*Assiut J. Agric. Sci., (47) No. (6-1) 2016 (34-48)* *ISSN: 1110-0486*
*Website: http://www.aun.edu.eg/faculty_agriculture* *E-mail: ajas@aun.edu.eg*

# Response of Two Grain Sorghum Genotypes Productivity to bio- and Mineral Fertilizers in Newly Reclaimed Soil

**Hassan, Eman M.M. [1]; K.A. Abd El-Rahman[2]; R.A. Dawood[2] and A.E.A.A. Mourad[3]**

[1] Agric. Res. Station at Arab El-Awamer, Assiut, Governorate.
[2] Agronomy Dept., Fac. Agric., Assiut Univ.
[3]ARC, FCRI, Sorghum Res. Department, Giza, Egypt

**Received on:** 27/12/2016 **Accepted for publication on:** 4/1/2017

## Abstract

Two field experiments were conducted in the Agricultural Research Station at Arab El-Awamer, Assiut Governorate, during the two growing seasons of 2014 and 2015 to investigate the response of two grain sorghum genotypes productivity to bio- and nitrogen fertilizer in newly reclaimed soil. The randomized complete block design using split-split-plot with four replications was employed, where the genotypes (Hybrid 305 and Dorado i.e. $G_1$ and $G_2$) were allocated in the main plots, while nitrogen fertilizer rates (60, 90 and 120 kg N/fed i.e. $N_1$, $N_2$ and $N_3$) were assigned in the sub-plots and bio-fertilizer (0, Microbin and Nitrobin i.e. $B_0$, $B_1$ and $B_2$) were fixed in the sub-sub-plots. The grains of sorghum genotypes were sown on 13th and 17th June in the first and second seasons, respectively. The plot area was 12 $m^2$ including 4 ridges of 60 cm apart with 4 m length.

The results could be summarized as the following:

- Hybrid 305 genotype surpassed the Dorado variety and gained the highest mean values of the plant height, panicle length, panicle weight and grain yield/fed, while the Dorado variety gave the highest mean values of panicle width and 1000 grain weight in both seasons.

- The all studied traits increased by increasing N fertilizer rates and the maximum values were achieved by the highest N fertilizer rate (120 kg N/fed.) in both seasons.

- The Microbin bio-fertilizer recorded the highest mean values for the all studied traits in both seasons, but Nitrobin bio-fertilizer recorded the heaviest 1000 grain in the 1st season only.

- The $G_1xN_3$ (Hybrid 305 x 120 kg N/fed.) interaction treatments gave the maximum values for panicle weight in both seasons and grain yield/fed. in the 2nd season, as well as $G_1xN_2$ (Hybrid 305 x 90 kg N/fed.) gave the maximum values for grain yield/fed. in the 1st season. Moreover, the maximum grain yield/fed. (18.89 and 14.62 ard.) were obtained by G1xB1 (Hybrid 305 x Microbin) interaction treatments in the 1st and 2nd seasons, respectively.

- In general, the first order interaction; $N_1xB_0$ (60 kg N/fed. x without bio-fertilizer) interaction treatment gave the lowest mean values for the all studied traits in both seasons.

- The highest mean values for panicle weight and grain yield/fed. were recorded by $G_1xN_3xB_0$ (Hybrid 305 x 120 kg N/fed. x without bio-fertilizer) and $G_1xN_2xB_1$ (Hybrid 305 x 90 kg N/fed. x Microbin) interaction treatments in the 1st season, respectively.

***Keywords:*** *Grain sorghum, N fertilizer rate, bio-fertilizer, Microbin, Nitrobin, and interaction treatment.*

## Introduction

Grain sorghum (*Sorghum bicolor* (L.) Moench) is one of the fourth important food grain crop of the world. The quick spreading of high yielding genotypes changed the scenario of sorghum production in Egypt. As well as, the suitable genotype with genetic potential is important to achieve high yielding, production. Mohamed (2002) noticed that plant height, panicle length, panicle width, panicle weight, seed index and grain yield/fed. were affected significantly by sorghum cultivars in both seasons. El-Aref *et al*. (2005) showed that the sorghum cultivars exerted a significant influence on the plant height, 1000 grain weight and grain yield/fed. Shandaweel-2 hybrid was superior for all characters under study, compared to Dorado variety. Singh *et al*. (2012) indicated that grain yield was significantly affected by tested sorghum genotypes in both season. Rahman *et al*. (2013) confirmed that the varieties had significantly effect on plant height, 1000 grain weight and grain yield/fed. Mahama *et al*. (2014) concluded that the sorghum hybrids were superior to inbred lines for grain yield. Gad, Ayat (2015) showed that plant height, panicle length, panicle width, panicle weight, 1000 grain weight and grain yield/fed. were affected significantly by the Giza 15 and Dorado cultivars in both season. Sheleme *et al*. (2015) found that sorghum genotypes differed significantly in plant height, 1000 grain weight and grain yield, and the highest values for this traits were recorded by Lalo variety. Sarmiso (2016) denoted that the panicle length was affected by sorghum varieties.

Fertilizers are rich source of plant nutrient required for increased crop productivity. It is essential to know the best level of fertilizers application for getting a higher crop yield, so that the maximum benefits could be achieved. Nitrogen is one of the major macronutrients that are most limiting in grain sorghum production worldwide. Allam *et al*. (2002) stated that the application of nitrogen fertilizer exerted a significant influence on panicle weight, seed index and grain yield of sorghum. El-Aref *et al*. (2005) reported that grain sorghum cultivars affected significantly by nitrogen fertilization and increase panicle weight, 1000 grain weight and grain yield. Miko and Manga (2008) declared that nitrogen exerted significantly influence on plant height and grain yield. Zand *et al*. (2014) concluded that the effect of nitrogen application rate was significant for grain yield, but it did not significant for 1000 grain weight. Gad, Ayat (2015) found that the application of NPK fertilizers exerted significantly influence on plant height, panicle length, panicle width, panicle weight, seed index and grain yield/fed. Sujathamma *et al*. (2015) showed that application of 100% recommended dose of NPK fertilizer to sorghum plants recorded the highest mean values for panicle length and grain yield/ha. Sarmiso (2016) declared that the panicle weight, 1000 kernel weight and grain

yield/ha and statistically significant different for N rates, but the panicle length was not significant different to nitrogen rates.

