Egyptian J. Desert Res., **67**, No. 2, 291-304 (2017)

# EFFECT OF POLYMERS AND SUBSURFACE IRRIGATION ON MAIZE PRODUCTIVITY (*ZEA MAYS*, L.) UNDER SANDY SOIL CONDITIONS IN BALOZA REGION, EGYPT

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The field work was carried out at the Experimental Station of the Desert Research Center, Balosa region, North Sinai Governorate, during two summer seasons of 2015 and 2016. To study the effect of subsurface drip irrigation (SDI) at depths of 10, 20 and 30 cm below soil surface and polymers at the rates of 0, 50, 100 and 150 kg polyacrylamide (PAM) per feddan (0.42 hectar) on productivity of maize under sandy soil conditions. Results indicated that all studied parameters [plant height (cm), number of ears/plant, ear length (cm), ear diameter (cm), grains weight/ear, 1000-grain weight (g), harvest index (%), shelling (%), water use efficiency grain yield (kg/feddan), total biomass (kg/feddan), as well as, protein and oil (%) in grains] were significantly affected by subsurface drip irrigation in both seasons. The highest values of these parameters were recorded when subsurface irrigation was used at a depth of 30 cm below the soil surface, followed by 20 cm, while the minimum values were recorded for subsurface irrigation at a depth of 10 cm below the soil surface in 2015 and 2016 growing seasons. Increasing PAM rates from 0 to 150 kg/feddan caused a significant increase in all studied parameters of maize plants in the both seasons. The highest values of these parameters were obtained at 100 kg PAM/feddan compared with control treatment (without PAM). This has occurred in both seasons and in all parameters, except plant height, ear diameter, water use efficiency, protein % and oil %, which were higher when using 150 kg PAM/feddan, but the differences between the two levels were insignificant in both seasons. Available data revealed that all studied parameters of maize were affected significantly by the interaction between subsurface drip irrigation and polymers in both seasons, except no. of ears/ plant, ear diameter and ear length, which did not reach a significant level in the two seasons. Maximum values of the interaction between subsurface drip irrigation and polymers were obtained when subsurface irrigation was used at a depth of 30 cm below the soil surface with the rate of polyacrylamide (100 kg/feddan) in two seasons under sandy soil conditions.

**Keywords:** maize, polyacrylamide, subsurface irrigation and yield components.

In Egypt, the total cropped area occupied by maize was 2.37 million feddan (0.42 hectar) with total production of 6.3 million ton (FAO, 2016). It is very important to increase production of maize to cover the gap between production and consumption. The development of non-traditional new technologies to conserve water is becoming important for attaining a sustainable economic growth, especially in agricultural countries. The subsurface irrigation system is a non-conventional method of irrigation, which corresponds with the water crisis that is worsening day by day. Thus, the use of this technique in the sandy soils leads to rationalize the water consumption of plants by up to 50% as a result of reducing the water lost from the soil either down by percolation or up by evaporation (Shahid et al., 2012). Improving the efficiency of irrigation water by different methods is one of the economically viable alternatives in overcoming the water scarcity. Sandy soils productivity can be improved when water is wisely managed by applying subsurface water retention technology that is regarded as apromising solution to sandy soils problems (Ismail and Ozawa, 2007). This is not only crucial for the sustainable agricultural yield but also to meet the challenges of current environmental issues and justice, financial problems and physical barriers (Ahmed et al., 2012). Many researchers have observed positive response of maize plants to subsurface irrigation and increasing yield and its components (Vories et al., 2009; Douh and Boujelben, 2011 and Robiul et al., 2011).

Polymers (polyacrylamide) is a water retaining, cross-linked hydrophilic, biodegradable amorphous polymer, which can absorb and retain water at least 300 times of its original weight and make at least 95 percent of stored water available for crop absorption (Johnson and Veltkamp 1985). When polymer is mixed with the soil, it forms an amorphous gelatinous mass on hydration and is capable of absorption and desorption over long period of time, hence acts as a slow release source of water in soil. These particles may be taken as “miniature water reservoir” in the soil and water will be removed from these reservoirs upon the root demand through osmotic pressure difference. Islam et al. (2011) reported that incorporating polymer into the soil will improve soil structure and water retention, thus reducing leaching, reducing water losses due to percolation and evaporation, protecting the plant against water stress and increasing both the nutrient and water supply to the roots. In addition, the structural improvement in soil will lead to better aeration for the root system and reduces soil compaction. Many researchers found that polymers increased yield and its components of maize as recorded by Azzam (1983), El-Hady (1987), Huttermann et al. (1999), Yazdani et al. (2007) and Adem et al. (2016).

This study was designed to improve the maize productivity and increases water use efficiency at sandy soils as a result of reducing the water lost from the soil either down by percolation or up by evaporation by using some water retention technologies, i.e. subsurface irrigation at different depths and rates of polymers application under sandy soil conditions in Baloza region, Egypt.

