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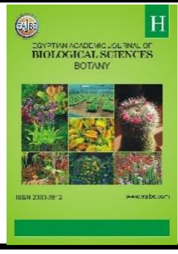


# Maize Hybrids Response to Nitrogen, Potassium Fertilization and Its Relation to Some Fungal Diseases

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**ABSTRACT**

Two field experiments were conducted at the Experimental Farm of Faculty of Agriculture (Saba Basha), Alexandria University, Egypt during 2017 and 2018 seasons, to study the response of the three maize hybrids productivity to different combination between nitrogen and potassium fertilizer and its effect to infection by fungal diseases. Split plot design with three replications was used, where the main plots occupied by three hybrids of maize (S.C.10, S.C.131 and T.W.C.321), meanwhile the subplots contained combination between nitrogen and potassium fertilizer forms (192 kg N/ha + 0 kg K/ha, 192 kg N + 57.6 kg K/ha, 192 kg N + 115.2 kg K/ha, 288 kg N/ha + 0 kg K/ha, 288 kg N + 57.6 kg K/ha, 288 kg N + 115.2 kg K/ha, 384 kg N/ha + 0 kg K/ha, 384 kg N + 57.6 kg K/ha, and 384 kg N + 115.2 kg K/ha). Each subplot consisted of 6 ridges 3.50 m in length and 70 cm in the width and plot area was 14.7 $m^2$. The results revealed that maize hybrids differed significantly and combination between nitrogen and potassium fertilizer affected significantly in plant height (cm), ear length, number grains/row, number of grains/ears, 100- grain weight, grain, straw, and biological yield (kg/ha.) as well as harvest index %. The results indicated that there was significant effect of fertilization levels on yield, its components and leaf blight infestation of some maize hybrids where fertilizing maize hybrid TWC321 by 288 kg N + 57.6 kg K/ha recorded the highest values of yield and its components, on the other hand, the maize hybrid TWC321 recorded the highest yield and high tolerant for leaf blight under Alexandria conditions.

## INTRODUCTION

Maize (*Zea mays* L.) is one of the three most important cereal crops in Egypt and the world. It is one of the important cereal crops next to wheat and rice in the world and it is high yielding, easy to process, readily digested and cheaper than other crops. Maize is consumed both as food and fodder and in addition, it is also required by the various industries. The cultivated area in Egypt occupied about 1.58 million fadan (one fadan=4200 $m^2$) producing up to 5.85 million tons of grains with an average yield of 24.02 ardab/fadan (ardab = 140 kg grains) according to FAO (2018).

Maize requires an adequate supply of nutrients such as P and K for good growth and high yield. Nevertheless, P and K are very essential for good vegetative growth and grain development in maize production. The quantity required of these nutrients depends on the pre-clearing vegetation, organic matter content, tillage method and light

Nitrogen is a key factor for plant photosynthesis, ecosystem productivity and leaf respiration (Martin *et al.,* 2008). Nitrogen stress may affect the light use efficiency and consequently influence long-term changes in vegetation biomass and carbon sequestration (Peng *et al.,* 2012). Increase nitrogenous fertilization rates up to 200 kg/ha increased yield and its components of maize (Dawadi and Sah, 2012). Application of intensity (Kang, 1981).nitrogenous fertilization lowest ear weight was related to the lowest nitrogen level, while the highest ear weight was observed by the highest nitrogen level (240 kg N $ha^{-1}$), while there was no significant difference among nitrogen levels was observed on harvest index (Hoshang, 2012). Nitrogen fertilization levels, maize hybrids, and their interactions showed such significant effects on maize growth, crop yield and its components. The maximum plant height, leaf area index (LAI), chlorophyll SPAD unit, number of rows/cob , number of kernels/row, number of kernels cob, 1000 grain weight, stover, grain, biological yields, harvest index and protein content were produced by the application either 429 or 357 kg N/ha (Kandil, 2013). There were gradual and significant increases in all growth parameters and grain yield resulted from foliar spray by raising N- fertilizer up to 288 kg N/ha., in both seasons. The S.C Pioneer 30K09 maize hybrid treated with 288 N/ha., produced the maximum values of plant height and grain yield in both seasons (Faheed *et al*., 2016). The highest means values of yield and chemical composition characters were obtained using nitrogen fertilizer at rate of 384 kg/ha., in both seasons, while the lowest ones were recorded by application of nitrogen at 192 kg/ha., in both seasons (Gomaa *et al.,* 2016).

Potassium (K) helps in the photosynthesis process, controlling water storage and stomata opening in leaves (Zhang and Wang, 2005). Potassium is an important macronutrient for improving the yield of crop. It is vital for physiological processes, water availability, photosynthesis, assimilate transport and enzyme activation with a direct effect on crop production. Potassium deficiency significantly reduces the leaves number and size of individual leaf and as a result photosynthetic activity of the plant was affected (William, 2008). Higher crop growth rate might be exhibited due to higher photosynthetic efficiency in leaves and supplied emerging cobs with existing photosynthates for proper filling, producing higher yield. Grain yield enhanced by increasing potassium uptake under the arid condition (Damon and Rengel, 2008).

Northern Corn leaf blight (NCLB) is a disease of corn caused by the fungus, *Exserohilum turcicum*. Severe outbreaks of the disease can cause up to 30-50% yield loss in corn if the disease is recognized before tassel (Lipps and Mills, 2011). Corn Leaf Blight: Northern Corn leaf blight also commonly known as Turcicum leaf blight (TLB) is one of the most important foliar diseases of maize. NCLB can be severe when the condition is favorable. High humidity associated with low temperature and cloudy weather is favorable conditions for disease development on the host plant (Singh *et al*., 2004). Heavy dew on the growing plant has also been cited as one of the factors leading to NCLB disease severity (Dingerdissen *et al*., 1996).