Bio-fertilizer reduce the use of chemical fertilizer which causes pollution of aerial and soil environment, as well as it have detrimental effects on human and animal health. In addition, the positive influence of bio-fertilizer on soil fertility, organic matter content, enzymes, microbial population, crop yield and quality has been demonstrated in the works of many researches. Ponnuswamy *et al*. (2002) denoted that the highest grain yield of sorghum was achieved in incorporation of 100% NPK, Azospirillum and phosphorus solubilizing bacteria (PSB). Ahmed, Manar (2009) concluded that the highest corn grain yield obtained from inoculated with bio-fertilizer and 80 kg N/fed. Akbari *et al*. (2009) mentioned that combination of bio- and chemical fertilizer increased plant height and grain yield in sunflower. Amal *et al*. (2010) found that the combined inoculation with *Azotobacter vinelandlii* and *Pseudomonas flurescens* surpassed the single inoculation in all characters of sorghum. Baral and Adhikari (2013) observed that inoculation of Azotobacter increased 15 to 35% grain yield for maize over non-inoculated treatments. Kushwaha *et al*. (2014) mentioned that inoculation of PSB (phosphorus solubilizing bacteria) combination with Azospirillum increased grain yield of sorghum. Ibrahim *et al*. (2015) concluded that application of Microbin + 90 kg N/fed. gave the highest values of 100 grain weight and grain yield of maize. Thus, suitable cultivars, proper nutrition and bio-fertilizers are very important to get higher yield. Hence, the present study was undertaken to find out the response of two grain sorghum genotypes productivity to bio- and mineral fertilizer in newly reclaimed soil.

**Materials and Methods**

The present investigation was carried out in the Agricultural Research Station, at Arab El-Awammer in Assiut Governorate during the two growing seasons of 2014 and 2015 to study the response of two grain sorghum genotypes productivity to bio- and mineral fertilize in the newly reclaimed soil. The soil used for these experiments was sandy and its structure as presented in Table 1.

**Table 1. Some soil physical and chemical properties of the experimental site before cultivation.**

**- Physical properties:**

| Particle size distribution (%) | | | Texture class | O.M (%) | $CaCO_3$ (%) | Moisture content (volumetric %) | | | A.W (%) |
|---|---|---|---|---|---|---|---|---|---|
| Sand | Silt | Clay | | | | S.P. | F.C. | W.P. | |
| 89.9 | 7.1 | 3.0 | Sandy | 0.25 | 30.9 | 23.3 | 10.9 | 4.5 | 6.5 |

**-Chemical properties**

| pH (1:1) | EC dS/m (1:1) | Soluble cations (meq/L) | | | | Soluble anions (meq/L) | | Available phosphorus (ppm) | Total nitrogen (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{--} + HCO_3^{-}$ | $Cl^{-}$ | | |
| 8.37 | 0.33 | 1.43 | 1.16 | 0.19 | 0.75 | 1.68 | 1.47 | 8.31 | 0.0125 |

O.M: Organic matter, S.P.: Saturation point,
F.C.: Field capacity, W.P.: Wilting point, A.W.: Available water

**Experimental Design:**

The field experiment was carried in a randomized complete block design (RCBD) using a split-split plot arrangement with four replications. The genotypes (Hybrid 305 and Dorado) were asigned in the main plot, while the N-mineral fertilizer (60, 90 and 120 kg N/fed.) were allotted in the sub plot and biofertilizer (Zero, Microbin and Nitrobin) were fixed in the sub-sub plots.

Prior to sowing, seed inoculation was carried out using biofertilizers of nitrogen fixing bacteria (NFB). The first group of NFB are *Azospirillum braselence* + *Azotobacter chrococcum* combined with PDB (i.e., phosphorus dissolving bacteria of *Bacillus megatherium*) are in a form of the commercial bio-fertilzier Microbin. The second group of NFB are *Azospirillum* ssp. + *Azotobacter* in the form of the commercial biofertilizer 'Nitrobin'. Both produced by the agriculture Microbiology Research Department, Soil Water and Environmental Research Institute, Agric. Res. Center, Ministry of Agriculture, Giza, Egypt. Seed inoculation was performed by mixing teosinte grains with the appropriate Mcirobin and Nitrobin using Arabic gum as adhesive material. The coated grains were then air dried in shade for minutes and swan immediately. Since there has been farming in sandy soil have been double the amount of Microbin and Nitrobin this was the first batch, while the second batch was after the first hoe one. Mixing the amount of biofertilizer with amount of sand and then added in hill under each plant and coverage.

Sorghum genotypes were planted on 13$^{th}$ and 17$^{th}$ June in the first and second season, respectively. After three weeks from planting, plants were thinned into two plants per hill. The preceding crop was wheat in both seasons. All other agricultural practices were carried out as recommend for grain sorghum in both seasons

The plot area was 12 m$^2$ (3x4) including 4 ridges of 60 cm apart at

spacing 20 cm between hills. Nitrogen fertilizer in the from ammonium nitrate (33.5% N) was divided into four equal doses: (1) The first dose was added after 10 days from sowing. (2) The second dose was added after 30 days from sowing. (3) The third dose was added after 37 days from sowing. (4) The fourth dose was added after 45 days from sowing.

