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# ENHANCEMENT OF PRODUCTIVITY AND QUALITY OF SOME MAIZE HYBRIDS BY APPLICATION OF ORGANIC AND BIO FERTILIZERS

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**ABSTRACT:** *A field experiment was conducted in clay soil at Giza research station, Agricultural Research Center (ARC) in 2012 and 2013 seasons, to study the effect of compost application as organic fertilizers at four levels (0, 10, 12 and 15 ton fed$^{-1}$) with or without inoculum composed of PGPR: 1- Azotobacter chroococcum and Azospirillum brasilense as $N_2$-fixing bacteria, 2- Bacillus megaterium as phosphate dissolving bacteria and 3- Bacillus circulans as potassium releasing bacteria, on maize growth, grain yield, as well as content of N, P and K of maize plant, and protein, N, P and K grain content of two maize hybrids SC131 and SC 173. Results revealed that application of both compost and PGPR as organic and bio-fertilizers were associated with a significant decrease in number of days to 50% tasseling and silking but increased plant height, ear height and grain yield Ardab fed$^{-1}$ in both seasons. Nitrogen, phosphorus and potassium plant content at 75 days after planting were increased and gave significant increase as compared to applied N, P, and K mineral fertilizers alone. The treatment which received compost at level 12 ton fed$^{-1}$ in combination with PGPR recorded highest maize grain yield (Ardab fed$^{-1}$), crud protein % as well as P and K % as compared to other tested treatments. Compost x biofertilizer interaction significantly decreased number of days to 50% tasseling and silking but increased plant height and grain yield (Ardab fed$^{-1}$). Compost x hybrids interaction significantly increased grain yield (Ardab fed$^{-1}$) in the first season. Biofertilizer x hybrids interaction significantly decreased number of days to 50% tasseling and silking but increased grain yield (Ardab fed$^{-1}$). Generally, application of organic and bio-fertilizers appeared to be most appreciate and effective for growth and grains yield of maize plants.*

***Key words:*** *Maize hybrids, organic fertilizer, biofertilizer, yield.*

## INTRODUCTION

Maize is one of the important grain crops grown in Egypt. There is an increasing-need to increase the production in Egypt in order to meet the continuously demand of growing population. Many interrelated factors, both natural and managerial, cause soil fertility decline. This decline may occur through leaching, soil erosion, and crop harvesting (Donovan and Casey, 1998). The nutrient supplying capacity of soil declines steadily under continuous and intensive cropping system. The optimum levels of N, P, K failed to maintain yield levels probably due to increasing secondary and micronutrient deficiencies and also unfavorable alterations in the physical and chemical issues, use of chemical fertilizers is also becoming more difficult for the farmers due to their high costs and scarcity during peak season. On thus, awareness is being created on the use of biofertilizers which are the sources of macro, micro and secondary nutrients to sustain the soil fertility and productivity. Organic matter improves water holding capacity of sandy soil and drainage in clay soil. Organic manure provide nutrients for the soil microorganisms, thus increases the activities of microbes in soil, which in turn help to convert unavailable plant nutrients into available form for plant growth promotion. The biofertilizers was found to

have positive contribution to soil fertility, resulting in an increase in crop growth and yield without causing any environmental water or soil pollution hazards. Nitrogen fixing and phosphorus solubilizing bacteria play an important role in nitrogen mobilization and phosphorus solubilization for the plant growth. Synthesis of chemical fertilizers consumes a large amount of energy and money. However, an organic farming with or without chemical fertilizers seems to be possible solution for these situations (Prabu *et al*., 2003). The integration of organic sources and synthetic sources of nutrients not only supply essential nutrients but also have some positive in traction with chemical fertilizers to increase their efficiency and reduce environmental hazards *(*Ahmad *et al.,* 1996*)*.

Using organic fertilizers (compost) is the most important and rewarding methods for increasing agricultural output by raising the level of soil fertility due to: 1) long term improvement of soil structure stability, 2) moisture retention and 3) the supply of plant nutrients under Egyptian soil condition (Abdel-Wahab, 2008). Organic fertilizers (compost) become the alterative solution for reduce or replace the chemical fertilizers, keeping a higher plant uptake minerals and enhance the fertility and productivity of agricultural soil, allowing a sustainable land use (Pérez-Piqueres *et al.,* 2006*)*. Soil microbes play an important role in many critical ecosystems processes including nutrient cycling and homeostasis, decomposition of organic matter as well as promoting plant health and growth as biofertilizers *(*Han *et al.,* 2007*)*. Biofertilizers; plant growth promoting rhizobacteria (PGPR) have the ability to enhance the plant growth either directly, by phytohormone production, $N_2$-fixation, siderophores production and solubilization of minerals *(*Bai *et al.,* 2002 and Kloepper, 2003) or indirectly, through biological control of pathogens or induction of host defense mechanisms(Van Loon and Bakker, 2003) . Compost and bio fertilizers, each type of fertilizers has advantage and disadvantage, these advantages need to be integrated in order to achieve optimum performance by each fertilizers type and realize balanced nutrients management of crop production (Chen, 2006). Therefore, the objective of the current study is to investigate the effect of various types and different levels of compost and biofertilizers on minerals uptake, yield and yield components of two maize hybrids plants.