The disease symptoms primarily appear on the leaves. Plants may be infected at any growth stage, but usually at or after anthesis. The disease starts first as a small elliptical spot on the leaves, grayish-green in color with water-soaked lesions. The spots turn greenish with age and increase in size, finally attaining a spindle shape. Spores of the fungus develop abundantly on both sides of the spot (Singh *et al*., 2012).

This investigation aimed to study the response of the three maize hybrids productivity to different combinations between nitrogen and potassium fertilizer and its relation to some fungal diseases.

## MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Faculty of Agriculture (Saba Basha), Alexandria University, Egypt, during the summer seasons of 2017 and 2018 to study the response of the three maize hybrids productivity to different combination between nitrogen and potassium fertilizer and its effect to reduce fungal diseases.

The preceding crop was Egyptian clover (berseem) in the first and second season.Soil physical and chemical analysis of the experimental site is given in Table (1).Each subplot area was 14.7 $m^2$consisted of 6 ridges 3.50 m in length and 70 cm in the width.

**Table 1.** Some physical and chemical properties of the experimental soil in 2017 and 2018 seasons.

| Soil properties | Season | |
|---|---|---|
| | 2017 | 2018 |
| A) Mechanical analysis: | | |
| Clay % | 38 | 37 |
| Sand % | 32 | 33 |
| Silt % | 30 | 30 |
| Soil texture | Clay loam soil | |
| B) Chemical properties | | |
| pH ( 1 : 1) | 8.00 | 8.10 |
| Ec (dS/m) | 3.30 | 3.20 |
| 1) Soluble cations (1:2) (cmol/kg soil) | | |
| $K^+$ | 1.53 | 1.54 |
| $Ca^{++}$ | 9.30 | 8.6 |
| $Mg^{++}$ | 14.3 | 15.0 |
| $Na^+$ | 13.10 | 13.00 |
| 2) Soluble anions (1 : 2) (cmol/kg soil) | | |
| $CO_3^{--} + HCO_3^-$ | 3.0 | 3.10 |
| $Cl^-$ | 21.0 | 20.7 |
| $SO_4^{--}$ | 13.8 | 14.0 |
| Calcium carbonate (%) | 6.50 | 6.60 |
| Total nitrogen % | 1.00 | 0.92 |
| Available phosphate (mg/kg) | 3.80 | 3.90 |
| Organic matter (%) | 1.42 | 1.41 |

Split plot design with three replications was used, where the main plots occupied by three hybrids of maize (S.C.10, S.C.121 and T.W.C.321), meanwhile the sub plots contained combination between nitrogen and potassium fertilizer forms (192 kg N/ha + 0.0 kg K/ha, 192 kg N + 57.6 kg K/ha, 192 kg N + 115.2 kg K/ha, 288 kg N + 0 kg K/ha, 288 kg N + 57.6 kg K/ha, 288 kg N + 115.2 kg K/ha, 384 kg N + 0.0 kg K / ha, 384 kg N + 57.6 kg K/ha, and 384 kg N + 115.2 kg K/ha).

Ammonium nitrate ($NH_4NO_3$ - 33.50 N%) was used as the N source which was applied in two equal doses, the first dose was before the first irrigation and the second one was before the second irrigation during both growing seasons. Potassium sulphate ($K_2SO_4$-48% $K_2O$) form was added at sowing time, in both seasons. Phosphorus fertilizer was applied before planting in form of Calcium super phosphate (15.5 % $P_2O_5$).

The planting date was 10th May in both seasons. The field was hand thinned before the first irrigation to one plant/hill. The experimental units were hand hoed twice for controlling weeds before the first and second irrigations. Other agricultural practices were done as recommended by the Ministry of Agriculture and Reclamation.

At harvest time 120 days from planting the most important studied characters were recorded; Plant height, ear length (cm), number of grains/row, number of rows/ear, number of grains/ear, 100-grain weight, grain yield, biological yield (ton/ha), harvest index (%), while disease incidence and disease severity % of leaf blight were recorded.

All collected data were subjected to analysis of variance according to Gomez and Gomez (1984). All statistical analysis was performed using analysis of variance technique using CoStat computer software package **(CoStat, Ver. 6.311., 2005).** The least significant difference (LSD at 0.05) was used to compare the treatment means.

## RESULTS AND DISCUSSION

The recorded results in Table (2) showed that plant height at harvesting (cm), ear length (cm) and the number of grains/row were significantly affected by maize hybrids and combined nitrogen and potassium fertilization rates and their interactions during both seasons.

The results showed that there was significant difference among maize hybrids on each of plant height at harvesting (cm), whereas the hybrid S.C. 10 recorded the highest mean value of plant height, On the other hand, TWC321 gave the shortest plant which recorded the longest ear (cm) and number of grains/row with no significant difference among the three maize hybrids on the pervious traits in both seasons. The different responses among these hybrids may be due to genetics. These results are confirmed with those observed by Kandil (2013) and Faheed *et al*. (2016). Also, Minjian *et al.* (2007) reported that modern hybrids of maize respond to K differently due to differences in its uptake, translocation, growth, and utilization.

The results in the same Table revealed the effect of N + K fertilization levels on plant height at harvesting (cm), ear length (cm), and number of grains/row, where application of the rate at 384 kg N + 115.2 kg K/ha recoded the longest maize plants, while the shortest plant was given with adding 192 kg N + 0 kg K kg/ha. On the otherwise, the longest ear and the highest number of grains/row were recorded with the combination of 192 kg N + 0 kg K kg/ha, while the lowest ones were obtained with 192 or 288 kg N/ha with no addition with K in both seasons. These results are in agreement with those reported by Damon and Rengel (2008), William (2008), Kandil (2013), Faheed *et al*. (2016) and Gomaa *et al.* (2016).

