*Zagazig J. Agric. Res., Vol. 33 No. (6) 2006* 1043 - 1062

# MAIZE YIELD AND ITS ATTRIBUTES AS AFFECTED BY CROPPING SEQUENCES, WATER REQUIREMENTS AND SOURCES OF NITROGEN FERTILIZATION UNDER DRIP IRRIGATION SYSTEM IN SANDY SOIL

**Hussein , Samira M.A.[1] and A.M. El-Melegy[2]**
**[1] Field Crop Institute, Agric. Res. Center, Giza, Egypt**
**[2] Soil, Water & Environ. Res. Inst., Agric. Res. Center, Giza, Egypt**

*Accepted 18/ 10 / 2006*

**ABSTRACT: This investigation was conducted at Wadi-El Areish North Sinai Governorate during the two growing seasons (2003/2004 and 2004/2005) to study the effect of double and triple sequences, water requirements and sources of nitrogen on grain yield of maize and its attributes ponents under drip irrigation system in sandy soil. The double sequence was faba bean (c.v. 461), followed by maize (S.C. 10). Triple sequence was faba bean (c.v. 461), followed by sunflower (c.v. Vedoc), followed by maize. Recommended water requirements of maize in sandy soils similar to that of Wadi-El-Areish soil was estimated to be 2841 $m^3$ under drip irrigation system per season. Irrigation treatments were; recommended + 25% (R1 = 3550 $m^3$), recommended (R2 = 2841 $m^3$) and recommended -25% (R3=2131$m^3$) per season. The recommended dose of nitrogen per feddan (130 kg N) were added from different sources; all N in organic form, 1/2 N in organic + 1/2 in mineral form of ammonium nitrate (33.5% N) and all N in mineral form. The study was conducted in a split-split plots design with 3 replications. The results indicated that maize yield and all of its attributes were significantly higher for the double cropping than for the triple cropping sequence, this was also true regarding applicat the more irrigation water as well as the addition of N partly in mineral and organic form.**

**The interaction between cropping sequences and water requirements had a significant effect on No of days to 50% tassling and silking, plant height, ear position, ear diameter, kernels weight/ear, 100-kernels weight, shelling % and grain yield/feddan. The highest values of these traits were obtained under double**

**cropping sequence with the increase of water requirements as in R1 (3550 m$^3$/fed). Also there were significant interactions effects between cropping sequences and sources of nitrogen on ear diameter, kernels weight/ear, shilling % and grain yield/fed.. The highest values of these traits were obtained under double cropping sequence and 50% organic and 50% mineral forms of N-fertilizer. In addition ear length, kernel weight/ear and grain yield/fed. were significantly affected by the interaction between water requirements and sources of N-fertilizer. It could be concluded that the highest values of ear length, kernel weight/ear and grain yield/fed. were obtained with the recommended irrigation treatment +25% (R1) with the treatment of fertilization (1/2 organic + 1/2 mineral). The effect of the 2$^{nd}$ order interaction was significant on grain yield/fed. Also, the highest yield and its components were obtained from double cropping sequence with water requirement of 3350 m$^3$/fed/season with nitrogen fertilization (130 kg N/fed.) in half amount in organic form + half amount in mineral form.**

**Economically; grain yield for each crop of faba bean, sunflower and maize was calculated in double and triple cropping sequences, the highest net profit and C.Us were obtained when maize plants were planted in triple sequence (faba bean – sunflower – maize) with water requirement 3550 m$^3$/fed/season under drip irrigation system with nitrogen dose of 130 kg/fed. given as 50% in organic form and 50% in mineral form.**

Key words: **Maize, cropping, sequences, water requirements, nitrogen fertilization sources sandy soil .**

## INTRODUCTION

The cropping sequence is a prime factor affecting yield potential, may have important role as a complex interaction of physical, chemical and biological equilibrium state. The effect of crop sequence and crop rotation in Egypt were studied by several investigators, Gouda (1989), Seif El-Nasr *et al.* (1993) and Hussein, Samira *et al.* (1998) revealed that yield of summer crops tended to be higher after legumes than after non-legumes. Khalil *et al.* (2004), found that sunflower planted after clover produced greater seed yield than when it was grown after faba been. Legumes as preceeding crops were always recommended than cereals. (Dansa and Papastylianou, 1992). Double sequence (faba bean-follow maize) expected to give higher maize yield than triple sequence (faba bean-sunflower-maize). Sunflower ranks the second to soybean among the world's oil crops, is receiving increasing attention in Egypt as a source of vegetable oil to decrease oil imports. Both of faba bean which is the most important legume crop and maize is one of the major cereal crops grown in Egypt and because no place in crop rotation for oil crops specially sunflower, could be grown in a triple cropping sequence as a solution for this problems. In Egypt as well as in other countries, maize growing several workers investigated the effect of irrigation requirements, forms of nitrogen application. Eid *et al*. (1996) reported that the total water requirements in the new lands for summer crops averages were 2841 $m^3$/season under drip irrigation system. Haikel and El-Badry Ola (1995), reported that the water quantity in the whole season was 2688.00 $m^3$ for maize under drip irrigation system. The form of nitrogen fertilizer as a manure is very important to improve the physical and chemical characters of the soil; increasing cations exchange capacity, minimizing the loss of nutrients increasing water holding capacity, improvement bulk density, soil structure and formation (Alexander, 1977 and Haikel *et al* 2000). However, some investigators found that, ammonium sulphate or ammonium nitrate were superior than slow-release N fertilizer on increasing growth and N-uptake (Sakia *et al*., 1987). However Haikel *et al*. (2000) found that the fertilizer which has nitrogen in organic form and in the same time fast-release (Mokattam manure) gave higher yield of maize compared with cow manure or ammonium nitrate.

## MATERIALS AND METHODS

The present investigation was conducted at Wadi-El-Areish, North Sinai Governorate during 2003/2004 and 2004/2005 growing seasons to investigate the effect of double and triple cropping sequences, water requirements and nitrogen fertilizer sources in form of organic and mineral (Ammonium nitrate 33.5% N) on yield and yield components of maize.

The first factor under study was cropping sequences as follows:

A)Double cropping sequence; faba bean (c.v. Giza 461) was planted on $15^{th}$ and $18^{th}$ of October in first and second seasons, respectively followed by maize (c.v. S.C. 10) which was planted on $10^{th}$ and $15^{th}$ of

May in first and second seasons, respectively and was harvested on 5th and 7th of September in the two seasons respectively.

