RESPONSE OF TWO MAIZE CULTIVARS (Zea mays L.) TO ORGANIC MAN- 
NUR AND MINERAL NANO NITROGEN FERTILIZER UNDER SIWA 
OASIS CONDITIONS

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ABSTRACT

Two trials were carried out at the Experimental Station farm of Desert Research Center, Teggerty from Siwa Oasis, Matrouh Governorate during the two summer seasons, 2015 and 2016. Trials were performed to study response of two maize hybrids (Single hybrid 131 and Triple hybrid 329) to organic manure (OM) levels (15 and 30 m³/fed.) and five combinations between mineral and nano nitrogen (N) fertilizers: 1)100% mineral N from the recommended dose (120 kg N/fed.), 2)75% mineral + 25% nano N fertilizers, 3)50% mineral + 50% nano N fertilizers, 4)25% mineral + 75% nano N fertilizers, 5)100% nano N as the recommended rate (500 ppm as foliar application). Mineral N rates were added in three equal doses, with foliar application by nano N rates, after 30, 45 and 60 days from sowing. Treatments, included twenty treatments, was laid out in a split-split plot design, with three replicates, OM levels were arranged in the main plots, maize cvs. were allocated in the sub plots, and mineral nano N fertilizer treatments were assigned in the sub-sub plots. At harvest the following characters were recorded, plant height (cm), number of rows/ear, ear length (cm), ear diameter (cm), number of grains/row, 100-grain weight (g), ear weight (ton/fed), grain, straw and biological yields (ton/ fed), shelling (%) and harvest index(%).

Results indicated that increasing OM levels significantly increased ear length harvest index and protein content (%), in the 2nd season only, triple hybrid gave the maximum values of all parameters, except no. of rows/ear and harvest index, in the 1st season, and 100-grain weight and carbohydrate (%), in both seasons, which had no significant difference with single hybrid in the most cases. Concerning with the effect of mineral and nano N, all parameters, except carbohydrate (%), were increased with increasing mineral N (%) and/or with decreasing nano N (%). Fertilized maize crop by mineral N at 100% or 75% plus 25% nano N fertilizer gave the maximum values of plant ht., no. of rows/ear, ear length and diameter, no. of grains/row, 100-grain wt., ear weight, grain, straw and biological yields, shelling (%), protein (%), protein yield and harvest index in both seasons. However, fertilized maize crop by nano N at 100% produced the highest value of carbohydrate content (%) in two seasons. Results suggested that selected triple maize hybrid cv. (329), at 30 m³ OM, with 100% mineral N (120 kg N/fed.) or with 75% mineral N (90 kg N/fed.) plus 25% nano N (125 ppm as foliar application) fertilizers could be utilized for attaining the maximal improvement in farmer income by increasing the maize yield under saline conditions at Siwa Oasis, Egypt.

Key words: Maize, Cultivars, Organic fertilizer, Mineral, Nano; Nitrogen.

INTRODUCTION

Maize (Zea mays L.) is one of the most important crops after wheat and rice crops which occupied the third order in Egypt and the world.
Siwa Oasis, as a depression in the Western desert of Egypt, is located within the extremely arid zone. The scarcity of fresh water sources forces to use of saline groundwater for the agricultural purposes leading to the risk of soil salinization. Therefore, Siwan farmers are not acquainted with such crop. So, they need maize crop more than in Delta Governorates.

The most of crops tolerate salinity to a threshold level and above which yield decreases as the salinity increases (Khan et al. 2006). However, the threshold of maize crop; the maximum allowable salinity without grain yield reduction is approximately 1.7 dS m$^{-1}$, as a moderately salt sensitive crop plants (Maas and Hoffman, 1977). They estimated yield reduction which was about 7.4 to 12.0% per dS m$^{-1}$ above this threshold. In another studies of Hoffman et al. (1983 and 1986), on organic soils, the threshold and percentage slope decrease had slightly higher values of 3.7 dS m$^{-1}$ and 14.0% per dS m$^{-1}$, respectively.

Organic manure improves soil fertility, by influencing its physical, chemical, biological properties and its release nutrients for a good response to plant growth. It improves water circulation, soil aeration, and increases the soil moisture holding capacity (Soltner, 1985 and Boateng et al. 2006) reported that application of 2 t poultry manure (pm)/ha was capable to increase maize yield by more than 100% over the control, while applied 4 t pm/ha may be recommended to produce grain yields similar to the chemical fertilizer rate.

Nitrogen fertilizer is very important particulary for cereal crops (Khan et al. 2017), enhancing the vegetative growth, biomass, dry matter and crop productivity of maize crop (Ogola et al. 2002 and Habitegebrial et al. 2007). But, it had also adverse effects on soil environment as well as the continued escalation prices of mineral N fertilizer (Waseem et al. 2012). Moreover, about 40–70% of N is lost causing a very serious environmental pollution (Trenkel, 1997 and Ombódí & Saigusa, 2000). In addition, adding any mineral fertilizer well be raises the osmotic pressure of soil solution and consequently soil salinization according to salt index of fertilizer type. So, recently, the use of slow release fertilizer combined with mineral N fertilizers, has become a new trend to save fertilizer consumption and to minimize environmental pollution (Guo et al. 2005 and Wu and Liu, 2008). The idea of developing encapsulated fertilizers, in which NPK fertilizers are entrapped within nanoparticles (Teodorescu et al. 2009). Consequently, the fertilizers are protected by the nanoparticles for better survival in inoculated soils, allowing for their controlled release into the soil (Ombódí and Saigusa, 2000) or plant. Therefore, the method of encapsulation of fertilizers components in polymeric nanoparticles is relatively novel, with potential commercial applications. Therefore, the objective of this study was to increase maize production and to improve soil productivity through use of organic, inorganic and nano N fertilizers.

**MATERIALS AND METHODS**

Two field experiments were conducted at Experimental Station of Desert Research Center at Tegzerty, Siwa Oasis, Matroh Governorate during the two successive summer seasons, 2015 and 2016. These experiments were performed to study the response of two maize hybrid cvs. (Single hybrid 131 and Triple hybrid 329) to OM levels (15 and 30 m$^2$/fed.) and the combination between mineral and nano N fertilizers: 1. 100% mineral N from the recommended dose.

