# YIELD AND NUTRIENT CONTENT OF WHEAT AND CORN AS INFLUENCED BY SLOW AND QUICK RELEASE NITROGEN FERTILIZERS APPLICATION IN CALCAREOUS SOIL

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***Abstract***

Two field experinents were carried out at Noubaria Research Station in the two successive years 1987 and 1988 . Urea formaldehyde (UF) , urea (U) and Ammonium nitrate (AN) fertilizers were evaluated as nitrogen sources for the production and quality of wheat (cv. Sakha 69). Urea formaldehyde and ammonium suplphate were also evaluted for corn (cv. H. 4141 ) on a calcareous soil . Great values of grain and straw yield of wheat were obtained in descending order when the plant received An, U and UF + AN at the rates 75,60 and 30+40 kg N /f. The lowest yield was obtained from the treatment that received (60+30) Kg N/f. from UF + AN, respectively.

Dry matter yield and N content of corn plant were greatly affected each by using AS and UF treatment at the rate of 105 kg N/f. and UF (45 kg N/fed. ) in combination with 45 KgN/f. as As . However , UF treamtment at the rate of 105 kg N /f. which was separately applied or in combiantion with 45 kg/f. As increased dry matter and N contents of ear's leaf . The grain from UF was proportionally less than that in ordinary As treament ( 105 Kg N / f.) which produced the higest yield . However, grain yield of corn was better when the plants received UF at the rate of 52.5 + 52 . 5 from UF and AN, respectivelly.

## INTRODUCTION

The agronomic efficiency of water - soluble fertilizer materials, such as ammonium sulphate, ammonium nitrate, and urea , may be low because of leaching, decomposition, luxury consumption and toxicity due to heavy application. Efficiency of

soluble N fertilizer use by the fertilized crop can usually be increased by proper placement to avoid seedling injury; by soil incorporation to reduce volatilization loss of N in largest amounts; by reducing leaching through having a growing crop on the land at time of application; or by avoiding application or excessive irrigation water . The results of long-term field and lysimeter studies showed that only 50 - 60 % of fertilizer nitrogen applied to soil is usually recovered by crop plants (Allison , 1966).

The major objective in using slow - release rather than soluble N ferilizer is to increase the efficiency of the fertilizer, modify the seasonal production pattern of the crop, and eliminate costs of repeated applications.

The data collected by Young (1974) indicated that many crops responded to controlled - release N fertilizers especially under irrigation conditions.

## MATERIALS AND METHODS

Two field experiments were carried out in winter season 1987 / 1988 using wheat (cv. Sakhah 69 ) , and in summer season 1988 for corn (cv. H. 4141 ) at Nubareia Resarch Station. The soil was highly calcareous containg 26% $CaCO_3$. The expeimental plots area was 1 / 400 f for each .

Treatments for the wheat crop are summarized as follows :

1. Control (unfertilized plots ).
2. Ammonium nitrate (AN 33 % N; at the rate of 60 kg N / f).
3. AN (75 Kg N / f).
4. Urea ( U 46 % N at the rate of 60 Kg N / f).
5. U (75 Kg N / f).
6. Ureaformaldehyde ( UF 41 . 27 % N at the rate of 60 Kg N / f).
7. UF (75 Kg N / f).
8. UF + AN (60 + 15 Kg N / f).
9. UF + AN (30 + 45 Kg N / f).
10. UF + U (60 + 15 Kg N / f).
11. UF + U (30 + 45 Kg N / f) .

Treatments for the second experiment for corn are summarized as follows :

1. Control ( unfertilized plots ).
2. Ammonium sulphate (AS 20. 6 % N at the rate of 90 kg N / f.
3. AS (105 kg N / f).
4. UF (105 kg N / f).
5. UF + AS (54 + 45 kg N / f).
6. UF + AS (52.5 + 52.5 kg N / f).