B) Triple cropping sequence; faba bean (c.v. Giza 461) was planted on the same dates of double cropping sequence, followed by sunflower (c.v. Vedoc) which planted on the 1st and 4th of April in first and second seasons respectively, followed by Maize (c.v. S.C. 10) which planted on 15th and 20th of July in first and second seasons, respectively and harvested on 10th and 13th of October in the two seasons respectively.

The second factor was irrigation water requirements for maize were; R1 (recommended + 25%), R2 (recommended only) and R3 (recommended -25%). The recommended water requirement of maize in sandy soil under drip irrigation system was 2841 $m^3$/season according to Eid *et al.* (1996). The irrigation treatments were R1 = recommended + 25% = 3550.0 $m^3$/fed./season and R3 = recommended -25%=2131 $m^3$/ fed./ season, the distance between laterals was 70.0 cm and between drippers was 30 cm. This system gives 20000 drippers/fed. Maize seeds were sown on each dripper and thinned to one plant/ hill expressed 20000 plants/fed. The discharge of each dripper was 2.4 liter/hour, as illustrated in Table 1 which shows the water requirements /season for maize and time of the irrigation/day for R1, R2 and R3 treatments.

The third factor was nitrogen fertilizer sources, maize plants received 130 kg N/fed/season as follows, (1) all the dose of nitrogen/fed was added as old chicken manure (1.73% N, 0.35% $P_2O_5$, 1.3% $K_2O$, 1:17 C/N ratio and organic matter 45%) added at a rate of 7.52 ton/fed (2) half the amount of nitrogen as old chicken manure (3.76 ton/fed) and the other half applied as mineral nitrogen in ammonium nitrate 33.5% N at a rate of 194.0 kg/fed, and (3) all the nitrogen amount was added as mineral fertilizer in form of ammonium nitrate 33.5% N at a rate of 388 kg/fed. The mineral fertilizer was split into 5 equal splits added in 10 days interval and was injected through the drip irrigation system after two weeks from planting. The chicken manure was fully added at seed bed preparation.

Two experiments were conducted in two successive growing seasons in a split-split plot design with three replications. Cropping sequences occupied the main plots, water requirements

(R1, R2 and R3) occupied the sub-plots, whereas nitrogen sources were allocated in the sub-subplots. The sub-subplot area was 98 $m^2$ (10.0 x 9.8 m) included 14 ridges, 10m long. Phosphorus was applied as calcium superphosphate (15% $P_2O_5$) at a rate of 200 kg/fed in one dose before plowing and potassium was applied as potassium sulphate (50% $K_2O$) at a rate of 50 kg/fed. in 3 doses; 1/3 with superphosphate, 1/3 at tassiling and 1/3 at grain filling. Thinning took place after two weeks from planting leaving one plant/hill. The other cultural practices were applied as recommended. In double and triple sequences, faba bean yield was calculated and seed yield of sunflower was determine in triple sequence. The recorded data on maize were; number of days to 50% tasseling and silking, ten garded plants from each sub-subplot were taken to determine some growth traits; i.e plant height (cm), stem diameter (cm), ear position (cm). After harvesting, 10 ears were taken at random from each sub-subplots to determine, ear length (cm), ear diameter (cm), kernels weight/ear (g), 100 kernals weight (g), shilling percentage. Grain yield/fed (ardab), maize plants in the four inner rows of each sub-subplot were harvested at maturity, tied and left to dry, then it was threshold, grain ratio was estimated in 15.5% moisture and converted to ardab/fed. before carrying out of the experiment, soil samples were taken from different places to represent the experimental site for analysis as well as before faba bean before sunflower and maize [P according to Olsen *et al.* (1954) and N & K according to Jackson (1967)] Table 2.

**Table 1. Averages of water requirements/season and period of irrigation/day for R1, R2 and R3 for maize productivity**

| Irrigation requirements | R1 Recommended + 25% $m^3$/fed. /season | R2 Recommended $m^3$/fed./ season | R3 Recommended - 25% $m^3$/fed. / season |
|---|---|---|---|
| (1) Water requirements/ fed./ season | 3550.0 | 2841.0 | 2131.0 |
| (2) Water requirements/ day (1) ÷100 day | 35.50 | 28.41 | 21.31 |
| (3) Water requirements/ plant/day (2) ÷20000 drippers | 1.78 liter | 1.42 liter | 1.07 liter |
| (4) Period of irrigation/day (3) ÷2.4 (discharge of dripper liter/hour) | 0.74 hour = 44.4 minutes | 0.59 hour = 35.4 minutes | 0.45 hour = 27 minutes |

**Table 2. Average of mechanical and chemical soil properties of the experimental site over the two seasons**

| Characters | Mechanical analysis before faba bean over two season | | |
|---|---|---|---|
| Clay | 3.05 | | |
| Silt | 5.85 | | |
| Fine sand | 61.83 | | |
| Coarse sand | 24.42 | | |
| O.M | 0.75 | | |
| Ca carbonate | 4.10 | | |
| Texture | Sandy | | |
| Crops / Chemical analysis | Before faba bean | Before sunflower (Triple), after faba bean before maize (Double sequence) | Before maize (after sunflower) (Triple sequence) |
| Aval. N ppm | 15.9 | 25.5 | 21.6 |
| Aval. P ppm | 8.9 | 9.5 | 7.3 |
| Aval. K ppm | 132.0 | 129.8 | 118.6 |
| pH | 8.8 | 7.9 | 8.4 |
| E.C. ds/m | 2.8 | 2.3 | 2.5 |
| Fe ppm | 1.05 | 1.01 | 1.00 |
| Mn ppm | 0.76 | 0.63 | 0.61 |
| Zn ppm | 0.07 | 0.06 | 0.04 |
| B ppm | 0.006 | 0.004 | 0.003 |

*1:2.5 soil-water suspension.

Obtained data were subjected to the proper statistical analysis as the usual technique of analysis of variance (ANOVA) for split-split plots design as mentioned by Gomez and Gomez (1984). The treatment means were compared using the newly least significant differences (N-LSD) as the procedures outlined by Waller and Duncan (1969).

Economical evaluation included Net return for crop sequences, of water consumption of maize and of different sources of nitrogen and cereal units (C.Us) according to Brochhous (1962).

