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Response of Two Maize Hybrids Productivity to Irrigation Intervals and Foliar Application Proline

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Abstract

Two field experiments were carried out during two summer seasons 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 (H_1) and Trible Cross (T.C.) 321 (H_2)] on yield and its components of three irrigation intervals (I_1= 11 day, I_2= 16 day and I_3= 21 day) and three foliar proline application (P_0= control (water only), P_1= 100 ppm and P_2= 200 ppm. Experimental design was randomized complete block design (RCBD) using split-plot in strips, where irrigation intervals allocated in the main vertically, proline were arranged in the main horizontally and maize hybrids were occupied the sub-plots.

According to research results, the maximum values for plant height, yield components and grain yield/fed. were obtained by the irrigated plants at 11 day interval in both seasons.

- The highest values of plant height, ear grains weight and 100 grain weight in both seasons; as well as grain yield/fed. in the 1st season were recorded by control, while grain yield/fed. as well as ear length and ear diameter in the 2nd season were realized by 100 and 200 ppm proline, respectively.
- The hybrid S.C. 10 grave the highest values for plant height and ear length in both seasons, as well as ear grains weight and grain yield/fed. in the 1st season, while hybrid T.C. 321 surpassed for traits of ear diameter and 100 grain weight in both seasons.
- The first order interaction H_1xI_1 (S.C. 10 x 11 day interval) achieved the maximum values for plant height and grains yield/fed. (21.1 and 22.5 ard.) in both seasons, while H_2xI_1 interaction (T.C. 321 x 11 day interval) achieved the maximum values for ear diameter in both seasons and 100 grain weight in the 1st season only.
- The interaction H_1xP_1 (S.C. 10 x 100 ppm proline) and H_2xP_2 (T.C. 321 x 200 ppm proline) gave the maximum grain yield/fed. (19.5 ard.) and ear diameter in the 2nd season only, respectively.
- The interaction P_1xI_1 (100 ppm proline x 11 day interval) and P_2xI_1 (200 ppm proline x 11 day interval) showed the maximum grain yield/fed. (22.5 ard.) and ear diameter in the 2nd season only, respectively.
- The second order interaction $H_1xP_0xI_1$ (S.C. 10 x control x 11 day interval) and $H_2xP_2xI_1$ (T.C. 321 x 200 ppm proline x 11 day interval) in both seasons gave the highest values for plant height and ear diameter, respectively, moreover, $H_1xP_1xI_1$ interaction (S.C. 10 x 100 ppm x 11 day interval) gave the maximum one for grain yield/fed. (23.9 ard.) in the 2nd season only.

Keywords: *Irrigation intervals, Maize hybrids, foliar proline application.*

Introduction

One of the most important cereal crop grown during the summer season in Egypt is corn. It is used for both human consumption and poultry feeding. 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.

The adequate supply of irrigation, genotypes and foliar proline application to plants are the main factors affecting the growth and productivity of corn plants

Water deficit is frequently the primary limiting factor of crop production under arid and semi-arid condition (Hussain *et al*., 2004). However, the stress response depends upon the intensity, rate and duration of exposure and the stage of crop growth (Wajid *et al*., 2004). In this concern, Abd El-Maksoud *et al*., 2008), El-Metwally *et al*. (2009), Ahmed, Howida *et al*. (2011), Khalili *et al*. (2013), Zamaninejad *et al*. (2013) and Ertiro *et al*. (2017) indicated that the prolonging irrigation intervals led to decreased growth, yield and yield components.

Proline is the most important amino acid that accumulate in various tissues of the plant in the leaves because the effect of water stress. Proline also is important for activity dividing cells as it helps to maintain sustainable growth under long term stress.

Kavi Kishor and Sreenivasulu (2014) reported that proline role in the reproductive tissue is to stabilize seed set and productivity. Al-Shaheen and Soh (2016) mentioned that the use of proline is an innovative and promising of drought on plant growth and crop reduction. Mosaad *et al*. (2020) stated that using 50 ppm proline with 403.43 kg N/ha gave the optimum economic yield of maize, especially in saline soil.

