

Impact of some Micro-Nutrients Foliar Application on Two Maize Hybrids Productivity



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Received on: 9/6/2020

Accepted for publication on: 15/6/2020

Abstract

Two field experiments were carried out during two summer seasons of 2018 and 2019 at the Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut, to study the response of two maize hybrids [Single Cross (S.C.) 10 (H₁) and Triple Cross (T.C.) 321 (H₂)] on yield and its components of three micro-nutrients (M₁= B, M₂= Zn and M₃= Mn) and three foliar spray levels= control (water only), S₁= (25 ppm B, 50 ppm Zn and 34 ppm Mn) and S₂= (50 ppm B, 100 ppm Zn and 68 ppm Mn). Experimental design was randomized complete block design (RCBD) using split-plot in strips, where nutrients allocated in the main vertically, foliar spray levels were arranged in the main horizontally and maize hybrids were occupied the sub-plots.

According to research results, the maximum values for plant height in two seasons, 100 grain weight and grain yield/fed. in the 2nd season were obtained by Zn treatment, as well as the maximum ones for grain yield/fed. and its components were achieved by B treatment in the 1st season.

- The highest values of plant height, ear length, ear diameter, grains weight/ear, 100 grain weight and grain yield/fed. were recorded by foliar (25, 50 and 34 ppm B, Zn and Mn, respectively) in the 1st season only.
- The hybrid S.C. 10 gave the highest values for plant height and ear length in both seasons, grain weight/ear and grain yield/fed. in the 1st season, while the hybrid T.C. 321 surpassed for 100 grain weight in both seasons, ear diameter, grains weight/ear and grain yield/fed. in the 2nd season.
- The first order interaction H₁xM₂ (hybrid S.C. 10 x Zn) achieved the maximum values for ear length in both seasons, plant height and grain yield/fed. (18.8 ard.) in the 1st season, as well as H₂xM₃ interaction (hybrid T.C. 321 x Mn) achieved the maximum ones for grain weight/ear, 100 grain weight and grain yield/fed. (20.2 ard.) in the 2nd season.
- The H₁xS₁ interaction (hybrid S.C. 10 x foliar 25, 50 and 34 ppm B, Zn and Mn) and H₂xS₂ interaction (hybrid T.C. 321 x foliar 50, 100 and 68 ppm B, Zn and Mn) gave the maximum values for grains weight/ear and grain yield/fed. (19.7 and 22.5 ard.) in the 1st and 2nd seasons, respectively.
- The M₁xS₁ interaction (B x foliar 25 ppm B) showed the highest values for grains weight and grain yield/fed. in the 1st season, while M₃xS₂ interaction (Mn x foliar 68 Mn) showed the highest ones for ear diameter and grain yield/fed. in the 2nd season.
- The second order interactions H₁xM₂xS₁ (hybrid S.C. 10 x Zn x foliar 50 ppm Zn) and H₂xM₃xS₂ (hybrid T.C. 321 x Mn x foliar 68 ppm Mn) gave the highest values for grains weight/ear and grains yield/fed. (21.1 and 29.1 ard.) in the 1st and 2nd seasons, respectively.

Keywords: *Micro-nutrient, Maize hybrids and foliar application.*

Introduction

Maize (*Zea mays* L.) is an important crop worldwide, its grain as a rich source of many important nutrients and used for multi purpose (human consumption and poultry feeding). One of the most important issues about increase of crop yield and improving the quality of agricultural products is balanced plant nutrition. The attempts to increase maize production to meet the decrease in the local production of crop, since the continuous increase of consumption. Such attempts could be achieved through numerous researchers in the scope of maize production.

Foliar application often is effective and economic method for quality improvement of nutrients in the plants. Zinc (Zn) is an essential nutrient for the standard and healthy growth and development of plants. Manganese (Mn) is involved in many biochemical functions and it is important activator of enzymes acting in the Krebs cycle. A primary function of boron (B) is related to cell wall formation, also flower retention and pollen formation and germination are affected by boron. Tahir *et al.* (2009) reported that increase in the cob length, cob diameter and 100 grain weight with foliar application of Zn over the control treatment. Foliar spray of micro power, containing B, Mn and Zn significantly increased plant height of Gerbera (Khosa *et al.*, 2011). Haghi *et al.* (2016) stated that 100 grain weight showed an average 5 times more than control due Zn spraying. Pooniya *et al.* (2018) indicated that coating of B, Zn and S onto urea increases maize yield. Bhangare *et al.* (2019) found that non-

significant difference for plant height and cob height due to foliar Mg, Zn and B application. Khalid *et al.* (2019) mentioned that 15 kg ZnSO₄/ha (ZnB₂) improved grain yield by 11.39% than control. They added that hybrid DK-6525 with ZnB₂ is suitable for the optimal maize yield. Konuskan *et al.* (2019) revealed that the effects of foliar B application positive but insignificant on plant characteristics. Zhang *et al.* (2020) pointed out that 20 kg ZnSO₄/ha under rainfed condition increased grain yield by 7.5% relative to the control (without Zn).