1. 75% mineral + 25% nano N fertilizers.
2. 50% mineral + 50% nano N fertilizers.
3. 25% mineral + 75% nano N fertilizers.
4. 100% nano N from the recommended rate.

The recommended dose of mineral N (120 kg N/fed.), as ammonium sulphate form (20.6% N) where added in three equal doses, after 30, 45 and 60 days from sowing. While, the recommended rate of nano N was 500 ppm as foliar application at three times after 30, 45 and 60 days from sowing date. Each experiment, included twenty treatments, was laid out in a split-split plot design with three replicates. Organic fertilizer were arranged in the main plots, maize cvs. were allocated in the sub plots, and mineral nano N fertilizer treatments were assigned in the sub-sub plots. Each experimental unit area was 10.5 m$^2$ (3m x 3.5m) and contained four furrows (3.5 m in length and 60 cm apart).

Prior to planting, OM rates and phophorus as calcium superphosphate (15.5% P$_2$O$_5$), at 30 kg P$_2$O$_5$/fed., were added during soil preparation. The preceding crop was alfalfa in both seasons. Maize grains were sown in hills, 25 cm apart, at the 1$^{st}$ week of August in both seasons. After 4 weeks, weed control was performed by hoeing and seedlings were thinned to one plant/hill. Soil samples(0-30 cm) was taken for mechanical and chemical analysis in the both seasons (Table 1). Chemical analysis of water irrigation and OM are presented in Tables (2 and 3).
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Table 1. Mechanical and chemical analysis of the soil in the two seasons.

| a): Mechanical analysis |
|-------------------------|
| Depth (cm) | Coarse sand (0.5–1.0 mm) | Fine sand (0.1–0.25 mm) | Silt (0.002–0.05 mm) | Clay (<0.002 mm) | Class Texture |
| 1st season (2015) |
| 0-30 | 51.1 | 42.1 | 6.8 | 0 | Sandy loam |
| 2nd season (2016) |
| 0-30 | 48.6 | 42.7 | 8.7 | 0 | Sandy loam |

b): Chemical analysis

| Seasons | EcdS/m | pH | Cations (meq/L) | Anions (meq/L) |
|---------|--------|----|----------------|----------------|
| Ca** | Mg** | Na+ | K+ | HCO3⁻ | Cl⁻ | SO4²⁻ |
| 1st | 7.6 | 7.5 | 34.6 | 17.24 | 65.7 | 1.43 | 2.45 | 85.4 | 35.6 |
| 2nd | 7.3 | 7.4 | 35.8 | 16.33 | 63.1 | 1.22 | 2.1 | 81.5 | 32.8 |

Table 2. Chemical analysis of saline water irrigation.

| Well | EC ds/m | pH | Soluble anions (meq/L) | Soluble cations (meq/L) |
|------|--------|----|------------------------|-------------------------|
| CO3⁻ | HCO3⁻ | SO4²⁻ | Cl⁻ | Ca** | Mg** | Na⁺ | K⁺ |
| Well | 5.43 | 7.1 | 0 | 3.04 | 9.12 | 50.62 | 15.20 | 5.06 | 40.5 | 2.02 |

Table 3. Chemical analysis of OM.

| Seasons | pH | EC dSm⁻¹ | N (%) | P (%) | K (%) | O.M (%) | O.C (%) | C:N Ratio | Humidity (%) |
|---------|----|----------|-------|-------|-------|---------|---------|-----------|--------------|
| 1st | 7.89 | 2.78 | 0.68 | 0.31 | 0.20 | 27.6 | 16.0 | 23.5:1 | 18.8 |
| 2nd | 7.78 | 2.69 | 0.70 | 0.29 | 0.22 | 26.9 | 17.0 | 22:1 | 18.1 |

At harvest, samples of 5 plants/plot were randomly taken after 119 and 120 days from sowing date in 2015 and 2016 seasons, respectively from the middle of plot for every treatments to determine the following characters, plant height (cm), number of rows/ear, ear length (cm), ear diameter (cm), number of grains/row, 1000-grain weight (g), ear weight (ton/fed), grains weight (ton/fed), straw yield (ton/fed), biological yield (ton/ fed), shelling (%) (grains wt. of ten ears/ten ears wt. x 100) and harvest index (%). All the obtained data for the experiment of each season were subjected to statistical analysis according to the method described by Gomez and Gomez (1984). Means comparison were done using least significant difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

1. Effect of OM

Data in Table (4) show that yield and most its components did not affected significantly by OM levels, except ear length, harvest index and grain protein (%) in the 2nd season only. Ear length, harvest index and protein (%) were significantly increased with increasing OM levels. These increments may be attributed to insignificant increase in the most yield attributes particularly number of grains/row and 100-grain wt., in both seasons, as well as to a significant increase in ear length, in the 2nd one. In this regard, grain yield of corn was increased by application of manure or compost and

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poultry manure (Boateng et al. 2006) as compared with the unfertilized check or control.

Increasing harvest index with OM application means that OM encarged photosynthates transformation into economic yield. Similar findings were found by Khan et al. (2017) by application of 5 t ha⁻¹ of sheep manure. These increments of harvest index with higher sheep manure levels could be associated with enhanced soil cation exchange capacity, increased C, N, and P content, and lowered hydraulic conductivity of soil as noticed by Uzoma et al. (2011).

2. Maize cultivars differences

Maize cultivars had a significant effect on plant height, number of rows/ear, grain protein (%) and protein yield (kg/fed.), in the 1st season, and number of rows/ear, ear length and diameter, number of grains/row, ear weight grain protein (%) and protein yield (kg/fed.), in the 2nd season as shown in Table (5). Maize triple hybrid had a significant increase in the above mentioned attributes, except number of rows/ear in the 1st season.