Recommended rate of phosphorus 15.5% $P_2O_2$ (150 kg $fed^{-1}$ as mono-super phosphate) and potassium 48% $K_2O$ (50 kg $fed^{-1}$) was applied after 10 days from sowing.

**Characters, sampling and measurement:**

Data were recorded by using competitive plants from each sub-sub plot (12 $m^2$). A plant was considered competitive when it was guarded from four sides, i.e. two sides on the same ridge and the other two sides on the adjacent ridges. Random samples of five plants were chosen from the four inner rows of every sub-sub plot.

The following characters were recorded:

Plant height (cm): measured from soil surface to the tip of the panicle, panicle length (cm): measured from the base to the tip of the panicle, panicle width (cm), seed index (g): is recorded by weight of 1000 grain from each plot, grains weight/panicle (gm) and grain yield/fed: It was estimated from the plot area in Kg/ plot and converted into ardab /fed.

**Statistical analysis**

The obtained data from each season were exposed to proper statistical analysis of variance according to Gomez and Gomez (1984) using the MSTAT-C Statistical Software Package described by Co-Stat (2004).The revised least significant difference (RLCD) at 5% level of probability were computed to detect the difference among means.

**Results and Discussion**

**Main effects:**

Data in Table 2 revealed that the most studied traits i.e. plant height, panicle length, grains weight/panicle, 1000 grain weight and grain yield/fed. had a significantly affected by sorghum genotypes, except panicle width did not significantly affected by this trail in both seasons. The highest main values for plant height, panicle length, panicle weight and grain yield/fed. were recorded by Hybrid 305 genotype in both season, whilst the highest mean values for panicle width and 1000 grain weight were recorded by Dorado variety in both seasons. The results mean that the Hybrid 305 genotype was the effective for achieving the maximum mean values of the all studied traits except panicle width and 1000 grain weight. The differences between the genotypes could be attributed the genetic make up. These results are in conformity with those reported by El-Aref *et al*. (2005), Singh *et al*. (2012), Rahman *et al*. (2013), Mahama *et al*. (2014), Gad, Ayat (2015), Sheleme *et al*. (2015) and Sarmiso (2016).

**Table 2. Main effects of genotypes (G), nitrogen fertilizer (N) and bio-fertilizer (B) on the plant height, yield components and yield for grain sorghum in 2014 and 2015 seasons.**

| Characters / Main effect | Plant height (cm) | | Panicle length (cm) | | Panicle width (cm) | | Grains weight/ panicle (g) | | 1000 grain weight (g) | | Grain yield/fed. (ard.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| **Genotypes (G)** | | | | | | | | | | | | |
| $G_1$ | 159.25 | 163.88 | 26.46 | 26.05 | 6.11 | 7.63 | 37.02 | 30.00 | 22.90 | 22.12 | 16.21 | 13.76 |
| $G_2$ | 95.28 | 113.64 | 19.561 | 21.41 | 6.27 | 8.42 | 29.44 | 24.46 | 24.95 | 24.57 | 13.82 | 11.31 |
| **F-test** | ** | ** | ** | * | N.S | N.S | ** | ** | * | ** | * | ** |
| **Nitrogen (N)** | | | | | | | | | | | | |
| $N_1$ | 122.71 | 136.42 | 22.16 | 22.73 | 6. 24 | 8.1 | 29.83 | 24.07 | 23.42 | 22.89 | 13.67 | 11.17 |
| $N_2$ | 129.17 | 138.42 | 23.06 | 23.54 | 6.08 | 7.98 | 34.51 | 26.13 | 23.44 | 23.11 | 15.67 | 12.19 |
| $N_3$ | 129.92 | 141.41 | 23.82 | 24.93 | 6.25 | 7.99 | 35.35 | 31.49 | 24.91 | 24.92 | 15.72 | 14.24 |
| **F-test** | * | * | ** | ** | N.S | N.S | ** | ** | N.S | * | ** | ** |
| **RLSD 5%** | 4.55 | 3.63 | 1.31 | 0.51 | 0.6 | 0.5 | 1.12 | 0.85 | 1.57 | 0.67 | 0.42 | 0.32 |
| **Bio-fertilizer (B)** | | | | | | | | | | | | |
| $B_0$ | 127.5 | 135.13 | 22.03 | 22.78 | 5.86 | 7.89 | 32.92 | 24.48 | 22.83 | 22.59 | 14.29 | 11.43 |
| $B_1$ | 130.13 | 141.71 | 24.01 | 24.42 | 6.48 | 8.23 | 34.44 | 29.83 | 24.34 | 23.91 | 16.12 | 13.58 |
| $B_2$ | 124.17 | 139.42 | 22.99 | 24 | 6.24 | 7.96 | 32.32 | 27.38 | 24.62 | 23.53 | 14.65 | 12.59 |
| **F-test** | N.S. | * | ** | ** | ** | * | N.S | ** | * | ** | ** | ** |
| **RLSD 5%** | 7.88 | 4.3 | 1.08 | 0.63 | 0.3 | 0.24 | 3.32 | 0.91 | 1.47 | 0.79 | 1.04 | 0.45 |

$G_1$ = Hybrid 305, $G_2$ = Dorado, $N_1$ = 60 kg N/fed., $N_2$ = 90 kg N/fed., $N_3$ = 120 kg N/fed.,
$B_0$ = Without bio-fertilizer, $B_1$ = Microbin and $B_2$ = Nitrobin.
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences.
RLSD=Revised Least Significant Difference.