## RESULTS AND DISCUSSION

### Effect of Cropping Sequences on Growth, Yield and Yield Attributes of Maize

Data in Tables 3a, b and c indicate that all studied growth traits, yield and yield attributes of maize were significantly affected by cropping sequences. Results revealed that all traits under study were higher after faba bean in double cropping sequence, than after sunflower in triple cropping sequence. The increase in growth duration to tasseling and silking along with the increase in maize grain yield and all of its attributes after faba bean could be mainly attributed to early planting of maize in May. The increases in grain yield in double sequence amounted 2.40 and 2.00 ard./fed. than in triple sequence in the two seasons respectively. These increases attributed to that maize was planted at the optimum date ($10^{th}$ and $15^{th}$ of May in first and second seasons, respectively) which put maize plants in suitable time for good growth, whereas in triple sequence maize was planted in $15^{th}$ and $20^{th}$ of July in first and second seasons respectively, the late planting does not give the optimum period for light or temperature to plant growth, for these reasons all studied traits showed the lower values in triple sequence comparing to double sequence. Similar results were recorded by Shafshak *et al.* (1982) and Hussain, Samira *et al.* (1998) mentioned that the highest values of maize grain yield/fed. under drip irrigation system in sandy soil was obtained when maize was sown after legume crops than after cereal crops.

**Table 3 a. Effect of cropping sequences, water requirements and sources of nitrogen fertilization on No. of days to 50% tasseling and silking, plant height (cm) and stem diameter (cm) in the two seasons**

| Treatments | No. of days to 50% tasseling | | No. of days to 50% selking | | Plant height (cm) | | Stem diameter (cm) | |
|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| **Cropping sequences (A)** | | | | | | | | |
| Double sequence | 62.69 | 65.50 | 67.40 | 71.20 | 258.00 | 260.70 | 3.09 | 3.43 |
| Triple sequence | 57.18 | 59.10 | 62.20 | 66.20 | 236.70 | 238.30 | 2.32 | 2.73 |
| F-test | * | ** | * | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 0.60 | 0.80 | 0.90 | 1.10 | 3.90 | 6.20 | 0.16 | 0.17 |
| **Water requirements (B)** | | | | | | | | |
| R1 = Recommended + 25% | 62.90 | 65.30 | 66.70 | 71.80 | 257.10 | 267.40 | 3.03 | 3.52 |
| R2 = Recommended | 59.40 | 63.30 | 65.10 | 68.60 | 252.10 | 255.50 | 2.79 | 3.16 |
| R3 = Recommended – 25% | 57.50 | 58.40 | 62.50 | 65.80 | 232.90 | 225.70 | 2.29 | 2.57 |
| F-test | ** | ** | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 0.70 | 1.10 | 1.20 | 1.40 | 4.90 | 7.60 | 0.21 | 0.31 |
| **Sources of N fertilization (C)** | | | | | | | | |
| All manure nitrogen | 58.80 | 60.30 | 61.40 | 65.70 | 239.20 | 240.40 | 2.53 | 2.90 |
| Manure 50% + Mineral 50% | 61.30 | 65.40 | 67.40 | 72.70 | 254.20 | 258.70 | 2.85 | 3.33 |
| All mineral nitrogen | 59.60 | 61.30 | 65.60 | 67.80 | 248.80 | 249.40 | 2.74 | 3.02 |
| F-test | ** | * | ** | ** | ** | * | ** | ** |
| N.L.S.D. 5% | 0.50 | 0.60 | 0.80 | 0.90 | 4.20 | 5.40 | 0.04 | 0.05 |
| **Interactions:** | | | | | | | | |
| A x B | * | * | * | * | * | * | N.S. | N.S. |
| A x C | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| B x C | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| A x B x C | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |

Table 3 b. Effect of cropping sequences, water requirements and sources of nitrogen fertilization on ear position (cm), ear length and ear diameter (cm) in the two seasons.

| Treatments | Ear position (cm) | | Ear length (cm) | | Ear diameter (cm) | |
|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| **Cropping sequences (A)** | | | | | | |
| Double sequence | 142.0 | 146.8 | 17.1 | 19.3 | 4.8 | 5.0 |
| Triple sequence | 131.0 | 135.7 | 16.0 | 16.8 | 3.4 | 4.1 |
| F-test | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 2.9 | 2.5 | 0.2 | 0.4 | 0.11 | 0.19 |
| **Water requirements (B)** | | | | | | |
| R1 = Recommended + 25% | 148.4 | 152.9 | 18.3 | 19.2 | 4.5 | 5.0 |
| R2 = Recommended | 137.0 | 142.4 | 16.9 | 18.1 | 4.3 | 4.7 |
| R3 = Recommended - 25% | 124.1 | 128.4 | 14.4 | 16.9 | 3.5 | 3.9 |
| F-test | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 2.6 | 3.0 | 0.4 | 0.5 | 0.15 | 0.24 |
| **Sources of N fertilization (C)** | | | | | | |
| All manure nitrogen | 129.5 | 135.4 | 14.4 | 16.2 | 3.7 | 4.3 |
| Manure 50% + Mineral 50% | 144.1 | 148.0 | 18.5 | 20.0 | 4.5 | 4.8 |
| All mineral nitrogen | 135.9 | 140.3 | 16.7 | 18.0 | 4.1 | 4.5 |
| F-test | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 2.1 | 2.2 | 0.3 | 0.4 | 0.08 | 0.16 |
| **Interactions:** | | | | | | |
| A x B | * | * | N.S. | N.S. | * | * |
| A x C | N.S. | N.S. | N.S. | N.S. | * | * |
| B x C | N.S. | N.S. | * | * | N.S. | N.S. |
| A x B x C | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |

## Effect of Water Requirements on Growth, Yield and Yield Attributes of Maize

All studied traits were significantly affected by water requirements as results are presented in Tables 3a, b and c. Results clearly indicate that the application of 3550.0 $m^3$ ($R_1$= recommended +25%) gave the highest values for all traits under study, followed by $R_2$ (recommended = 2841 $m^3$/ season) and the lowest values were for $R_3$ ($R_2$–25% =2131 $m^3$). The increases of yield with increasing irrigation water from R3 (2131 $m^3$/season) to R1 (3350$m^3$/season) was 35.17%. The increase in maize grain yield and all its attributes due to the increase in the amount of irrigation water was rather expected as the soil of the experimental site was sandy Table 3a, b and c. The averages grain yield/fed were 13.450, 15.895 and 18.180 for $R_3$, $R_2$ and $R_1$ respectively over both seasons. The increase of yield and its attributes in $R_1$ (recommended +25%) attributed to the importance of the water in sandy soil and its availability in the soil which solve