Table 4. Effect of organic manure (OM) fertilizer (%) on yield, yield components and grain chemical contents of maize crop during the two seasons (2015 and 2016).

| Organic manure fertilizer levels | Yield and yield components | Chemical content of grains |
|---------------------------------|-----------------------------|---------------------------|
|                                 | Plant height (cm) | Number of rows/ear | Ear length (cm) | Ear diameter (cm) | Number of grains/row | 100-grain weight (gm.) | Ear weight (ton/fed.) | Grain yield (ton/fed.) | Straw yield (ton/fed.) | Biological yield (ton/fed.) | Shelling (%) | Harvest index (%) | Protein content (%) | Carbohydrate content (%) |
| 1st season (2015)               | 50%               | 163.1             | 12.34           | 15.82           | 4.09              | 33.67                | 31.19                | 4.12               | 3.17                | 6.35                   | 10.47           | 76.08               | 30.18               | 8.47               | 76.17               |
|                                 | 100%              | 178.4             | 12.38           | 16.41           | 4.27              | 36.96                | 33.70                | 4.65               | 3.72                | 6.37                   | 11.02           | 79.66               | 33.73               | 8.58               | 75.95               |
| LSD at 5%                      | n.s               | n.s               | n.s             | n.s             | n.s               | n.s                  | n.s                  | n.s               | n.s                 | n.s                    | n.s             | n.s                 | n.s                 | n.s               | n.s                 |
| 2nd season (2016)              | 50%               | 185.7             | 12.88           | 13.50           | 3.84              | 28.67                | 26.25                | 2.05               | 1.59                | 11.45                  | 13.49           | 75.41               | 12.10               | 8.26               | 76.78               |
|                                 | 100%              | 194.1             | 12.79           | 14.12           | 4.07              | 30.58                | 26.75                | 2.85               | 2.29                | 11.54                  | 14.39           | 80.05               | 16.37               | 8.54               | 75.45               |
| LSD at 5%                      | n.s               | n.s               | 0.553           | n.s             | n.s               | n.s                  | n.s                  | n.s               | n.s                 | n.s                    | n.s             | 4.22                | 0.17                | n.s               | n.s                 |

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In this connection, a significant differences in yield and its components of maize cultivars were noticed by many authors (Hassan, 1998 and 1999, Soliman et al. 2004, Shahrorkhi and Khorasani, 2013 and Awdalla et al. 2018). Hassan (1998) who reported that grain yield and its attributes of S.C.103 and T.W.C.310 were superior than that of other maize cultivars.

3. Effect of mineral nano N fertilizers

Results in Table (6) indicate that fertilized maize plants by combination of mineral and nano N fertilizers had a significant effect on all yield and yield components in the two growing seasons, except, number of rows/ear, shelling and harvest index percentages, in the 1st season, and plant height, in the 2nd one. In both seasons, all parameters, except carbohydrate (%) were increased with increasing mineral N percentage and/or with decreasing nano N percentage. Fertilized maize crop by mineral N at 100% or 75% plus 25% nano N fertilizer gave the maximum values of plant height, number of rows/ear, ear length and diameter, number of grains/row, 100-grain wt., ear weight, grain, straw and biological yields, shelling (%), protein (%), protein yield and harvest index in both seasons. However, fertilized maize crop by nano N at 100% produced the highest value of carbohydrate content (%) in the two seasons. The highest grain yield/fed. was obtained from the application of 100% mineral N fertilizer. These increments may be due to the increase in one or more triangle attributes, i.e. number of rows/ear, number of grains/row and/or 100-grain weight. Whereas, the lowest grain yield/fed. was produced from 75% nano N plus 25% mineral N, in the 1st season, and 100% nano N, in the 2nd one. Many workers came to similar trend as Fan et al. (2012), Kandil (2013), Awdalla and Morsy (2016), Ahmad et al. (2018) and Emara et al. (2018).

4. Effect of the interaction between organic and maize cultivars

Interaction between OM levels and maize cultivars had a significant effect on plant height, number of rows/ear, 100 grain weight, shelling percentage, harvest index and protein (%), in the 1st season and number of rows/ear, ear length and diameter, number of grains/row, ear weight, grain yield/fed., protein (%) and protein yield, in the 2nd one (Table 7).

At the highest OM rate (30 m³/fed.), triple maize cv. had a significant increase in plant height, shilling (%), and protein (%), in the 1st season, ear length and diameter, number of grains/row, ear weight/fed., grain yield/fed and protein (%) and protein yield, in the 2nd one. Moreover, at the same level of OM, single hybrid maize cv. gave the highest value of 100-grain weight and harvest index in the 1st season. While, single hybrid maize at the lowest OM level (15 m³/fed.), gave the highest value of number of rows/ear. At the lowest OM level (15 m³/fed.), the highest value of number of rows/ear was obtained from single and triple maize hybrids in the 1st and 2nd seasons, respectively. This result may be due to better growth and positive influence on yield parameters under organic production system as reported by Layek et al. (2014 and 2016) and Kareem et al. (2017).

5. Effect of interaction of OM and mineral nano N fertilizers

Interaction between OM and mineral, nano N fertilizers had a significant effect on yield and yield components of maize plants in the two seasons except number of rows/ear in the 1st season as shown in Table (8). In the 1st season, at 30 m³/fed.organic level, fertilized maize plants by 100% mineral N produced the maximum plant height, ear length and diameter, number of grains/row, 100 grain weight, ear weight/fed., grain, straw and biological yields per fed, protein (%) and protein yield. However, the highest values of shelling (%) and harvest index were obtained from fertilized maize plants by 75% mineral plus 25% nano N at 30 m³/fed. organic level. In the 2nd season, at 30 m³/fed. organic level, fertilized maize plants with 75% mineral plus 25% nano N fertilizers gave the highest values of plant height, number of rows/ear, ear length and diameter, number of grains/row and biological yield/fed. While, at the lowest organic level (15 m³/fed.), fertilized maize plants by 75% mineral plus 25% nano N and 100% mineral N recorded the highest values of 100 grain weight and straw yield/fed., respectively. Moreover, fertilized maize plants by 100% mineral N, at 30 m³/fed. organic level, gave the maximum ear wt./fed., grain yield/fed., shelling (%), harvest index, protein (%) and protein yield.