Regarding to nitrogen fertilizer rates, the results in Table 2 showed that the plant height, panicle length, panicle weight and grain yield/fed. in both seasons, as well as 1000 grain weight in the 2nd season exerted significantly influence by the nitrogen fertilizer rates, whilst the panicle width in both season and 1000 grain in the 1st season did not significant affected by this trail. In general, the all above studied traits increased by increasing N fertilizer rates and the maximum mean values were achieved by the highest N fertilizer rate (120 kg N/fed.) in both seasons. It clear from these data that N fertilizer to grain sorghum enhanced the vegetative growth of the plants, increased photosynthetic activity and metabolites required to produce wide and heavy panicles, increase grains weight and consequently, reacted grain sorghum yield. Gebremarium and Assefa (2015) mentioned that the application of N-fertilizer significantly increased the plant height, panicle length, yield per panicle, 100 grain weight and grain yield over the control. These results are coincided with those mentioned by Allam *et al*. (2002), El-Aref *et al*. (2005), Miko and Manga (2008), Zand *et al*. (2012), Sujathamma *et al*. (2015) and Gad, Ayat (2015). However, she was reported that the panicle length was not significant different to nitrogen rates.

Concerning with the bio-fertilizers, the data in Table 2 declared that the bio-fertilizer exerted a significant influence on the plant height and grains weight panicle in the 2nd season, as well as in both seasons reacted significantly on panicle length, panicle width, 1000 grain weight and grain yield/fed. The Microbin bio-fertilizer gave the tallest plants, the longest panicle, the widest panicle, the highest panicle weight, the heaviest 1000 grain and the maximum grain yield in both seasons, except 1000 grain weight in the 2nd season. Similar findings were concluded by Ponnuswamy *et al*. (2002), Ahmed, Manar (2009), Amal *et al*. (2010), Kushwaha *et al*. (2014) and Patil (2014).

**Interaction effect:**

Data in Table 3 cleared that genotypes x nitrogen fertilizer (GxN) interaction had a significantly effect grains weight/panicle in both seasons and grain yield/fed. in the 1st season only. The other traits did not show any significant in both seasons. The heaviest panicle weight (39.82 and 34.18 g) were realized by $G_1xN_3$ (Hybrid 305 x 120 kg N/fed.) interaction treatments in both seasons. Also, the maximum grain yield/fed. (17.68 ard.) followed by (17.13 ard.) were realized by $G_1xN_2$ (Hybrid 305 x 90 kg N/fed.) followed by $G_3xN_3$ (Hybrid 305 x 120 kg N/fed.) interaction treatment in the 1st season without significant difference between them, as well as in the 2nd season the maximum grain yield/fed. (15.38 ard.) was realized by $G_1xN_3$ (Hybrid 305 x 120 kg N/fed.) interaction treatment. On the other hand, the thinnest panicle weight (27.65 and 21.90 g) and the minimum grain yield/fed. (13.51 and 10.16 ard.) were realized by $G_2xN_1$ (Dorado variety x 60 kg N/fed.) interaction treatment in the 1st and 2nd seasons, respectively. Sheleme *et al*. (2015) mentioned that there was significant

interaction effect of N rates and sorghum genotypes on most of the parameters studied. Significantly higher grain yield was obtained in response to the application of 92 kg N/ha with Lalo genotype as compared with local variety. Similar findings were confirmed by Azam *et al*. (2015) and Gad, Ayat (2015).

With attention to the GxB (genotypes x bio-fertilizers) interaction, the data in Table 4 showed that the GxB interaction exerted significantly influence on the grain yield/fed. in the 1st season only. The other all studied traits did not show any significant for this trail in both seasons. The maximum values grain yield/fed. (18.89 and 14.62 ard.) were achieved by $G_1xB_1$ (Hybrid 305 x Microbin) interaction treatments, while the minimum grain yield/fed. (14.00 and 10.15 ard.) were achieved by $G_2xB_0$ (Dorado variety x without bio-fertilizer) interaction treatments in the 1st and the 2nd seasons, respectively.

With respect to NxB (nitrogen fertilizer x bio-fertilizer) interaction, the results in the Table 5 pointed out that the NxB interaction exerted significantly influence on the all studied traits, except 1000 grain weight did not significant by this trail in both seasons. The $N_1xB_1$ (60 kg N/fed. x Microbin) interaction treatment gave the widest panicle (6.68 and 8.74 cm) in the 1st and 2nd seasons, respectively. Also, $N_2xB_1$ (90 kg N/fed. x Microbin) interaction treatment gave the tallest plant (132.50 cm) and the maximum grain yield/fed. (17.82 ard.) in the 1st season. Moreover, the $N_3xB_1$ (120 kg N/fed. x Microbin) gave the longest panicle (25.87 cm) and the heaviest panicle (31.66 g) in the 2nd season. On the other hand, the $N_1xB_0$ (60 kg N/fed. x without bio-fertilizer) interaction treatment gave the lowest mean values for all the studied traits in both seasons. Patil (2014) showed that sorghum grain yield was 44% higher when seed were treated with Azospirillum and applied with 50% RRN (recommended rate of nitrogen) compared the control. Similar results were demonstrated by Ponnuswamy *et al*. (2002), Akbari *et al*. (2009), Ahmed, Manar (2009) and Ibrahim *et al*. (2015).