The results in Table (2) reveal that there were significant interaction effects on some plant characters *i.e*., plant height and number of grains/row of maize, where the highest mean value of plant height was recorded with 384 kg N + 0 kg K/ha and number of grains/row was obtained by 192 kg N + 115.2 kg K/ha, while the lowest value of plant height was given with fertilizing TWC321 with the rate of 192 kg N + 0 kg K/ha but the lowest number of grains/row with SC. 121 + 192 kg N + 0 kg K/ha during the two seasons.

**Table (2).** Plant attributes of three maize hybrids as affected by potassium fertilization forms and their interaction in both seasons

| Attributes | N + K- fertilizer (B) | Season 2017 | | | | | | | Season 2018 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | |
| | | S.C.10 | S.C.121 | T.W.C. 321 | | A | B | AB | S.C.10 | S.C.10 | T.W.C. 321 | | A | B | AB |
| Plant height at harvesting (cm) | 192 kg N + 0 kg K/ha | 218.3 | 213.3 | 150.0 | 193.9 | 11.7 | 12.3 | 21.3 | 203.7 | 224.0 | 192.7 | 206.8 | 17.0 | 14.2 | 24.6 |
| | 192 kg N + 57.6 kg K/ha | 223.7 | 215.0 | 192.0 | 210.2 | | | | 238.0 | 237.0 | 197.3 | 224.1 | | | |
| | 192 kg N + 115.2 kg K/ha | 242.3 | 212.7 | 255.0 | 236.7 | | | | 264.3 | 234.7 | 277.0 | 258.7 | | | |
| | 288 kg N + 0 kg K/ha | 203.0 | 200.3 | 224.3 | 209.2 | | | | 201.7 | 204.3 | 239.0 | 215.0 | | | |
| | 288 kg N + 57.6 kg K/ha | 250.0 | 221.7 | 230.3 | 234.0 | | | | 275.3 | 236.7 | 234.7 | 248.9 | | | |
| | 288 kg N + 115.2 kg K/ha | 237.7 | 211.0 | 251.0 | 233.2 | | | | 259.7 | 233.3 | 273.0 | 255.3 | | | |
| | 384 kg N + 0 kg K/ha | 256.7 | 207.3 | 184.0 | 216.0 | | | | 282.7 | 208.7 | 202.3 | 231.2 | | | |
| | 384 kg N + 57.6 kg K/ha | 250.0 | 211.3 | 222.0 | 227.8 | | | | 272.0 | 233.3 | 239.3 | 248.2 | | | |
| | 384 kg N + 115.2 kg K/ha | 250.0 | 230.0 | 241.3 | 240.4 | | | | 272.0 | 252.0 | 246.7 | 256.9 | | | |
| | Average (A) | 236.9 | 213.6 | 216.7 | | | | | 252.2 | 229.3 | 233.6 | | | | |
| Ear length (cm) | 192 kg N + 0 kg K/ha | 17.0 | 17.3 | 17.3 | 17.2 | ns | ns | ns | 18.0 | 18.8 | 18.8 | 18.5 | ns | ns | ns |
| | 192 kg N + 57.6 kg K/ha | 21.3 | 12.3 | 20.0 | 17.9 | | | | 22.8 | 13.8 | 21.5 | 19.4 | | | |
| | 192 kg N + 115.2 kg K/ha | 21.3 | 18.8 | 20.5 | 20.2 | | | | 22.0 | 20.3 | 22.0 | 21.4 | | | |
| | 288 kg N + 0 kg K/ha | 18.0 | 19.7 | 18.7 | 18.8 | | | | 18.7 | 21.2 | 20.2 | 20.0 | | | |
| | 288 kg N + 57.6 kg K/ha | 18.0 | 17.8 | 18.7 | 18.2 | | | | 19.5 | 19.3 | 20.2 | 19.7 | | | |
| | 288 kg N + 115.2 kg K/ha | 16.7 | 17.7 | 20.3 | 18.2 | | | | 18.2 | 19.2 | 21.8 | 19.7 | | | |
| | 384 kg N + 0 kg K/ha | 19.7 | 17.7 | 19.7 | 19.0 | | | | 21.2 | 19.2 | 21.2 | 20.5 | | | |
| | 384 kg N + 57.6 kg K/ha | 19.0 | 17.7 | 19.7 | 18.8 | | | | 20.5 | 19.2 | 20.8 | 20.2 | | | |
| | 384 kg N + 115.2 kg K/ha | 18.5 | 17.7 | 21.0 | 19.1 | | | | 20.0 | 19.2 | 22.6 | 20.6 | | | |
| | Average (A) | 18.8 | 17.4 | 19.5 | | | | | 20.1 | 18.9 | 21.0 | | | | |
| Number of grains/row | 192 kg N + 0 kg K/ha | 33.0 | 33.0 | 34.0 | 33.3 | ns | 1.9 | 3.3 | 31.0 | 30.0 | 34.3 | 31.8 | 2.5 | 1.9 | 3.4 |
| | 192 kg N + 57.6 kg K/ha | 43.7 | 40.0 | 39.3 | 41.0 | | | | 33.0 | 43.3 | 39.7 | 38.7 | | | |
| | 192 kg N + 115.2 kg K/ha | 45.3 | 42.3 | 44.3 | 44.0 | | | | 46.7 | 42.3 | 47.3 | 45.4 | | | |
| | 288 kg N + 0 kg K/ha | 34.3 | 32.0 | 32.0 | 32.8 | | | | 32.3 | 34.3 | 32.3 | 33.0 | | | |
| | 288 kg N + 57.6 kg K/ha | 35.3 | 42.0 | 43.0 | 40.1 | | | | 38.3 | 44.0 | 45.3 | 42.5 | | | |
| | 288 kg N + 115.2 kg K/ha | 40.7 | 47.3 | 41.7 | 43.2 | | | | 42.0 | 46.7 | 44.7 | 44.5 | | | |
| | 384 kg N + 0 kg K/ha | 33.7 | 32.0 | 35.7 | 33.8 | | | | 36.0 | 33.7 | 36.0 | 35.2 | | | |
| | 384 kg N + 57.6 kg K/ha | 43.3 | 40.3 | 42.7 | 42.1 | | | | 44.7 | 42.7 | 45.7 | 44.4 | | | |
| | 384 kg N + 115.2 kg K/ha | 41.0 | 45.0 | 43.3 | 43.1 | | | | 43.3 | 44.7 | 46.0 | 44.7 | | | |
| | Average (A) | 38.9 | 39.4 | 39.4 | | | | | 38.6 | 40.2 | 41.3 | | | | |

