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# EFFECT OF NITROGEN FERTILIZATION AND HUMIC ACID LEVELS ON YIELD AND ITS COMPONENTS OF MAIZE (*ZEA MAYS,* L.) CV. S.C 131

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**ABSTRACT:** ***Field experiments were carried - out at Gemmeiza Agriculture Research Station, during summer seasons of 2014 and 2015. A split - plot design with four replications was used, where nitrogen fertilizer levels (N) (0, 45, 90 and 135 kg.fad$^{-1}$) were plotted in main plots and humic acid (HA) (0, 1, 2, and 3kg.fad$^{-1}$ ) were assigned to sub plots. Increasing nitrogen levels up to 135 kg N.fad$^{-1}$ .increased all yield and yield components in both seasons. Increasing humic acid levels, recorded highly significant increased for 100 - grain weight (g), grain yield fad$^{-1}$, biological yield and straw yield in both seasons. While, harvest index had significantly decreased in both seasons, with increases in either nitrogen or humic acid levels. The interaction between nitrogen and humic acid was significant for ear height, 100 -grain weight (gm) and grain yield ard.fad.$^{-1}$, while, was insignificant for No. of rows ear$^{-1}$ and No. of grains row$^{-1}$ in both season. Hence it might be concluded that, 135 kg N + 2 or 3 kg HA.fad.$^{-1}$, in separate application or in combination led to significant increase in maize grain yield and its components of SC. 131.***

*Key words:* ***Maize, Humic acid, Nitrogen fertilization, Grain yield, Yield components.***

## INTRODUCTION

**Maize (*Zea mays* L.) ranks 3$^{rd}$ among world's cereals crops following wheat and rice as food crop (Chaudary, 1994). Total area of maize in Egypt is 857329 ha. which is about 25 % of the total cultivated area, with average yield of 8.40 ton.ha.$^{-1}$, (FAO, 2016). Application of humic acid increased soil acidity, soil organic carbon and cation exchange capacity (Hanafi and Salwa, 1998). It significantly enhanced phosphorus (P) and N availability in calcium-containing soil and has an effect on availability of potassium (Tahir *et al.* 2011).**

**Nitrogen levels (N) significantly affect the agronomic performance of maize. Application of N increases soil fertility and crop productivity. Where, nitrogen element plays an essential rule in many compounds essential for plant growth, including chlorophyll and many enzymes. It is considered the key element in increasing crops productivity. Also, it helps in the use of P, K and other elements by plants .(Bader and Othman, 2006). Increasing nitrogen fertilizer rate from zero up to 250 kg N.ha.$^{-1}$ increased significantly the maize growth, yield and yield components characters, where, maximum number of leaves/plant, number of cobs/plant, number of grains/cob, taller plants, grain and biological yields were recorded with application of 200 kg N.ha.$^{-1}$ compared to other treatments (Bakht *et al.* 2006). The present research was - therefore - designed to evaluate the effect of different nitrogen fertilization and humic acid levels on yield and its components of maize cv. S.C 131.**

## MATERIALS AND METHODS

Two experiments were conducted at the Experimental Farm of Gemmeiza Agriculture Research Station, Agricultural Research Center (ARC), Egypt, to study the "effect of different levels of nitrogen fertilization (N) and humic acid (HA) on yield of maize cv. S.C131 during summer seasons of 2014 and 2015. Each experiment was carried-out in split- plot design with four replications, where, nitrogen levels was plotted in main plots and humic acid was assigned to subplots. Four nitrogen levels (0, 45, 90, 135 kg.fad.$^{-1}$) as 1/3$^{rd}$ at sowing, 1/3$^{rd}$ at 4-5 leaf stage and remaining 1/3$^{rd}$ at tasseling stage. Whereas, four levels of humic acid (0, 1, 2, 3 kg.fad.$^{-1}$) were applied at sowing. Each sub- plot consisted of four ridges; each ridge was 6 m long, 80 cm in width, and 25 cm between hills. Both physical and chemical analysis of the used soil were carried- out according to Jackson (1973). Whereas micronutrients were determined by applying the procedure documented by Lindsay and Norvell (1978). Soil analyses Table (1) were analyzed in center Laboratory of Gemmeiza Agriculture Research Station.

