Response of Two Maize Hybrids Productivity to Inter-and Intra-Rows Spacing

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Abstract

Two field experiments were carried out during two summer seasons (2017 and 2018) at the Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut, to study the response of two maize hybrids [Single Cross 128 (S.C. 128) and Triple Cross 310 (T.C. 310)] yield and its components for three inter-rows spacing (Rw₁= 60 cm, Rw₂= 70 cm and Rw₃= 80 cm) and three intra-rows spacing (S₁= 20 cm, S₂= 25 cm and S₃= 30 cm). Experimental design was randomized complete block design (RCBD) using split-plot in strips, where inter-row spacing allocated in the main horizontally, maize hybrids were arranged in the main vertically and intra-row spacing were occupied the sub-plots.

According to results, the maximum values of plant height and ear diameter in both seasons, ear length in the 1st season, ear grains weight and grain yield/fed. (20.4 ard.) in the 2nd season were obtained at row width 70 cm (Rw₂), moreover, ear grains weight, 100 grain weight and grain yield/fed. (25.1 ard.) were obtained at row width 60 cm (Rw₁) in the 1st season.

- The hybrid S.C. 128 gave the highest values of ear length, ear grains weight and 100-grain weight in the both seasons and grain yield/fed. (19.7 ard.) in the 2nd season, while hybrid T.C. 310 surpassed for traits of plant height and ear length in the both seasons and grain yield/fed. (24.1 ard.) in the 1st season.

- The highest values of plant height in the 2nd season and grain yield/fed. (23.6 and 19.6 ard.) in the both seasons and ear length, ear grains weight and 100-grain weight were recorded by 30 cm (S₃) hill spacing apart.

- The first order interaction H₃xRw₃ (T.C. 310 x 80 cm) achieved the maximum values of plant height and H₃xRw₁ interaction (S.C. 128 x 60 cm) for ear diameter and 100-grain weight in the both seasons, while the H₃xRw₁ (T.C. 310 x 60 cm) and H₃xRw₂ (T.C. 310 x 70 cm) for grain yield/fed. (25.9 and 20.6 ard.) in the 1st and 2nd seasons, respectively.

- The H₃xS₃ interaction (T.C. 310 x 30 cm) gave the highest values of ear length and plant height in the 1st and 2nd seasons, respectively, while the H₃xS₃ interaction (S.C. 128 x 30 cm) gave the highest ones for 100-grain weight and grain yield/fed. (20.9 ard.) in the 2nd season.

- The Rw₂xS₂ interaction (70x25 cm) showed the maximum values of plant height, as well as the Rw₁xS₃ (60x30 cm) showed the maximum ones for 100-grain weight and grain yield/fed. (26.5 ard.) in the 2nd season.

- The second order interaction H₃xRw₃xS₃ (T.C. 310 x 80 cm x 30 cm), as well as the H₁xRw₃xS₂ (S.C. 128 x 80 cm x 25 cm) gave the height values of plant height and ear diameter in the 2nd season, respectively, moreover the either H₃ or H₁xRw₁xS₃ interactions (either T.C. 310 or S.C. 128 x 60 cm x 30 cm) gave
the maximum ones (27.2 and 22.5 ard.) for grain yield/fed. in the 1st and 2nd seasons, respectively.

**Keywords**: Maize hybrids, Inter-row spacing (row width), Intra-row spacing (hill spacing), Single Cross (S.C.) and Triple Cross (T.C.).

**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 feed. The attempts for increasing 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.

Row width plays a great effect on the maize plant population. In this respect, Darwich (2009) reported that increasing distance between rows from 60 to 70 and 80 cm lead to a significant increase in growth characters, grain yield and its components due to better interception and utilization of solar radiation led to increase in photosynthetic processes. Attia et al. (2012) showed that increasing ridge spacing significantly increase plant and ear heights, as well as, planting on the 80 cm ridge was associated with a significant increase in ear length, 1000 kernel weight and grain yield. Gobeze et al. (2012) pointed out that planting maize in ridges 80 or 90 cm apart produced the highest values of all studied characters. Planting maize in ridges 70 cm apart gave the lowest values of these characters. Recently, Fahad et al. (2016) reported that maize plants sown in line having (60 cm) row to row distance had the highest plant height, heaviest 1000 grains weight and highest grain yield.