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) initiate 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 were determine the effects of different irrigation intervals and foliar proline 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 hy-

brids under different irrigation intervals and foliar proline 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 irrigation intervals (11, 16 and 21 day= I_1, I_2 and I_3) were allotted in the main vertically. The three foliar proline application (0, 100 and 200 ppm= P_0, P_1 and P_2) were assigned in the main horizontally, where spraying of proline was done at 45 and 60 days after sowing as well as the control plants were sprayed by distilled water. The two maize hybrids, Single cross (S.C.) 10 and Trible Cross (T.C.) 321 were distributed in the sub-plot, which were 3x3.5 m^2. 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 preceding 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 irrigation intervals (I) had a highly significant effect on the plant height, grains weight/ear and grain yield/fed. in the both seasons, moreover it had highly significantly effect on ear diameter and 100 grain weight or significantly effect on ear length in the first season only.

The plant height as well as other studied traits were decreased with increasing the irrigation period and the maximum values were obtained at I_1 (11 day interval) in the two growing seasons (Table 1). These results are logic, hence the decrease in supply or nun-sufficient water may be reduced the necessary elements for plant growth. Abdo, Fatma (2007) reported that increasing interval up to 28 days significantly reduced all the studied traits. El-Atawy (2007) concluded that low available soil water content resulted in a significant reduction in kernel yield due to disparity in flow-

ering and the frequency of sterile plants. Similar findings were concluded with those reported by Kamara *et al*. (2003), Abd El-Aziz and El-Bialy (2004), Oraby *et al*. (2005), El-Bably (2007), El-Metwally *et al*. (2009), Ahmed, Howida *et al.* (2011), Khalili *et al*. (2013) and Ertiro *et al*. (2017).

The data in Table 1 revealed that the main effect of foliar proline application (P) had significantly effect on the plant height and grains yield/fed. in both seasons and for ear diameter in the second season only. The other studied traits had non-significant affected by this trial in both seasons. The P_0 (control) recorded the tallest plants, the heaviest ear grains weight and 100 grain weight in the both seasons and the maximum grain yield/fed. in the 1st season only. Meanwhile, 200 ppm proline (P_2) also recorded the longest ear and the best ear diameter in the 2nd season. Moreover, the 100 ppm proline (P_1) gave the maximum grain yield/fed. (19.2 ard.) in the 2nd season.

As for, the main effect maize hybrids (H) had a highly significant or/and significantly effect on the plant height and ear diameter in the both seasons. Moreover, it had highly significant and significantly effect on grains yield/fed. and 100 grain weight in the 1st season only, respectively (Table 1). On the other hand, the grains weight/ear trait had non-significant affected by this trial in the both seasons. Al-Shaheen and Soh (2016) confirmed that the use of proline is an innovative and promising of drought on plant growth and crop production. Similar findings were reported by Mosaad *et al*. (2020).

The hybrid H_1 (S.C. 10) surpassed the hybrid H_2 (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 H_2 surpassed hybrid H_1 for ear diameter and 100-grain weight in both seasons. 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 irrigation (HxI) had a significant and highly significant effects on the plant height in the 1st and 2nd seasons, respectively. The other studied traits were not significant in the both seasons. The maximum values for the significant trait plant height were observed by irrigation at 11 day interval (I_1) with S.C. 10 (H_1), while the minimum ones were recorded by irrigation at 21 day (I_3) with either S.C. 10 (H_1) and T.C. 321 (H_2) in the 1st and 2nd seasons, respectively.

On the other hand, the maximum grain yield/fed. values (21.1 and 22.5 ard.) and the minimum ones (5.7 and 13.7 ard.) were realized by H_1xI_1 and H_2xI_3, respectively, in the both seasons. Ahmed, Howida *et al*. (2011) mentioned that the maximum values for plant height and grain yield/fed. were stated by I_1xG_1 (irrigation at 12 day interval with S.C. Watania 4).

Regarding to the interaction between maize hybrids and foliar proline application, the data in Table 3 stated that the grain yield in the 1st season only had significantly affected by the (HxP) 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_1xP_0) and (H_2xP_1), while the minimum grain yield/fed. were achieved by (H_2xP_2) and (H_1xP_0) in the 1st and 2nd seasons, respectively.

As for the first order interaction (PxI), the data in Table 4 cleared that the grain yield had significantly affected by this interaction trial 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. (13.5 followed by 12.1 ard.) were recorded by (P_1xI_2 followed by P_0xI_2), while the minimum ones (5.4 and followed by 5.8 ard.) were recorded by (P_2xI_3) followed by (P_0xI_3) in the 1st season.

