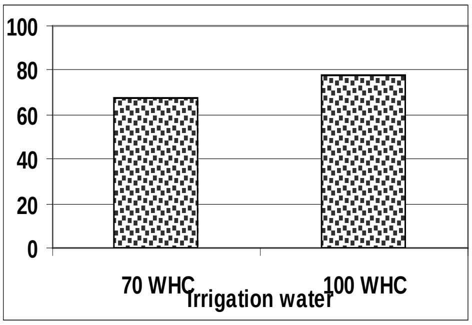
LSD (5% N-fertilize. Form): 1.9



***LSD (5% Soil type):* 1.7**



***LSD (5%) N-fertilz.Rate:* 1.6**



***LSD (5%)Moisture Regime:* 1.4**

Fig (1): Mean effects of the individual N-fertilizers form, N-fertilizer rates, soil types and soil moisture regimes on wheat dry weights (gm. /pot) .

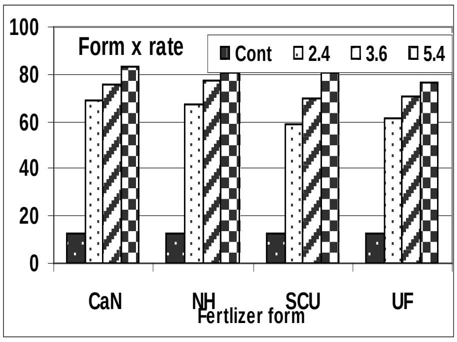
As for the effects of N-fertilizers forms & rates (gm N/pot), in general, graphs showed that all N-fertilizer forms and rates increased dry weights of wheat plants (gm/pot) in compare with the control treatment (0 N-fertilizer). On the other hand, traditional soluble N-fertilizers of CaN & NH were more effective in increasing dry matter than slow release N-fertilizers of SUC & UF. Whereas, the mean values of dry matter were 75.9, 75.1, 69.9 and 69.4 gm/pot when fertilized by CN, NH, SCU and UF, respectively. While, as for N-fertilizer rate, the average values of dry matter for rates 2.45, 3.6 and 5.6 gm/pot were 64.2, 73.5 and 80.2 gm/pot for the mentioned rates, respectively.

Also the average vales of dry matter for soils of alluvial, calcareous and sandy were 84.0, 74.0, 57.8 gm/pot, respectively. From another side, dry matter of wheat plants (mg/pot) recorded the highest values under moisture regimes of 100% than 70% WHC.

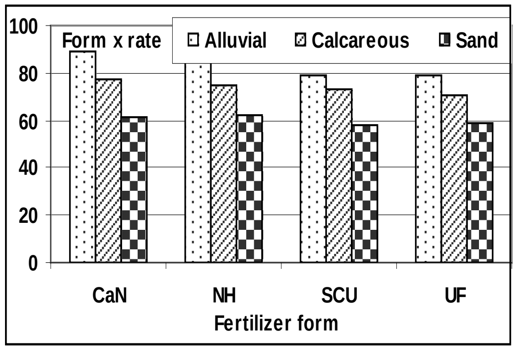
With respect to the dual interaction mean effects of N- fertilizers forms with any of the other experimental factors of N-fertilizers rates, soil type and moisture regimes, Fig (2) showed that the rate of 5.4 (gm.N/pot) of CaN recorded the highest wheat dry matter (gm. /pot) compared to control and the other rates and forms of NH, SCU and UF.

Fertilization with CaN in alluvial soil yielded higher wheat dry matter (gm. /pot) than the yielded of other N-fertilizers forms in the other soils. Also the application of traditional soluble N-fertilizers forms under moisture regime of 100% WHC, of CaN or NH achieved higher wheat dry matter (gm. /pot) followed with slow release N-fertilizers of SUC or UF & moisture regime of 100% WHC. While, CaN or NH & 70% WHC then SUC or UF & moisture regime of 70% WHC occupied the third and the fourth ranks, respectively.

Dry matter (gm/pot)