## MATERIALS AND METHODS

A field experiment at two consecutive summer seasons (2012 and 2013) was carried out at the Experimental Farm of Agricultural Research Center (ARC) at Giza, Egypt to study the effect of application the organic fertilizer (compost) with or without presence of biofertilizers on minerals uptake, grain yield and yield components of maize plants. The average of physical and chemical characteristics of the experimental soil in the two seasons (Table 1) were determined according to the methods described by Piper (1950) and Jackson (1973). The preceding crop was wheat in both seasons. Two maize hybrids were used namely SC131 (White) and SC173 (Yellow), the maize grains were obtained from maize research department, field crops research institute (FCRI). Organic fertilizer (compost) was prepared from mixed plant and animal residual and used at three rates as 10, 12 and 15 ton $fed^{-1}$ and was added during seed preparation. Some physical and chemical properties of compost used (Table 2) were determined according to Zucconi *et al.* 1981, Page *et al.* 1982 and Culley 1993. Biofertilizers i.e. plant growth promoting rhizobacteria (PGPR) including some bacterial isolates a) *Azotobacter chroococcum* and *Azospirillum brasilense* as associative $N_2$-fixers bacteria, b) *Bacillus megaterium* as phosphate dissolving bacteria and c) *Bacillus circulans* as potassium releasing bacteria. Strains and isolates of bacterial were used as mixed cultural ($10^9$ cell $ml^{-1}$) by the ratio of (1:1:1) as peat beside inoculum, seed inoculation at the time of cultivation. The PGPR was kindly obtained from Bio-fertilizers Production unit,

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The tested 8 fertilization treatment are as follows:

T1- Un-organic fertilizer + un-biofertilizer + application of mineral fertilizers (NPK).
T2- Un-organic fertilizer + biofertilizer (PGPR).
T3- Application of organic fertilizer (compost) at a rate of 10 ton $fed^{-1}$ + without biofertilizer.
T4- Application of organic fertilizer (compost) at a rate of 10 ton $fed^{-1}$ + biofertilizer (PGPR).
T5- Application of organic fertilizer (compost) at a rate of 12 ton $fed^{-1}$ + without biofertilizer.
T6- Application of organic fertilizer (compost) at a rate of 12 ton $fed^{-1}$ + biofertilizer (PGPR).
T7- Application of organic fertilizer (compost) at a rate of 15 ton $fed^{-1}$ + without biofertilizer.
T8- Application of organic fertilizer (compost) at a rate of 12 ton $fed^{-1}$ + biofertilizer (PGPR).

**Table (1): Some mechanical, physical and chemical properties of the experimental soil (means over 2012 and 2013 seasons).**

| Soil Property | Value |
|---|---|
| Mechanical analysis: | |
| Coarse Sand % | 6.49 |
| Fine Sand % | 24.17 |
| Silt % | 31.49 |
| Clay % | 37.80 |
| TEXTURE | Clay loamy |
| Chemical analysis: | |
| pH | 7.48 |
| EC (ds/m) | 2.61 |
| Water Holding Capacity % | 57.27 |
| Organic Carbon % | 0.71 |
| Organic Matter % | 1.27 |
| Total Nitrogen % | 0.19 |
| Anions (meq/L): | |
| $HCO_3^-$ | 8.14 |
| $Cl^-$ | 10.77 |
| $SO_4^{--}$ | 15.17 |
| Cations (meq/L): | |
| $Ca^{++}$ | 8.51 |
| $Mg^{++}$ | 2.44 |
| $Na^-$ | 23.13 |

**Table (2): Some physical, chemical and microbiological characteristics of used compost.**

| Character | Value |
|---|---|
| Physical: | |
| Color | Dark brown |
| Moisture content % | 28 |
| Water Holding Capacity % | 281.3 |
| Bulk density ($Kg/m^3$) | 698.0 |
| Chemical: | |
| pH | 7.22 |
| EC (ds/m) | 3.75 |
| Organic carbon % | 21.95 |
| Total N % | 1.28 |
| Organic matter % | 37.70 |
| Total P % | 1.08 |
| Total K % | 1.32 |
| $N - NH_4^+$ ppm | 74.30 |
| $N - NO_3^-$ ppm | 199.31 |
| Available – P | 286.30 |
| Available – K | 463.00 |
| DTPA- extractable-Fe ppm | 295.40 |
| DTPA- extractable-Mn ppm | 76.90 |
| DTPA- extractable-Zn ppm | 85.70 |
| DTPA- extractable-Cu ppm | 8.30 |
| Microbiological: | |
| Total count of bacteria (cfu/g) | $12 \times 10^6$ |
| Total count of fungi (cfu/g) | $2.2 \times 10^4$ |
| Germination test of seeds (%) | 89.0 |