It is obvious that, at the highest organic level (30 m³/fed.), yield and the most yield components were increased when fertilized maize plants by 100% mineral N, and to some extent, 75% mineral plus 25% nano N fertilizers.
Table 6. Effect of mineral and nanoN fertilizers percentage on yield, yield components and grain chemical contents of maize crop during the two seasons (2015 and 2016).

| Mineral and nanoN fertilizers (%) | Yield and yield components | Grain chemical content |
|-----------------------------------|---------------------------|------------------------|
|                                   | Plant height (cm) | Number of rows/ear | Ear length (cm) | Ear diameter (cm) | Number of grains/row | 100-grain weight (gm.) | Ear weight (ton/fed.) | Grain yield (ton/fed.) | Straw yield (ton/fed.) | Biological yield (ton/fed.) | Shelling (%) | Harvest index (%) | Protein content (%) | Carbohydrate content (%) |
|-----------------------------------|-------------------|---------------------|-----------------|------------------|----------------------|------------------------|------------------------|------------------------|------------------------|-----------------------------|----------------|----------------|------------------|------------------------|
|                                   |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| **1st season (2015)**            |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| Mineral N (100%)                 | 179.2             | 12.44               | 16.81           | 4.29             | 37.07                | 34.92                  | 4.78                   | 3.78                   | 7.24                   | 12.02                        | 78.86         | 31.72           | 8.97             | 74.46                  |
| Mineral N (75%)                  | 176.4             | 12.56               | 16.80           | 4.32             | 36.64                | 32.19                  | 4.47                   | 3.54                   | 6.50                   | 10.97                        | 78.47         | 32.56           | 8.77             | 76.2                   |
| + Nano N (25%)                   | 169.4             | 14.43               | 15.67           | 4.10             | 35.13                | 32.35                  | 4.35                   | 3.39                   | 5.64                   | 9.99                         | 77.20         | 33.43           | 8.33             | 75.98                  |
| Mineral N (50%)                  | 163.1             | 13.13               | 15.28           | 4.07             | 34.42                | 30.39                  | 3.91                   | 3.04                   | 5.80                   | 9.71                         | 77.72         | 31.31           | 8.49             | 75.72                  |
| + Nano N (50%)                   | 165.5             | 12.23               | 16.02           | 4.16             | 33.60                | 32.38                  | 4.42                   | 3.46                   | 6.63                   | 11.05                        | 77.10         | 30.74           | 8.06             | 77.87                  |
| Nano N 100%                      |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| LSD at 5%                        | 12.20             | n.s                 | 0.92            | 0.16             | 3.36                 | 2.37                   | 0.52                   | 0.45                   | 1.16                   | 1.372                        | n.s           | n.s             | 0.25             | 1.53                   |
|                                   |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| **2nd season (2016)**           |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| Mineral N (100%)                 | 194.5             | 12.95               | 14.33           | 4.18             | 31.75                | 29.93                  | 3.43                   | 2.82                   | 13.52                  | 16.95                        | 82.32         | 17.37           | 8.97             | 75.18                  |
| Mineral N (75%)                  | 188.6             | 13.38               | 15.69           | 4.28             | 33.13                | 29.65                  | 2.92                   | 2.27                   | 12.57                  | 15.49                        | 78.70         | 15.63           | 8.73             | 75.67                  |
| + Nano N (25%)                   | 190.0             | 12.73               | 14.23           | 4.07             | 30.08                | 26.79                  | 2.39                   | 1.89                   | 10.37                  | 12.76                        | 78.13         | 14.91           | 8.51             | 75.81                  |
| Mineral N (50%)                  | 184.1             | 12.81               | 12.68           | 3.77             | 27.71                | 23.82                  | 2.06                   | 1.62                   | 9.572                  | 11.63                        | 76.41         | 13.98           | 7.99             | 76.19                  |
| + Nano N (50%)                   | 192.2             | 12.30               | 12.11           | 3.55             | 25.48                | 22.30                  | 1.45                   | 1.10                   | 11.32                  | 12.88                        | 73.11         | 9.292            | 7.80             | 77.73                  |
| Nano N 100%                      |                   |                     |                 |                  |                      |                        |                        |                        |                        |                             |               |                 |                  |                        |
| LSD at 5%                        | n.s               | 0.35                | 0.88            | 0.17             | 1.99                 | 1.71                   | 0.67                   | 0.32                   | 2.34                   | 2.680                        | 5.302         | 3.571            | 0.24             | 1.33                   |
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**Table 7.** Effect of interaction between organic manure (OM) fertilizer (%) and maize cultivars on yield, yield components and grain chemical contents during the two seasons (2015 and 2016).

| OM Fertilizer (%) | Maize Varieties | Plant Height (cm) | No. of rows ear | Ear length (cm) | Ear diameter (cm) | No. grains/row | 100-grain wt. (gm.) | Ear weight/tfed | Grain wt/tfed | Straw yield/tfed | Biological yield per fed. (ton) | Shelling % | HI % | Grain chemical content | Protein % | Carbohydrate (%) |
|-------------------|-----------------|-------------------|-----------------|----------------|-------------------|----------------|-------------------|----------------|----------------|----------------|--------------------------|-------------|------|-----------------------|------------|------------------|
|                   |                 |                   |                 |                |                   |                |                   |                |                |                |                          |             |      |                       |            |                  |
| 1st season (2015) |                 |                   |                 |                |                   |                |                   |                |                |                |                          |             |      |                       |            |                  |
| 50%               | Single hybrid   | 158.6             | 12.69           | 15.89          | 4.13              | 32.69          | 33.86            | 4.31           | 3.29           | 6.26           | 10.57                    | 75.80       | 31.24           | 8.39                  | 76.86       |
|                   | Triple hybrid   | 167.6             | 12.00           | 15.76          | 4.05              | 34.84          | 28.52            | 3.93           | 3.05           | 6.44           | 10.37                    | 76.36       | 29.11           | 8.55                  | 75.49       |
| 100%              | Single hybrid   | 166.0             | 12.37           | 15.97          | 4.23              | 34.39          | 34.27            | 4.37           | 3.42           | 5.72           | 10.08                    | 78.24       | 33.78           | 8.46                  | 76.42       |
|                   | Triple hybrid   | 190.8             | 12.38           | 16.84          | 4.31              | 39.57          | 33.13            | 4.94           | 4.01           | 7.02           | 11.96                    | 80.07       | 33.67           | 8.71                  | 75.48       |
| LSD at 5%         | 20.36           | 0.31              | n.s             | n.s             | 5.37             | n.s             | n.s              | n.s             | 3.34           | 4.14           | n.s                      | n.s         | n.s             | n.s                  | n.s         |
| 2nd season (2016) |                 |                   |                 |                |                   |                |                   |                |                |                |                          |             |      |                       |            |                  |
| 50%               | Single hybrid   | 183.4             | 12.57           | 13.03          | 3.77              | 27.07          | 26.56            | 1.81           | 1.40           | 11.05          | 12.86                    | 74.74       | 11.06           | 7.95                  | 77.12       |
|                   | Triple hybrid   | 187.9             | 13.18           | 13.97          | 3.91              | 30.28          | 25.94            | 2.28           | 1.79           | 11.84          | 14.13                    | 76.08       | 13.14           | 8.58                  | 76.45       |
| 100%              | Single hybrid   | 194.2             | 12.71           | 13.31          | 4.03              | 29.43          | 26.56            | 2.68           | 2.16           | 10.15          | 12.82                    | 80.98       | 17.36           | 8.28                  | 76.10       |
|                   | Triple hybrid   | 194.1             | 12.87           | 14.93          | 4.11              | 31.73          | 26.93            | 3.03           | 2.41           | 12.93          | 15.96                    | 79.13       | 15.39           | 8.80                  | 74.80       |
| LSD at 5%         | n.s             | 0.34              | 1.24            | 0.16           | 1.68             | n.s             | 0.43             | n.s             | n.s             | n.s             | n.s                      | n.s         | 0.13           | n.s                  | n.s         |