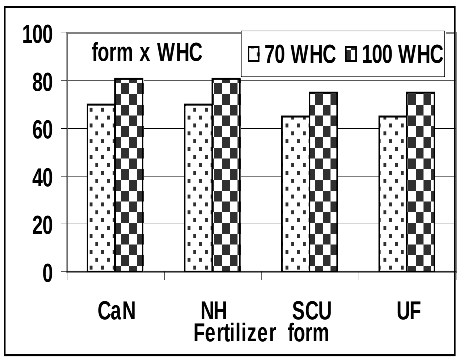


LSD (5%) N-Form x N-Rate: **3.3**



LSD (5%) N-Form x Soil type: **3.3**

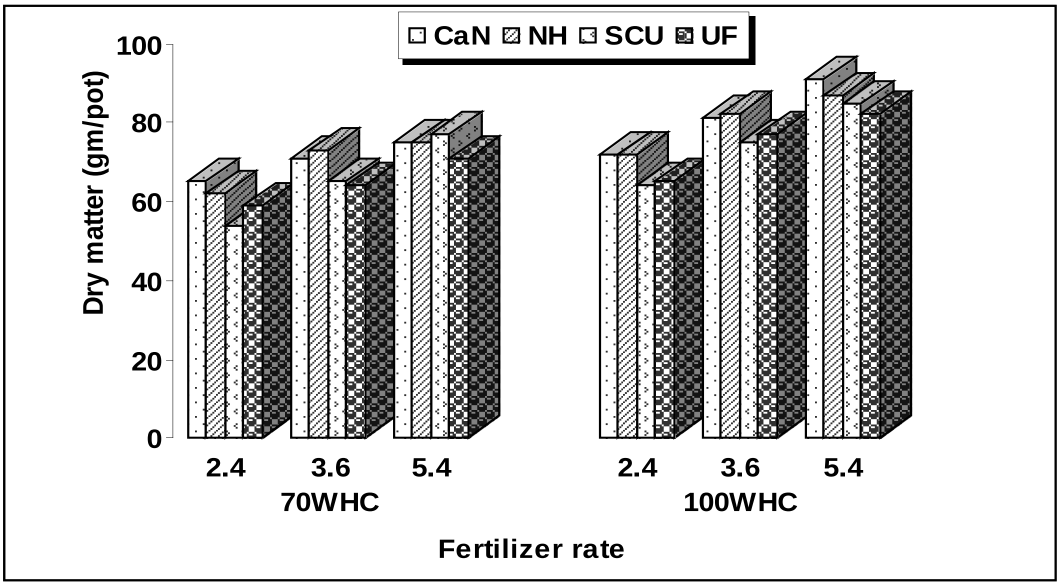
Dry matter (gm/pot)



LSD (5%) N-Form x Moisture regime: **NS**

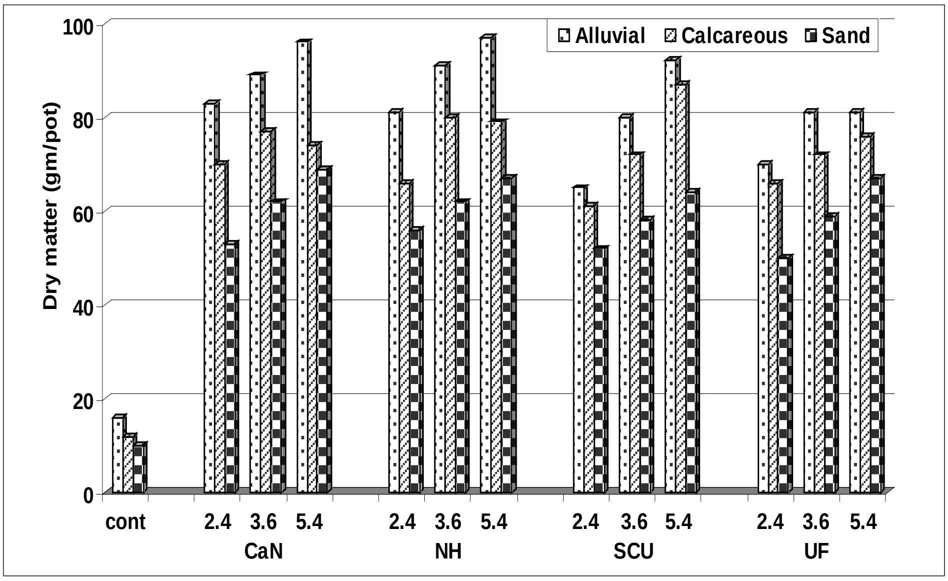
Fig (2): Mean effects of the dual interactions of (N-fertilizers forms *x* N-fertilizers rates), (N-fertilizers forms *x* soil type) and (N-fertilizers forms *x* moisture regimes) on wheat dry weight (gm. /pot).

Fig. (3) showed dry matter weight of wheat plant (gm/pot) affected with the triple interactions of N-fertilizers forms, N-fertilizers rates, and moisture regimes. While Fig. (4) showed the mean effects of the triple interactions of N-fertilizers forms, N-fertilizers rates, and soil types on dry matter weight of wheat plant (gm/pot). The two figures showed that, the highest average of dry weight (gm/pot) resulted under fertilization with the tradition N-fertilizers forms with high N-rate on alluvial soils under irrigation of 100% moisture regime.