- ns.: not significant difference at 0.05 level of probability according to LSD.

The recorded results in Tables (3) showed that the number of grains/ear and 100- grain weight (g) was significantly affected by maize hybrids and combined nitrogen and potassium fertilization rates and their interactions in both seasons.

The results showed that there was a significant effect due to maize hybrids on 100- grain weight (g), whereas the hybrid TWC321 recorded the highest mean value of 100- grain weight, On the other hand, SC10 gave the lightest 100- grain weight (cm) in the two seasons. On the other hand, there was significant difference among the three maize hybrids on number of rows/ear in both seasons and on number grains/ear in the first season. The different responses among these hybrids may be due to genetics. These results are in agreement with those reported by Kandil (2013) and Faheed *et al*. (2016). Also, Minjian *et al.* (2007) stated that modern hybrids of maize respond to K differently due to differences in its uptake, translocation, growth, and utilization.

The results in the same Table revealed the effect of N + K fertilization rates on number of grains/ear and 100- grain weight (g) where addition of the rate at 192 kg N + 115.2 kg K/ha recorded the highest value s of number of grains/ear and 100- grain weight followed by the rate of 288 N kg + 57.6 Kg K/ha, while the lowest ones were observed with adding 192 kg N + 0 kg K kg/ha in both seasons. On the other hand, NK fertilization rate did not affect on number of rows/ear in both seasons. These results are in agreement with those reported William (2008), Kandil (2013), Faheed *et al*. (2016) and Gomaa *et al.* (2016).

The results in Table (3) revealed that there were significant interaction effects on some plant characters *i.e*., number of grains/ear and 100- grain weight, where the highest mean value of number of grains/ear were recorded with maize hybrid SC10 with the rate of 192 kg N + 115.2 kg K/ha and the highest 100- grain weight was obtained by fertilizing the hybrid of maize 'TWC321 by 192 kg N + 115.2 kg K/ha, while the lowest value of number of grains/ear and 100- grain weight (g) were given with fertilizing SC 121 with the rate of 192 kg N + 0 kg K/ha during the two seasons.

**Table (3).** Plant attributes of three maize hybrids as affected by potassium fertilization forms and their interaction in both seasons