Maize hybrids differences on agronomic characters and grain yield. In this respect, Oraby *et al.* (2005) concluded that the single cross 10 significantly surpassed the other hybrids. Sief *et al.* (2005) and El-Bably (2007) revealed that maize cultivar (single cross 10) significantly surpassed maize cultivars single cross 122 and single cross 124 in the mean values of plant height, ear length, 100-grain weight and grain yield/fed. El-Metwally *et al.* (2011) showed a significant difference among maize hybrids in plant height, grains weight/ear and grain yield/plant. Zamir *et al.* (2011) initiated that hybrid 30Y87 was early in maturity, produced less cob length than the hybrid 31R88, similarly 1000-grain weight and grain yield of hybrid 30Y87 was significantly greater than the hybrid 31R88. Kandil (2013) concluded that maize hybrid S.C. 10 with 429 Kg N/ha, recorded the tallest cob. Also, hybrid S.C. 10 gave the maximum 1000-kernel weight and grain yield.

The objective of this study was to determine the impact of B, Zn and Mn micronutrients through foliar application on yield and its components of two corn genotypes under Assiut climatic conditions.

Materials and Methods

The present research is concerned with studying the response of yield and its attributes of maize hybrids under some micro-elements and its foliar application. Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Assiut Univ., during 2018 and 2019 summer seasons. The soil type was clay in texture with pH of 7.8, 1.7 organic matter and having 0.72, 9.0 and 350 ppm available N, P and K, respectively (average of two seasons for the upper 30 cm of soil). Each experiment was laid out in randomized complete block design (RCBD) using a split plot in strips with three replications. Three micro-elements (B, Zn and Mn = M₁, M₂ and M₃) were allotted in the main vertically. The three foliar nutrients application [0 = S₀, (25, 100 and 34 ppm B, Zn and Mn) = S₁ and (50, 100 and 68 ppm B, Zn and Mn) = S₂] were assigned in the main horizontally, where spraying of micro-elements were done at 50 days after sowing as well as the control plants were sprayed by distilled water. The two maize hybrids, Single cross (S.C.) 10 and Tribble Cross (T.C.) 321 were distributed in the sub-plot, which were 3x3.5 m². The maize was planted on 19 of June and 14 of July in 2018 and 2019 seasons, respectively. The grains were sown in hills 30 cm apart and the plants were thinned after 21 day to keep one plant/hill. The pre-

ceding crop was clover in both seasons. All cultural practices were done as recommended.

Recording data

A- Growth traits

1- Plant height (cm): was measured as the distance from the ground surface to the base of the tassel node.

B- Yield components: (10 ears as a sample were taken from each sub-plot to determine):

1- Ear length (cm).

2- Ear diameter (cm).

3- Grains weight/ear.

4- 100-grain weight (gm). Adjusted to 15.5% moisture.

C- Grain yield: (Two center rows) were harvested from each sub-plot to determine grain yield/ (ardab)/fed. after the weight of grain adjusted to 15.5% moisture.

Statistical analysis:

All the obtained data were subjected to normal statistical analysis according to Gomez and Gomez (1984). Means comparison were done using Revised Least significant differences (RLSD) at 5% probability level.

Results and Discussion

A- The main effects:

The presented data in Table 1 showed that the main effect micro-elements (M) had a highly significant effect on the grains weight/ear and grain yield/fed. in the first season, moreover it had significantly effect on the grains weight/ear in the second season only. The maximum values for ear length, ear diameter, grains weight/ear, 100 grain weight and grain yield/fed. were obtained by M₁ (Boron) in the 1st season. Meanwhile, M₂ (Zinc) also recorded the tallest

plants in the both seasons, maximum 100 grain weight and grain yield/fed. in the 2nd season. Moreover, M₃ (Manganese) gave the longest ears and heaviest ears grain in the 2nd season. In this respect, Tahir *et al.* (2018) concluded that use of boron (B) significant positive effect of plant height, cob length, cob diameter, cob weight, 1000 grain weight and grain yield/ha. Similar findings were confirmed by Khosa *et al.* (2011), Haghi *et al.* (2016), Pooniya *et al.* (2018), Konuskan *et al.* (2019) and Zhang *et al.* (2020).