Table 3c. **Effect of cropping sequences, water requirements and sources of nitrogen fertilization on kernels weight (gm), 100 kernel weight (gm), shilling %, and grain yield ardab/fed. in the two seasons**

| Treatments | Kernels weight gm/ear | | 100 kernel weight (gm) | | Shilling % | | Grain yield ardab/fed | |
|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| **Cropping sequences (A)** | | | | | | | | |
| Double sequence | 136.4 | 138.8 | 21.5 | 22.7 | 75.8 | 78.7 | 16.530 | 17.350 |
| Triple sequence | 122.5 | 126.0 | 20.1 | 21.1 | 70.2 | 74.3 | 14.130 | 15.350 |
| F-test | ** | ** | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 1.5 | 1.7 | 0.2 | 0.3 | 0.4 | 0.5 | 0.350 | 0.410 |
| **Water requirements (B)** | | | | | | | | |
| R1 = Recommended + 25% | 138.2 | 142.4 | 23.5 | 24.8 | 76.2 | 79.8 | 17.670 | 18.690 |
| R2 = Recommended | 130.9 | 133.5 | 20.3 | 21.4 | 73.6 | 77.3 | 15.270 | 16.520 |
| R3 = Recommended – 25% | 119.2 | 121.3 | 18.6 | 19.6 | 69.2 | 72.4 | 13.050 | 13.850 |
| F-test | ** | ** | ** | ** | ** | ** | ** | ** |
| N.L.S.D. 5% | 1.8 | 1.9 | 0.3 | 0.4 | 0.5 | 0.6 | 0.370 | 0.600 |
| **Sources of N fertilization (C)** | | | | | | | | |
| All manure nitrogen | 126.6 | 129.0 | 19.2 | 20.2 | 70.4 | 75.2 | 13.970 | 14.530 |
| Manure 50% + Mineral 50% | 132.1 | 136.0 | 22.5 | 23.8 | 75.7 | 77.7 | 16.870 | 18.520 |
| All mineral nitrogen | 129.6 | 131.7 | 20.7 | 21.9 | 72.8 | 76.6 | 15.160 | 16.000 |
| F-test | ** | ** | ** | ** | ** | * | ** | ** |
| N.L.S.D. 5% | 1.00 | 1.0 | 0.26 | 0.31 | 0.4 | 0.4 | 0.180 | 0.230 |
| **Interactions:** | | | | | | | | |
| A x B | * | * | * | * | * | * | * | * |
| A x C | * | * | N.S. | N.S. | * | * | * | * |
| B x C | * | * | N.S. | N.S. | N.S. | N.S. | * | * |
| A x B x C | * | * | N.S. | N.S. | N.S. | N.S. | * | * |

the nutrition elements and became easier and faster uptake to the plants and covered the requirements of maize plant from irrigation water for growth and development. Similar results were reported by Haikel and El-Badry Ola (1995).

### Effect of Nitrogen Sources on Growth, Yield, and Yield Attributes of Maize:

The data listed in Tables 3a, b and c revealed that all traits were significantly affected by nitrogen sources. It was noticed that maximum values for all traits under study were obtained from the treatment of 50% organic N + 50% mineral N fertilizer. These results may be attribute to when nitrogen is used in mineral form the leaching was at the maximum value, however when all nitrogen fertilization was added as organic, nitrogen release was very slow and not enough to meat the growth and development of maize plants, while when nitrogen fertilization was added from both sources, organic and mineral, cations were adsorbed and less leaching occurred. It is well known that organic matter improves soil structure, increase water holding capacity and exchangeable capacity, also decrease the susceptibility to erosion led to an increase in the availability of nutrients. Zohry *et al.* (1998), found that the maximum values of all studied traits of wheat were obtained from the treatment of 50% organic N + 50 % mineral N. Haikel *et al.* (2000) mention that organic matter has a role in stimulating cell division and encouraging the meristimatic activity of the plant and gave highest yield than mineral forms. Abd El-All (2002) reported that the highest values of maize traits were obtained with the use of 75.0% organic +25% mineral,

**Effect of Interactions on Growth, Yield and Yield Attributes of Maize:**

The results of the interaction effects between water requirements and crop sequences Table 4 on number of days to 50% tassling revealed that the number of days to 50% tassling was increased with increasing irrigation water under both double and triple cropping sequences in both seasons, but this increase did not reach the 5% of significant with increasing water requirements from R3 to R2 in triple cropping sequence. Concerning number of days to 50% silking, it can be concluded that this trait took the same trend of number of days to 50% tassling. Plant height in double sequence showed no significant differences when irrigation water was increased by 25% than recommended, but plant height was significantly reduced when irrigation water was decreased 25% than recommended. While by triple cropping sequence the height of maize plants were significantly increased with increasing irrigation water by 25% than recommended. The height of ear position on maize plants was significantly increased under both double and triple cropping sequences with increasing irrigation water by 25% than recommended and from R3 to R2. The results in Table 4 also showed that ear diameter, kernels weight/ ear and 100-kernels weight were significantly increased in both double and triple cropping sequences with increasing irrigation water by 25% than recommended. Shelling percentage was significantly increased under both cropping sequences by 4.55 and 2.56% in the first seasons and by 4.92 and 1.46% in the second season respectively with increase of irrigation by 25% than recommended while the reduction in shelling percentage due to

**Table 4. The interaction effects between cropping sequences and water requirements (A x B) on some growth traits of maize in the two sessions**