Table (1). Physical and some chemical properties of the experimental site (30-60 cm depth).

| Properties | Seasons | |
|---|---|---|
| | 2014 | 2015 |
| Mechanical analysis : | | |
| Sand % | 22.70 | 21.98 |
| Silt % | 31.50 | 31.85 |
| Clay % | 45.80 | 46.17 |
| Soil texture | Clay loam | Clay loam |
| Chemical analysis : | | |
| pH | 8.30 | 8.05 |
| EcdS / m | 2.30 | 2.34 |
| O.M % | 1.80 | 1.85 |
| Available N ( mg/kg) | 31.80 | 30.79 |
| Available P ( mg/kg) | 7.01 | 6.01 |
| Available K ( mg/kg) | 119.00 | 121.02 |
| Available Zn ( mg/kg) | 0.21 | 0.27 |
| Cation ( meq / L ) : | | |
| $Ca^{++}$ | 12.85 | 13.04 |
| $Mg^{++}$ | 10.23 | 11.85 |
| $Na^{+}$ | 42.08 | 41.22 |
| $K^{+}$ | 51.37 | 53.07 |
| Anion (meq / L ) : | | |
| $CO^{-}_{3}$ | 0.02 | 0.05 |
| $HCO\text{-}_3$ | 2.87 | 2.93 |
| $Cl^{-}$ | 62.57 | 63.45 |
| $SO\text{-}_4$ | 49.88 | 51.07 |

**At harvest, three middle rows were chosen from each sub- plot, where, ten guarded plants were taken to determine the following traits:**

**1-Ear height (cm).**
**2-Ear length (cm).**
**3-Ear diameter (cm).**
**4-No. of rows/ear.**
**5-No. of grains/ row.**
**6-100-grain weight.**
**7-Grain yield(ard.fad$^{-1}$).**
**8-Biological yield (ard.fad$^{-1}$).**
**9- Straw yield (ard.fad$^{-1}$).**
**10-Harvest Index (Grain Yield/ Biological yield).**

**The data were statistically analyzed according to Gomez and Gomez (1984), using the computer MSTAT-C statistical analysis package (Freed *et al.*, 1989). Means were compared by LSD test, according to Snedecor and Cochran (1980).**

## RESULTS AND DISCUSSION

### 1-Effect of nitrogen fertilizer rates:

**Tables (2 and 3), showed means of yield and its components as affected by nitrogen and humic acid levels in 2014 and 2015 seasons. Nitrogen levels had a highly significant effects in all yield and yield attributes in both seasons, except for, ear length, ear diameter and No. of rows ear$^{-1}$ which had highly significant effects in the first season (2014), (Table 2). On the other hand, increasing nitrogen levels up to 135 kg N.fad$^{-1}$ significantly increased ear height, No. of grains row$^{-1}$, 100- grain weight and grain yield fad.$^{-1}$ in both seasons and ear length, ear diameter and No. of grains row$^{-1}$ in the first season only. While, the least significant values for yield and its components were recorded with 0 kg N.fad.$^{-1}$ in both seasons. However, the highest value of nitrogen fertilizer 135 kg N.fad.$^{-1}$ did not significantly differ from 90 kg N.fad.$^{-1}$ for No. of rows ear$^{-1}$ and No. of grains row$^{-1}$ in both seasons. The increase in nitrogen level resulted in higher ear placement, ear length, ear diameter, No. of rows ear$^{-1}$, No. of grains row$^{-1}$, No. of rows ear$^{-1}$ and 100- grain weight (g) might be due to an optimum utilization of solar light, higher assimilation rate and consequently higher number and weight of grains that give more biomass and seed yield. Soliman and Gharib (2011), Abdou (2012), Attia *et al.,* (2012), Bamuaafa (2012), El-Naggar, *et al.*, (2012), Khan *et al.*, (2012) and Tarighaleslami *et al.,* (2012) reported that, grain yield of maize and its components were significantly increased due to application of nitrogen level up to 135 kg N.fad.$^{-1}$**

**Data in Table (3) showed that, increasing nitrogen levels up to 135 Kg N.fad.$^{-1}$ increased significantly biological yield (25.95 and 22.95) and straw yield (12.82 and 12.33) compared to control treatment, whereas, a lower harvest index (51.05 and 46.49 in the first and the second seasons, respectively) were attained.**

### 2- Effect of Humic acid levels:

**Increasing humic acid levels recorded highly significant increased in 100 - grain weight (g), grain yield fad.$^{-1}$, biological yield and straw yield in both seasons. While, ear height (cm), ear length and No. of grains row$^{-1}$ showed highly significant responses, only in the first season. Also, ear diameter recorded highly significant values only in the second season, (Table 2). On the other hand, the increase in humic acid levels, led to a significantly decrease in harvest index, in both seasons, (Table 3). Plots that received 3 kg HA.fad.$^{-1}$ gave higher grains row$^{-1}$, higher 100- grain weight and higher biological yield. The decrease in harvest index with each increase in humic acid as well as nitrogen fertilizer rates might be due to an increase in plant vigor by rate higher than the increase in grain weight, Puglisi *et al.,* (2009) explained**