The experimental design used was split plot design with 4 replications, where the two maize hybrids were arranged at random in the main plot, whereas the compost rate treatments and the two biofertilizers were assigned at random in the split plots. The experimental plot area was 10.5 $m^2$ (3 x 3.5 m), 5 ridges, 70 cm in width and 20 cm between hills. One blank ridge is left between plots. The mineral fertilizers $P_2O_5$ and $K_2O$ were added during seed preparation, i.e as single super phosphate (15.5% $P_2O_5$) and potassium sulphate (48% $K_2O$) at rate of 200 kg and 50 kg $fed^{-1}$ respectively. N-mineral fertilizer was added form of ammonium sulphate (20.5% N) at rate of 120 kg $fed^{-1}$. Hills were over seeded then thinned to one plant/hill after composts emergence. Recorded data at growth stage were number of days from planting to 50% of tasseling (TAS), number of days from planting to 50% of silking (Silk), plant height (PHT), ear height (EHT), and plant N, P, K uptake (%). At harvest (October 2012 and 2013) samples of Three rows were taken from each plot and the following traits were

recorded; grain yield as Ardab fed$^{-1}$ (one Ardab = 140 kg), and crud protein (%), grain phosphor content (P %) and grain potassium content (K%) were recorded. The all above mentioned data were determined according to A.O.C.A. (2005) and FAO (2003). The collected data were subjected to statistical analysis of variance as described by Snedecor and Cochran (1980).

## RESULTS AND DISCUSSION

### Compost main effect:

Data in Table (3) indicate that the main effect of application of compost manure was significant on maize growth attribute and grain yield in 2012 and 2013 growing season. Early days to 50% tasseling and days to 50% silking were associated with application of compost manure in both growing seasons. Application of compost levels from 10 to 12 significantly increased plant and ear height, but this effect was not significant when added 15 ton fed$^{-1}$ the tallest plants and the highest values of ear height were associated with using 12 ton fed$^{-1}$ in the two seasons.

The positive effect of compost on plant growth might be attributed to its role in improving soil structure through aggregate formation, hydraulic properties and also through providing plants by some of their needs from macro and micro –elements. Effect of application compost fertilizer on grain yield (Ardab fed$^{-1}$) was significant in the two seasons. The highest grain yield was obtained when compost application of 12 ton fed$^{-1}$ in both seasons. It could be concluded that the positive effect of compost was due to its ameliorating effect on the physical, chemical and microbiological properties of the soil as well as to the stimulation of macro and micro nutrients which released and become available to the growing plant. These results are in agreement with those obtained by Abou El-Magd *et al.,* 2008, Abd El-Wahed, 2009 and Ahmed *et al.,* 2011 who found that grain yield was significantly increased by applying farm yard manure.

**Table (3): Main effect of compost fertilizer on some growth characters and grain yield of maize hybrids in 2012 and 2013 growing seasons.**

| Compost (Ton fed$^{-1}$) | 50% Tasseling | 50 % Silking | Plant height (cm) | Ear height (cm) | Grain yield |
|---|---|---|---|---|---|
| | **2012** | | | | |
| 0 | 62.3 | 63.5 | 206 | 108 | 26.4 |
| 10 | 60.5 | 62.1 | 212 | 110 | 28.0 |
| 12 | 59.8 | 61.3 | 225 | 124 | 32.5 |
| 15 | 60.1 | 61.5 | 220 | 118 | 28.2 |
| $LSD_{0.05}$ | 1.03 | 0.93 | 13 | 11 | 6.5 |
| | **2013** | | | | |
| 0 | 62.1 | 63.6 | 220 | 118 | 25.3 |
| 10 | 59.6 | 62.1 | 227 | 124 | 29.9 |
| 12 | 58.9 | 60.9 | 238 | 134 | 32.5 |
| 15 | 60.6 | 61.3 | 234 | 132 | 31.8 |
| $LSD_{0.05}$ | 0.54 | 0.57 | 5 | 5 | 2.7 |

0= un-organic fertilizer.
10= application of compost at a rate of 10 ton fed$^{-1}$.
12= compost at a rate of 12 ton fed$^{-1}$.
15= compost at a rate of 15 ton fed$^{-1}$.

## Main effect of biofertilizer:

Data present in Table (4) revealed that all studied traits were significantly affected by applying of biofertilizer in the two seasons. Maize plants were earlier in 50% tasseling and silking when biofertilizer was applied compared control (untreated) in the second season. It could be noticed that there were no significant differences between biofertilizer and control for days to 50 tasseling and silking in the first season. It could be concluded that biofertilizer application induced an increase in maize plant and ear height and grain yield Ardab $fed^{-1}$. These data showing the important role of biofertilizer for maize plant growth .Similar results were also obtained by Subramaniyan and Malliga, 2011 and Hassan *et al.,* 2014 explained that the use of cyanobacteria as biofertilizer for maize plants increased significantly the morphological, biochemical parameters such as plant height, internodes, tassel, silk and grain yield.

## Hybrids main effect:

No significant differences were detected among hybrids regarding flowering dates, plant and ear height and grain yield (Ardab $fed^{-1}$) in both growing season (Table 5).