In this respect, Munyabarenzi (2014), Wapa (2014) and Admas et al (2015) came to similar results.

6. Effect of the interaction of maize cultivars and mineral nano N fertilizers:

Data in Table (9) pointed out that the effect of interaction between maize cvs. and mineral, nano N fertilizers had a significant effect on yield and yield attributes in the two seasons, except shelling (%) in the 1st season. At the 1st season, fertilized single hybrid maize cv. by 100% mineral N gave the maximum number of rows/ear, ear diameter and 100-grain weight. Also, fertilized triple hybrid cv. by the same N fertilizer treatment produced the highest values of number of grains/row, straw, biological yields per fed. and protein (%). Moreover, triple hybrid maize cv. which fertilized by 75% mineral plus 25% nano N fertilizers gave the highest values of plant height, ear length, ear weight/fed., grain and protein yields per fed. Whereas, shelling (%) and harvest index (%) were obtained from fertilized triple hybrid by 50% mineral plus 50% nano N fertilizers. Yet, fertilized single hybrid maize cv. by 100% N gave the highest value of carbohydrate (%). At the 2nd season, 100% mineral N fertilizer had the highest values of plant height, 100.grain weight, straw yield/fed., shelling (%) and harvest index with single hybrid, and ear wt./fed., grain yield/fed. protein (%) and protein yield/fed. for triple hybrid maize cv. Moreover, applied 75% mineral plus 25% nano N fertilizers gave the maximum values of number of rows/ear, ear diameter for single hybrid, and ear length, number of grains/row and biological yield for triple hybrid maize cv.

This finding was confirmed with Awadalla and Morsy (2016) and Ahmad et al (2018) and Awadalla et al (2018) who reported that maize cultivars differ in grain yield and yield attributes response to N application.
Table 8. Effect of interaction between OM fertilizer (%) and mineral nano fertilizer on yield, yield components and grain chemical contents of maize plants during the two seasons (2015 and 2016).

| OM Fertilizer (%) | Plant height (cm) | No. row ear | Ear length (cm) | Ear diameter (cm) | No. grain row | 100-grain wt. (g.m.) | Ear weight ton/fed | Grain wt. ton/fed | Straw yield ton/fed | Biological yield per fed. (ton) | Shelling % | HI % | Protein % | Carbohydrate % |
|-------------------|-------------------|-------------|-----------------|------------------|---------------|---------------------|---------------------|------------------|------------------|---------------------------|------------|------|----------|--------------|
| 50%               |                   |             |                 |                  |               |                     |                     |                  |                  |                           |            |      |          |              |
| Mineral N (100%)  | 171.4             | 12.35       | 16.32           | 4.15             | 35.32         | 34.23               | 4.47                | 3.51             | 7.12             | 11.59                     | 78.68      | 31.08| 8.86     | 74.35        |
| Mineral N (75%)   | 173.1             | 12.53       | 16.90           | 4.25             | 36.67         | 29.90               | 4.23                | 3.23             | 7.12             | 11.34                     | 75.92      | 29.09| 8.68     | 76.61        |
| + Nano N (25%)    | 160.7             | 12.30       | 14.90           | 3.97             | 32.07         | 32.06               | 3.90                | 2.96             | 5.04             | 8.938                     | 74.57      | 32.20| 8.28     | 76.03        |
| + Nano N (50%)    | 152.2             | 12.20       | 15.13           | 4.00             | 33.33         | 29.76               | 3.81                | 2.90             | 5.90             | 9.702                     | 76.12      | 29.82| 8.46     | 76.03        |
| + Nano N (75%)    | 158.1             | 12.33       | 15.87           | 4.08             | 31.43         | 30.01               | 4.10                | 3.25             | 6.59             | 10.79                     | 75.12      | 28.77| 8.06     | 77.95        |
| Mineral N (100%)  | 180.2             | 12.58       | 16.70           | 4.30             | 36.62         | 34.47               | 4.71                | 3.85             | 5.88             | 10.59                     | 81.02      | 36.10| 8.86     | 75.92        |
| + Nano N (25%)    | 178.1             | 12.57       | 16.43           | 4.23             | 38.20         | 32.65               | 4.80                | 3.83             | 6.23             | 11.04                     | 79.83      | 34.67| 8.39     | 75.94        |
| + Nano N (50%)    | 174.1             | 12.07       | 15.43           | 4.13             | 35.50         | 31.02               | 4.01                | 3.19             | 5.71             | 9.719                     | 79.32      | 32.80| 8.53     | 75.41        |
| + Nano N (75%)    | 172.9             | 12.13       | 16.17           | 4.23             | 35.82         | 34.74               | 4.64                | 3.67             | 6.67             | 11.31                     | 79.08      | 32.72| 8.06     | 77.89        |
| LSD at 5%         | 17.26             | n.s          | 1.30            | 0.22             | 4.76          | 3.35                | 0.73                | 0.63             | 1.64             | 4.95                      | 6.05       | 0.35 | 2.169    |              |
| 100%              |                   |             |                 |                  |               |                     |                     |                  |                  |                           |            |      |          |              |
| Mineral N (100%)  | 197.3             | 12.98       | 14.23           | 4.13             | 30.67         | 30.38               | 3.12                | 2.54             | 14.34            | 17.45                     | 81.55      | 15.12| 8.82     | 75.67        |
| + Nano N (25%)    | 177.7             | 12.90       | 15.23           | 4.23             | 31.30         | 31.23               | 2.40                | 1.86             | 10.67            | 13.28                     | 78.28      | 15.07| 8.64     | 75.90        |
| + Nano N (50%)    | 189.3             | 12.90       | 13.63           | 4.07             | 29.75         | 26.55               | 2.14                | 1.73             | 9.54             | 11.68                     | 79.30      | 14.82| 8.42     | 76.33        |
| + Nano N (75%)    | 173.9             | 13.42       | 12.70           | 3.58             | 26.92         | 24.12               | 1.62                | 1.19             | 10.22            | 11.84                     | 71.43      | 10.66| 7.64     | 77.04        |
| + Nano N 100%     | 190.1             | 12.18       | 11.68           | 3.20             | 24.73         | 18.97               | 0.95                | 0.64             | 12.26            | 13.21                     | 66.48      | 4.833| 7.59     | 78.96        |
| LSD at 5%         | 14.84             | 0.49        | 1.25            | 0.24             | 2.82          | 2.41                | 0.94                | 0.45             | 3.31             | 3.79                      | 7.50       | 5.05 | 0.34     | 1.878        |
Table 9. Effect of interaction between maize cultivars and mineral nano fertilizer on yield, yield components and grain chemical contents during the two seasons (2015 and 2016).