Table 2. Effect of nitrogen fertilization and humic acid levels on yield and its components during 2014 and 2015 seasons.

| Main effects and interactions | Ear height (cm) | | Ear length (cm) | | Ear diameter (cm) | | No. of rows/ear | | No.of grains row-1 | | 100 grains weight (g) | | Grain yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| Nitrogen levels (kg N/fad.) N : | | | | | | | | | | | | | | |
| 0 | 117.19 | 115.94 | 18.81 | 21.59 | 3.73 | 4.51 | 13.71 | 14.33 | 38.24 | 38.43 | 26.03 | 26.72 | 5.03 | 6.27 |
| 45 | 110.63 | 111.25 | 21.04 | 21.98 | 3.83 | 4.73 | 13.94 | 14.53 | 39.53 | 40.88 | 31.35 | 34.92 | 6.47 | 7.66 |
| 90 | 119.06 | 118.13 | 22.19 | 22.36 | 4.29 | 4.69 | 14.20 | 14.20 | 42.15 | 43.78 | 44.23 | 42.28 | 8.37 | 9.61 |
| 135 | 126.88 | 128.13 | 23.75 | 22.42 | 4.84 | 4.86 | 14.50 | 14.75 | 42.55 | 45.59 | 48.04 | 51.37 | 11.28 | 12.30 |
| F-test | ** | ** | ** | NS | ** | NS | ** | NS | ** | ** | ** | ** | ** | ** |
| LSD 0.01 | 4.12 | 6.21 | 1.59 | -- | 0.40 | -- | 0.62 | -- | 1.39 | 2.85 | 1.07 | 1.03 | 0.53 | 0.67 |
| Humic acid levels (kg. H/fad.) H | | | | | | | | | | | | | | |
| 0 | 118.75 | 117.19 | 20.89 | 21.89 | 4.08 | 4.60 | 13.89 | 14.25 | 39.46 | 42.05 | 35.71 | 36.20 | 6.90 | 8.34 |
| 1 | 114.06 | 117.19 | 21.24 | 22.34 | 4.08 | 4.80 | 13.84 | 14.43 | 40.80 | 41.81 | 36.95 | 37.94 | 7.53 | 8.54 |
| 2 | 120.94 | 119.38 | 21.72 | 21.73 | 4.23 | 4.60 | 14.38 | 14.48 | 40.05 | 42.08 | 37.96 | 40.15 | 8.03 | 9.26 |
| 3 | 120.00 | 119.69 | 21.95 | 22.38 | 4.30 | 4.79 | 14.24 | 14.65 | 42.15 | 42.74 | 39.03 | 41.00 | 8.68 | 9.71 |
| F-test | ** | NS | ** | NS | NS | * | NS | NS | ** | NS | ** | ** | ** | ** |
| LSD 0.01 | 4.79 | -- | 0.92 | -- | -- | 0.19 | -- | -- | 1.31 | -- | 0.83 | 0.64 | 0.67 | 0.51 |
| Interactions | | | | | | | | | | | | | | |
| N. H | ** | ** | NS | NS | NS | NS | NS | NS | NS | NS | ** | ** | ** | ** |

**Table 3. Effect of nitrogen fertilization and humic acid levels for biological yield, straw yield and harvest index during 2014 and 2015 seasons.**

| Main effects and interactions | biological yield (kg/fad.) | | Straw yield (kg/fad.) | | Harvest index | |
|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| **Nitrogen levels (kg N/fad.) N :** | | | | | | |
| 0 | 10.44 | 11.53 | 4.81 | 5.91 | 54.50 | 53.43 |
| 45 | 16.66 | 17.16 | 7.42 | 8.89 | 55.49 | 48.76 |
| 90 | 20.39 | 21.23 | 9.35 | 11.88 | 54.16 | 44.63 |
| 135 | 25.95 | 22.95 | 12.82 | 12.33 | 51.05 | 46.49 |
| F-test | ** | ** | ** | ** | ** | ** |
| $LSD_{0.01}$ | 1.60 | 0.89 | 1.38 | 0.84 | 3.33 | 2.83 |
| **Humic acid levels (kg. H/fad.) H:** | | | | | | |
| 0 | 16.91 | 15.65 | 7.67 | 7.46 | 55.79 | 57.02 |
| 1 | 17.39 | 17.45 | 7.86 | 9.11 | 55.16 | 48.60 |
| 2 | 18.27 | 19.32 | 8.48 | 10.77 | 53.69 | 44.57 |
| 3 | 20.89 | 20.45 | 10.39 | 11.66 | 50.56 | 43.12 |
| F-test | ** | ** | ** | ** | ** | ** |
| $LSD_{0.01}$ | 0.77 | 1.74 | 0.71 | 1.73 | 2.37 | 2.83 |
| **Interactions** | | | | | | |
| N. H | ** | NS | ** | ** | ** | ** |