**Table 3. Interaction effect of genotypes (G) and nitrogen fertilizer (N) on the plant height, yield components and yield for grain sorghum in 2014 and 2015 seasons.**

| Characters / Interact. (GxN) | | Plant height (cm) | | Panicle length (cm) | | Panicle width (cm) | | Grains weight/ panicle (g) | | 1000 grain weight (g) | | Grain yield/fed. (ard.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| $G_1$ | $N_1$ | 152.25 | 162.50 | 25.78 | 24.82 | 6.13 | 7.48 | 32.01 | 26.24 | 22.29 | 21.50 | 13.82 | 12.18 |
| | $N_2$ | 162.17 | 162.83 | 26.82 | 26.12 | 5.94 | 7.68 | 39.23 | 29.58 | 22.23 | 21.89 | 17.68 | 13.73 |
| | $N_3$ | 163.33 | 166.25 | 26.78 | 27.23 | 6.26 | 7.73 | 39.82 | 34.18 | 24.19 | 22.97 | 17.13 | 15.38 |
| $G_2$ | $N_1$ | 93.17 | 110.33 | 18.53 | 20.63 | 6.35 | 8.72 | 27.65 | 21.90 | 24.56 | 24.27 | 13.51 | 10.16 |
| | $N_2$ | 96.17 | 114.00 | 19.30 | 20.96 | 6.23 | 8.29 | 29.79 | 22.68 | 24.66 | 24.34 | 13.65 | 10.65 |
| | $N_3$ | 96.50 | 116.58 | 20.85 | 22.64 | 6.24 | 8.25 | 30.88 | 28.79 | 25.64 | 25.10 | 14.31 | 13.11 |
| **F-test** | | N.S | N.S | N.S | N.S | N.S | N.S | ** | * | N.S | N.S | ** | N.S |
| **RLSD 5%** | | 7.85 | 6.68 | 2.78 | 0.97 | 0.85 | 0.96 | 1.7 | 1.38 | 2.79 | 1.42 | 0.6 | 0.95 |

**$G_1$ =** Hybrid 305, **$G_2$** = Dorado**, $N_1$** = 60 kg N/fed., **$N_2$** = 90 kg N/fed., **$N_3$** = 120 kg N/fed.,
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences.
RLSD=Revised Least Significant Difference.

**Table 4. Interaction effect of genotypes (G) and bio-fertilizer (B) on the plant height, yield components and yield for grain sorghum in 2014 and 2015 seasons.**

| Characters / Interact. (GxB) | | Plant height (cm) | | Panicle length (cm) | | Panicle width (cm) | | Grains weight/ panicle (g) | | 1000 grain weight (g) | | Grain yield/fed. (ard.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| $G_1$ | $B_0$ | 161.42 | 160.83 | 25.98 | 25.27 | 5.88 | 7.64 | 35.98 | 26.91 | 21.82 | 21.54 | 14.57 | 12.71 |
| | $B_1$ | 163.42 | 165.58 | 27.39 | 26.50 | 6.34 | 7.73 | 39.74 | 32.58 | 23.43 | 22.56 | 18.89 | 14.62 |
| | $B_2$ | 152.92 | 165.17 | 26.00 | 26.39 | 6.12 | 7.52 | 35.34 | 30.51 | 23.46 | 22.25 | 15.17 | 13.97 |
| $G_2$ | $B_0$ | 93.58 | 109.42 | 18.08 | 20.29 | 5.85 | 8.14 | 29.87 | 22.04 | 23.84 | 23.63 | 14.00 | 10.15 |
| | $B_1$ | 96.83 | 117.83 | 20.63 | 22.33 | 6.61 | 8.72 | 29.15 | 27.09 | 25.25 | 25.26 | 13.34 | 12.54 |
| | $B_2$ | 95.42 | 113.67 | 19.97 | 21.61 | 6.37 | 8.40 | 29.30 | 24.25 | 25.77 | 24.82 | 14.12 | 11.22 |
| **F-test** | | N.S | N.S | N.S | N.S | N.S | N.S | N.S | N.S | N.S | N.S | ** | N.S |
| **RLSD 5%** | | 10.53 | 8.95 | 2.94 | 1.4 | 0.64 | 0.38 | 3.96 | 2.13 | 2.93 | 1.66 | 1.53 | 1.04 |

**$G_1$** = Hybrid 305, **$G_2$** = Dorado**, $B_0$** = Without bio-fertilizer, **$B_1$** = Microbin and **$B_2$** = Nitrobin.
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively.
N.S. = Non-significant differences.
RLSD=Revised Least Significant Difference.

**Table 5. Interaction effect of nitrogen fertilizer (N) and bio-fertilizer (B) on the plant height, yield components and yield for grain sorghum in 2014 and 2015 seasons.**

| Characters / Interact. (NxB) | | Plant height (cm) | | Panicle length (cm) | | Panicle width (cm) | | Grains weight/ panicle (g) | | 1000 grain weight (g) | | Grain yield/fed. (ard.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| $N_1$ | $B_0$ | 125.88 | 124.38 | 18.85 | 21.10 | 5.53 | 7.55 | 27.45 | 19.85 | 22.25 | 21.70 | 11.55 | 9.21 |
| | $B_1$ | 125.88 | 143.13 | 23.80 | 23.48 | 6.68 | 8.74 | 31.15 | 27.32 | 24.02 | 24.04 | 14.30 | 12.68 |
| | $B_2$ | 116.38 | 141.75 | 23.83 | 23.60 | 6.53 | 8.01 | 30.88 | 25.04 | 24.00 | 22.92 | 15.14 | 11.62 |
| $N_2$ | $B_0$ | 126.38 | 136.38 | 22.35 | 22.43 | 5.80 | 7.79 | 30.87 | 22.22 | 22.17 | 22.33 | 14.09 | 10.55 |
| | $B_1$ | 132.50 | 142.00 | 23.94 | 23.90 | 6.38 | 8.19 | 37.46 | 30.51 | 24.33 | 23.55 | 17.82 | 14.12 |
| | $B_2$ | 128.63 | 136.88 | 22.89 | 24.29 | 6.08 | 7.98 | 35.20 | 25.67 | 23.82 | 23.46 | 15.09 | 11.91 |
| $N_3$ | $B_0$ | 130.25 | 144.63 | 24.90 | 24.81 | 6.25 | 8.34 | 40.46 | 31.36 | 24.06 | 23.73 | 17.21 | 14.53 |
| | $B_1$ | 132.00 | 140.00 | 24.30 | 25.87 | 6.38 | 7.75 | 34.72 | 31.66 | 24.65 | 24.14 | 16.23 | 13.94 |
| | $B_2$ | 127.50 | 139.63 | 22.25 | 24.11 | 6.13 | 7.89 | 30.88 | 31.43 | 26.03 | 24.23 | 13.72 | 14.25 |
| **F-test** | | N.S | ** | ** | ** | * | ** | ** | ** | N.S | N.S | ** | ** |
| **RLSD 5%** | | 15.94 | 7.16 | 1.98 | 1.24 | 0.60 | 0.38 | 4 | 1.66 | 3.58 | 2.03 | 1.96 | 0.81 |