| Attributes | N + K- fertilizer (B) | Season 2017 | | | | | | | Season 2018 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | |
| | | S.C.10 | S.C.121 | T.W.C. 321 | | A | B | AB | S.C.10 | S.C.10 | T.W.C. 321 | | A | B | AB |
| Number of rows/ear | 192 kg N + 0 kg K/ha | 11.3 | 12.0 | 12.0 | 11.8 | ns | ns | ns | 12.0 | 12.0 | 12.0 | 12.0 | ns | ns | ns |
| | 192 kg N + 57.6 kg K/ha | 11.3 | 12.0 | 12.0 | 11.8 | | | | 11.3 | 12.0 | 12.0 | 11.8 | | | |
| | 192 kg N + 115.2 kg K/ha | 12.0 | 12.0 | 12.0 | 12.0 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 288 kg N + 0 kg K/ha | 12.7 | 12.0 | 12.0 | 12.2 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 288 kg N + 57.6 kg K/ha | 12.0 | 12.0 | 12.0 | 12.0 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 288 kg N + 115.2 kg K/ha | 12.7 | 12.0 | 12.0 | 12.2 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 384 kg N + 0 kg K/ha | 12.0 | 12.0 | 12.0 | 12.0 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 384 kg N + 57.6 kg K/ha | 12.0 | 12.0 | 12.0 | 12.0 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| | 384 kg N + 115.2 kg K/ha | 12.0 | 12.0 | 12.0 | 12.0 | | | | 12.0 | 12.0 | 12.0 | 12.0 | | | |
| Average (A) | | 12.0 | 12.0 | 12.0 | | | | | 11.9 | 12.0 | 12.0 | | | | |
| Number of grains/ear | 192 kg N + 0 kg K/ha | 372.9 | 408.0 | 396.0 | 392.3 | ns | 34.7 | 45.6 | 372.0 | 360.0 | 411.6 | 381.2 | 20.1 | 25.9 | 44.9 |
| | 192 kg N + 57.6 kg K/ha | 493.8 | 480.0 | 471.6 | 481.8 | | | | 372.9 | 519.6 | 476.4 | 456.3 | | | |
| | 192 kg N + 115.2 kg K/ha | 543.6 | 507.6 | 531.6 | 527.6 | | | | 560.4 | 507.6 | 567.6 | 545.2 | | | |
| | 288 kg N + 0 kg K/ha | 435.6 | 384.0 | 384.0 | 401.2 | | | | 387.6 | 411.6 | 387.6 | 395.6 | | | |
| | 288 kg N + 57.6 kg K/ha | 423.6 | 504.0 | 516.0 | 481.2 | | | | 459.6 | 528.0 | 543.6 | 510.4 | | | |
| | 288 kg N + 115.2 kg K/ha | 516.9 | 567.6 | 500.4 | 528.3 | | | | 504.0 | 560.4 | 536.4 | 533.6 | | | |
| | 384 kg N + 0 kg K/ha | 404.4 | 384.0 | 428.4 | 405.6 | | | | 432.0 | 404.4 | 432.0 | 422.8 | | | |
| | 384 kg N + 57.6 kg K/ha | 519.6 | 483.6 | 512.4 | 505.2 | | | | 536.4 | 512.4 | 548.4 | 532.4 | | | |
| | 384 kg N + 115.2 kg K/ha | 492.0 | 540.0 | 519.6 | 517.2 | | | | 519.6 | 536.4 | 552.0 | 536.0 | | | |
| Average (A) | | 466.9 | 473.2 | 473.3 | | | | | 460.5 | 482.3 | 495.1 | | | | |
| 100- grain weight (g) | 192 kg N + 0 kg K/ha | 40.0 | 36.3 | 39.0 | 38.4 | 0.73 | 2.1 | 3.6 | 39.0 | 37.7 | 40.0 | 38.9 | 1.3 | 2.2 | 3.8 |
| | 192 kg N + 57.6 kg K/ha | 47.3 | 44.7 | 51.0 | 47.7 | | | | 48.3 | 45.7 | 51.7 | 48.6 | | | |
| | 192 kg N + 115.2 kg K/ha | 43.7 | 48.7 | 50.7 | 47.7 | | | | 44.7 | 50.0 | 52.0 | 48.9 | | | |
| | 288 kg N + 0 kg K/ha | 38.3 | 37.7 | 39.3 | 38.4 | | | | 38.0 | 39.3 | 40.0 | 39.1 | | | |
| | 288 kg N + 57.6 kg K/ha | 39.0 | 46.3 | 47.3 | 44.2 | | | | 40.0 | 47.7 | 48.7 | 45.5 | | | |
| | 288 kg N + 115.2 kg K/ha | 43.7 | 51.0 | 45.7 | 46.8 | | | | 44.0 | 52.0 | 46.7 | 47.6 | | | |
| | 384 kg N + 0 kg K/ha | 37.0 | 38.7 | 38.6 | 38.1 | | | | 36.7 | 37.7 | 39.3 | 37.9 | | | |
| | 384 kg N + 57.6 kg K/ha | 44.7 | 43.3 | 44.3 | 44.1 | | | | 45.7 | 44.7 | 45.3 | 45.2 | | | |
| | 384 kg N + 115.2 kg K/ha | 43.7 | 45.7 | 51.0 | 46.8 | | | | 45.0 | 46.7 | 52.7 | 48.1 | | | |
| Average (A) | | 41.6 | 44.3 | 44.8 | | | | | 42.1 | 45.3 | 45.9 | | | | |

- ns.: not significant difference at 0.05 level of probability according to LSD.

The obtained results in Tables (4) showed that grain yield, biological yield, and harvest index (%) were significantly affected by maize hybrids and combined nitrogen and potassium fertilization rates in both seasons.

The results showed that there was significant effect of grain yield, biological yield and harvest index (%) for the three maize hybrids, whereas the hybrid TWC321 achieved the highest mean value of grain yield (4.0 and 4.7 t/ha), biological yield (13.4 and 11.0 t/ha) and harvest index (39.5 and 42.5 %) as compared with the others two hybrids in both seasons. The different responses among these hybrids may be due to genetics. These results are in agreement with those reported by Kandil (2013) and Faheed *et al*. (2016). Also, Minjian *et al.* (2007) reported that modern hybrids of maize respond to K differently due to differences in its uptake, translocation, growth, and utilization.

The results in the same Table show the effect of N + K fertilization levels on grain yield, biological yield and harvest index (%), where application of the rate at 384 kg N + 57.6 kg K/ha achieved the highest mean value of grain yield (5.9 and 5.3 t/ha) and biological yield (14.6 and 12.2 t/ha) followed by the rate of 288 N kg + 57.6 Kg K/ha which gave the highest harvest index (40.2 and 43.4 %), respectively, while the lowest ones were observed with adding 192 kg N + 0 kg K kg/ha in both seasons. These results are in the same line as those indicated by Damon and Rengel (2008), William (2008), Kandil (2013), Faheed *et al*. (2016) and Gomaa *et al.* (2016).

Table (4) resulted that there were significant interaction effects on some plant characters *i.e*., grain yield, biological yield and harvest index (%) of maize, where the highest mean value of grain yield (6.4 and 5.8 t/ha), biological yield (15.6 and 13.2 t/ha) were recorded with fertilizing TWC321 with 384 kg N + 57.6 kg K/ha, but the highest value of harvest index (41.1 and 44.1 %) was given with TWC321 + 192 kg N + 57.6 kg K/ha, respectively in both seasons, while the lowest ones were obtained with fertilizing SC121 with the rate of 192 kg N + 0.0 kg K/ha during the two seasons.