LSD (5%) N-form x N-rate x moisture regime : N.S

Fig (3): Mean effect of the triple interaction of (N-fertilizer forms x N-fertilizer rate x moisture regimes) on wheat dry weight (gm/pot).



LSD (5%) N-form x N-rate x soil type : 5.6

Fig (4): Mean effect of the triple interaction of (N-fertilizer forms x N-fertilizer rates x soil type) on wheat dry weight (gmlpot).

Wheat N-uptake (mg/pot)

Data in Fig. (5) represented the individual mean effects of N-fertilizers form, N-fertilizers rates , soil type and soil moisture regimes on N-uptake (mg. /pot) by wheat. Whereas, N-fertilizer form as CaN, N-fertilizers rate at 5.4 (gm/pot), alluvial soil and irrigation regime at 100% WHC achieved the superiority N-uptake than the other corresponding treatments.

While, the mean values of N- uptake were 983, 910, 776, and 786 (mg/pot) resulted from the treatments of the N-fertilizer forms of CaN, NH, SCU, and UF, respectively. As for the individual mean effects of N-fertilizers rates 0.0, 2.4, 3.6 and 5.4 (gm/pot), the mean values of N-uptake were 112, 762, 871, and 951 (mg/pot), respectively. Also, the average values of N-uptake (mg/pot) by wheat, as affected by soil types, were 1000, 876 and 709 mg/pot for alluvial, calcareous and sand soils, respectively. Whereas, the average values of N uptake (mg/pot) by wheat under the two irrigation regime were 793 and 930 mg/pot for 70 and 100WHC, respectively.

The dual interaction mean effects of N-fertilizers forms with any of the other experimental factors of N-fertilizers rates, soil type and moisture regimes on N-uptake (mg/pot) by wheat plants was shown in Fig. (6). It's clear showed that, dual interactions of fertilization wheat plants with CaN under N-fertilizer rate at 5.4 (gm.N/pot) or under grown on alluvial soil or under moisture regime at 100% WHC produced higher N-uptake by wheat plants (mg/pot) than the other dual interactions.

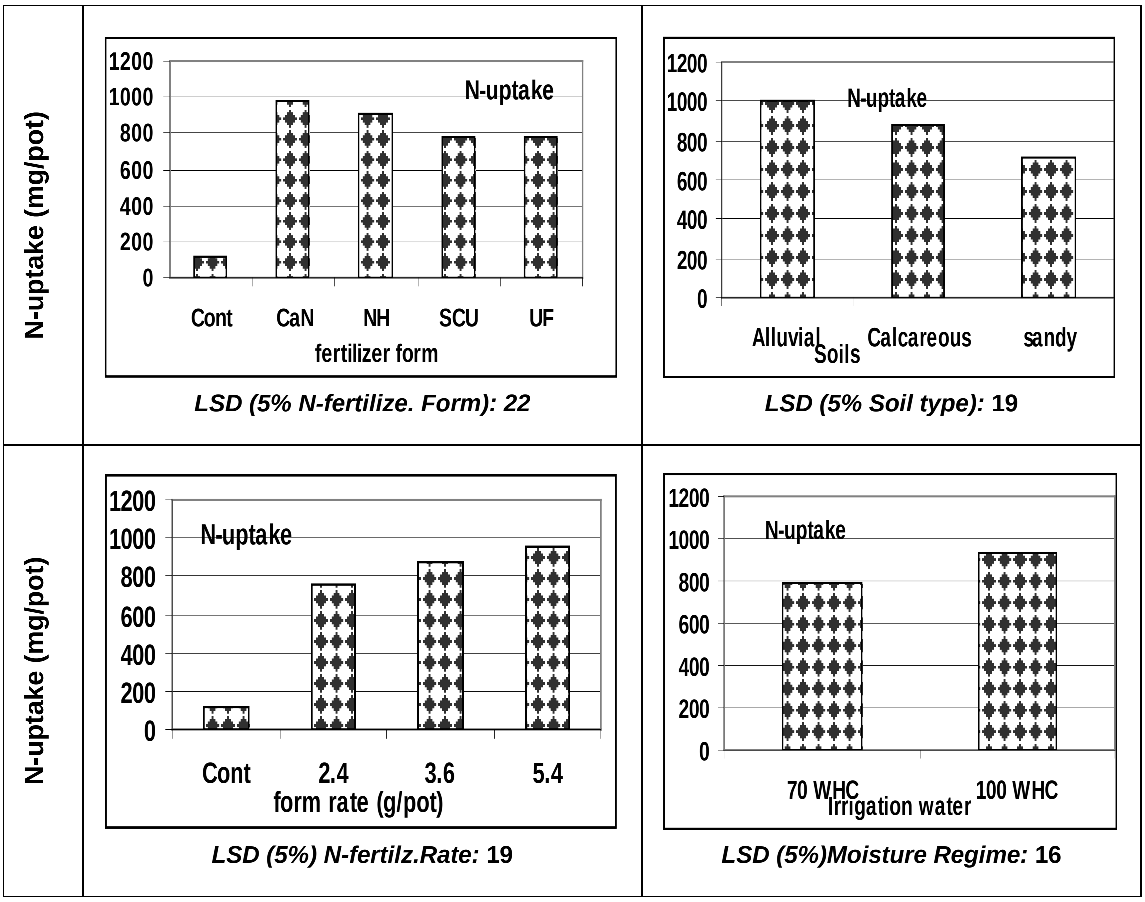
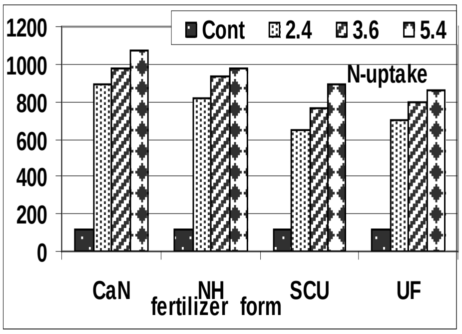
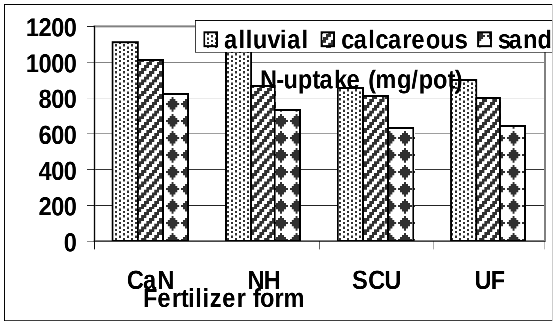