| OM Fertilizer (%) | Mineral and nanoN fertilizers (%) | Plant height (cm) | No. of rows/ear | Ear length (cm) | Ear diameter (cm) | No. of grains/row | 100-grain wt. (gm.) | Ear weight ton/fed. | Grain wt. (ton/ha) | Straw yield (ton/ha) | Biological yield (ton/ha) | Shelling (%) | HI % | Protein (%) | Carbohydrate (%) |
|-------------------|----------------------------------|------------------|-----------------|----------------|------------------|------------------|------------------|-----------------|----------------|----------------|---------------------|--------------|------|------------|----------------|
|                   |                                  |                  |                 |                |                  |                  |                  |                 |                |                  |                     |              |      |            |                |
|                   | **Single Hybrid**                       |                  |                 |                |                  |                  |                  |                 |                |                  |                     |              |      |            |                |
| Mineral N (100%)  |                                  | 170.6            | 12.82           | 16.45          | 4.35             | 34.28            | 37.53            | 4.81             | 3.80            | 7.05             | 11.85               | 79.03        | 32.53| 8.79       | 75.53           |
| Mineral N (75%) + Nano N (25%) |                  | 160.5            | 12.47           | 16.27          | 4.20             | 34.00            | 34.08            | 4.05             | 3.16            | 5.92             | 9.97               | 77.40        | 31.55| 8.68       | 77.13           |
| Mineral N (50%) + Nano N (50%) |                   | 160.3            | 12.65           | 16.02          | 4.05             | 33.70            | 34.30            | 4.49             | 3.37            | 5.74             | 10.22              | 74.85        | 32.55| 8.24       | 76.44           |
| Mineral N (25%) + Nano N (75%) |                   | 157.1            | 12.13           | 15.15          | 4.10             | 33.40            | 31.56            | 3.93             | 3.02            | 5.36             | 9.29               | 76.33        | 32.35| 8.38       | 75.67           |
| Nano N 100%       |                                  | 163.2            | 12.58           | 15.77          | 4.18             | 32.30            | 32.84            | 4.44             | 3.44            | 5.87             | 10.31              | 77.48        | 33.57| 8.02       | 78.40           |
| LSD at 5%         |                                  | 14.84            | 0.49            | 1.25            | 0.24             | 2.82             | 2.41             | 0.94             | 0.45            | 3.31             | 3.79               | 7.50         | 5.05 | 0.34       | 1.88            |
|                   | **Triple Hybrid**                       |                  |                 |                |                  |                  |                  |                 |                |                  |                     |              |      |            |                |
| Mineral N (100%)  |                                  | 187.7            | 12.07           | 17.17          | 4.23             | 39.80            | 32.31            | 4.76             | 3.76            | 7.43             | 12.19              | 78.68        | 30.90| 9.15       | 73.38           |
| Mineral N (75%) + Nano N (25%) |                  | 192.7            | 12.65           | 17.33          | 4.35             | 39.28            | 30.29            | 4.89             | 3.92            | 7.07             | 11.96              | 79.53        | 33.57| 8.86       | 75.40           |
| Mineral N (50%) + Nano N (50%) |                   | 178.5            | 12.22           | 15.32          | 4.15             | 36.57            | 30.41            | 4.22             | 3.42            | 5.54             | 9.75               | 79.55        | 34.32| 8.42       | 75.52           |
| Mineral N (25%) + Nano N (75%) |                   | 169.2            | 12.13           | 15.42          | 4.03             | 35.43            | 29.23            | 3.88             | 3.07            | 6.25             | 10.13              | 79.10        | 30.27| 8.60       | 75.77           |
| Nano N 100%       |                                  | 167.8            | 11.88           | 16.27          | 4.13             | 34.95            | 31.91            | 4.39             | 3.49            | 7.38             | 11.79              | 76.72        | 27.92| 8.09       | 77.34           |
| LSD at 5%         |                                  | 17.26            | 0.92            | 1.30            | 0.22             | 4.76             | 3.35             | 0.73             | 0.63            | 1.64             | 1.94               | n.s          | 6.05 | 0.35       | 2.17            |

1st season (2015)

2nd season (2016)
Table 10. Effect of interaction between organic manure (OM) fertilizer (%), maize cultivars and mineral nano fertilizers on yield, yield components and grain chemical contents during the two seasons (2015 and 2016).