The data in Table 1 revealed that the main effect of foliar micro-elements application (S) had a highly significant effect on the grains weight/ear and grains yield/fed. as well as significantly effect on ear diameter in the both seasons and for plant height in the 1st season. The other studied traits had non-significant affected by this trial in both seasons. The S₀ (control) recorded the tallest plants and heaviest 100 grain in the 2nd season. Meanwhile, S₁ (25, 50 and 34 ppm for B, Zn and Mn) recorded the highest values for all studied traits in the 1st season. Moreover, the S₂ (50, 100 and 68 ppm for B, Zn and Mn) gave the maximum values for ear length, ears grain weight and grain yield/fed. in the 2nd season. Nural *et al.* (2015) declared that the foliar Zn application increased yield compared than control. As well as, Almosawy *et al.* (2019) pointed out that the maximum cob length, 500 grain weight and grain yield/ha were recorded by boron (ml/L) with spring time at 60 days after planting. The same find-

ings were reported by Bhangar *et al.* (2019) and Konuskan *et al.* (2019).

As for, the main effect maize hybrids (H) had a highly significant or/and significantly effect on the plant height and grains weight ear in the both seasons. Moreover, it had highly significant effect on grain yield/fed. and ear diameter in the 2nd season only (Table 1). Moreover, the 100 grains weight trait had significant affected by this trial in the 1st season. The hybrid H₁ (S.C. 10) surpassed the hybrid H₂ (T.C. 321) for the plant height, ear length in both seasons; for ear grains weight and grains yield/fed. in the 1st season only. On the contrary, the hybrid H₂ surpassed hybrid H₁ for ear diameter and 100-grain weight in both seasons and for grain yield/fed. in the 2nd season. This result may be due to the genetic factors. Ahmed, Howida *et al.* (2011) found that Single cross Watania 4 surpassed in the mean values of ear diameter, 200 grain weight and grains yield/fed. than Triple cross 310 in the both seasons. These results are in agreement with those found by El-Bably (2007), El-Metwally *et al.* (2011), Attia *et al.* (2012), Kandil *et al.* (2017) and Hassan, Alshimaa (2019).

B- The interaction effects:

The obtained results in Table 2 revealed that the first order interaction hybrids x micro-elements (HxM) had a highly significant effects on the grains weight/ear and grain yield/fed. in the 1st season only. The other studied traits were not significant in the both seasons. The maximum values for the significant trait grain weight were observed by boron (M₁) with S.C. 10 (H₁), while the minimum

ones were recorded by Zinc (M_2) and Manganese (M_3) with either S.C. 10 (H_1) and T.C. 321 (H_2) in the 1st season, respectively. On the other hand, the maximum grain yield/fed. (18.8 ard.) and the minimum one (14.1 ard.) were realized by $H_1 \times M_2$ and $H_2 \times M_3$, respectively, in the 1st season. Khalid *et al.* (2019) mentioned that the optimum grain yield/ha was stated by hybrid DK-6525 with Zn (15 kg $ZnSO_4 \cdot 7H_2O$ /ha).

Regarding to the interaction between maize hybrids and foliar micro-elements application, the data in Table 3 stated that the grain yield in the both seasons and ear length in the 2nd season only had significantly affected by the (HxS) interaction. The other traits either in the 1st or/and in the 2nd season(s) had non-significant affected by this trial. The maximum grain yield/fed. were recorded by ($H_1 \times S_1$) and ($H_2 \times S_2$), while the minimum grain yield/fed. were achieved by ($H_2 \times S_0$) in the 1st and 2nd seasons, respectively.

As for the first order interaction (MxS), data in Table 4 cleared that the grains weight/ear and grain yield/fed. had a highly significant af-

ected by this interaction in the 1st season only, while the other traits either in the 1st or/and the 2nd season(s) had non-significant affected by this trial. The maximum grain yield/fed. (19.4 and 22.1 ard.) were recorded by ($M_1 \times S_1$ and $M_3 \times S_2$), while the minimum ones (14.0 and 16.4 ard.) were recorded by ($M_3 \times S_0$ and $M_1 \times S_0$) in the 1st and 2nd seasons, respectively.

Concerning the second order interaction (HxMxS), the data in Table 5 showed that the plant height and ear diameter had significantly affected as well as for grains weight and grain yield had a highly significant affected by the HxMxS interaction in the 1st season, while the other traits either in the 1st or/and in the 2nd seasons) had non-significant affected by this trial. The tallest plant and the maximum grain yield/fed. (21.1 ard.) were recognized by ($H_1 \times M_1 \times S_1$), as well as thickest ear was recorded by $H_2 \times M_3 \times S_1$ in the 1st season.