$N_1$ = 60 kg N/fed., $N_2$ = 90 kg N/fed., $N_3$ = 120 kg N/fed.,
$B_0$ = Without bio-fertilizer, $B_1$ = Microbin and $B_2$ = Nitrobin.
*, ** indicated to significantly and highly significantly at 5% and 1% levels of probability, respectively
N.S. = Non-significant differences.
RLSD=Revised Least Significant Difference.

**Table 6. Interaction effect of genotypes (G), nitrogen fertilizer (N) and bio-fertilizer (B) on the plant height, yield components and yield for grain sorghum in 2014 and 2015 seasons.**

| Characters / Interact. (GxNxB) | | Plant height (cm) | | | | | | Panicle length (cm) | | | | | | Panicle width (cm) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | | | 2015 | | | 2014 | | | 2015 | | | 2014 | | | 2015 | | |
| | | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ |
| $G_1$ | $N_1$ | 161.00 | 156.75 | 139.00 | 148.00 | 169.00 | 170.50 | 22.25 | 27.40 | 27.70 | 23.50 | 25.15 | 25.80 | 5.63 | 6.40 | 6.38 | 7.28 | 7.75 | 7.43 |
| | $N_2$ | 159.00 | 165.50 | 162.00 | 161.75 | 165.50 | 161.25 | 26.55 | 27.83 | 26.08 | 25.35 | 26.30 | 26.70 | 5.70 | 6.15 | 5.98 | 7.58 | 7.88 | 7.58 |
| | $N_3$ | 164.25 | 168.00 | 157.75 | 172.75 | 162.25 | 163.75 | 29.15 | 26.95 | 24.25 | 26.95 | 28.05 | 26.68 | 6.30 | 6.48 | 6.00 | 8.08 | 7.58 | 7.55 |
| $G_2$ | $N_1$ | 90.75 | 95.00 | 93.75 | 100.75 | 117.25 | 113.00 | 15.45 | 20.20 | 19.95 | 18.70 | 21.80 | 21.40 | 5.44 | 6.95 | 6.68 | 7.83 | 9.73 | 8.60 |
| | $N_2$ | 93.75 | 99.50 | 95.25 | 111.00 | 118.50 | 112.50 | 18.15 | 20.05 | 19.70 | 19.52 | 21.50 | 21.88 | 5.90 | 6.60 | 6.18 | 8.00 | 8.50 | 8.38 |
| | $N_3$ | 96.25 | 96.00 | 97.25 | 116.50 | 117.75 | 115.50 | 20.65 | 21.65 | 20.25 | 22.67 | 23.70 | 21.55 | 6.20 | 6.28 | 6.25 | 8.60 | 7.93 | 8.23 |
| **F-test** | | N.S | | | N.S | | | N.S | | | N.S | | | N.S | | | N.S | | |
| **RLSD 5%** | | 22.62 | | | 14.88 | | | 4.3 | | | 2.43 | | | 1.1 | | | 0.66 | | |
| **Characters / Interact. (GxNxB)** | | **Grain weight / panicle (g)** | | | | | | **1000 Grain weight (g)** | | | | | | **Grain yield/fed. (ard.)** | | | | | |
| | | 2014 | | | 2015 | | | 2014 | | | 2015 | | | 2014 | | | 2015 | | |
| | | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ | $B_0$ | $B_1$ | $B_2$ |
| $G_1$ | $N_1$ | 27.98 | 36.79 | 31.26 | 22.13 | 29.23 | 27.35 | 21.47 | 22.87 | 22.52 | 20.49 | 22.52 | 21.50 | 10.20 | 16.77 | 14.50 | 10.27 | 13.57 | 12.69 |
| | $N_2$ | 31.47 | 44.95 | 41.26 | 25.25 | 33.90 | 29.61 | 20.40 | 24.02 | 22.26 | 21.50 | 22.15 | 22.00 | 14.14 | 22.21 | 16.70 | 11.72 | 15.74 | 13.74 |
| | $N_3$ | 48.50 | 37.48 | 33.50 | 33.37 | 34.60 | 34.58 | 23.59 | 23.39 | 25.60 | 22.63 | 23.02 | 23.24 | 19.38 | 17.69 | 14.33 | 16.14 | 14.54 | 15.47 |
| $G_2$ | $N_1$ | 26.92 | 25.51 | 30.51 | 17.56 | 25.40 | 22.74 | 23.03 | 25.17 | 25.47 | 22.90 | 25.57 | 24.35 | 12.90 | 11.84 | 15.78 | 8.15 | 11.79 | 10.55 |
| | $N_2$ | 30.26 | 29.97 | 29.15 | 19.20 | 27.13 | 21.73 | 23.95 | 24.65 | 25.39 | 23.16 | 24.96 | 24.91 | 14.04 | 13.43 | 13.48 | 9.38 | 12.49 | 10.07 |
| | $N_3$ | 32.41 | 31.96 | 28.26 | 29.36 | 28.73 | 28.28 | 24.54 | 25.91 | 26.47 | 24.84 | 25.27 | 25.21 | 15.04 | 14.77 | 13.11 | 12.93 | 13.35 | 13.04 |
| **F-test** | | ** | | | N.S | | | N.S | | | N.S | | | ** | | | N.S | | |
| **RLSD 5%** | | 5.84 | | | 3.68 | | | 5.04 | | | 2.87 | | | 2.9 | | | 1.53 | | |