| Treatments                        | Plant height (cm) | No. of rows/ear | Ear length (cm) | Ear diameter (cm) | No. of grains/row | 100-grain wt. (gm.) | Ear weight (ton/ha) | Grain yield (ton/ha) | Straw yield (ton/ha) | Biological yield (ton/ha) | Shelling (%) | HI (%) | Protein (%) | Carbohydrate (%) |
|-----------------------------------|-------------------|-----------------|-----------------|-------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------|-------|-------------|------------------|
| **Organic fertilizer**            |                   |                 |                 |                   |                   |                     |                     |                     |                     |                     |              |       |             |                  |
| **Organic 50%**                   |                   |                 |                 |                   |                   |                     |                     |                     |                     |                     |              |       |             |                  |
| Single hybrid                     |                   |                 |                 |                   |                   |                     |                     |                     |                     |                     |              |       |             |                  |
| Mineral N 100%                    | 176.8             | 12.53           | 17.30           | 4.50              | 36.67             | 37.40               | 5.09                | 3.99                | 6.89               | 11.98               | 77.93        | 32.93 | 8.90        | 75.16            |
| Nano N 25% + mineral 75%          | 160.0             | 12.40           | 16.50           | 4.17              | 33.27             | 35.42               | 4.10                | 3.29                | 5.16               | 9.26               | 79.30        | 34.93 | 8.75        | 76.70            |
| Nano N 50% + mineral 50%          | 164.9             | 12.73           | 16.50           | 4.13              | 35.93             | 32.70               | 4.91                | 3.73                | 6.01               | 10.92              | 76.33        | 34.00 | 8.31        | 76.66            |
| Nano N 75% + mineral 25%          | 166.1             | 11.87           | 14.27           | 4.13              | 31.93             | 32.18               | 3.60                | 2.86                | 4.89               | 8.48                | 79.30        | 33.50 | 8.31        | 75.38            |
| Nano N 100%                       | 162.3             | 12.33           | 15.77           | 4.20              | 34.13             | 33.63               | 4.15                | 3.25                | 5.63               | 9.78                | 78.33        | 33.53 | 8.02        | 78.19            |
| **Organic 100%**                  |                   |                 |                 |                   |                   |                     |                     |                     |                     |                     |              |       |             |                  |
| Single hybrid                     |                   |                 |                 |                   |                   |                     |                     |                     |                     |                     |              |       |             |                  |
| Mineral N 100%                    | 197.0             | 12.53           | 17.30           | 4.37              | 40.87             | 33.82               | 5.11                | 4.10                | 7.81               | 12.92               | 80.13        | 31.77 | 9.26        | 73.97            |
| Nano N 25% + mineral 75%          | 200.3             | 12.77           | 17.37           | 4.43              | 39.97             | 33.53               | 5.33                | 4.41                | 6.60               | 11.93              | 82.73        | 37.27 | 8.97        | 75.14            |
| Nano N 50% + mineral 50%          | 191.2             | 12.40           | 16.37           | 4.33              | 40.47             | 32.60               | 4.70                | 3.93                | 6.45               | 11.16              | 83.33        | 35.33 | 8.46        | 75.22            |
| Nano N 75% + mineral 25%          | 182.1             | 12.27           | 16.60           | 4.13              | 39.07             | 29.87               | 4.42                | 3.51                | 6.54               | 10.95              | 79.33        | 32.10 | 8.75        | 75.45            |
| Nano N 100%                       | 183.5             | 11.93           | 16.57           | 4.27              | 37.50             | 35.85               | 5.12                | 4.09                | 7.71               | 12.84              | 79.83        | 31.90 | 8.09        | 77.60            |
| **LSD at 5%**                     | 24.41             | 1.30            | 1.85            | 0.32              | 6.73              | 4.74                | 1.03                | 0.89                | 2.31               | 2.74                | 7.00         | 8.55  | 0.50        | 3.07             |

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Table (10): cont.

| Treatments | Plant height (cm) | No. of rows/ear | Ear length (cm) | Ear diameter (cm) | No. of grains/row | 100-grain wt. (gm.) | Ear weight (ton fed) | Grain yield (ton/ha) | Straw yield (ton/ha) | Biological yield (ton/ha) | Shelling (%) | HI (%) | Protein (%) | Carbohydrate (%) |
|------------|------------------|-----------------|----------------|------------------|------------------|---------------------|---------------------|---------------------|---------------------|------------------------|------------|--------|------------|------------------|
| Organic fertilizer | Organic Variety | Mineral, nano fertilizer | 2nd season (2018) | | | | | | | | | | | | | |
| Single Hybrid | | | | | | | | | | | | | | | | |
| Mineral N 100% | 204.5 | 12.5 | 14.33 | 4.10 | 30.33 | 33.10 | 2.97 | 2.43 | 15.32 | 18.29 | 82.03 | 13.70 | 8.38 | 75.98 |
| Nano N 25%+ mineral 75% | 175.1 | 12.90 | 14.63 | 4.33 | 30.67 | 30.50 | 2.18 | 1.68 | 9.31 | 11.48 | 79.17 | 15.90 | 8.31 | 76.17 |
| Nano N 50%+ mineral 50% | 184.1 | 12.23 | 13.17 | 3.90 | 27.33 | 23.73 | 1.67 | 1.30 | 8.74 | 10.40 | 76.33 | 12.50 | 8.24 | 76.30 |
| Nano N 75%+ mineral 25% | 170.0 | 13.47 | 13.00 | 3.33 | 29.20 | 23.87 | 1.60 | 1.11 | 11.24 | 12.84 | 65.23 | 8.690 | 7.59 | 77.70 |
| Nano N 100% | 185.9 | 11.77 | 10.00 | 3.20 | 17.80 | 21.58 | 0.64 | 0.48 | 10.63 | 11.27 | 70.93 | 4.500 | 7.22 | 79.44 |
| Triple Hybrid | | | | | | | | | | | | | | | | |
| Mineral N100% | 190.0 | 13.47 | 14.13 | 4.17 | 31.00 | 27.65 | 2.37 | 2.64 | 13.35 | 16.62 | 81.07 | 16.53 | 9.26 | 75.36 |
| Nano N 25%+ mineral 75% | 180.3 | 12.90 | 15.83 | 4.13 | 31.93 | 31.97 | 2.64 | 2.05 | 12.44 | 15.08 | 77.40 | 142.3 | 8.97 | 75.63 |
| Nano N 50%+ mineral 50% | 197.2 | 13.57 | 14.10 | 4.23 | 32.17 | 29.37 | 2.62 | 2.16 | 10.35 | 12.96 | 82.27 | 17.13 | 8.0 | 76.36 |
| Nano N 75%+ mineral 25% | 177.9 | 13.37 | 12.10 | 3.83 | 24.63 | 24.37 | 1.64 | 1.28 | 9.199 | 10.84 | 77.63 | 12.63 | 8.10 | 76.38 |
| Nano N 100% | 194.3 | 12.60 | 13.37 | 3.20 | 31.67 | 16.35 | 1.26 | 0.80 | 13.89 | 15.15 | 62.03 | 5.167 | 7.95 | 78.52 |
| Single Hybrid | | | | | | | | | | | | | | | | |
| Mineral N 100% | 193.8 | 12.53 | 14.10 | 4.13 | 32.10 | 28.42 | 3.74 | 3.09 | 10.90 | 14.63 | 82.90 | 22.27 | 8.75 | 75.66 |
| Nano N 25%+ mineral 75% | 188.8 | 14.10 | 13.63 | 4.33 | 32.00 | 28.05 | 3.57 | 2.84 | 11.60 | 15.18 | 82.17 | 19.73 | 8.38 | 76.05 |
| Nano N 50%+ mineral 50% | 189.8 | 12.63 | 14.17 | 4.03 | 31.07 | 26.95 | 2.34 | 1.86 | 9.641 | 11.98 | 79.20 | 16.87 | 8.38 | 76.02 |
| Nano N 75%+ mineral 25% | 200.0 | 12.07 | 11.87 | 3.67 | 25.30 | 20.92 | 1.86 | 1.51 | 8.188 | 10.05 | 79.77 | 14.30 | 8.02 | 75.99 |
| Nano N 100% | 198.5 | 12.23 | 12.80 | 4.00 | 26.67 | 28.48 | 1.87 | 1.52 | 10.40 | 12.27 | 80.87 | 13.63 | 7.88 | 76.76 |
| Triple Hybrid | | | | | | | | | | | | | | | | |
| Mineral N100% | 189.8 | 13.30 | 14.77 | 4.33 | 33.57 | 30.57 | 3.75 | 3.13 | 14.51 | 18.26 | 83.27 | 16.97 | 9.48 | 73.72 |
| Nano N 25%+ mineral 75% | 210.2 | 13.63 | 18.67 | 4.33 | 37.90 | 28.08 | 3.30 | 2.51 | 16.94 | 20.24 | 76.07 | 12.67 | 9.26 | 74.83 |
| Nano N 50%+ mineral 50% | 191.6 | 12.47 | 15.50 | 4.10 | 29.73 | 27.10 | 2.92 | 2.22 | 12.76 | 15.68 | 74.70 | 13.13 | 8.82 | 74.55 |
| Nano N 75%+ mineral 25% | 188.5 | 12.33 | 13.47 | 4.00 | 31.70 | 26.13 | 3.12 | 2.60 | 9.66 | 12.78 | 83.00 | 20.30 | 8.24 | 74.68 |
| Nano N 100% | 190.2 | 12.60 | 12.27 | 3.80 | 25.77 | 22.77 | 2.04 | 1.60 | 10.78 | 12.82 | 78.60 | 13.87 | 8.17 | 76.20 |
| LSD at 5% | 20.99 | 0.70 | 1.77 | 0.35 | 3.99 | 3.41 | 1.33 | 0.63 | 4.68 | 5.26 | 10.60 | 7.14 | 0.49 | 2.66 |
7. Effect of the interaction between OM, maize cultivars and mineral, nano N fertilizers