Conclusion

It could be concluded that sown either hybrid S.C. 10 under 50 ppm Zn or hybrid T.C. 321 under 68 ppm Mn maximized maize productivity under Assiut conditions.

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تأثير الرش ببعض العناصر الصغرى علي إنتاجية هجينين من الذرة الشامية

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المخلص

نفذت تجربتان حقليتان خلال الموسمين الصيفيين ٢٠١٨ ، ٢٠١٩ في مزرعة التجارب بكلية الزراعة جامعة أسيوط لدراسة تأثير ثلاث عناصر صغرى (بورون ، زنك ومنجنيز) وثلاث مستويات رش لهذه العناصر (صفر، ٢٥ أو ٥٠ ج.ف.م بورون ، ٥٠ أو ١٠٠ ج.ف.م زنك و ٣٤ أو ٦٨ ج.ف.م منجنيز) لهجينين من الذرة الشامية هما الهجين الفردي (ه.ف.) ١٠ والهجين الثلاثي (ه.ث.) ٣٢١ علي المحصول ومكوناته. وكان التصميم المستخدم هو القطاعات الكاملة العشوائية بترتيب الأحواض المنشقة في شرائح حيث تم وضع العناصر الصغرى رأسياً والرش لهذه العناصر أفقياً وهجن الذرة الشامية في الوحدة المنشقة مرة واحدة. وأوضحت النتائج ما يلي:

-كانت أعلا القيم لصفات طول النبات في كلا الموسمين، وزن ١٠٠ حبة ومحصول الحبوب/فدان في الموسم الثاني بمعاملة الزنك، كما تحقق أعلا محصول حبوب/فدان ومكوناته في الموسم الأول بمعاملة البورون.

-سجلت أعلا القيم لصفات طول النبات، طول الكوز، قطر الكوز، وزن الحبوب/كوز، وزن ١٠٠ حبة ومحصول الحبوب/فدان بالرش بمعدل ٢٥ ، ٥٠ و ٣٤ ج.ف.م. لكل من البورون، الزنك والمنجنيز علي الترتيب في الموسم الأول فقط.

-تفوق الـ ه.ف. ١٠ لصفات طول النبات وطول الكوز في كلا الموسمين، وزن الحبوب/كوز ومحصول الحبوب/فدان في الموسم الأول، بينما تفوق الـ ه.ث. ٣١٠ لصفات وزن ١٠٠ حبة في كلا الموسمين، قطر الكوز ووزن الحبوب/كوز ومحصول الحبوب/فدان في الموسم الثاني.

-أظهر التفاعل $H_1 \times M_2$ (ه.ف. ١٠ × الزنك) أعلا القيم لصفات طول الكوز في كلا الموسمين، طول النبات ومحصول الحبوب/فدان (١٨,٨ أردب) في الموسم الأول، كما حقق التفاعل $H_2 \times M_3$ (ه.ث. ٣١٠ × المنجنيز) أعلا القيم لصفات وزن الحبوب/كوز، وزن ١٠٠ حبة ومحصول الحبوب/فدان (٢٠,٢ أردب) في الموسم الثاني.

-أعطى التفاعل الثنائيان $H_1 \times S_1$ (ه.ف. ١٠ × الرش ٢٥ و ٥٠ و ٣٤ ج.ف.م. بورون ، زنك ومنجنيز)، $H_2 \times S_2$ (ه.ث. ٣١٠ × الرش ٥٠ ، ١٠٠ و ٦٨ ج.ف.م. بورون، زنك ومنجنيز) أعلا القيم لصفات وزن الحبوب/كوز ومحصول الحبوب/فدان (١٩,٧ و ٢٢,٥ أردب) في الموسم الأول والثاني علي الترتيب.

-أظهر التفاعل $M_1 \times S_1$ (البورون × الرش ٢٥ ج.ف.م. بورون) أعلا القيم لصفات وزن الحبوب/كوز ومحصول الحبوب/فدان في الموسم الأول، كما أعطى التفاعل $M_3 \times S_2$ (المنجنيز × الرش ٣٨ ج.ف.م. منجنيز) أعلا القيم لصفات طول الكوز ومحصول الحبوب/فدان في الموسم الثاني.

-أعطى التفاعل الثلاثي $H_1 \times M_2 \times S_1$ (ه.ف. ١٠ × الزنك × ٥٠ ج.ف.م. زنك) و $H_2 \times M_3 \times S_2$ (ه.ث. ٣١٠ × المنجنيز × ٦٨ ج.ف.م. منجنيز) أعلا القيم لصفات وزن الحبوب/كوز ومحصول الحبوب/فدان (٢١,١ و ٢٣,٢ أردب) في الموسم الأول والثاني علي الترتيب.