Fig (5): Mean effects of the individual N-fertilizers form, N-fertilizer rates, soil types and soil moisture regimes on Wheat N-uptake (mg/pot).

N-uptake (mg/pot)

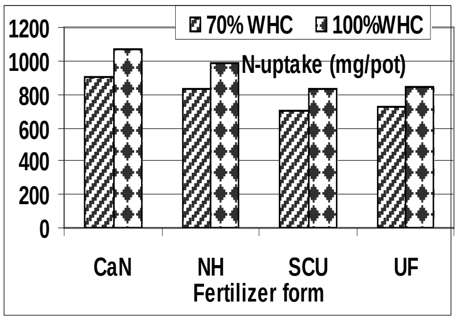


LSD (5%) N-Form x N-Rate: **39**



LSD (5%) N-Form x Soil type: **39**

N-uptake (mg/pot)

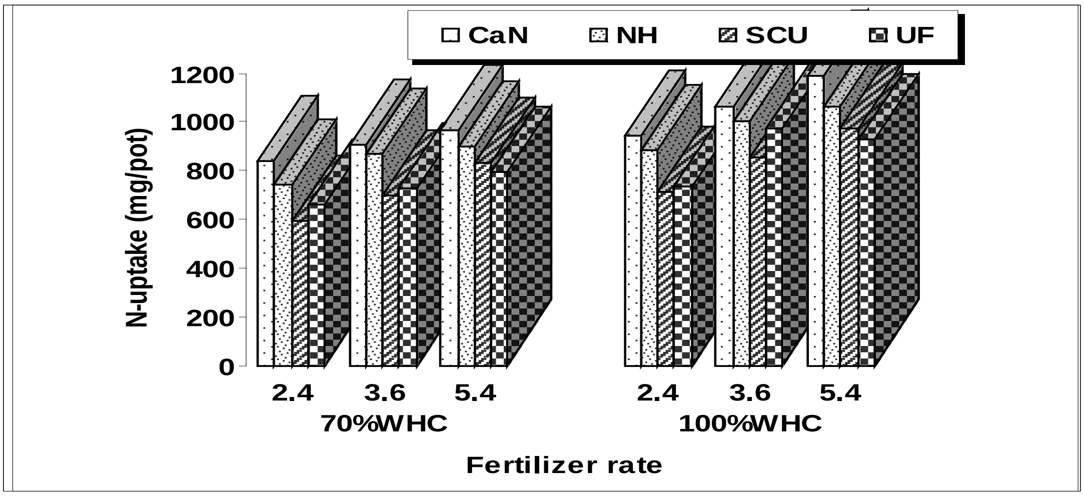


LSD (5%) N-Form x Moisture regime: **N.S**

Fig (6): Mean effects of the dual interactions of (N-fertilizers forms *x* N-fertilizers rates), (N-fertilizers forms *x* soil type) and (N-fertilizers forms *x* moisture regimes) on N-uptake (mg. /pot).