Interaction between OM levels and mineral plus nano N fertilizers on the two maize cv. had a significant effect on yield and yield components as shown in Table (10). In the 1st season, at 100% OM, fertilized triple hybrid by 100% mineral N or 75% mineral plus 25% nano N fertilizers produced the highest plant ht., ear length, number of grains/row, ear weight/fed., grain, straw, biological yields per fed., protein (%) and protein yield/fed. However, fertilized single hybrid maize by 100% mineral N, at 50% OM, gave the maximum harvest index, number of rows/ear and 100 grain weight as well as ear diameter at 100% organic level. Whereas, the maximum value of shellings (%) was attained from fertilized triple hybrid maize cv. by 50% mineral plus 50% nano N fertilizers at 100% organic level.

In the 2nd season, adding 100% OM level, triple hybrid with 100% mineral N produced the highest values of ear diameter, ear weight/fed., grain yield/fed., shellings (%) and protein (%). While, fertilized the same maize cv. by 75% mineral plus 25% nano N fertilizers gave the highest values of plant height, ear length, number of grains/row, straw yield/fed. and protein yield/fed. as shown in Table (10). The maximum of rows/ear were obtained from single maize hybrid. which fertilized by 100% mineral N fertilizer at the above mentioned organic level (100%). On the other hand, at 50% organic level, single hybrid maize cv. by 100% mineral N gave the highest values of 100-grain weight and biological yield/fed. In this respect, Ali et al (2011) came to similar trend.

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استجابة صنفي الذرة الشامية للتمثيد العضوي والنيتروجيني المعدني والنا노
تحت ظروف واحة سيوة

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Received 20 February, 2019, Accepted 12 March, 2019

الخلاصة

أجريت تجربتان بمحطة مركز بحوث الصحراء بمنطقة نجريتى - واحة سيوة بمحافظة مطروح خلال موسم الزراعة المتاحيين 2015، 2016.

أجريت التجربتين لدراسة استجابة صنفي الذرة الشامية هجين فردى 131، هجين ثلاثي 329 لمستويات التمثيد العضوي (0، 30، 60، 90 م/٪)، وفحص العحالات النهائية للتفاعل بين التمثيد النباتي والتمثيد المعدني الموسمي به (120، 180، 240 يوما) وتأنئ المتاعلات كالتالي: 100 % ملجرام/لتر. وكانت المتاعلات كانت 0 % نيتروجين معدني + 25 % نيتروجين نانو، 75 % نيتروجين معدني + 50 % نيتروجين نانو، 100 % نيتروجين نانو. وقد أظهرتم التجربتين النباتي والعائدي على ثلاث فعاليات مكافحة خشبة في ناجم بالنيتروجين النانو بعد 30، 45، 60 يوم وذلك من الزراعة، وقد وضعت النماذج في تسمية طبع منشقة منزقة مع ثلاث مكبات وكان التمثيد العضوي في الطاعة الرئيسية، وأصبحوا التمثيد في النانو في الطاعة الأولى والمتاعلات الناشئة بين التمثيد العائدي والنيتروجين النانو في النانو تحت ظروف النازلة عند الحصاد: ارتفاع النباتات/ سم، عدد صرف الكورز، طول قطر الكرز/ سم، عدد حيوانات الصفح، وزن 100 حب/جم.

الكلمات المفتاحية: الذرة الشامية، الأصناف، التمثيد العضوي، المتاعلات، النباتات، النانو، البازوبات.

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