**that, humus had beneficial effects on nutrient uptake, transport and availability to maize plant that enhances the maize plant growth and increases maize yield. David and Samule (2002), Albayrak and Carnas (2005) and Bakry *et al.,* (2009) showed that, the application of humic acid significantly influenced plant length, growth and yield and its components. Azeem *et al.*, (2014) found that, humic acid levels significantly increased grains ear$^{-1}$ and grain yield with 3 kg HA.ha.$^{-1}$ Khan *et al.,*(2015) revealed that, different humic acid levels significantly affected grains cob$^{-1}$, grain yield and biological yield.**

## 3- Effect of the interaction between nitrogen and humic acid.

**Data shown in Table (4) indicated that, the interaction between nitrogen and humic acid levels was significant for ear height, 100- grain weight (gm), grain yield ard.fad.$^{-1}$, straw yield fad.$^{-1}$ and harvest index. While, was insignificant for No. of rows ear$^{-1}$ and No. of grains row$^{-1}$ in both seasons and biological yield in the second season.**

**The highest values of ear height, 100- grain weight and grain yield fad.$^{-1}$ were recorded when 135 Kg N + 3 kg HA.fad.$^{-1}$ were added in both seasons. However, the interaction of 135 Kg N.fad.$^{-1}$ and 0 kg HA.fad.$^{-1}$ in the first season and 2 kg HA.fad.$^{-1}$ in the second one did not significantly differ from the formers interaction for 100- grain weight. While, the same interaction did not significantly differ from the interaction between 135 Kg N and 2 kg HA.fad.$^{-1}$ for grain yield fad.$^{-1}$ in both seasons.**

Table 4. Effect of interaction between nitrogen fertilization and humic acid levels on yield and its components in 2014 and 2015 seasons.

| Nitrogen levels (kg N/fad) N : | Humic acid levels (kg. H/fad.) H: | Ear height | | 100 grains-weight (gm) | | Grain yield (kg/fad.) | | Biological yield (kg/fad.) | Straw yield (kg/fad.) | | Harvest index | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2014 | 2015 | 2014 | 2015 |
| 0 | 0 | 120.00 | 118.75 | 24.72 | 25.91 | 12.45 | 16.03 | 3861.25 | 1468.75 | 592.75 | 61.92 | 79.70 |
| | 1 | 115.00 | 111.25 | 25.85 | 26.31 | 13.53 | 16.31 | 3994.88 | 1778.25 | 2493.00 | 55.40 | 49.36 |
| | 2 | 113.75 | 113.75 | 26.88 | 27.27 | 14.41 | 17.61 | 4368.75 | 2058.00 | 3022.50 | 52.87 | 44.68 |
| | 3 | 120.00 | 120.00 | 26.68 | 27.42 | 15.50 | 19.78 | 5179.50 | 2704.5 | 3742.25 | 47.81 | 39.98 |
| 45 | 0 | 111.25 | 107.50 | 30.13 | 31.14 | 16.78 | 19.72 | 6329.38 | 2768.75 | 3353.25 | 56.22 | 49.91 |
| | 1 | 106.25 | 113.75 | 30.71 | 32.97 | 17.75 | 21.71 | 6821.88 | 3021.25 | 3187.00 | 55.73 | 52.14 |
| | 2 | 118.75 | 116.25 | 31.70 | 37.33 | 18.57 | 21.81 | 7043.00 | 3145.25 | 4092.50 | 55.31 | 46.66 |
| | 3 | 106.25 | 107.50 | 32.85 | 38.23 | 18.75 | 21.87 | 7576.00 | 3432.25 | 4182.75 | 54.69 | 46.33 |
| 90 | 0 | 121.25 | 120.00 | 38.95 | 39.19 | 21.02 | 25.50 | 8007.63 | 38170 | 4026.50 | 52.33 | 49.85 |
| | 1 | 112.50 | 115.00 | 43.50 | 41.82 | 22.80 | 25.77 | 7940.25 | 3481.50 | 4454.00 | 56.15 | 46.44 |
| | 2 | 122.50 | 121.25 | 46.55 | 42.96 | 22.25 | 26.50 | 8640.00 | 3918.75 | 5057.00 | 54.65 | 43.61 |
| | 3 | 120.00 | 116.25 | 47.93 | 45.17 | 26.93 | 29.05 | 9399.38 | 4367.25 | 6257.00 | 53.54 | 38.63 |
| 135 | 0 | 122.50 | 122.50 | 49.05 | 48.55 | 26.44 | 31.41 | 9977.88 | 4732.75 | 4454.00 | 52.70 | 48.62 |
| | 1 | 122.50 | 128.75 | 47.73 | 50.69 | 29.64 | 31.11 | 10219.75 | 4826.50 | 5057.00 | 53.36 | 46.48 |
| | 2 | 128.75 | 126.25 | 46.70 | 53.04 | 33.96 | 36.97 | 10397.63 | 5004.00 | 5785.75 | 51.935 | 43.34 |
| | 3 | 133.75 | 135.00 | 48.68 | 53.20 | 35.25 | 37.24 | 12656.63 | 6807.00 | 5253.25 | 46.217 | 47.53 |
| F- test | | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD 0.01 | | 9.58 | 9.63 | 1.66 | 1.27 | 3.45 | 2.84 | 643.9 | 588.5 | 1340 | 4.734 | 11.36 |