| Cropping sequences \ Irrigation requirements | 2004 R1 | 2004 R2 | 2004 R3 | 2005 R1 | 2005 R2 | 2005 R3 |
|---|---|---|---|---|---|---|
| | **No. of days to 50% tassling** | | | | | |
| Double sequence | 66.22 | 62.47 | 59.40 | 69.41 | 66.66 | 60.40 |
| Triple sequence | 59.51 | 56.37 | 55.67 | 61.18 | 60.00 | 56.40 |
| N.L.S.D. 5% | | 0.9 | | | 1.02 | |
| | **No. of days to 50% selking** | | | | | |
| Double sequence | 70.3 | 68.0 | 63.9 | 73.5 | 71.8 | 67.4 |
| Triple sequence | 63.1 | 62.2 | 61.2 | 70.1 | 65.4 | 64.2 |
| N.L.S.D. 5% | | 1.5 | | | 1.7 | |
| | **Plant height (cm)** | | | | | |
| Double sequence | 265.0 | 261.5 | 247.5 | 277.1 | 264.0 | 241.0 |
| Triple sequence | 249.1 | 242.7 | 218.4 | 258.1 | 247.2 | 210.4 |
| N.L.S.D. 5% | | 5.0 | | | 5.6 | |
| | **Ear position (cm)** | | | | | |
| Double sequence | 158.6 | 141.0 | 126.4 | 162.9 | 146.4 | 131.2 |
| Triple sequence | 138.3 | 133.0 | 122.1 | 142.9 | 138.4 | 125.7 |
| N.L.S.D. 5% | | 2.3 | | | 2.4 | |
| | **Ear diameter (cm)** | | | | | |
| Double sequence | 5.3 | 5.2 | 3.8 | 5.7 | 5.3 | 4.0 |
| Triple sequence | 3.7 | 3.4 | 3.1 | 4.4 | 4.1 | 3.8 |
| N.L.S.D. 5% | | 0.08 | | | 0.10 | |
| | **Kernels weight/ear (g)** | | | | | |
| Double sequence | 145.9 | 139.7 | 123.5 | 150.5 | 141.1 | 124.6 |
| Triple sequence | 130.5 | 122.0 | 114.9 | 133.8 | 125.6 | 118.0 |
| N.L.S.D. 5% | | 2.6 | | | 2.7 | |
| | **100-Kernels weight (gm)** | | | | | |
| Double sequence | 25.0 | 20.7 | 18.8 | 26.6 | 22.1 | 20.2 |
| Triple sequence | 22.0 | 19.9 | 18.4 | 23.0 | 20.7 | 19.0 |
| N.L.S.D. 5% | | 0.4 | | | 0.5 | |
| | **Shilling (%)** | | | | | |
| Double sequence | 80.4 | 76.9 | 70.2 | 83.2 | 79.3 | 73.5 |
| Triple sequence | 72.1 | 70.3 | 68.2 | 76.4 | 75.3 | 71.3 |
| N.L.S.D. 5% | | 0.6 | | | 0.7 | |
| | **Grain yield (ardab/fed.)** | | | | | |
| Double sequence | 19.015 | 16.803 | 13.773 | 19.370 | 17.966 | 14.726 |
| Triple sequence | 16.324 | 13.740 | 12.326 | 18.006 | 15.080 | 12.974 |
| N.L.S.D. 5% | | 0.3 | | | 0.4 | |

R1=Recommended + 25% R2=Recommended R3=Recommended - 25%

reducing irrigation water by 25% than recommended were 8.5 and 3.1% in both cropping sequences, respectively in the first season and 5.8 and 4.0% in the second seasons, respectively. Grain yield/ feddan was significantly higher in both double and triple cropping sequences by 13.16 and 18.81%, respectively in the first season and by 7.81 and 19.4% respectively in the second season, when irrigation water was increased by 25% than recommended. On the other hand, the reduction in grain yield/fed. due to reducing irrigation water by 25% than recommended was 18.0 and 10.29% under double and triple cropping sequences, respectively in the first season and 18.03 and 13.96% respectively in the second season.

The interaction effects between cropping sequences and nitrogen sources on ear diameter, kernels weight/ear, shelling percentage and grain yield/fed. are presented in Table 5. The results showed that ear diameter was significantly increased under the two cropping sequences when maize plants fertilized with 50% manure and 50% mineral N fertilization. The same trends were found with kernels weight/ear and shelling percentage, where the highest kernel weight/ear and shelling percentage were produced when maize was fertilized with the mixed nitrogen sources (50% manure and 50% mineral) under the two cropping sequences. Grain yield/ feddan appeared to be significantly higher in both cropping sequences when maize fertilized with 50% manure + 50% mineral nitrogen. The increments in grain yields due to adding mixed fertilization under the two cropping sequences were 20.9 and 20.6% in the first season and were 30.97 and 23.8% in the second season compared with manure fertilization, respectively and were 10.81 and 11.91% in the first season and 11.49 and 20.9% in the second season compared with mineral nitrogen source alone, respectively. In general ear diameter, kernells weight/ear, shelling % and grain yield/fed. under double cropping sequences surpassed that under triple cropping sequence.

The interaction effects between water requirements and nitrogen sources on ear length, kernels weight / ear and grain yield/fed. are illustrate in Table 6. The significant longest ears of maize were produced under recommended + 25% with the mixed nitrogen sources (50% manure + 50% mineral N), but the shorts ears were found with all manure under reducing water requirement (recommended -25%),

Table 5. The interaction effects between cropping sequences and sources of nitrogen fertilization (A x C) on some growth traits of maize in the two seasons

| Sources of N fertilization / Cropping sequences | Ear diameter (cm) | | | | | |
|---|---|---|---|---|---|---|
| | 2004 | | | 2005 | | |
| | All manure | 50% manure + 50% mineral | All mineral | All manure | 50% manure + 50% mineral | All mineral |
| Double sequence | 4.4 | 5.2 | 4.8 | 4.6 | 5.3 | 4.9 |
| Triple sequence | 3.0 | 3.8 | 3.4 | 4.0 | 4.3 | 4.1 |
| N.L.S.D. 5% | | 0.04 | | | 0.05 | |
| | | | Kernel weight/ear (g) | | | |
| Double sequence | 132.5 | 140.0 | 136.6 | 135.1 | 143.5 | 137.9 |
| Triple sequence | 120.7 | 124.1 | 122.6 | 124.1 | 128.5 | 125.5 |
| N.L.S.D. 5% | | 1.3 | | | 1.6 | |
| | | | Shelling (%) | | | |
| Double sequence | 72.9 | 79.0 | 75.5 | 77.0 | 80.5 | 78.7 |
| Triple sequence | 68.0 | 72.4 | 70.1 | 73.3 | 75.0 | 74.5 |
| N.L.S.D. 5% | | 0.61 | | | | |
| | | | Grain yield (ardab/fed.) | | | |
| Double sequence | 15.030 | 18.164 | 16.400 | 14.938 | 19.565 | 17.548 |
| Triple sequence | 12.907 | 15.576 | 13.920 | 14.120 | 17.474 | 14.452 |
| N.L.S.D. 5% | | 0.28 | | | 0.25 | |