## Compost x biofertilizer interaction effect:

As shown in Table (6) compost x biofertilizer interaction was significant for number of days to 50 % Tasseling and 50 % silking and plant height in both seasons and grain yield (Ardab $fed^{-1}$) in both seasons. But this interaction did not affect plant height in 2013 season. The lowest number of days to 50% tasseling and 50% silking were recorded for 12 ton $fed^{-1}$ compost manure when it was application biofertilizer. Application of compost manure 12 ton $fed^{-1}$ + biofertilizer had the highest plant height. The use of biofertilizer under different compost levels led to increase maize grain yield compared to control treatment. The highest grain yield (32.7 and 35.6 Ardab $fed^{-1}$) in the first and second seasons, respectively was corresponded to the use of 12 ton $fed^{-1}$ for compost manure application with biofertilizer. Generally, the use of biofertilizer was better than the control treatment under different compost levels in both seasons.

**Table (4): Main effect of biofertilizer on days to 50% Tasseling (Tass), days to 50% silking (silk), plant height (PHT), ear height (EHT) and grain yield (GY) in 2012 and 2013 season.**

| Biofertilizer | Tass | Silk | PHT (cm) | EHT (cm) | GY (Ardab $fed^{-1}$) |
|---|---|---|---|---|---|
| | **2012** | | | | |
| non | 60.8 | 62.3 | 214 | 114 | 28.4 |
| Biofertilizer | 60.6 | 61.9 | 217 | 117 | 29.1 |
| $LSD_{0.05}$ | NS | NS | NS | NS | NS |
| | **2013** | | | | |
| non | 60.9 | 62.7 | 226 | 124 | 26.4 |
| Biofertilizer | 59.7 | 61.3 | 233 | 130 | 33.4 |
| $LSD_{0.05}$ | 0.37 | 0.40 | 3 | 3 | 1.8 |

**Table (5): Main effect of hybrids on some growth characters and grain yield in 2012 and 2013 growing season.**

| Hybrids | Tass | Silk | PHT (cm) | EHT (cm) | GY (Ardab fed$^{-1}$) |
|---|---|---|---|---|---|
| | **2012** | | | | |
| SC131 | 60.7 | 62.1 | 215 | 114 | 28.6 |
| SC173 | 60.6 | 62.1 | 217 | 116 | 28.9 |
| $LSD_{0.05}$ | NS | NS | NS | NS | NS |
| | **2013** | | | | |
| SC131 | 60.3 | 62.1 | 229 | 126 | 29.5 |
| SC173 | 60.3 | 62.0 | 230 | 128 | 30.2 |
| $LSD_{0.05}$ | NS | NS | NS | NS | NS |

**Table (6): Effect of interaction between compost manure and biofertilizer on some growth characters and grain yield of maize hybrids in 2012 and 2013 growing seasons.**

| Treatments | | Tass | | Silk | | PHT | | GY | |
|---|---|---|---|---|---|---|---|---|---|
| Com. | Bio | **2012** | **2013** | **2012** | **2013** | **2012** | **2013** | **2012** | **2013** |
| 0 | - | 62.9 | 62.5 | 64.0 | 64.0 | 204 | 217 | 25.3 | 22.2 |
| 0 | + | 61.8 | 61.6 | 63.0 | 63.1 | 208 | 222 | 27.4 | 28.3 |
| 10 | - | 60.4 | 60.0 | 61.9 | 62.1 | 215 | 224 | 26.6 | 26.9 |
| 10 | + | 60.6 | 59.1 | 62.3 | 62.0 | 208 | 230 | 29.5 | 32.9 |
| 12 | - | 59.9 | 60.1 | 61.3 | 62.1 | 221 | 233 | 32.2 | 29.4 |
| 12 | + | 59.6 | 57.8 | 61.4 | 59.6 | 229 | 242 | 32.7 | 35.6 |
| 15 | - | 59.9 | 61.0 | 62.0 | 62.0 | 216 | 230 | 29.5 | 27.0 |
| 15 | + | 60.3 | 60.1 | 61.0 | 60.6 | 224 | 238 | 26.8 | 36.6 |
| $LSD_{0.05}$ | | 1.45 | 0.76 | 1.31 | 0.81 | 18.6 | NS | NS | NS |

0= un-organic fertilizer.
10= application of compost at a rate of 10 ton fed$^{-1}$.
12= compost at a rate of 12 ton fed$^{-1}$.
15= compost at a rate of 15 ton fed$^{-1}$.
- = unbiofertilizer.
+ = application of biofertilizer.

## Compost x hybrids interaction:

Compost x hybrids interaction on grain yield Ardab fed$^{-1}$ was significant in 2012 but not significant in 2013 season (Table 7). Single cross 131 (SC131) had the highest grain yield (34.47 and 33.00 Ardab fed$^{-1}$) in the first and second seasons, respectively when used 12 ton fed$^{-1}$ compost manure. The difference between SC131 and SC173 was not significant in 2013 growing season.

## Biofertilizer x hybrids interaction effect:

Effect of biofertilizer x hybrids interaction in table (8) showed that the lowest number of days to 50% tasseling and 50 % silking was recorded for SC 173 when bio fertilizer was added in both growing seasons, but this interaction did not affect days to 50% tasseling in 2012 growing season. SC 173 had the highest grain (Ardab fed$^{-1}$) when application of biofertilizer.