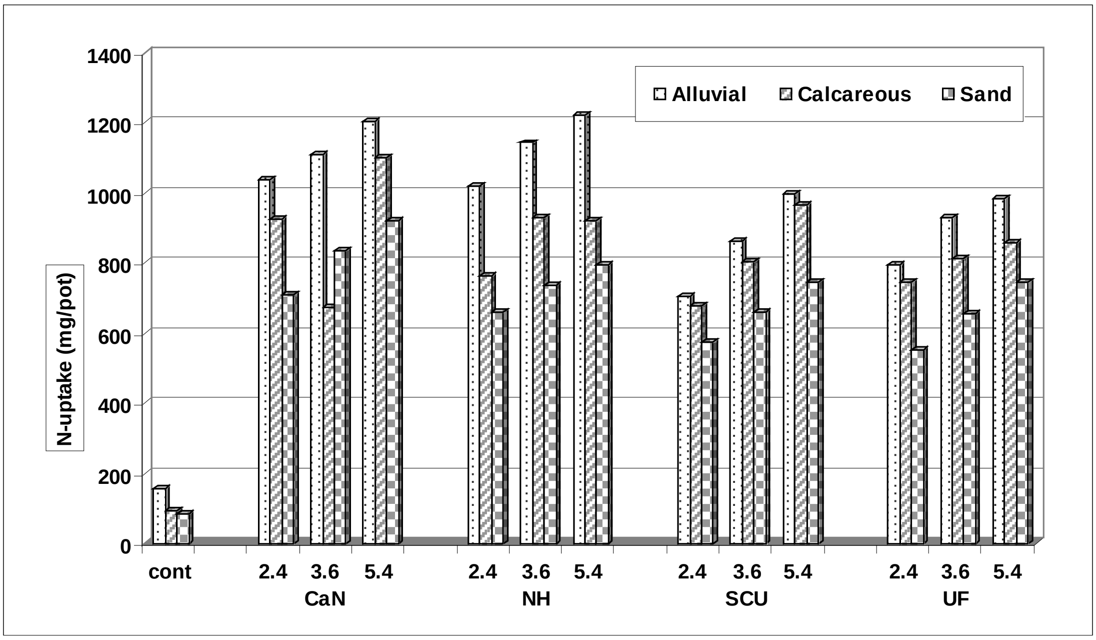
Fig. (7) show the effects of the triple interactions of the studied treatments (N-fertilizer forms *x* N-fertilizer rates *x* moisture regimes) on N uptake (mg/pot) by wheat plants. This figure showed increase of N-uptake was found in the treatment of 5.4 (gm N/pot) as CaN with moisture regime of 100% WHC but with no significant trend with other similar interactions. On the other hand, Fig (8) showed the triple interaction of N-fertilizer forms *x* N-fertilizer rates *x* soil type on N-uptake (mg/pot) by wheat significant. Where these effects were as shown with trend supported the discussed trends.

The aforementioned data indicated that, dry matter (gm/pot) & N-uptake (mg./pot) of wheat (which grown at the beginning of the experimental first winter season of 2015) under fertilization with quick-traditional soluble N-fertilizers of CaN & NH were more than those fertilized with slow release N-fertilizers of SUC & UF can be considered an expected and a logical trend. This is due to the fact that, the quick-traditional soluble N-fertilizers have insurance adequate needed of N for the growing plants of wheat during the vegetative growth stage faster than the N-slow fertilizers. These N-slow fertilizers have a continuous supply of crops with their needs of N for long periods of time. This supply may be continues for many subsequent seasons, then for other successive crops as a residual effect. A lot of studies were conducted in this field, such as the studies of Karrou, *et al* (2003), Silva *et al* (2007) and Ostrom (2011). On the other hand increasing dry matter (gm/pot) & N-uptake (mg/pot) of wheat with increasing N-fertilization rate , regardless N-fertilization form or soil type, were coinciding with the researches of Steve *et al.,* (2012) , Ladha *et al.,* (2005), Halvorson *et al.* ,(2005) and Irene *et al.* , (2015).



LSD (5%) N-Form x N-Rate x irrigation regime: **N.S**

Fig (7): Mean effects of the triple interactions of (N-fertilizer forms *x* N-fertilizer rates *x* moisture regimes) on N uptake (mg./pot) by Wheat.



LSD (5%) N-Form x N-Rate x Soil type : **67**

Fig (8): Mean effects of the triple interaction of (N-fertilizer forms *x* N-fertilizer rates *x* soil type) on N uptake (mg./pot) by wheat .