**Table (4).** Plant attributes of three maize hybrids as affected by potassium fertilization forms and their interaction in both seasons.

| Attributes | N + K- fertilizer (B) | Season 2017 | | | | | | | Season 2018 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | |
| | | S.C.10 | S.C.121 | T.W.C. 321 | | A | B | AB | S.C.10 | S.C.10 | T.W.C. 321 | | A | B | AB |
| Grain yield (t/ha) | 192 kg N + 0 kg K/ha | 4.1 | 3.5 | 3.7 | 3.8 | 0.3 | 0.3 | 0.7 | 3.5 | 2.9 | 3.1 | 3.2 | 0.3 | 0.4 | 0.7 |
| | 192 kg N + 57.6 kg K/ha | 4.7 | 5.6 | 6.4 | 5.5 | | | | 4.1 | 5.0 | 5.6 | 4.9 | | | |
| | 192 kg N + 115.2 kg K/ha | 4.8 | 5.2 | 5.6 | 5.2 | | | | 4.2 | 4.6 | 5.0 | 4.6 | | | |
| | 288 kg N + 0 kg K/ha | 3.7 | 4.7 | 4.2 | 4.2 | | | | 3.1 | 4.1 | 3.6 | 3.6 | | | |
| | 288 kg N + 57.6 kg K/ha | 5.1 | 6.3 | 5.8 | 5.7 | | | | 4.5 | 5.7 | 5.0 | 5.1 | | | |
| | 288 kg N + 115.2 kg K/ha | 5.2 | 6.0 | 5.7 | 5.6 | | | | 4.6 | 5.4 | 5.1 | 5.0 | | | |
| | 384 kg N + 0 kg K/ha | 4.1 | 4.3 | 4.5 | 4.3 | | | | 3.5 | 3.7 | 3.9 | 3.7 | | | |
| | 384 kg N + 57.6 kg K/ha | 6.0 | 5.2 | 6.4 | 5.9 | | | | 5.4 | 4.6 | 5.8 | 5.3 | | | |
| | 384 kg N + 115.2 kg K/ha | 4.5 | 4.9 | 5.8 | 5.1 | | | | 3.9 | 4.3 | 5.2 | 4.5 | | | |
| Average (A) | | 3.8 | 3.8 | 4.0 | | | | | 4.1 | 4.5 | 4.7 | | | | |
| Biological yield (t/ha) | 192 kg N + 0 kg K/ha | 11.1 | 9.8 | 10.3 | 10.4 | 0.7 | 0.8 | 1.2 | 8.6 | 7.4 | 7.9 | 8.0 | 0.7 | 0.8 | 1.3 |
| | 192 kg N + 57.6 kg K/ha | 12.1 | 14.0 | 15.1 | 13.7 | | | | 9.7 | 11.6 | 12.7 | 11.3 | | | |
| | 192 kg N + 115.2 kg K/ha | 12.5 | 13.3 | 13.9 | 13.2 | | | | 10.1 | 10.9 | 11.5 | 10.8 | | | |
| | 288 kg N + 0 kg K/ha | 10.2 | 12.1 | 11.2 | 11.2 | | | | 7.8 | 9.7 | 8.8 | 8.8 | | | |
| | 288 kg N + 57.6 kg K/ha | 12.9 | 15.3 | 14.3 | 14.2 | | | | 10.5 | 12.9 | 11.9 | 11.8 | | | |
| | 288 kg N + 115.2 kg K/ha | 13.1 | 14.7 | 14.2 | 14.0 | | | | 10.7 | 12.3 | 11.8 | 11.6 | | | |
| | 384 kg N + 0 kg K/ha | 11.0 | 11.1 | 11.7 | 11.3 | | | | 8.6 | 8.9 | 9.3 | 8.9 | | | |
| | 384 kg N + 57.6 kg K/ha | 14.9 | 13.3 | 15.6 | 14.6 | | | | 12.5 | 10.9 | 13.2 | 12.2 | | | |
| | 384 kg N + 115.2 kg K/ha | 11.7 | 12.7 | 14.3 | 12.9 | | | | 9.3 | 10.3 | 11.9 | 10.5 | | | |
| Average (A) | | 12.2 | 12.9 | 13.4 | | | | | 9.8 | 10.5 | 11.0 | | | | |
| Harvest index (HI %) | 192 kg N + 0 kg K/ha | 36.9 | 35.7 | 35.9 | 36.2 | 0.4 | 0.7 | 1.2 | 40.7 | 39.2 | 39.2 | 39.7 | 0.4 | 0.6 | 1.1 |
| | 192 kg N + 57.6 kg K/ha | 38.8 | 40.0 | 41.1 | 40.0 | | | | 42.3 | 43.1 | 44.1 | 43.1 | | | |
| | 192 kg N + 115.2 kg K/ha | 38.4 | 39.1 | 40.3 | 39.3 | | | | 41.6 | 42.2 | 43.5 | 42.4 | | | |
| | 288 kg N + 0 kg K/ha | 36.3 | 38.8 | 37.5 | 37.5 | | | | 39.7 | 42.3 | 40.9 | 41.0 | | | |
| | 288 kg N + 57.6 kg K/ha | 39.5 | 41.2 | 40.6 | 40.4 | | | | 42.9 | 44.2 | 42.0 | 43.0 | | | |
| | 288 kg N + 115.2 kg K/ha | 39.7 | 40.8 | 40.1 | 40.2 | | | | 43.0 | 43.9 | 43.2 | 43.4 | | | |
| | 384 kg N + 0 kg K/ha | 37.3 | 38.7 | 38.5 | 38.2 | | | | 40.7 | 41.6 | 41.9 | 41.4 | | | |
| | 384 kg N + 57.6 kg K/ha | 40.3 | 39.1 | 41.0 | 40.1 | | | | 43.2 | 42.2 | 43.9 | 43.1 | | | |
| | 384 kg N + 115.2 kg K/ha | 38.5 | 38.6 | 40.6 | 39.2 | | | | 41.9 | 41.7 | 43.7 | 42.5 | | | |
| Average (A) | | 38.4 | 39.1 | 39.5 | | | | | 41.8 | 42.3 | 42.5 | | | | |

The obtained results in Table (5) showed that disease incidence % of leaf blight on three maize hybrids were significantly affected by combined nitrogen and potassium fertilization rates in both seasons.