**Table (7): Effect of interaction between compost manure x hybrids on grain yield in both seasons.**

| Treatments | | Grain yield (Ardab fed$^{-1}$) | |
|---|---|---|---|
| Compost (Ton fed$^{-1}$) | Hybrids | 2012 | 2013 |
| 0 | SC131 | 24.15 | 24.58 |
| 0 | SC173 | 28.28 | 25.98 |
| 10 | SC131 | 25.94 | 29.63 |
| 10 | SC173 | 30.09 | 30.13 |
| 12 | SC131 | 34.47 | 33.00 |
| 12 | SC173 | 30.46 | 32.02 |
| 15 | SC131 | 29.80 | 30.79 |
| 15 | SC173 | 26.55 | 32.79 |
| $LSD_{0.05}$ | -- | 5.70 | NS |

0= un-organic fertilizer.
10= application of compost at a rate of 10 ton fed$^{-1}$.
12= compost at a rate of 12 ton fed$^{-1}$.
15= compost at a rate of 15 ton fed$^{-1}$.

**Table (8): Effect of interaction between biofertilizer x hybrids on days to 50% tasseling, days to 50% silking and grain yield (Ardab fed$^{-1}$) in 2012 and 2013 growing seasons.**

| Biofertilizers | Hybrids | Tass | | Silk | | Grain Yield | |
|---|---|---|---|---|---|---|---|
| | | **2012** | **2013** | **2012** | **2013** | **2012** | **2013** |
| - | SC131 | 60.69 | 60.69 | 62.50 | 62.50 | 29.89 | 25.99 |
| - | SC173 | 60.94 | 61.13 | 62.13 | 63.00 | 26.91 | 26.76 |
| + | SC131 | 60.69 | 59. 81 | 61.69 | 61.63 | 27.29 | 33.04 |
| + | SC173 | 60.44 | 59.50 | 62.06 | 61.06 | 30.93 | 33.70 |
| $LSD_{0.05}$ | -- | NS | 0.52 | 0.63 | 0.57 | 4.03 | NS |

- = unbiofertilizer.
+ = application of biofertilizer.

## Minerals content of maize plants:

Data in Table (9) showed that application of compost at 12 ton fed$^{-1}$ gave the highest N, P and K content in plant tissue at 75 day after planting as compared to other tested compost levels as well as recommended N, P and K mineral fertilizers. Application of biofertilizer in combination with various compost levels gave the highest values of N, P and K contents among all tested treatments and recorded significant increases. Generally, the treatment which received 12 ton fed$^{-1}$ compost manure with biofertilizer inoculation recorded the highest values where (2.23 and 2.50), (0.41 and 0.43) and (3.39 and 3.44) for N, P and K% at maize plants SC131 and SC173 respectively for the first season and the corresponding values at second season were (2.28 and 2.41), (0.43 and 0.45) and (3.17 and 3.25) for N, P and K% in the same order. These results are in agreement with Nevens and Raheal (2003), Navead *et al*. (2008), Suke *et al*. (2011) and Umesha *et al*.

(2014) who reported that increased of plant N, P and K % content of maize plants maybe due to the application of organic fertilizers and biofertilizer inoculation (N-fixers, phosphate dissolving and potassium releasing bacteria) increased and release nutrient slowly and may reduce the leaching losses of nutrient as well as enhanced nutrient use efficiency.

## Quality of grain content:

Data in Table 10 indicated that the effect of application of compost and biofertilizer was significant increased crud protein (%), phosphorus (%) and potassium (%) content of the two maize hybrids as compared to mineral fertilized treatment. The highest crud protein (12.67%), phosphorus content (0.51%) and potassium content (3.24%) recorded at second season for SC173 at the treatment which received compost at 12 ton $fed^{-1}$ with application of PGPR. These data are in agreement with Shaharoona *et al.,* 2006, Abdel-Wahab (2008), Hameeda *et al* 2008, Balbaa and Awad (2013) and Umesha *et al.* 2014 who reported that application of organic fertilizer and/or biofertilizer did support and enhance growth of maize plants under different soil types as well as led to gave increases in mineral uptake (i.e. N, P and K), crud protein (%).