Furthermore, the superiority of increasing dry weight (gm/pot) & N-uptake (mg/pot) of wheat was recorded in pots of alluvial soil follow with in pots of calcareous soil and the latest increasing was noticed in pots of sandy soils. While moisture regime of 100% WHC achieved higher dry weight (gm/pot) & N-uptake (mg/pot) of wheat was more than those under moisture regime of 70%WHC. These trends can be interpreted as Allan (2004) who stated that, the most important way in which soil texture affects plant growth is water and with it the nutrient supply. The available water holding capacity of soil is related to soil texture. Clayey soils show high water holding capacity, high plasticity, and stickiness and swelling, whereas sandy soils are conspicuous by the absence of these properties. Also Khafagi *et al.* (1987) reported that, nitrate ions movement in some Egyptian soil is strongly positively affected by moisture content of soil with a linear relationship.

Residual effects of N- fertilizers on successive crops

The second phase of the current search included the study of residual effects of the used N- fertilizers, with previous crop, on the successive crops. As mentioned previously, after wheat harvested and in the pots without any new additions of N-fertilizers, "Sorghum" was planted at the following summer season for 9 weeks, then "Barley" was planted at the next winter season for 16 weeks.

With respect to the effects of N-fertilizers-rates, moisture regimes and soil types either as individual or as interaction on dry weight (gm/pot) and N-uptake (mg/pot) of sorghum and barley, they showed similar trends to the corresponding data of wheat, with a predominant tendency for significant differences between the experimental treatments as shown in Table (2).

Nevertheless, the residual effects N-fertilizer forms on dry weight (gm./pot) and N-uptake (mg./pot) of the successive crops i.e. sorghum and barley showed a contrary trends to their effects on the previous crop (wheat) , as will be discussed later.

Table (2): LSD at 5% of residual effects of the used N-fertilizers ,with the previous crop , on the successive crops of sorghum and Barley.

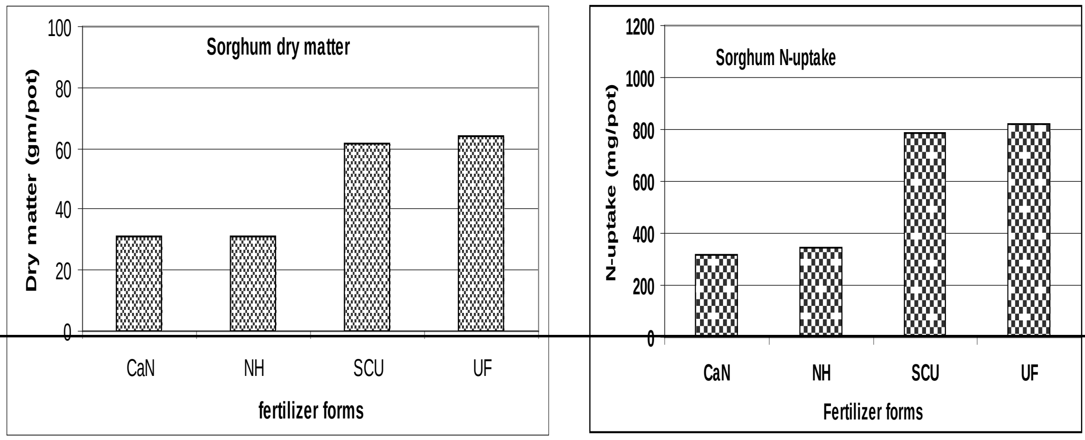
Different effects of the experimental factors	LSD (5%) values			
	Sorghum		Barley	
	Dry matter *(gm/pot)*	N-Uptake *(mg/pot)*	Dry matter *(gm/pot)*	N-Uptake *(mg/pot)*
N-Fertilizer Form *(F)*	1.5	15	0.70	8.0
N-Form Rate *(R)*	1.0	13	0.60	7.0
Soils Types *(S)*	1.0	13	0.60	7.0
Moisture Regime *(M)*	0.8	11	0.47	6.0
F x R	2.1	27	1.20	14.0
F x S	Ns	27	1.20	14.0
F x M	1.7	21	1.00	11.0
F x M x R	Ns	Ns	Ns	Ns
F x S x R	Ns	46	2.01	23.0

Sorghum Dry matter (gm/pot) & N-uptake (mg/pot).

Slow release N-fertilizers forms SUC & UF gave dry matter (gm./pot) and N-uptake (mg./pot) greater than the two forms of traditional soluble N-fertilizers of CaN & NH (Fig. 9). The two slow-release forms gave dry matter (gm/pot) and N-uptake (mg/pot) twice greater than those of the traditional soluble N-fertilizers forms. But, there was no significant difference between any of the two slow-release N-fertilizer forms or between the two forms of traditional soluble N-fertilizers.