The results showed that there was no significant effect of disease incidence % for the three maize hybrids, whereas the hybrid TWC321 had no leaf blight infestation % as compared with the other two hybrids in both seasons. On the other hand, there was no significant difference between the other two hybrids in both seasons. These results are in agreement with those reported by Williams and Hallauer (2000); Kraja *et al*. (2000**)** who showed that the difference of genotypes in disease severity was due to diversity in their genetic makeup.

The results in the same Table show the effect of N + K fertilization levels on leaf blight incidence (%) and disease severity %, where application of the rate at 384 kg N + 57.6 kg K/ha gave the highest % of leaf blight incidence (%) and disease severity (%), while the lowest % of was observed with adding 288 kg N + 0.0 kg K kg/ha in both seasons. The use of fertilizers produces a more direct means of using nutrients to reduce the severity of many diseases and together with cultural practices can affect the control of diseases (Marschner, 1995; Atkinson and McKinlay, 1997; Oborn *et al*., 2003). Nutrients can affect the development of a disease by affecting plant physiology or by affecting pathogens, or both of them. The level of nutrients can influence the plant growth, which can affect the microclimate, therefore affecting infection and sporulation of the pathogen (Marschner, 1995). Also, the level of nutrients can affect the physiology and biochemistry and especially the integrity of the cell walls, membrane leakage and the chemical composition of the host

Application of K can decrease Helminthosporium leaf blight severity and increase grain yields in wheat (Sharma and Duveiller, 2004; Sharma *et al*., 2005). It has been shown that K fertilization can reduce the intensity of several infectious diseases of obligate and facultative parasites

Table (5) resulted that there were significant interaction effects on disease incidence (%) and disease severity % of maize leaf blight, where the highest value of disease incidence (%)

and disease severity (%) was recorded with fertilizing SC121 with 288 kg N + 57.6 kg K/ha in both seasons.

**Table 5.** Disease incidence and disease severity % of leaf blight on three maize hybrids as affected by potassium fertilization forms and their interaction in both seasons.

| Attributes | N + K- fertilizer (B) | Season 2017 | | | | | | | Season 2018 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | | Maize hybrids (A) | | | Average (B) | L.S.D. at 0.05 | | |
| | | S.C.10 | S.C.121 | T.W.C. 321 | | A | B | AB | S.C.10 | S.C.10 | T.W.C. 321 | | A | B | AB |
| Disease incidence % | 192 kg N + 0 kg K/ha | 4.3 | 37.3 | - | 20.8 | | | | 7.0 | 40.3 | - | 23.7 | | | |
| | 192 kg N + 57.6 kg K/ha | 3.3 | 46.3 | - | 24.8 | | | | 6.7 | 50.7 | - | 28.7 | | | |
| | 192 kg N + 115.2 kg K/ha | 3.0 | 30.0 | - | 16.5 | | | | 5.7 | 32.7 | - | 19.2 | | | |
| | 288 kg N + 0 kg K/ha | 7.8 | 10.0 | - | 8.9 | | | | 11.0 | 9.7 | - | 10.4 | | | |
| | 288 kg N + 57.6 kg K/ha | 5.7 | 46.7 | - | 26.2 | ns | 8.9 | 12.6 | 9.3 | 47.3 | - | 28.3 | ns | 22.9 | 11.5 |
| | 288 kg N + 115.2 kg K/ha | 6.7 | 28.3 | - | 17.5 | | | | 10.0 | 31.3 | - | 20.7 | | | |
| | 384 kg N + 0 kg K/ha | 16.7 | 26.7 | - | 21.7 | | | | 20.0 | 33.0 | - | 26.5 | | | |
| | 384 kg N + 57.6 kg K/ha | 6.3 | 42.0 | - | 24.2 | | | | 9.3 | 15.3 | - | 12.3 | | | |
| | 384 kg N + 115.2 kg K/ha | 4.3 | 5.3 | - | 4.8 | | | | 8.3 | 6.7 | - | 7.5 | | | |
| Average (A) | | 6.5 | 30.3 | - | | | | | 9.7 | 29.7 | - | | | | |
| Disease Severity % | 192 kg N + 0 kg K/ha | 15.0 | 24.3 | - | 19.7 | | | | 17.3 | 26.3 | - | 21.8 | | | |
| | 192 kg N + 57.6 kg K/ha | 5.0 | 24.0 | - | 14.5 | | | | 7.3 | 26.0 | - | 16.7 | | | |
| | 192 kg N + 115.2 kg K/ha | 30.7 | 10.0 | - | 20.4 | | | | 30.3 | 12.0 | - | 21.2 | | | |
| | 288 kg N + 0 kg K/ha | 17.0 | 43.3 | - | 30.2 | | | | 19.0 | 45.3 | - | 32.2 | | | |
| | 288 kg N + 57.6 kg K/ha | 62.3 | 13.3 | - | 37.8 | ns | 10.0 | 14.2 | 64.3 | 15.3 | - | 39.8 | ns | 10.2 | 14.4 |
| | 288 kg N + 115.2 kg K/ha | 13.3 | 20.0 | - | 16.7 | | | | 15.3 | 22.0 | - | 18.7 | | | |
| | 384 kg N + 0 kg K/ha | 7.3 | 33.7 | - | 20.5 | | | | 12.3 | 29.7 | - | 21.0 | | | |
| | 384 kg N + 57.6 kg K/ha | 17.7 | 15.7 | - | 16.7 | | | | 19.7 | 12.0 | - | 15.9 | | | |
| | 384 kg N + 115.2 kg K/ha | 3.7 | 11.0 | - | 7.4 | | | | 6.3 | 12.3 | - | 9.3 | | | |
| Average (A) | | 19.1 | 21.7 | - | | | | | 21.3 | 22.3 | - | | | | |

- ns.: not significant difference at 0.05 level of probability according to LSD.