Ureaformaldehyde (UF) was used as a slow - release N fertilizer, containing 41.27% N and had an activity index (AI) about 66.35 % and water soluble nitrogen (WSN) of 29.23 %. The fertilizer was supplied by Hegazy (1985). Its granule size ranged from 1. 0 to 2.0 mm in diamters. The quick N - fetilizers were split in two equal doses and applied at 21 and 45 days after planting. The exprimemtal design was a randomized complete blocks with four replicates. Regardless the control teatement , all plots were subjected to a basal application of 15 Kg / f. $P_2O_5$ as calcium superphosphate (15 %) and 24 kg $K_2O$ / f. as potassium sulphate (48 %). The fertilizers and UF treatments were applied before planting. Plant samples were taken after 60 days from planting . Dry matter yield of whole plant and ear's leaf were oven dried at $70^{o}$ C . N content was determined by the method described by Jackson (1973) . At harvesting of wheat and corn, yield of grain was determined. Straw yield of wheat and seed index (1000-grain weight) were also estimated. Total N of grain for both crops was detrmined in the grain of corn as indicated by Troug and Mayer (1949) and Chapman and Pratt (1961).

All data were subjected to statistical analysis according to the methods described by Snedecor and Cochran (1969).

## RESULTS AND DISCUSSION

**Wheat (cv . Sakha 69 ) :**

In the wheat trial fertilized with 75 , 75 , 30 + 45 , 60 , 60 + 15 kg $fed^{-1}$ in

forms of ammonium nitrate, urea, ureaformaldehyde + ammonium nitrate, ammonium nitrate, ureaformalddehyde + urea, respectively, gave the highest grain and straw yield (Table 1). They were signigicanlty higher than those fectilized with 0, 60 + 15 Kg N $fed^{-1}$ as ureaformaldehyde + ammonium nitrate. Ureaformaldehyde at the rates of 60 and 75 kg N $fed^{-1}$ gave similar grain and straw yields .

Source of N ferilizer and the rate of N application are the main factors which affect N content and seed index (1000 - grain weight) in wheat, Table I. Gerevally wheat plants with ureaformaldehyde especially at the rate of 75kg N fed-$^{1}$ resulted in an increase in the N content of grains and seed index . This agrees with the results of McCutchen *et al.*, (1975) dealing with a slow - release fertilizer applied in the fall for winter wheat . Statistical analysis also showed that there were no significant differences among the different treatments in N content of grain and seed index. In this respect, Nazir *et al.,* (1985) found that there was no significant difference between the slow - release N fertilizer and urea applied to wheat.

**Corn ( cv. H. 4141 ) :**

The growth of corn plants cv. H. 4141 expressed as dry matter yields of stems and leaves as well as ear's leaf is presented in Table 2. The results clearly indicated that the dry weight of stem significantly increased by applying ureaformaldehyde (UF) and ammonium sulphate at the rates of 105 kg N $fed^{-1}$ . Also , ammonium sulphate significantly enhanced growth of leaves and ear's leaf . However, UF applied separately at the rate of 105 kg N $fed^{-1}$ or in combination at rate of 45 kg N $fed^{-1}$ with 45 kg N $fed^{-1}$ as ammmonium sulphate showed stimulation effects on the dry weight of whole plant. Good results were also obtained from ammounium sulphate at 105 kg N $fed^{-1}$ ( 49.04 g $plant^{-1}$ ), Uf at 105 kg N $fed^{-1}$ (49 . 41 g $plant^{-1}$) and UF + $(NH_4)_2 SO_4$ at 45 + 45 kg N $fed^{-1}$ (48.04 g $plant^{-1}$ ). These results are in line with those of Sartain (1982) who found that slow - release fertilizers (IBDU and $(NH_4)_2 SO_4$ ) produced the highest yield of clippings and best visual rating on the ryegrass.

Data in Table 2 also show that the the application of $(NH_4)_2 SO_4$ and UF in combination with $(NH_4)_2 SO_4$ significantly increased the uptake of N in stem and leaves of corn as compared with the check treatment or with UF at the rate of 105 Kg N $fed^{-1}$. However , all UF treatments significantly enhanced N content of ear's leaf of corn plant either applied separately or in combination with $(NH_4)_2 SO_4$.

Table 1. Effect of ureaformaldehyde on yield , N content and seed index of wheat (Sakha 69 ) as compared with fast release N - fertilizers in calcareous soil.