According to the results listed in Table 3, the highest significant value of biological yield was observed when 135 Kg N and 3 kg HA.fad.$^{-1}$ were added in the first season, while in the second season there was insignificant differences were added among the studied treats combinations. The highest values of straw yield/fad. was detected when 135 Kg N + 3 kg HA.fad.$^{-1}$ were added in the first season or when 90 Kg N + 3 kg HA.fad.$^{-1}$ were added in the second season. The interaction of 0 Kg N + 0 kg HA.fad.$^{-1}$ (control treatments) significantly exhibited the highest harvest index in both seasons. These results are in the same lines with those reported by Celik *et al.*, (2010), Ghazal *et al.*, (2013) and Azeem *et al.,* (2014).

## Conclusion

From the obtained results it might be concluded that, the yield and yield components of *Zea mays* L. Cultivation Varity SC.131 were maximum when applying 135 kg N + 2 or 3 kg HA.

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# تأثير مستويات التسميد الآزوتي والهيوميك علي المحصول ومكوناته لمحصول الذرة الشامية صنف هجين فردي ١٣١

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## الملخص العربى

أجريت تجربة حقلية بالمزرعة البحثية بالجميزة التابعة لمركز البحوث الزراعية خلال الموسمين ٢٠١٤ ، ٢٠١٥ باستخدام تصميم القطع المنشقه مرة واحدة في أربع مكررات حيث كانت مستويات التسميد النيتروجيني في القطعة الرئيسية (بدون أضافة، ٤٥ ، ٩٠ ، ١٣٥ كجم نيتروجين/فدان) وأربعة مستويات من حامض الهيوميك (بدون أضافة ، ١ ، ٢ ، ٣ كجم هيوميك /فدان) في القطعة الشقية.

أدت زيادة مستويات التسميد النيتروجيني إلي ١٣٥ كجم نيتروجين / فدان الي زيادة المحصول ومكوناته في كلا الموسمين. أما زيادة مستويات حامض الهيوميك فقد كان لها تأثير عالي المعنوية في زيادة وزن الـ ١٠٠ حبه ومحصول الحبوب / فدان والمحصول البيولوجى ومحصول القش في كلا الموسمين بينما إنخفض دليل الحصاد بزيادة كلا من النيتروجين والهيوميك في كلا الموسمين. وقد سجلت إختلافات معنوية نتيجة التفاعل بين النيتروجين والهيوميك في كل من صفات إرتفاع الكوز ووزن الـ ١٠٠ حبه ومحصول الحبوب أردب / فدان بينما لم تسجل تفاعلات معنوية في صفات عدد الصفوف في الكوز وعدد الحبوب في الصف في كلا الموسمين. لذلك ينصح بتطبيق مستوي التسميد ١٣٥ كجم نيتروجين + ٢ أو ٣ كجم هيوميك / فدان للحصول علي أعلي إنتاجية من الهجين الفردي ١٣١.

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