**Table (9): Nitrogen, phosphorus and potassium (%) of maize plants as affected application of compost and biofertilizer under clay soil condition.**

| Parameters | | N% | | P% | | K% | |
|---|---|---|---|---|---|---|---|
| Hybrids | | **SC131** | **SC173** | **SC131** | **SC173** | **SC131** | **SC173** |
| Com. | Bio. | Season 2012 | | | | | |
| 0 | - | 1.98 | 1.97 | 0.28 | 0.28 | 2.21 | 2.20 |
| 0 | + | 2.11 | 2.10 | 0.29 | 0.29 | 2.23 | 2.24 |
| 10 | - | 2.13 | 2.13 | 0.31 | 0.33 | 2.25 | 2.29 |
| 10 | + | 2.14 | 2.17 | 0.35 | 0.36 | 2.29 | 2.37 |
| 12 | - | 2.18 | 2.21 | 0.40 | 0.41 | 3.17 | 3.25 |
| 12 | + | 2.23 | 2.50 | 0.41 | 0.43 | 3.39 | 3.44 |
| 15 | - | 2.15 | 2.16 | 0.36 | 0.38 | 3.05 | 2.99 |
| 15 | + | 2.17 | 2.20 | 0.38 | 0.39 | 3.15 | 3.17 |
| $LSD_{0.05}$ | | 0.18 | | 0.07 | | 0.72 | |
| Com. | Bio. | Season 2013 | | | | | |
| 0 | - | 1.99 | 1.98 | 0.27 | 0.29 | 2.25 | 2.29 |
| 0 | + | 2.01 | 2.00 | 0.30 | 0.31 | 2.27 | 2.31 |
| 10 | - | 2.11 | 2.13 | 0.31 | 0.34 | 2.34 | 2.48 |
| 10 | + | 2.16 | 2.17 | 0.33 | 0.39 | 2.41 | 2.53 |
| 12 | - | 2.23 | 2.27 | 0.41 | 0.44 | 3.11 | 3.18 |
| 12 | + | 2.28 | 2.41 | 0.43 | 0.45 | 3.17 | 3.25 |
| 15 | - | 2.17 | 2.18 | 0.36 | 0.41 | 2.49 | 2.88 |
| 15 | + | 2.19 | 2.25 | 0.37 | 0.43 | 2.89 | 3.09 |
| $LSD_{0.05}$ | | 0.13 | | 0.04 | | 0.63 | |

0= un-organic fertilizer.
10= application of compost at a rate of 10 ton $fed^{-1}$.
12= compost at a rate of 12 ton $fed^{-1}$.
15= compost at a rate of 15 ton $fed^{-1}$.
- = unbiofertilizer.
+ = application of biofertilizer.

**Table (10): Crude protein (%), phosphrous % and potassium % of maize as affected by application of different compost levels and biofertilizers under clay soil condition.**

| Parameters | | Crud protein (%) | | P% | | K% | |
|---|---|---|---|---|---|---|---|
| Hybrids | | **SC131** | **SC173** | **SC131** | **SC173** | **SC131** | **SC173** |
| Com. | Bio. | Season 2012 | | | | | |
| 0 | - | 10.17 | 10.23 | 0.31 | 0.32 | 2.34 | 2.35 |
| 0 | + | 10.41 | 10.77 | 0.39 | 0.40 | 2.45 | 2.47 |
| 10 | - | 10.65 | 11.66 | 0.40 | 0.42 | 2.46 | 2.51 |
| 10 | + | 11.48 | 11.84 | 0.43 | 0.43 | 2.51 | 2.57 |
| 12 | - | 12.38 | 12.49 | 0.49 | 0.48 | 3.01 | 3.07 |
| 12 | + | 12.55 | 12.61 | 0.49 | 0.50 | 3.11 | 3.15 |
| 15 | - | 11.60 | 11.95 | 0.44 | 0.45 | 2.55 | 2.60 |
| 15 | + | 11.96 | 12.14 | 0.45 | 0.46 | 2.81 | 2.87 |
| $LSD_{0.05}$ | | 0.47 | | 0.11 | | 0.37 | |
| Com. | Bio. | Season 2013 | | | | | |
| 0 | - | 10.31 | 10.31 | 0.30 | 0.32 | 2.41 | 2.43 |
| 0 | + | 10.47 | 10.65 | 0.33 | 0.34 | 2.44 | 2.45 |
| 10 | - | 11.48 | 11.54 | 0.41 | 0.42 | 2.46 | 2.47 |
| 10 | + | 11.78 | 11.84 | 0.44 | 0.45 | 2.48 | 2.48 |
| 12 | - | 12.19 | 12.44 | 0.49 | 0.51 | 2.98 | 3.01 |
| 12 | + | 12.44 | 12.67 | 0.50 | 0.51 | 3.15 | 3.24 |
| 15 | - | 11.84 | 11.96 | 0.45 | 0.48 | 2.44 | 2.51 |
| 15 | + | 12.02 | 12.14 | 0.47 | 0.49 | 2.50 | 2.53 |
| $LSD_{0.05}$ | | 1.18 | | 0.42 | | 0.31 | |

0= un-organic fertilizer.
10= application of compost at a rate of 10 ton $fed^{-1}$.
12= compost at a rate of 12 ton $fed^{-1}$.
15= compost at a rate of 15 ton $fed^{-1}$.
- = unbiofertilizer.
+ = application of biofertilizer.

## CONCLUSION

Finally, The highest grain yield (32.7 and 35.6 Ardab $fed^{-1}$) in the first and second seasons, respectively was associated with application of compost manure 12 ton $fed^{-1}$ + biofertilizer . Single cross 131 (SC131) had the highest grain yield (34.47 and 33.00 Ardab $fed^{-1}$) in the first and second seasons, respectively when used 12 ton $fed^{-1}$ compost manure. Single cross 173 (SC 173) had the highest grain yield (Ardab $fed^{-1}$) when application of biofertilizer.