## CONCLUSION:

Yield and its components of the three maize hybrids were affected by N + K fertilization. The highest value of yield characters was achieved when fertilizing TWC321 by the rate of N and K (384 kg N/ha + 57.6 kg K/ha) and no fungal diseases infestation with this hybrid under Alexandria conditions.

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## ARABIC SUMMARY

### أستجابة بعض هجن الذرة الشامية للتسميد النيتروجيني والبوتاسي وعلاقتها ببعض الأمراض الفطرية

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الذرة الشامية تعتبر ثالث أهم محاصيل الحبوب بعد القمح والأرز حيث تستخدم كغذاء للإنسان كدقيق مع دقيق القمح ، كعلف أخضر أو مركز وفي الوقود الحيوي وغيرها من الاستخدامات وتهتم به الحكومة المصرية لتقليل الفجوة الغذائية منه وتقليل الكميات المستوردة منه عن طريق إختيار أفضل الهجن عالية الأنتاج والمناسبة للمنطقة وتحديد معدلات التسميد المناسبه والأقل إصابة بالأمراض الفطرية او الأكثر مقاومة.

لذلك أقيمت تجربتان حقليتان بمزرعة كلية الزراعة سابا باشا - بمنطقة ابيس – محافظة الأسكندرية – مصر خلال موسمى الزراعة 2017 و 2018 لدراسة تأثير التسميد النتروجيني والبوتاسي على ثلاثة هجن من الذرة الشامية والإصابة ببعض الأمراض الفطرية. وكان التصميم المستخدم هو القطع المنشقة مرة واحدة فى ثلاثة مكررات حيث وزعت معاملات كالأتي:

أ- القطع الرئيسية: (هجن الذرة الشامية) : ثلاث هجن من الذرة الشامية هجين فردي 10 أبيض ، هجين فردي 121 أبيض و هجين فردي 321 أصفر.

ب- القطع الشقية: (معدلات التسميد الأزوتي و البوتاسي : 192كجم نتروجين/هكتار + بدون بوتاسيوم ، 192 كجم نتروجين/هكتار+ 57.5 كجم بوتاسيوم /هكتار ، 192 كجم نتروجين/هكتار+ 115.2كجم ، 288كجم نتروجين/هكتار+ بدون بوتاسيوم /هكتار ، 288كجم نتروجين/هكتار+ 57.5 كجم ، 288كجم نتروجين/هكتار+ 115.2 كجم بوتاسيوم /هكتار ، 384كجم نتروجين/هكتار + بدون بوتاسيوم ،384 كجم نتروجين/هكتار+ 57.5 كجم بوتاسيوم/هكتار ، 384كجم نتروجين/هكتار+ 115.2 كجم بوتاسيوم/هكتار).

أضيف النيتروجين في صورة نترات النشادر (33.5 % ن) البوتاسيوم في صورة سلفات البوتاسيوم (48 % بو$_2$أ).

**ويمكن تلخيص أهم النتائج:**

1- اختلفت هجن الذرة الشامية فيما بينها معنوياً في صفات ارتفاع النبات ، وعدد الحبوب في الصف ووزن 100 حبة و محصول الحبوب والمحصول البيولوجي ودليل الحصاد خلال موسمي الزراعة، حيث أن هجين فردي 10 سجل أطول النباتات مقارنة بالهجينين الأخريين (فردي 121 ، ثلاثي321) خلال موسمي الدراسة في حين أن الهجين الثلاثي 321 سجل أعلى عدد حبوب في الصف خلال الموسم الثاني فقط ، وحقق أعلى القيم في صفة وزن مائة حبة ، ومحصول الحبوب والمحصول البيولوجي ودليل الحصاد مقارنة بالهجن الأخري خلال موسمى الزراعة.

2- كما اثر التسميد بعنصري النتروجين والبوتاسيوم معنويا على الصفات المدروسة مثل ارتفاع النبات وطول وعدد الحبوب في الصف وعدد الحبوب في الكوز ووزن 100 حبة و محصول الحبوب والمحصول البيولوجي ودليل الحصاد ، حيث أن التسميد بمعدل 384 كجم نتروجين + 115.2 كجم بوتاسيوم للهكتار أعطى أطول النباتات ، بينما التسميد بمعدل 192 كجم نتروجين + 115.2 كجم بوتاسيوم للهكتار سجل أعلى عدد للحبوب لكل صف وعدد حبوب في الكوز ووزن 100 حبة يليه المعدل 384 كجم نتروجين + 115.2 كجم بوتاسيوم للهكتار ثم اضافة 384 كجم نتروجين + 115.2 كجم بوتاسيوم للهكتار دون فرق معنوي خلال موسمي الزراعة. في حين أن المعدل 384 كجم نتروجين + 57.6 كجم بوتاسيوم للهكتار حقق أعلى محصول حبوب ومحصول بيولوجي يليه المعدل 288 كجم نتروجين + 57.6 كجم بوتاسيوم للهكتار دون فروق معنوية ، وهذا المعدل حقق أعلى دليل حصاد خلال موسمي الزراعة.

3- لم يظهر اي إصابة بلفحة الأوراق على الهجين الثلاثي 321 مقارنة بالهجينين فردي 10 و فردي 121 خلال موسمي الدراسة.

4- يمكن التوصية بزراعة هجين الذرة الشامية الثلاثي 321 والتسميد بمعدل 288 كجم نتروجين + 57.6 كجم بوتاسيوم للهكتار لأن هذا أدى الى أعلى محصول حبوب ومكوناته وأقل إصابة بالأمراض الفطرية تحت ظروف منطقة أبيس – الأسكندرية.