As for, the second order interaction GxNxB (genotypes x nitrogen fertilizer x bio-fertilizer) interaction, the results in Table 6 cleared that GxNxB interaction exerted highly significantly influence for panicle weight and grain yield/fed. in the 1st season only. The rest studied traits did not show any significant difference for this trail in both seasons. The $G_1xN_3xB_0$ (Hybrid 305 x 120 kg N/fed. x without fertilizer) and $G_2xN_1xB_1$ (Dorado variety x 60 kg N/fed. x without fertilizer) gave the heaviest panicle (48.50 g) and the thinnest one (25.51 g) in the 1st season. Moreover, the $G_1xN_2xB_1$ (Hybrid 305 x 90 kg N/fed. x Microbin) and $G_1xN_1xB_0$ (Hybrid 305 x 60 kg N/fed. x without bio-fertilizer) gave the maximum grain yield/fed. (22.21 ard.) and the minimum one (10.20 ard.) in the 1st season. Generally, the other studied traits the $G_1$ or $G_2$ with $N_1xB_0$ (Hybrid 305 or Dorado variety x 60 kg N/fed. x without bio-fertilizer) gave the lowest mean values in both seasons.

**References**

Ahmed, Manar, A.M.A. (2009). Yield and quality of maize in response to bio-fertilizer application. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.

Akbari, P.; A. Ghalavand and Modarres (2009). Effects of different nutrition systems (organic, chemical and integrated) and bio-fertilizer on yield and other growth traits of sunflower (*Helianthus annuus* L.). Electronically J. of Sustainable Agric., 19: 84-93.

Allam, A.; G.R. El-Nagar; M.M. Abd-Alla and N. Ibrahim (2002). Response of some grain sorghum cultivar to planting density and nitrogen fertilization. Assiut J. Agric. Sci., 33 (2): 133-150.

Amal, G.A.; S. Orabi and A.M. Gomaa (2010). Bio-organic farming of grain sorghum and its effect on growth, physiological and yield parameters and antioxidant enzymes activity. J. Agric. and Biological Sci., 6 (3): 270-279.

Azam, M.; E.A. Waraich; A. Pervaiz and F. Nawaz (2010). Response of newly developed fodder sorghum (*Sorghum bicolor*, L. Moench) variety (F-9917) to NPK application. Pak. J. Life Soc. Sci., 8 (2): 117-120.

Baral, B.R. and P. Adhikari (2013). Effect of *Azotobacter* on growth and yield of maize. Saarc. J. Agric.,11 (2): 141-147.

Costat Statistical Software (2004). Co-Stat Manual Revision, 4 (2) 271.

El-Aref, A.O.; S.E. Abdel-Mawly and A.S. Abo-Elhamd (2005). Improving yield and water use efficiencies of two sorghum cultivars irrigated by surface and drip irrigation systems and fertilized by nitrogen. Assiut Univ. Bull. Environ. Res., 8 (2): 67-80.

Gad, Ayat, B.H. (2015). Physiological response of two sorghum varieties to different rates and splitting of NPK. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.

Gebremariam, G. and D. Assefa (2015). Nitrogen fertilization effect on grain sorghum (*Sorghum bicolor* L., Moench) yield, yield components and witchweed (*Striga hermonthica* (Del.) Benth) infestation in northern Ethiopia. Int. J. Agric. Res., 1-10.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedure for Agricultural Research. 2nd Ed, John Wily and sons, Ins. New York.

Ibrahim, H.I.M.; E.A. Hassan and S.M.H.A. Eissa (2015). Impact of

bio-fertilization on productivity, grain quality and economic revenue of rayana. World J. of Agric. Sci., 11 (5): 268-278.

Kushwaha, B.b.; N.S. Thakur; U. Saxena; D.K. Shrivastava; V.P. Kataria; S.N. Upadhyay and R.K. Choudhary (2014). Effect of fertility levels, farmyard manure and inoculants on growth, yield and uptake of nutrients by sorghum. Annals of Plant and Soil Res., 16 (2): 139-142.

Mahama, G.Y.; P.V. Vara Prasad; D.B. Mengel and T.T. Tesso (2014). Influence of nitrogen fertilizer on growth and yield of grain sorghum hybrids and inbred lines. Agron. J. 106 (5): 1623-1630.

Miko, S. and A.A. Manga (2008). Effect of intra-spacing and nitrogen rates on growth and yield of sorghum (*Sorghum bicolor* L.) var. ICSV 400. Pat 4 (2): 66-73.

Mohamed, N.I. (2002). Effect of plant density and nitrogen fertilization on growth and yield of some grain sorghum cultivars. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Assiut, Egypt.

Patil, S.L. (2014). *Azospirillum* based integrated nutrient management for conserving soil moisture and increasing sorghum productivity. African Journal of Agricultural Research, 9 (23): 1761-1769.

Ponnuswamy, K.; P. Subbian; P. Santhi and N. Sankaran (2002). Integrated nutrient management for rainfed sorghum. Crop Res., 23: 243-246.

Rahman, A.M.S.; K.M.Z. Hossin; M.A. Hossain; B.K. Saha and H.M. Anowarul (2013). Variation among grain sorghum varieties in response to nitrogen fertilizer. Bangladesh J. Seed Sci. & Tech., 17 (1-2): 7-14.

Sarmiso, Z. (2016). Effect of nitrogen fertilizer on striga infestation, yield and yield related traits in sorghum (*Sorghum bicolor* (L.) Moench) varieties at Kile, Eastern Ethiopia. J. Biology, Agric. and Helthcar, 61 (2): 74-89.