Table 6. The interaction between water requirements and sources of nitrogen fertilization (B x C) on some growth traits of maize in the two seasons

| Sources of N fertilization / Water requirements | Ear length (cm) | | | | | |
|---|---|---|---|---|---|---|
| | 2004 | | | 2005 | | |
| | All manure | 50% manure + 50% mineral | All mineral | All manure | 50% manure + 50% mineral | All mineral |
| R1=Recommended + 25% | 17.0 | 20.7 | 18.0 | 17.6 | 21.1 | 19.0 |
| R2 = Recommended | 14.3 | 19.9 | 16.7 | 16.6 | 20.0 | 17.8 |
| R3 =Recommended -25% | 12.1 | 14.8 | 15.4 | 14.4 | 18.9 | 17.2 |
| N.L.S.D. 5% | | 0.4 | | | 0.5 | |
| | | | Kernel weight/ear (g) | | | |
| R1 = Recommended+25% | 134.4 | 143.1 | 137.6 | 138.3 | 147.4 | 141.6 |
| R2 =Recommended | 128.7 | 134.0 | 130.0 | 131.4 | 136.6 | 132.5 |
| R3 =Recommended -25% | 116.17 | 122.0 | 119.0 | 118.9 | 124.1 | 120.8 |
| N.L.S.D. 5% | | 1.0 | | | 1.2 | |
| | | | Grain yield (ardab/fed.) | | | |
| R1=Recommended + 25% | 16.163 | 19.346 | 17.507 | 16.159 | 21.210 | 18.700 |
| R2 =Recommended | 13.883 | 16.766 | 15.197 | 15.435 | 18.722 | 15.405 |
| R3 =Recommended -25% | 11.863 | 14.496 | 12.777 | 12.005 | 15.635 | 13.902 |
| N.L.S.D. 5% | | 0.380 | | | 0.420 | |

kernels weight/ear was the highest by mixed fertilization (50% manure + 50% mineral N) under the different water requirements in the two seasons but in the second season, there was no significant differences between the fertilization with all manure and all mineral under recommended water application in the second season grain yield/feddan was increased by using mixed fertilizer (50% manure + 50% mineral N) in the three water requirements with 19.7, 20.8 and 22.2% in the first season, respectively and 31.3, 21.3 and 30.2% in the second season, respectively compared with all manure treatment which increased by 10.5, 10.3 and 13.4% in the first season and 13.4, 21.5 and 12.5% in the second season, respectively compared with mineral fertilization in the three water requirements, respectively but in the second season there was no significant differences between the fertilization with all manure and all mineral form under recommended water. From the for mentioned percentages it could be concluded that mixed fertilization (50% manure + 50% mineral N) was more benefit with increasing water requirement.

From the triple interaction effects on grain yield/feddan Table 7, it could be conclude that the highest grain yield/feddan was produced when maize plants grown under double cropping sequence and received more irrigation water (recommended + 25%) as well as fertilized with 50% manure + 50% mineral N, this was true in the two seasons. While the lowest grain yield/ feddan was obtained when maize plants grown under triple cropping sequence, water requirements - 25% and manure fertilization only.

**Table 7. The interaction effects between cropping sequences, water requirements and sources of nitrogen fertilization (A x B x C) on grain yield ardab/fed. in the two seasons.**

| Cropping sequences | Water requirements / Sources of N fertilization | Grain yield (ardab/fed.) 2004 All manure | 2004 50% manure + 50% mineral | 2004 All mineral | 2005 All manure | 2005 50% manure + 50% mineral | 2005 All mineral |
|---|---|---|---|---|---|---|---|
| Double sequence | R1 = Recommended+25% | 17.590 | 21.157 | 19.058 | 18.647 | 21.767 | 18.768 |
| | R2 = Recommended | 14.957 | 17.947 | 16.464 | 16.229 | 19.619 | 17.159 |
| | R3 = Recommended -25% | 12.520 | 15.350 | 13.734 | 12.641 | 17.081 | 14.232 |
| Triple sequence | R1 = Recommended+25% | 14.714 | 17.521 | 15.908 | 15.055 | 20.265 | 17.635 |
| | R2 = Recommended | 12.837 | 15.621 | 13.848 | 13.677 | 17.747 | 14.717 |
| | R3 = Recommended -25% | 11.164 | 13.621 | 11.948 | 10.779 | 14.839 | 13.529 |
| | N.L.S.D. 5% | | 0.31 | | | 0.41 | |

**Economical Evaluations**

Although yield and yield attributes of maize recorded the highest values in double cropping sequence, but net-income (L.E.) in triple cropping sequence was higher than double cropping sequence by 462.25 L.E. per feddan Table 8a. The explanation of this view that the double cropping sequence started by planting faba bean with net-profit of 1940.0 L.E, following with maize with net profit of 1244.0 L.E., whereas in triple cropping sequence if started with faba bean with net profit of 1820 L.E., followed with sunflower with net profit of 802.25 L.E, followed with maize with net-profit of 1024.0 the total profit in double sequence was 3184.0 L.E. compared with triple cropping sequence 3646.25 L.E. According by an increase of 462.25 L.E. was obtained in the triple sequence. Also, the data presented in Table 8a indicated that the average value of C.Us of triple sequence was higher than those obtained under double sequence.

Results in Table 8b show that the highest average grain yield ard./fed. (18.180) obtained from R1=3550 $m^3$/fed. / season (recommended + 25%), and with the highest cost of irrigation 355.0 [the cost of one $m^3$ = 0.1 (L.E.)]. The gained increase of income amounts to 473.0 L.E. due to the increase of maize grain yield (4.730 ardab/fed.) from R3 to R1. The cost of the additional irrigation water was 141.9 L.E., therefore the net profile amounted to 331.1 L.E. as the cost of one cubic meter of water is 0.1 L.E. From another angle of data the highest C.Us was obtained from yield of maize under water requirement R1 (25.45), while the lowest value of C.Us was obtained when maize was irrigated with R3 (18.83).

From this Table 8c it is clear that highest grain yield/fed was obtained from source of nitrogen in form of 50% organic and 50% mineral which gave 17.695 ard./fed. with net return of 1295.7 L.E., however the lowest grain yield was obtained when nitrogen source was fully in organic (14.25 ard./fed. with net return of only 749.1 L.E.). However, addition of N fully in mineral form produced a yield of 15.58 ardab/fed. with net return of 1286.4 L.E. The data presented in Table 8c indicate that the average values of C.Us of grain maize behaved the same trend. The percentage increase of grain C.Us of maize reached 24.18% due to the use of N as 50% organic and 50% mineral compared with manure from. Also, C.Us of maize yield was increased due to the use of nitrogen in organic N form (19.95) to source of nitrogen in

**Table 8a. Net return (L.E.) and cereal units (C.Us) of maize yield as affected by cropping sequences over the two seasons**

| | Faba bean | | | | | Sun flower | | | | | Maize | | | | | Net income L.E. | C.Us | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average yield ard./ fed | Price of ard. (L.E) | Income (L.E) | Cost L.E./fed. | Net profit L.E | Yield kg/ fed | Price of kg (L.E) | Income (L.E) | Cost | Net profit L.E | Yield ard./ fed | Price of ard. (L.E) | Income (L.E) | Cost | Net profit L.E | | Faba bean | Sun flower | Maize | Total/fed. |
| Double sequence | 6.1 | 400.0 | 2440.0 | 500.0 | 1940.0 | - | - | - | | - | 16.940 | 100.0 | 1694.0 | 450.0 | 1244.0 | 3184.0 | 11.346 | - | 23.716 | 35.062 |
| Triple sequence | 5.8 | 400.0 | 2320.0 | 500.0 | 1820.0 | 685.0 | 1.85 | 1267.25 | 465.0 | 802.25 | 14.740 | 100.0 | 1474.0 | 450.0 | 1024.0 | 3646.25 | 10.788 | 13.300 | 20.636 | 44.724 |

C.Us for 100 kg from faba bean = 1.2 C.Us
C.Us for 100 kg from sunflower = 2.0 C.Us
C.Us for 100 kg from maize = one C.Us

form 50% organic N + 50% mineral N form (24.77) by 24.18%.