Concerning the second order interaction (HxPxI), the data in Table 5 showed that the plant height had significantly affected by the HxPxI interaction in the both seasons, while the other traits either in the 1st or/and in the 2nd seasons) had non-significant affected by this trial. The tallest plant (233.7 and 256.0 cm) were recognized by ($H_1xP_0xI_1$) in the both seasons, as well as the maximum grains yield/fed. (14.3 and 23.4 ard.) were recorded by $H_1xP_0xI_1$ and $H_2xP_0xI_1$ in the 1st and 2nd seasons, respectively.

Conclusion

It could be concluded that sown either hybrid S.C. 10 or hybrid T.C. 321 under irrigation 11 day interval with proline or without proline maximized maize productivity under Assiut conditions.

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استجابة إنتاجية هجينين للذرة الشامية لفترات الري والرش بالبرولين

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الملخص:

نفذت تجربتان حقليتان خلال الموسمين الصيفيين ٢٠١٨ ، ٢٠١٩ في مزرعة التجارب بكلية الزراعة جامعة أسيوط لدراسة تأثير ثلاث فترات ري (١١ ، ١٦ و ٢١ يوم) وثلاث معاملات رش بالبرولين (صفر، ١٠٠ و ٢٠٠ جزء في المليون (ج.ف.م) 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 فترات الري رأسياً والرش بالبرولين أفقياً وهجن الذرة الشامية في الوحدة المنشقة مرة واحدة.

وأوضحت النتائج أن:

- حصل علي أعلا القيم لصفات طول النبات، مكونات المحصول ومحصول الحبوب/فدان بري النباتات كل ١١ يوم في كلا الموسمين.
- سجلت أعلا القيم لصفات طول النبات، ووزن ١٠٠ حبة في كلا الموسمين ومحصول الحبوب/فدان في الموسم الأول بالرش بالمياه (معاملة الكنترول)، بينما تحقق أعلا محصول الحبوب/فدان وكذا طول الكوز وقطر الكوز في الموسم الثاني بالرش بالبرولين بمعدل ١٠٠ و ٢٠٠ ج.ف.م علي الترتيب.
- تفوق الـ ه.ف. ١٠ لصفات طول النبات وطول الكوز في كلا الموسمين، ووزن الحبوب/كوز ومحصول الحبوب/فدان في الموسم الأول بينما تفوق الـ ه.ث. ٣٢١ لصفات قطر الكوز ووزن ١٠٠ حبة في كلا الموسمين.
- حقق التفاعل H_1xI_1 (ه.ف. ١٠ × الري كل ١١ يوم) أعلا القيم لصفات طول النبات ومحصول الحبوب/فدان (٢١,٢ و ٢٢,٥ أردب) في كلا الموسمين، بينما حقق التفاعل الثنائي H_2xI_1 (ه.ث. ٣٢١ × الري كل ١١ يوم) لصفات قطر الكوز في كلا الموسمين ووزن ١٠٠ حبة في الموسم الأول فقط.
- أعطي التفاعل الثنائي H_1xP_1 (ه.ف. ١٠ × ١٠٠ ج.ف.م. برولين) والثنائي H_2xP_2 (ه.ث. ٣٢١ × ١٠٠ ج.ف.م. برولين) أعلا القيم لصفتي محصول الحبوب/فدان (١٩،٥ أردب) وقطر الكوز في الموسم الثاني فقط علي الترتيب.
- أظهر التفاعلان الثنائي P_1xP_1 (١٠٠ ج.ف.م. برولين × الري كل ١١ يوم) و P_2xI_1 (٢٠٠ ج.ف.م. برولين × الري كل ١١ يوم) أعلا القيم لصفتي محصول الحبوب/فدان (٢٢،٥ أردب) وقطر الكوز في الموسم الثاني فقط علي الترتيب.
- أعطي التفاعلان الثلاثي $H_1xP_0xI_1$ (ه.ف. ١٠ × كنترول × الري كل ١١ يوم) و $H_2xP_2xI_1$ (ه.ث. ٣٢١ × ٢٠٠ ج.ف.م. برولين × الري كل ١١ يوم) أعلا القيم لصفتي طول النبات وقطر الكوز علي الترتيب في كلا الموسمين، علاوة علي ذلك أعطي التفاعل الثلاثي $H_1xP_1xI_1$ (ه.ف. ١٠ × ١٠٠ ج.ف.م. × الري كل ١١ يوم) أعلا القيم لصفة محصول الحبوب/فدان (٢٣,٩ أردب) في الموسم الثاني فقط.