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. Leilah et al. (2017) found that S.C. 128 produced the highest values when planting in ridges 80 cm apart 22 cm between hills and one plant hill. 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.

Growth and grain yield of maize is more affected by variations in hill spacing than other members of the grass family. Hill spacing affected of agronomic, flowering characteristics, and grain yield. Many investigators studied the effect of plant density of maize as a spacing between hills, in this regard, Sharifai et al. (2012) found that highest grain yield ob-
tained at 10 plants/m². The highest cob length was recorded at 8 plants/m², while the highest values of plant height were recorded at 12 plants/m². Leilah et al. (2013) showed that increase in intra-row spacing from 20 to 25 cm significantly increased cob diameter, 100-grain weight and grain yield. Ukonze et al. (2016) showed that the 70 x 30 and 60 x 40 cm spacing gave higher values of the morphological parameters than 80 x 20 cm. With regard to yield, 80 x 20 cm gave the highest average cob weight and 1000-grain weight.

The objective of this study was to determine the effects of different inter-and intra-rows spacing on yield and yield components of 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 inter- and intra-rows spacing. Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Assiut Univ., during 2017 and 2018 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 inter-rows spacing (Rw₁, Rw₂ and Rw₃) (60, 70 and 80 cm) were allotted in the main horizontally. The two maize hybrids, Single cross 128 (S.C. 128) and Three-Way Cross 310 (T.C. 310) were assigned in the main vertically. The three intra-rows spacing (S₁, S₂ and S₃) (20, 25 and 30 cm) were distributed in the sub-plot, which were 3 x 3.5 m². The maize was planted on 28 and 26 of June in 2017 and 2018 seasons, respectively. The grains were sown in hills 20, 25 and 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 (R-LSD) at 5% probability level.

Results and Discussion

A- The main effects:

The presented data in Table 1 showed that the main effect inter-row spacing= row width (Rw) had significantly effect on the plant height, ear
length and grains weight/ear in the second season, moreover it had highly significantly effect on grains yield/fed. in the first season only. The ear diameter and 100-grain weight had non-significant affected by this trial in the both seasons. The tallest plants (253.0 and 243.1 cm) and the thickest ear (4.4 and 4.1 cm) in both seasons, the tallest ear (20.8 cm) in the 1st season, the heaviest ear grains (158.0 g), and the maximum grain yield/fed. (20.4 ard.) in the 2nd season were realized by Rw2 (70 cm). Meanwhile, the highest ear grains weight (182.0 g), the heaviest 100-grain (33.2 g) and the maximum grain yield/fed. (25.1 ard.) were realized by Rw1 (60 cm) in the 1st season. On the contrary, the minimum means values (250.6 and 231.1 cm) and (20.2 and 18.7 cm) in both seasons as well as (4.0 cm), (141.3 g), (29.0 g) and (18.1 ard.) in the 2nd season, were realized by Rw1 (60 cm) for plant height, ear length, ear diameter, ear grains weight, 100-grain weight and grain yield/fed., respectively. Kandil et al. (2017) concluded that sown maize plants in width row (70 cm) produced the highest ear length, ear diameter, grains weight/ear and 100-grain weight. Therefore, the larger availability of solar radiation probably allowed plants to set more grains per ear and to produce heavier grains. These results are in good accordance with those stated by Mahgoub and El-Shenawy (2006), Darwich (2009), Attia et al. (2012), Gobeze et al. (2012) and Fahad et al. (2016).

As for, the main effect maize hybrids (H) had significantly effect on the plant height and 100-grain weight or highly significantly effect on grains yield/fed. in the 1st season only (Table 1). On the other hand, the ear length, ear diameter and grains weight/ear traits had non-significant affected by this trial in the both seasons.

The hybrid H3 (T.C. 310) surpassed the hybrid H1 for the plant height, ear length in both season and for grains yield/fed. in the 1st season only. On the contrary, the hybrid H1 surpassed hybrid H3 for ear diameter, grains weight/ear and 100-grain weight in both seasons. This result may be due to the genetic factors. Ahmed, Howida (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 Mahgoub and El-Shenawy (2006), El-Babily (2007), Attia et al. (2012), El-Metwally et al. (2017) and Kandil et al. (2017).