## REFERENCES

A.O.A.C. (2005). Association of Official Analytical Chemists, Official methods of analysis. The 23rd Ed., AOAC International, Washington D.C., USA.

Abd El-Wahed, M. H. (2009). Effect of irrigation scheduling and organic manure on barley yield, yield components and water use efficiency under arid regions conditions. Egyptian journal of Applied Sciences, 24(5b): 856-877.

Abdel-Wahab, A. F. M. (2008). Evaluation of enriched compost and its role in synergy with Rhizobacteria and N-fertilization for improving maize productivity in sandy soil. Arab University Journal of Agricultural Sciences, Ain Shams Univ., Cairo, Egypt, 16:319-334.

Abou El-Magd, M. M., M. F. Zaki and S. D. Abou-Hussein (2008). Effect of organic manure and different levels of saline irrigation water on growth, grain yield and chemical content of sweet fennel. Australian Journal of Basic and Applied Sciences, 2(1): 90-98.

Ahmad, N., M. Rashid and A. G. Vaes (1996). Fertilizer and their uses in Pakistan. NFDC Pub. No. 4/96, pp. 142-149 and 172-175, Training Bulletin, 2nd Edition, Planning Commission, NFDC, Islamabad, Pakistan.

Ahmed, S. Y., E. A. Ali and M. H. Abd El-Wahed (2011). Some physiological and agronomical traits of corn and water use efficiency as affected by irrigation scheduling and farm yard manure mulching under drip irrigation system. Egyptian journal of Applied Sciences, 26(1): 1-16.

Bai, Y., A. Souleimanov and D. L. Smith (2002). An inducible activator produced by a *Serratia proteamaculans* strain and its soybean growth-promoting activity under greenhouse conditions. Journal of Experimental Botany, 53(373):1495-1502.

Balbaa, Maha G. and A. M. Awad (2013). Effect of humic acid and micronutrients foliar fertilization on yield, yield components and nutrients uptake of maize in calcareous soils. Journal of Plant Production, Mansoura Univ., Egypt, 4(5):773-785.

Chen, J.H. (2006). The combined use of chemical and organic fertilizers and/or bio-fertilizer for crop growth and soil fertility. International workshop on sustained management of the soil-rhizosphere system for efficient crop production and fertilizer use. 16 – 20 October 2006, Land Development Department, Bangkok 10900, Thailand.

Culley, J. L. B. (1993). Density and compressibility. *In*: M. R. Carter (Ed.), Soil sampling and methods of analysis. Canadian Society of Soil Science, Lewis Publishers, Boca Raton, FL, U.S.A., pp. 529-539.

Donovan, G. and M. Casey (1998). Soil fertility management in sub-Saharan Africa World Bank Technical Paper No. 408, The World Bank, Washington, DC, 60 pp.

FAO, (2003). Food and Agriculture Organization of the United Nations, FAO fertilizer year book, Vol. 53.

Hameeda, B., G. Harini, O. P. Rupela, S. P. Wani and G. Reddy (2008). Growth promotion of maize by phosphate-solubilizing bacteria isolated from composts and macrofauna. Microbiological Research, 163(2):234-242.

Han, X.M., R.Q. Wang, J. Liu, M.C. Wang, J. Zhou and W.H. Guo (2007). Effects of vegetation type on the soil microbial community structure and catabolic diversity assessed by polyphasic methods in North China. Journal of Environmental Sciences, 19(10):1228-1234.

Hassan, M. M. M., S. T.H. M. Mousa and Hoda Kh. A. El-Mekser (2014). Effect of Biofertilizer, nitrogen and potassium fertilization on growth and yield of maize. Egyptian journal of Applied Sciences, 29(7): 288-302.

Jackson, M. L. (1973). Soil Chemical Analysis. Prentice-Hall of India Private Limited, New Delhi, pp. 38-269.

Kloepper, J.W. (2003). A review of mechanisms for plant growth promotion by PGPR, *In*: Reddy, M.S.; Anandaraj M.; Eapen S.J.; Sarma Y.R. and Kloepper, J.W. (Eds.), 6th International PGPR workshop (Abstracts and Short papers), 5-10 October 2003. Indian Institute of Spices Research, Calicut, India, pp. 81-92.

Naveed, M., M. Khalid, D. L. Jones, R. Ahmad and Z. A. Zahir (2008). Relative

efficacy of *Pseudomonas* spp., containing ACC-deaminase for improving growth and yield of maize (*Zea mays* l.) in the presence of organic fertilizer. Pakistan Journal of Botany, 40(3):1243-1251.

Nevens, F. and D. Reheul (2003). The application of vegetable, fruit and garden waste (VFG) compost in addition to cattle slurry in a silage monoculture: nitrogen availability and use, European Journal of Agronomy, 19:189-203.

Page, A. L., R. H. Miller and D. R. Keeney (1982). Methods of Soil Analysis; II. Chemical and Microbiological Properties, 2nd Ed., American Soc. of Agronomy (Publ.), Madison, Wisconsin, USA.