**(Nubaria, 1987 - 1989)**

| Treatment fertilizer | KgN / f | Yield Ton / f | | Nitogen % | | 100 g Weight (g) |
|---|---|---|---|---|---|---|
| | | Grain | Straw | Grains | Straw | |
| Control | 0 | 2.263 | 2.625 | 1.28 | 0.43 | 47.5 |
| Amm. nitrate | 60 | 3.650 | 6.250 | 2.13 | 0.75 | 50.3 |
| Amm. nitrate | 75 | 4.838 | 7.375 | 1.17 | 0.95 | 50.3 |
| Urea | 60 | 4.000 | 7.313 | 1.10 | 0.85 | 51.4 |
| Urea | 75 | 4.688 | 7.500 | 2.13 | 0.70 | 52.9 |
| Ureaformaldehyde | 60 | 3.038 | 5.250 | 2.18 | 0.43 | 52.3 |
| Ureaformaldehyde | 75 | 3.025 | 5.313 | 2.56 | 0.77 | 53.1 |
| UF + Amm. Nit. | 60 + 15 | 2.950 | 4.625 | 1.70 | 0.43 | 49.0 |
| UF + Amm. Nit. | 30 + 45 | 4.113 | 6.375 | 1.70 | 0.43 | 48.8 |
| UF + Urea | 60 + 15 | 3.200 | 5.875 | 1.70 | 0.43 | 49.5 |
| UF + Urea | 30 + 45 | 3.800 | 5.688 | 1.70 | 0.75 | 49.9 |
| L.S.D at 0.05 level | | 0.689 | 1.398 | n.s | n.s | n.s |
| 0.01 level | | 0.929 | 1.883 | | | |

Table 2. Dry weights and N content of corn (H.414) plant organs (H. 4141) as afected by ureaformaladehyde and ammonium sulfate fertilizers in calcareous soil.

( Nubareia : Summer saeason , 1988 )

| Treatment fertilizer | KgN / f | Whole plant | Ear's leaf | Whole plant | | | Ear's leaf |
|---|---|---|---|---|---|---|---|
| | | Dry matter yield (g / plant) | | Nitrogen content | | | |
| | | | | mg / plant | mg / plant | % | mg / plant |
| Control | 0 | 36.71 | 4.975 | 221 | 491 | 1.73 | 75.9 |
| Amm. sulphate | 90 | 47.18 | 5.150 | 456 | 938 | 1.47 | 85.9 |
| Amm. sulphate | 105 | 49.89 | 6.325 | 467 | 922 | 1.73 | 108.8 |
| Ureaformaldehyde | 105 | 49.41 | 6.275 | 306 | 914 | 1.85 | 122.1 |
| UF + Amm sulf. | 45 + 45 | 48.04 | 6.125 | 374 | 822 | 1.98 | 123.9 |
| UF + Amm. sulf. | 52.5 + 52.5 | 44.60 | 5.400 | 351 | 754 | 1.93 | 103.5 |
| L.S.D at 0.05 level | | 5.53 | n . s | 41 | 145 | 0.22 | 39.9 * |
| 0.01 level | | 7.65 | | 57 | 200 | 0.30 | n . s |

Data reported in Table 3 indicate the effect of UF $(NH_4)_2SO_4$ and their combinations on yield of corn and the nutrient contents of grains. Grain yield was significantly enhanced by N fertilizers. The highest values were obtained with 105 kg N $f.^{-1}$ of $(NH_4)_2SO_4$ , UF (52. kg N $f.^{1}$ ) + $(NH_4)_2SO_4$ (53. Kg N $f^{1}$) and UF (45 kg N $f^{-1}$) + $(NH_4)_2SO_4$ , (45 kg N $f.^{-1}$ ). The obtained results were 4.228 , 3.850 and 3.710 tons $f.^{-1}$ , respctively .

Statistical analysis showed that the treatments had no effect on the nutrient contents of grain (Table 3). However , UF treatment at the rate of 105 kg N $fed^{-1}$ gave a stimulation effect on NPK content of grain which resulted the high values (1.163 % , 0.564 % , 1.32 % , respectively ) . It seems that slow - release N fertilizer has affected nutrients balance and accumulation. Young (1974) indicated that many crops responded to controlled - release N - fertilizers under irrigation conditions.

Table 3. Effect of ureaformaldehyd and ammonium sulfate fertilization on yield and yield components of corn (H.4141 ) grown on calcareous soil.