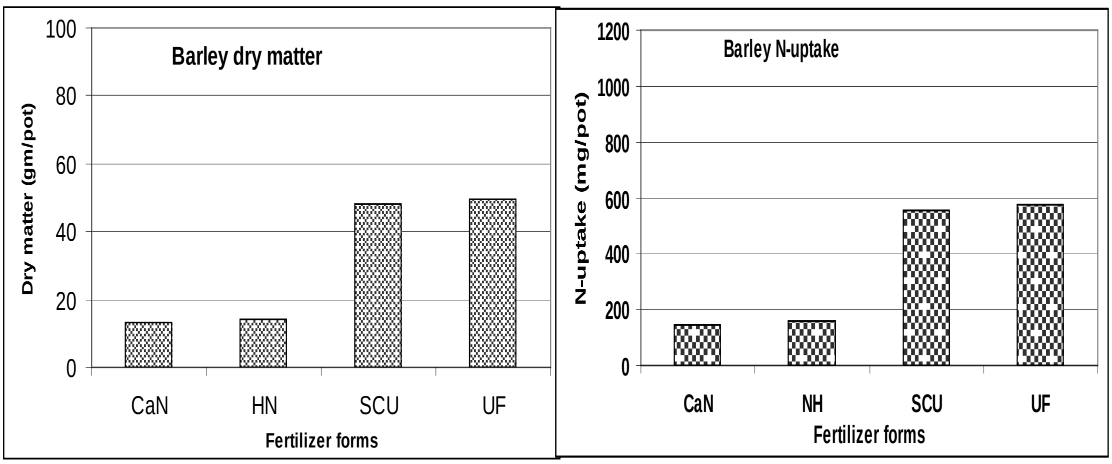
Barley Dry matter (gm/pot) & N-uptake (mg/pot).

Slow release N-fertilizers forms of SUC & UF gave dry matter (gm. /pot) and N-uptake (mg. /pot) greater than the two forms of traditional soluble N-fertilizers CaN & NH (Fig. 10).



LSD (5% N-fertilize. Form): 1.5 ***LSD (5% N-fertilize. Form): 15***

Fig (9): Mean residual effects of the individual N-fertilizers form on weights (gm. /pot) of Sorghum.



LSD (5% N-fertilize. Form): 0.7 ***LSD (5% N-fertilize. Form): 8.0***

Fig (10): Mean residual effects of the individual N-fertilizers form on weights (gm. /pot) of Barley.

The two slow-release forms gave dry matter (gm. /pot) and N-uptake (mg. /pot) threefold more than those of the traditional soluble N-fertilizers forms. There was no significant difference between any of the two slow-release N-fertilizer forms or between the two forms of traditional soluble N-fertilizers.

Relative effects of slow release N-fertilizers.

Relative effects of slow release N-fertilizers, which calculated as a ratio of the corresponding values of traditional soluble N- fertilizers, will be used to display the importance of slow release N-fertilizers for the successive crops. Tables (3 & 4) showed means of the relative effects of slow release N-fertilizers for all the experimental factors on dry weigh (gm/pot) and N-uptake (mg/pot) of wheat, sorghum and barley.

The two tabulated data gave similar trends , whereas mean values of relative effects of slow release N-Fertilizers obviously higher in the two successive seasons of summer 2016 sorghum and winter 2016/2017 barley than those in winter season of 2015/2016 wheat for both of dry weights (mg/pots) and N-uptake (mg/pot).

Table (3): Means of relative effects of slow release N-fertilizers on dry weights (gm./pot).

Experimental factors	Growth Season		
	Winter 2015/2016	Summer 2016	Winter 2016/2017
	Wheat	Sorghum	Barley
	Relative effects of slow release N-Fertilizers (Relative to traditional soluble N-fertilizers , suppose =1)		
	N-Additive	*N-Residues*	
R1: (2.4 gm.N /pot)	0.89	2.19	3.98
R2: (3.6 gm.N /pot)	0.91	2.01	4.44
R3: (5.4 gm.N /pot)	0.96	1.91	3.31
R –Mean	0.92	2.04	3.91
S1 :(alluvial ,"Clay loam")	0.88	1.69	3.04
S2 :(Calcar."Sandy clay loam")	0.95	2.19	3.72
S3 :(alluvial, "Sandy loam")	0.95	1.94	4.36
S-Mean	0.92	1.94	3.71
M1: (70% WHC)	0.93	2.22	3.37
M2: (100% WHC)	0.92	2.17	3.72
M –Mean	0.92	2.20	3.55
(Total mean effects)	0.92	2.06	3.72

Table (4): Means of relative effects of slow release N-fertilizers on N-uptake (mg./pot).