Therefore recommending that the highest net return when maize planting in triple sequence (faba bean – sunflower – maize) with water irrigation 3550 $m^3$/season under drip irrigation system using nitrogen fertilization at rate 130 kg N/fed in form 50% organic and 50% mineral in sandy soil.

**Table 8b. Net return (L.E.) and cereal units (C.Us) of maize yield as affected by water requirements into two seasons**

| | Average water consumption $m^3$/season/fed | Average grain yield ard./fed. | Income return (L.E./fed.) | Cost of irrigation L.E./fed. | Cost of one ardab L.E. | Net return L.E./fed. | C.Us. |
|---|---|---|---|---|---|---|---|
| R1 | 3550.0 | 18.180 | 1818.0 | 355.0 | 19.53 | 1463.0 | 25.45 |
| R2 | 2841.0 | 15.895 | 1589.5 | 284.1 | 17.87 | 1305.4 | 22.25 |
| R3 | 2131.0 | 13.450 | 1345.0 | 213.1 | 15.84 | 1131.9 | 18.83 |

**Table 8c. Net return (L.E.) and cereal units (C.Us) of maize yield as affected by different sources of nitrogen over the two seasons**

| Source of nitrogen fertilization | Amount of N. fertilization per fed. | Average grain yield ard./fed. | Incom return L.E./fed | Fertilizer price cost (L.E.) | Net return L.E. | C.Us |
|---|---|---|---|---|---|---|
| (All organic nitrogen 1.73% N) | 7.51 ton | 14.250 | 1425.0 | 675.90 | 749.1 | 19.950 |
| All mineral nitrogen (ammonium nitrate 33.5% N) | 388 kg | 15.580 | 1558.0 | 271.60 | 1286.4 | 21.810 |
| 50% organic + 50% mineral | 3.76 ton (organic) +194.0 kg N (mineral) | 17.695 | 1769.5 | 338.0 + 135..8 (473.8) | 1295.7 | 24.773 |

* Price of ard./maize = 100 L.E.. one ton organic fert. = 90.0 L.E., one kg ammonium nitrate = 0.7 L.E.

## REFERENCES

Abd El-All, A.M. 2002. Effect of preceding crops, organic and mineral nitrogen and plant density on productivity of maize plant. J. Agric. Sci. Mansoura Univ., 27 (12): 9011-9023.

Alexander, M. 1977. Introduction to soil microbiology 2nd, ed., pp.

No.143, 144, 148-162, 423-437, John Wiley and Sons. Inc., New York.

Brockaus, F.A. 1962. ABC der Landwirtschaft, Vol. I, VEB, F.A. Brockhaus Verlag. Leipzing, G.D.R. PP. 790 (In German).

Dansa, S.K. and I. Papastylianou. 1992. Evaluation of nitrogen contribution of legumes to subsequent cereals. J. Agric. Sci., 119: 13-18.

Eid, H.M.; N.G. Ainer, S.M. ElMarsafawy and A.N. Khaber. 1996. Crop water needs under different irrigation systems in the newly reclaimed lands. Third Conf. of on farm Irrig. & Agroclimatology, P. No. 52 SWERL ARC.Egypt.

Gomez, K.A. and A.A. Gomez. 1984. Statistical Procedure for Agriculture Research. Jhon Wiley and Sons,Inc. New York.

Gouda, A.S. 1989. Agronomic studies on maize. Ph.D. Thesis Fac. Agric. Zagazig Univ., Egypt.

Haikel, M.A. and Z. El-Badry Ola 1995. Response of corn to different irrigation systems in newly reclaimed soil. Ann. of Agric. Sci. Moshtoher, Zagazig Univ., 33 (3): 1025-1034.

Haikel, M.A.; M.A. Hussein Samira and A.M. El-Melegy 2000. Effect of organic and mineral nitrogen on maize and its residual effect on wheat as a successive crop in sand soil under new irrigation systems. J. Agric. Sci. Mansoura Univ., 25 (7): 3803-3816.

Hussein Samira M.A.; M.A. Haikel and M.A. El-Masry. 1998. Effect of some preceding crops, hill spaces and nitrogen fertilization on yield attributes and grain yield of maize under reclaimed sandy soil conditions in East Delta. Proc. 8th Conf. Agron., Suez Canal Univ., Ismailia, Egypt, 28-29.

Jackson, M.L. 1967. Soil chemical analysis Printice-Hall of India, New Delhi.

Khalil, H.E.; A.I. Nawar and A.S.M. Kamel. 2004. Response of sunflower to multiseasonal crop sequences under different regimes of NPK fertilization. Alex. J.Agric.Res.,49 (3):13-23.

Olsen, S.R.; C.V. Cole; F.S. Wotonable and L.A. Dean. 1954. Estimation of available phosphorus in soil by interaction with sodium bicarbonate U.S. Dept. Agric. Cr. 939.

Sakia, S.; Y. Takada, R. Nakagawa and Y. Yamada. 1987. Metabolism of slow-release nitrogen fertilizer oxamide. Soil. Sci. Nutr., 32 (2):281-290.

Seif El-Nasr, F.M.; M. Attia Zahera and I.O. Metwally.

1993. Effect of some preceding crops on growth yield and yield components of maize under two levels of nitrogen fertilizer. J. Agric. Sci., Mansoura Univ., 11: 3166-3172.

Shafshak, S.E.; A.S. El-Debaby; M.S. Salam and G.Y. Gelilah. 1982. Crop rotation studies in Egypt. II. Growth and yield of maize as affected by crop rotation and fertilization residues. Res. Bull. Fac. Agric. Ain Shams Univ., Egypt, No. 209:. 1-38

Waller, R.A. and D.B. Duncan (1969): A bays rule for the symmetric multiple comparison problem. J Am. Stat. assoc., 1485-1503.