The data in Table 1 revealed that the main effect intra-row spacing= hill spacing (S) had significantly effect on the plant height, 100-grain weight and grains yield/fed. in the second season only. The other studied traits had non-significant affected by this trial in both seasons.

The hill-spacing S3 (30 cm) recorded the tallest plant (240.6 cm) in the 2nd season and the maximum grain yield/fed. (23.6 and 19.6 ard.) in the 1st and 2nd seasons, respectively. Meanwhile, intra-row spacing S3 also recorded the longest ear (20.5 cm), the best grains weight/ear (182.6 g) and the heaviest 100-grain (33.1 g) in the 1st season. On the other hand, the hill-spacing 25 cm apart (S2) gave the minimum values (20.3 cm) for ear
length and (33.0 g) for 100-grain weight in the 1st season, as well as the minimum ones (21.7 and 18.6 ard.) for grain yield/fed. in the 1st and 2nd seasons, respectively. This is logic, hence the distribution of plants in S3 may be favorable the light intensity, therefore, the plant height and the other studied traits must be increased in tall and information of grains. These results are in harmony with those stated by Sener et al. (2004), El-Metwally et al. (2011), Sharifai et al. (2012) and Ukonze et al. (2016).

**B- The interaction effects:**

The presented data in Table 2 declared that the all studied traits had non-significant affected by the interaction between maize hybrids and row width (HxRw) in the both seasons. However, the tallest plants (261.8 and 251.0 cm) and the longest ear (20.5 cm) followed by (20.4 and 20.0 cm) were recorded by (H3xRw3) and (H1xRw2) followed by (H3xRw1), while the shortest ones (243.3 and 229.7 cm) and (20.0 and 18.0 cm) were recorded by (H1xRw3) and (H3xRw3 and H1xRw1) in the 1st and 2nd seasons, respectively. Meanwhile, the best ear diameter (4.5 and 4.1 cm) and the heaviest 100-grain (34.0 and 30.0 g) were recorded by H1xRw1, as well as the maximum grain yield/fed. (25.5 and 20.6 ard.) were recorded by H3xRw1 and H3xRw2 in the 1st and 2nd seasons, respectively, while the minimum ones (4.0 cm), (27.7 g) and (16.7 ard.) were achieved by H3xRw1 for ear diameter, ear grains weight and grain yield/fed. in the 2nd season, respectively. Fahad et al. (2016) demonstrated that Hybrid-3025 sown in ridges having a 60 cm row to row distance produce more grain yield as compared to Azam variety.

Regarding to the interaction between maize hybrids and hill spacing (HxS), the data in Table 3 revealed that the plant height in the 2nd season and ear diameter in the 1st season 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 tallest plant (249.7 cm) and the longest ear (20.7 cm) were obtained by (H3xS3), while the shortest plant (225.7 cm) and thinnest ear (4.3 cm) were obtained by (H1xS1) and (H1xS2) or (H3xS3) in the 2nd and 1st seasons, respectively. Meanwhile, the heaviest 100-grain (29.2 g) and the maximum grain yield/fed. (20.9 ard.) were realized by (H1xS3), while the minimum 100-grain weight (27.2 g) and grain yield/fed. (17.1 ard.) were realized by (H3xS3) and (H3xS2) in the 2nd season, respectively. Sener et al. (2004) establish that maize hybrids react differently to various plant population density. Meanwhile, Kandil et al. (2017) showed that there were varietal differences in response to intra-row spacing.
As for, the first order interaction (RwxS) the data in Table 4 cleared that the plant height had significantly affected by this trial in the 2nd season only, while the other traits either in the 1st or and the 2nd season(s) had non-significant affected by this trials. The tallest plants (246.2 followed by 245.3 cm) were recorded by (Rw xS2 followed by Rw xS3), while the shortest ones (229.8 cm followed by 231.3 cm) were recorded by (Rw xS2 followed by Rw xS1) in the 2nd season. Meanwhile, the heaviest 100-grain (34.0 g) and the maximum grain yield/fed. (26.5 ard.) were achieved by (Rw xS3) in the 2nd season, respectively. Mahgoub and El-Shenawy (2006) decided that planting maize on 80 cm row of plant densities of 25-30 thousand plants/fed. (17.20 cm between hills) maximized grain yield. Kandil et al. (2017) came the same conclusion.