Experimental factors	Growth Season		
	Winter 2015/2016	Summer 2016	Winter 2016/2017
	Wheat	Sorghum	Barley
	Relative effects of slow release N-Fertilizers (Relative to traditional soluble N-fertilizers , suppose =1)		
	N-Additive	*N-Residues*	
R1: (2.4 gm.N /pot)	0.79	2.61	4.19
R2: (3.6 gm.N /pot)	0.82	2.42	3.62
R3: (5.4 gm.N /pot)	0.85	2.30	3.47
R -Mean	0.82	2.44	3.76
S1 :(alluvial ,"Clay loam")	0.78	1.96	3.22
S2 :(Calcar."Sandy clay loam")	0.86	2.72	3.91
S3 :(alluvial, "Sandy loam")	0.83	3.40	4.56
S-Mean	0.82	2.69	3.90
M1: (70% WHC)	0.82	2.47	3.54
M2: (100% WHC)	0.82	2.4	3.92
M -Mean	0.82	2.44	3.73
(*Total mean effects)*	0.82	2.25	3.80

Also, it's important to notice that the relative effects of slow release N- fertilizers, on dry weights (mg/pots) and N-uptake (mg/pot), were the lowest in the growth season of winter 2015/2016 "*wheat*", where added N- fertilizers. While, they increased in the two subsequent growth seasons summer 2016" *sorghum*" and winter 2016/2017 " *barley*", whereas no new addition of N-fertilizers, and the growing crops dependent on the residues of the previous addition of N-fertilizers. Also, the highest responded for the residues of slow release N-fertilizers were noticed during the growth season of winter 2016/2017 under growing barley.

The previous trends, as previously explained, can due to slow release N-fertilizers have a continuous supply of crops with their needs of N for long periods of time. This supply may be continues for many subsequent growth seasons, then for other successive crops as a residual effect (Steve *et al.,* 2012).

Conclusion

Slow release nitrogen fertilizers can be applied as a pre-plant application, because they may insure adequate supply of N-fertilizers for many successive crops. Thus, reduce production costs and eliminates the need for multiple applications of soluble nitrogen fertilizers. As well as slow release nitrogen fertilizers were able to increase nitrogen use efficiency by reduce nitrogen leachate and volatilization from soils.

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تأثير استخدام الأسمده النتروجينية بطيئة وسريعة الذوبان على محصول القمح مع دراسة لتأثيرها المتبقى على ذرة العلف والشعير

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الملخص العربى

أقيمت تجربة أصص تحت ظروف الصوبه بأستخدام اصص مثقبة من أسفل ووضع فيها 12 كجم تربه وزرع بها بذور القمح فى الموسم الأول 0 كما خضعت التجربة للنظام الأحصائى "بلوكات عشوائية فى ثلاث مكررات" ، وتم تسميدها بـ 12 مللجم p /كيلوجرام تربه وتم الأكتفاء بما تحتويه من بوتاسيوم0

وكانت المعاملات هى ثلاث انواع تربة (طينية – جيرية – رملية)، اربعة انواع اسمد (اثنين سريعة الذوبان وهى نترات الكالسيوم وسلفات الأمونيوم، واثنان بطيئة الذوبان وهى سلفات يوريا مغلفه و يوريا فورمالدهيد) وثلاث معدلات هى (2.4، 3.6 ، 5.4 جرام نتروجين/اصيص) ومستويين رى (70% سعة تشبعية و 100% سعة تشبعية) وكان اجمالى المعاملات 216 معاملة/اصيص ، وبعد 24 اسبوع تم اخذ عينات النبات من نباتات القمح0

وبعد حصاد القمح وفي نفس الأواني، من أجل دراسة تأثير التسميد الأزوتى المتبقي، تم زراعة محصولين متعاقبين من الذرة الرفيعة ثم الشعير لمدة 9 و 16 أسابيع، على التوالي0

كانت الأسمدة النتروجينية سريعة الذوبان لها تأثير عالى علي المادة الجافة وكذلك على النتروجين الممتص لمحصول القمح مقارنة بالأسمدة بطيئة الذوبان ، حيث كان سماد نترات الكالسيوم اعلى ما يمكن يليه فى الترتيب سلفات الأمونيوم ثم الأسمده النترجينية البطيئه الذوبان. وبالنسبة لنباتات الذره علف والشعير فقد كان تأثير الأسمده البطئيه الذوبان أعلى من تأثير الأسمده السريعة وذلك بالنسبة للمادة الجافة النتروجين الممتص0

أظهرت مخلفات بقايا الأسمدة النتروجينية البطيئة القدرة على الإستمرار فى إمداد نباتات ذرة العلف والشعير، المنزعة فى الموسمان التاليان بكميات مناسبة من النتروجين لقدرتها على الأستمرار فى إطلاق النتروجين لفترات طويلة من الزمن.