Sheleme, K.S.; R. Cherukuri; T. Balemi and I. Hamza (2015). Differential productivity response of rainfed sorghum (*Sorghum bicolor* L.) genotypes in relation to graded levels of nitrogen in Kellem Wollega Zone of Ethiopia, East Africa. Intr. J. of Life Sci., 3 (4): 306-316.

Singh, P.; H.K. Sumeriya and N.S. Solanki (2012). Effect of fertilizer levels on productivity and econoics of elite sorghum (*Sorghum bicolor* (L.) Moench) genotypes. Madras Agric. J., 99 (7-9): 567-569

Sujathamma, P.; K. Kavitha and V. Suneetha (2015). Response of grain sorghum (*Sorghum bicolor* L.) cultivars to different fertilizer levels under rainfed condition. Inter. J. of Agric. Sci., 5 (1): 381-385.

Zand, N.; M.R. Shakiba; M.M. Vahed and A.D.M. Nasab (2014). Response of sorghum to nitrogen fertilizer at different plant densities. Int. J. of Farming and Allied Sci., 3 (1): 71-74.

*Assiut J. Agric. Sci., (47) No. (6-1) 2016 (34-48)* *ISSN: 1110-0486*
*Website: http://www.aun.edu.eg/faculty_agriculture* *E-mail: ajas@aun.edu.eg*

# إستجابة إنتاجية تركيبين وراثيين من الذرة الرفيعة الحبوب للسماد الحيوي والمعدني في الأراضي حديثة الاستصلاح

**إيمان محمد محمد حسان[١]، كامل علي عبد الرحمن[٢]، رجب أحمد داود[٢]، أحمد الرفاعي عبدالعظيم أحمد[٣]**
[١] محطة البحوث الزراعية بعرب العوامر
[٢] قسم المحاصيل – كلية الزراعة – جامعة أسيوط
[٣] قسم بحوث الذرة الرفيعة، معهد بحوث محاصيل الحقل – مركز البحوث الزراعية بالجيزة

**الملخص**

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية، عرب العوامر خلال موسمي الزراعة ٢٠١٤ و٢٠١٥ لبحث إستجابة إنتاجية تركيبين وراثيين من الذرة الرفيعة للحبوب للسماد الحيوي والنيتروجيني في الأراضي حديثة الإستصلاح. وكان تصميم التجربة هو قطاعات كاملة العشوائية باستخدام الأحواض المنشقة مرتين في أربع مكررات، حيث تم وضع التراكيب الوراثية (هجين ٣٠٥ والصنف دورادو) في القطع الرئيسية، بينما تم وضع معدلات السماد النيتروجيني (٦٠ ، ٩٠ ، ١٢٠ كجم ن/فدان) في القطع المنشقة مرة واحدة، كما تم وضع معدلات السماد الحيوي (صفر ، ميكروبين ونيتروبين) في القطع المنشقة مرتين. وتم زراعة حبوب الذرة الرفيعة للتراكيب الوراثية بتاريخ ١٣ و ١٧ يونيو في السنة الأولي والثانية علي الترتيب وكانت مساحة القطعة التجريبية هو ١٢ م٢ (٤ خطوط بمسافة ٦٠ سم بين الخطوط وطول الخط ٤ م).

**ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:**

- تفوق التركيب الوراثي هجين ٣٠٥ علي الصنف دورادو وأعطي أعلي قيم المتوسطات لطول النبات، طول القنديل، وزن القنديل ومحصول الحبوب/فدان، بينما أعطي الصنف دورادو أعلي قيم المتوسطات لعرض القنديل ووزن ١٠٠٠ حبة في كلا الموسمين.
- زادت جميع الصفات المدروسة بزيادة معدلات التسميد النيتروجيني وتحققت أعلي متوسطات القيم بمعدل التسميد الأعلي للنيتروجين (١٢٠ كجم ن/فدان) في كلا الموسمين.
- سجل السماد الحيوي ميكروبين أعلي متوسطات القيم لجميع الصفات المدروسة في كلا الموسمين، ولكن سجل السماد الحيوي نيتروبين أثقل ألف حبة في الموسم الأول فقط.
- أعطت معاملات التفاعل G1xN3 (هجين ٣٠٥ × ١٢٠ كجم ن / فدان) أعظم القيم لوزن القنديل في كلا الموسمين ومحصول الحبوب / فدان في الموسم الثاني، كما أعطت معاملات التفاعل $G_1xN_2$ (هجين ٣٠٥ × ٩٠ كجم ن / فدان) أعظم القيم لمحصول الحبوب / فدان في الموسم الأول، علاوة علي ذلك حصل علي أعظم محصول حبوب / فدان (١٨,٨٩ و ١٤,٦٢ أردب) لمعاملات التفاعل $G_1xB_1$ (هجين ٣٠٥ × ميكروبين) في الموسم الأول والثاني علي الترتيب.
- عامة، في التفاعل من الدرجة الأولي، أعطت معاملة التفاعل $N_1xB_0$ (٦٠ كجم ن / فدان × بدون تسميد حيوي) أقل متوسطات القيم لجميع الصفات المدروسة في كلا الموسمين.
- سجلت أعلي متوسطات القيم لوزن القنديل ومحصول الحبوب/فدان بمعاملات التفاعل الثنائي $G_1xN_3xB_0$ (هجين ٣٠٥ × ١٢٠ كجم ن / فدان × بدون تسميد حيوي) ومحصول الحبوب / فدان بمعاملات التفاعل $G_1xN_2xB_1$ (هجين ٣٠٥ × ٩٠ كجم ن / فدان × ميكروبين) في الموسم الأول والثاني علي الترتيب.