Concerning the second order interaction (HxRwxS), the data in Table 5 showed that the plant height, ear diameter and grains weight/ear had significantly or highly significantly affected by the HxRwxS interaction in the 2nd season only, respectively, while the other traits either in the 1st or and in the 2nd season(s) had non-significant affected by this trial. The tallest plant (258.7 cm), the thickest ear (4.2 cm) and the maximum ear grains weight (177.8 g) were recognized by (H1 xRw xS2) in the 2nd season, respectively, as well as the maximum grains yield/fed. (27.2 and 22.5 ard.) were recorded by H3 xRw xS1 and H1 xRw xS3 in the 1st and 2nd seasons, respectively. Sharifai et al. (2012) reported that the highest grain yield due to increase plant population and reduce row spacing depended mainly on different factors, like the hybrid type in use. Similar finding was mentioned by Kandil et al. (2017).

Conclusion

It could be concluded that sown either S.C. 128 or T.C. 310 at 60 cm row width and hill spacing of 30 cm apart maximized maize productivity under the environmental conditions of Assiut Governorate, Egypt.

References


استجابة إنتاجية هجينين للدورة الشامية لمسافة بين وداخل الخيوط

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المختص

نفتذ تجربتان حكليتان خلال الموسمين الصيفيين ٢٠١٧، ٢٠١٨ في مزرعة التجارب بكلية الزراعة جامعة أسيوط لدراسة تأثير ثلاث مسافات بين الخيوط (٠، ١، ٥، ٧ سـ) وثلاث مسافات بين الحبوب (٢، ٥، ٣ سـ) لهجينين من الدورة الشامية هما الهجيني الفردي (دـف) ودالف ودلاف (دـف). كان التسمية المستخدم هو الفطريات الكاملة العشوائية بترتيب الأحراش المشنقة في شرائح حيث تم وضع المسافة بين الخيوط أفتحاً ودهم الدورة الشامية رأسياً والمسافة بين الدرج في الوحدة المشنقة مرة واحدة.

وأوضح نتائج أن:

- كانت أعلا القيم لصفات طول الدرج وقطر الكوز في كل المراحل، وطول الدرج في الموسم الأول، ووزن الحبوب ومحصول الحبوب للفدان في الموسم الثاني للمسافة بين الخيوط ٠، ١، ٥، ٧ سـ، علاوة على ذلك كانت أعلا القيم لصفات وزن الحبوب ومحصول الحبوب للكوز في الخيوط ٠، ١، ٥، ٧ سـ، ومحصول الحبوب في الخيوط ٠، ١، ٥، ٧ سـ، ومحصول الحبوب للفدان (٠، ١، ٥، ٧ سـ).

- توفيق ٠، ١، ٥، ٧ سـ، ٦، ٣، ٢، ١ سـ، ٢، ٥، ٨، ٣ سـ. كانmiddleware] لصفات طول الدرج، وزن الكوز، ووزن الحبوب في كل المراحل، ومحصول الحبوب للفدان (٠، ١، ٥، ٧ سـ)، بينما توفيق ٠، ١، ٥، ٧ سـ، ٦، ٣، ٢، ١ سـ، ٢، ٥، ٨، ٣ سـ لصفات طول الدرج، وزن الكوز، ومحصول الحبوب للفدان (٠، ١، ٥، ٧ سـ).

- سجلت المسافة بين الدرج ٣ سـ أعلا القيم لصفات طول الدرج في كل المراحل، وطول الدرج في كل المراحل، وطول الدرج ووزن الحبوب للكوز ووزن الحبوب للفدان (٠، ١، ٥، ٧ سـ).

- حقق التفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، والتفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، والتفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج.

- أعطي التفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، والتفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج.

- أظهر التفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، كما أن التفاعل الثاني (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج (٠، ١، ٥، ٧ سـ) في الموسم الثاني.

- أعطي التفاعل الثالث (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، والتفاعل الثالث (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج، والتفاعل الثالث (٠، ١، ٥، ٧ سـ × ٠، ١، ٥، ٧ سـ) أعلا القيم لصفة طول الدرج (٠، ١، ٥، ٧ سـ) في الموسم الثاني.