Zohry, A.A.; M.A. Haikel and F.A. Zahran. 1998. Influence of seed rates and nitrogen sources on wheat plant grown in reclaimed soil under sprinkler irrigation system. J. Agric. Sci. Mansoura Univ., 23 (11): 4751-4752.

## تأثر حاصل الذرة الشامية ومكوناته بالتعاقب المحصولى والاحتياجات المائية ومصادر التسميد الأزوتى تحت نظام الرى بالتنقيط فى الأراضى الرملية

**سميرة محمد على حسين[1] -عاطف محمد المليجى[2]**

[1] معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية - الجيزة

[2] معهد بحوث الأراضى والمياه والبيئة- مركز البحوث الزراعية- الجيزة

أجريت هذه الدراسة فى المحطة البحثية بوادى العريش محافظة شمال سيناء خلال موسمى النمو ٢٠٠٣ / ٢٠٠٤ ، ٢٠٠٤ / ٢٠٠٥ لدراسة تأثير التعاقب الثنائى والثلاثى والإحتياجات المائية ومصادر التسميد النيتروجينى على حاصل الذرة الشامية ومكوناته تحت ظروف منطقة العريش. وفى نظام التعاقب الثنائى تم زراعة الفول البلدى صنف ٤٦١ تبعه الذرة الشامية هجين فردى ١٠، حيث تمت زراعة الفول البلدى فى ١٥، ١٨ أكتوبر والذرة الشامية فى ١٠، ١٥ مايو بالموسم الأول والثانىعلى التوالى. وفى التعاقب الثلاثى تم زراعة الفول البلدى صنف ٤٦١ فى ١٥ ، ١٨ أكتوبر تبعه زراعة عباد الشمس صنف فيدوك فى الأول والرابع من أبريل ثم زراعة الذرة فى ١٥ ، ٢٠ يوليو فى موسمى النمو الأول والثانى على التوالى. هذا وقد تم تحديد متوسط كميات المياه الموصى بها التى تعطى للذرة فى الأراضى الرملية القريبة من خواص وادى العريش من نتائج البحوث السابقة وكانت ٢٨٤١ م$^3$ $(R_2)$ تحت نظام الرى بالتنقيط وأعطى أكثر منها ٢٥% فكانت ٣٥٥٠ م$^3$ $(R_1)$ لموسم النمو وأقل منها ٢٥% فكانت ٢١٣١ م $(R_3)$ لموسم النمو وسمد الذرة بمعدل ١٣٠كجم نيتروجين للفدان من مصادر النيتروجين المختلفة إما كلها على صورة عضوية (١,٧٣% ن) بمعدل ٧,٥١ طن / فدان أو كله على صورة معدنية (٣٨٨ كجم نترات أمونيوم ٣٣,٥% ن ) أو نصف كمية السماد فى صورة سماد عضوى ٣,٧٦ طن للفدان والنصف الأخر معدنى

١٩٤,٠ كجم نترات أمنيوم للفدان. نفذت الدراسة فى تصميم القطع المنشقة مرتين فى شرائح فى ثلاث مكررات. وخصصت القطعة الرئيسية لنظام التعاقب المحصولى وخصصت القطع الشقية الأولى لمعدلات الرى ($R_1$, $R_2$, $R_3$) بينما القطع الشقية الثانية لمصادر التسميد النيتروجينى وتتلخص أهم نتائج الدراسة فيما يلى:

* تفوقت جميع الصفات تحت الدراسة فى نباتات الذرة الشامية فى التعاقب الثنائى عنه فى التعاقب الثلاثى حيث أعطى أعلى حاصل من الحبوب.
* أعطى معدل الرى ($R_1$) (الموصى به +٢٥%) أعلى القيم فى جميع الصفات المدروسة لنباتات الذرة الشامية.
* أعطى السماد النيتروجينى فى صورة نصفه عضوى ونصفه معدنى أعلى القيم لحاصل الحبوب ومكوناته لنباتات الذرة الشامية.

التفاعل:

كان تأثير التفاعل بين التعاقب المحصولى وكميات المياه المستخدمة زيادة معنويا لمعظم الصفات المدروسة عدد الأيام لظهور ٥٠% من النورة المذكرة والمؤنثة، وطول النبات، وإرتفاع وقطر الكوز، ووزن حبوب الكوز، ووزن ١٠٠حبة، ونسبة التصافى، حاصل الحبوب للفدان، وكانت أعلى قيم ناتجة من معاملة التعاقب الثنائى ومعدل الرى ($R_1$) ٣٥٥٠م٣ فى الموسم للفدان.

كان تأثير التفاعل بين التعاقب المحصول ومصادر النيتروجين معنويا على صفات قطر الكوز، ووزن حبوب الكوز، ونسبة التصافى، وحاصل الحبوب للفدان، حيث كانت أعلى القيم ناتجة من التفاعل بين التعاقب الثنائى والتسميد النيتروجينى بمعدل ٥٠% من كل من المصدرين.

كان تأثير التفاعل بين معدلات الرى ومصادر التسميد النيتروجينى معنويا على طول الكوز، ووزن حبوب الكوز، وحاصل الحبوب للفدان، وكانت أعلى القيم ناتجة من التسميد النيتروجينى بمعدل ٥٠% من السماد العضوى والمعدنى، ومعدل الرى ($R_1$) ٣٥٥٠م٣ فى الموسم للفدان.

كان تأثير التفاعل الثلاثى معنويا على وحاصل الفدان، حيث كانت أعلى القيم للحاصل ناتجة من التفاعل بين التعاقب الثنائى ومعدل الرى $R_1$ (٣٥٥٠م٣ فى الموسم للفدان) والتسميد النيتروجينى (٥٠% عضوى + ٥٠% معدنى).

التقييم الإقتصادى:

وللحصول على أعلى عائد اقتصادى وكذلك عند حساب معامل الحبوب الذى أخذ نفس الاتجاه فإنه يتم زراعة الذرة الشامية فى نظام التعاقب الثلاثى (فول بلدى _ عباد الشمس _ ذرة شامية) مع استخدام معدل الرى ٣٥٥٠ م٣فى الموسم للفدان بنظام الرى بالتنقيط مع التسميد النيتروجينى بمعدل ١٣٠ كجم ن للفدان تضاف جزئياً على صورة معدنية (٥٠%) وفى صورة عضوية (٥٠%) تحت ظروف الأراضى الرملية.