( Nubareia : Summer saeason , 1988 )

| Treatment fertilizer | KgN / fed | Grain yield Ton / fed. | Nutrients Content of grain, % | | |
|---|---|---|---|---|---|
| | | | N | P | K |
| Control | 0 | 2.030 | 1.630 | 0.379 | 1.19 |
| Amm. sulphate | 90 | 3.360 | 1.263 | 0.463 | 1.20 |
| Amm. sulphate | 105 | 4.228 | 1.525 | 0.409 | 1.28 |
| Ureaformaldehyde | 105 | 3.262 | 1.613 | 0.564 | 1.32 |
| UF + Amm sulf. | 45 + 45 | 3.710 | 1.538 | 0.344 | 0.92 |
| UF + Amm. sulf. | 52.5 + 52.5 | 3.850 | 1.338 | 0.448 | 1.26 |
| L.S.D at 0.05 level | | 0.714 | n. s | n. s | n. s |
| 0.01 level | | 0.980 | | | |

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# تأثير الأسمدة الأزوتية السريعة والبطيئة الذوبان على محصولى القمح والذرة والمحتوى العنصرى للنبات فى التربة الجيرية

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اقيمت تجربتان حقليتان فى منطقة شمال التحرير بمحطة البحوث الزراعية بالنوبارية وذلك على محصولى القمح ( سخا ٦٩ ) فى الموسم الشتوى ٨٧ / ١٩٨٨ والذرة الشامية ( هجين ٤١٤١ ) فى الموسم الصيفى ١٩٨٨ . تم مقارنة سماد اليوريا فورمالدهيد كسماد بطئ الإنسياب بمعدلات ٦٠ ، ٧٥ كجم أزوت للفدان تضاف دفعة واحدة مع الزراعة لمحصول القمح . كما تم استخدام معاملات مختلطة من السماد مع الأسمدة الشائعة ( ٣٠ ، ٦٠ كجم أزوت للفدان فى صورة يوريا فورمالدهيد ) مع ( ١٥ ، ٤٥ وحدة أزوت للفدان ) فى صورة اليوريا ونترات الأمونيوم بالإضافة الى الدفعات المتماثلة والكاملة منها . وبالنسبة لمحصول الذرة . تم استخدام ١٠٥ كجم ازوت للفدان على صورة سماد بطئ ( يوريا فورمالدهيد ) مقارنة بسلفات النشادر ( ٩٠ ، ١٠٥ كجم ن / ف ) ومخلوط من كلا السمادين ( ٤٥ ، ٥ر ٥٢ كجم ن / ف مع وجود معاملة مقارنة بكل تجربة بدون إضافة سماد أزوتى، كما تم تثبيت إضافات الفوسفور والبوتاسيوم طبقا للتوصية السمادية لكل محصول.

وأظهرت النتائج مايلى :-

**١ - محصول القمح :**

أظهرت النتائج أن اعلى قيم لمحصول الحبوب القش هى نتيجة المعاملة بنترات الأمونيوم عند إضافتها بالمعدل ٧٥ كجم ن / فدان يليها المعاملة بسماد اليوريا بمعدل ٧٥ كجم ن / فدان ثم المعاملة المشتركة من السماد البطئ الإنسياب وهو اليوريا فورمالدهيد بمعدل ٣٠ كجم ن / فدان مع ٤٥ كجم ن / فدان على صورة نترات الأمونيوم. و كانت المعاملة المسمدة بمعدل ٦٠ كجم أزوت فى صورة يورياقورمالدهيد + ٣٠ كجم ازوت فى صورة نترات النشادر أقلها.

**١ - محصول الذرة الشامية :**

أظهرت النتائج زيادة نمو نبات الذرة وكذلك محتواه من الأزوت عند استخدام سماد سلفات النشادر واليوريا فورمالدهيد بمعدل ١٠٥ كجم ن / فدان لكل منهاا وكذلك بمعاملة مخلوطهما بمعدل ٤٥ كجم ن / فدان .

كما ان معاملة اليوريا فورمالدهيد سواء أضيفت بمفردها بمعدل ٤٥ كجم ن / فدان أو مع سلفات الأمونيوم بمعدل ٤٥ كجم ن/ فدان تعمل على تحسين الوزن الجاف والمحتوى الأزوتى لورقة الكوز.