Pérez-Piqueres, A., V. Edel-Hermann, C. Alabouvette and C. Steinberg (2006). Response of soil microbial communities to compost amendments. Soil Biology and Biochemistry, 38(3):460-470.

Piper, C. S. (1950). Soil and Plant Analysis. 1st ed. Interscience Publisher Inc. New York, USA, pp. 30-229.

Prabu, T., P. R. Narwadkar, A. K. Sanindranath and M. Rafi (2003). Effect of integrated nutrient management on growth and yield of Okra cv. Parbhani Kranti. Orissa Journal of Horticulture, 31(1):17-21.

Shaharoona, B., M. Arshad, Z. A. Zahir and A. Khalid (2006). Performance of *Pseudomonas* spp. containing ACC-deaminase for improving growth and yield of maize (*Zea mays* L.) in the presence of nitrogenous fertilizer. Soil Biology & Biochemistry, 38:2971–2975.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods. 7th edition, Iowa State Univ. Press Ames, Iowa, USA., p. 593.

Subramaniyan, V. and P. Malliga (2011). Effect of cyanopith biofertilizer as basal and spray on *Zea mays* (corn) cultivation. International Journal of Environmental Sciences, 2(2): 649-658.

Suke, S. N., R. D. Deotale, Priyanka Hiradeve, Mitali Deogirkar and N. V. Sorte (2011). Effect of nutrients and biofertilizers of chemical and biochemical parameters of maize (*Zea mays* L.). Journal of Soils and Crops, 21(1):107-112.

Umesha, S., M. Srikantaiah, K. S. Prasanna, K. R. Sreeramulu, M. Divya and R. N. Lakshmipathi (2014). Comparative effect of organics and biofertilizers on growth and yield of maize (*Zea mays* L). Current Agriculture Research Journal, 2(1):55-62.

Van Loon, L. C. and P. A. H. M. Bakker (2003). Signaling in Rhizobacteria-plant interactions. *In*: H. De Kroon & E. J. W. Visser (Eds.), Root Ecology, (Ecological studies, 168:297–330), Springer-Verlag Berlin Heidelberg.

Zucconi, F., M. Forte, A. Monaco and M. de Bertoldi (1981). Biological evaluation of compost maturity. Biocycle, 22:27-29.

# تحسين نمو وانتاجية بعض هجن الذرة الشامية بتطبيق الاسمدة الحيوية والعضوية

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## الملخص العربي

أجريت تجربة حقلية في الأراضي الطينية بمحطة البحوث الزراعية بالجيزة خلال موسمي ٢٠١٢ ، ٢٠١٣ لدراسة تاثير استخدام الكمبوست (السماد العضوي) بأربعة معدلات (صفر، ١٠، ١٢، ١٥ طن/فدان) في وجود أو عدم وجود لقاح مركب من البكتيريا المشجعة للنمو عبارة عن: ١- ازوتوبكتر كروكوكم + ازوسبريللم (بكتيريا مثبته لنيتروجين الهواء الجوي) ، ٢- الباسلس ميجاثيرم (بكتيريا محلله للفوسفور)، ٣- الباسلس سيركيولنس (بكتيريا ميسرة للبوتاسيوم) علي نمو ومحصول هجينين من الذرة الشامية هـ. ف. ١٣١ ، هـ. ف. ١٧٣ بالاضافة الي محتوي المجموع الخضري من عناصر النيتروجين والفوسفور والبوتاسيوم (%) وكذلك محتوي الحبوب من البروتين والفوسفور والبوتاسيوم.

وتتلخص أهم النتائج فيما يلي: أدت اضافه كلا من الكمبوست (السماد العضوي) والسماد الحيوي كلا علي حده الي التبكير في ظهور النورات المذكرة والمؤنثة كما أدت إلي زيادة معنويه في كلا من ارتفاع النبات وارتفاع الكوز ومحصول الحبوب بالأردب/فدان في كلا الموسمين وكذلك محتواها من عناصر النيتروجين والفوسفور والبوتاسيوم وذلك مقارنه بالتسميد بالنيتروجين والفوسفور والبوتاسيوم بدون اضافه الكمبوست والسماد الحيوي. سجلت النباتات المسمدة بـ ١٢ طن كمبوست / فدان في وجود السماد الحيوي أعلي قيم للمحصول ومحتوي البروتين % كذلك الفوسفور والبوتاسيوم % مقارنة بباقي المعاملات. كان التفاعل بين الكمبوست والسماد الحيوي معنويا في كلا من التزهير في كلا الموسمين وارتفاع النبات في الموسم الاول والمحصول في الموسم الثاني. التفاعل بين الكمبوست والهجن معنويا في صفة المحصول في الموسم الاول. التفاعل بين السماد الحيوي والهجن معنويا في صفتي التزهير والمحصول وبصفة عامة أظهر التسميد بالسماد العضوي (الكمبوست) والسماد الحيوي مع الهجن تأثيرا مشجعا علي كلا من النمو الخضري والمحصول لنباتات الذرة.