## MATERIALS AND METHODS

Two field experiments were carried out at Baloza Station of the Desert Research Center, North Sinai Governorate during two consecutive seasons of 2015 and 2016. The experiments aimed to study the effect of subsurface drip irrigation (SDI) and polymers (polyacrylamide, PAM) on productivity of maize plants cv. Giza 321 under sandy soil conditions. Twelve treatments were resulted from the combination of three depths of subsurface irrigation, where percolation lines were buried to a depth of 10, 20 and 30 cm and four rates of polymers (PAM) as a soil conditioner, i.e. 0, 50, 100 and 150 kg/feddan, which were added at the depths of subsurface irrigation and mixed with fertilizers. The physical and chemical soil characteristics of the studied site were determined according to Klute (1986), as recorded in table (1). The chemical analysis of irrigation water was carried out using the standard method of Page et al. (1982) and presented in table (2).

**Table (1).** Physical and chemical properties of the experimental soil.

| Particle size distribution (%) | | | Soil texture | Ec ($dsm^{-1}$) | pH | Available nutrients (cations) | | | | | Available nutrients (anions) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sand | Silt | Clay | | | | P (%) | $K^+$ (%) | $Na^+$ (%) | $Ca^{++}$ (me/l) | $Mg^{++}$ (me/l) | $Co_3^=$ | $HCO_3^-$ (me/l) | $Cl^-$ (me/l) | $SO_4^=$ (me/l) |
| 91.0 | 5.0 | 4.0 | sand | 1.29 | 8.0 | 0.39 | 0.51 | 4.54 | 3.42 | 4.11 | - | 3.62 | 3.00 | 5.80 |

**Table (2).** Chemical analysis of irrigation water.

| Samples | pH | E.C. (ppm) | S.A.R. | Soluble cations (me/l) | | | | Soluble anions (me/l) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ | $CO_3^=$ | $HCO_{3-}$ | $SO_4^=$ | $Cl^-$ |
| 2015 season | 7.63 | 1411 | 3.55 | 3.41 | 3.12 | 8.47 | 0.63 | 0.17 | 3.22 | 2.38 | 7.47 |
| 2016 season | 7.74 | 1355 | 3.18 | 3.54 | 3.25 | 7.36 | 0.58 | 0.32 | 3.68 | 2.79 | 8.24 |

Organic manure was added at the rate of 15 m³/feddan. While, calcium super-phosphate (15.5% $P_2O_5$) at the rate of 150 kg /feddan, potassium sulphate (48% $K_2O$) at the rate of 100 kg/feddan and nitrogen fertilizer was added as ammonium sulphate (20.5% N) at the rate of 150 kg N/feddan. Maize was planted in 1st May in both growing seasons. All agricultural practices for maize crop production were followed according to the recommendation of Egyptian Ministry of Agriculture throughout the two experimental seasons.

At harvest, samples of 5 plants/ plot were taken randomly 121 and 126 days after sowing in 2015 and 2016 growing seasons, respectively, from the middle of plot for every treatments to determine the following characters: plant height (cm), number of ears/plant, ear length (cm), ear diameter (cm), grains weight/ear, 1000-grain weight (g), harvest index (%), shelling (%), water use efficiency, grain yield (kg/feddan), total biomass (kg/feddan), as well as, protein and oil (%) in grains, at harvest grain and total biomass (kg) of each plot were recorded.

Whereas, shelling percentage (%) was worked out by using the formula as suggested by Beadle (1987), shelling percentage (%) was calculated according the following formula = weight of grains from ten ears / weight ten ears x 100. Water use efficiency (WUE) was calculated by dividing the crop yield (kg) by the amount of water used ($m^3$) according to Molden et al. (2003). Harvest index (%) was computed by using the following formula (Beadle, 1987): HI (%) = grain yield/ total biomass x 100.

A split plot design with three replicates was used. Main plots were occupied with subsurface irrigation and the sub plots allotted with polymer. Each experimental unit area was 10.5 $m^2$ (1/400 feddan) in the two seasons. All recommended common agricultural practices were adopted throughout the two experimental seasons. All the obtained data for subsurface irrigation and PAM treatments were subjected to analysis of variance according to the method described by Gomez and Gomez (1984). Means comparison were done using least significant difference (LSD) at 5% level of probability.

## RESULTS AND DISCUSSION

### 1. Effect of Subsurface Drip Irrigation, SDI

Data in table (3) reveal that all studied parameters, i.e. plant height, number of ears/plant, ear diameter, ear length, grains weight/ ear, 1000-grain weight, shelling %, grain yield, total biomass, harvest index, crop index, water use efficiency, protein % and oil %, were significantly affected by subsurface drip irrigation in both seasons. The highest values of these characters were recorded when subsurface irrigation was at a depth of 30 cm below the soil surface, followed by 20 cm, while the minimum values were recorded for subsurface irrigation at a depth of 10 cm below the soil surface in both 2015 and 2016 growing seasons.

**Table (3).** Effect of subsurface drip irrigation on yield and quality of maize plant during 2015 and 2016 growing seasons under sandy soil conditions in Baloza, North Sinai, Egypt.

| Characters / SDI (cm) | Plant height (cm) | No. of ears/ plant | Ear diameter (cm) | Ear length (cm) | Grains weight/ ear (g) | 1000 grain weight (g) | Shelling (%) | Grain yield (kg/fed) | Total biomass (kg/fed) | Harvest index (%) | Crop index (%) | WUE (kg/m$^3$) | Protein (%) | Oil (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2015 Season** | | | | | | | | | | | | | | |
| **10** | 170.88 | 1.38 | 4.00 | 15.19 | 33.04 | 202.42 | 54.23 | 1107 | 5699 | 18.87 | 23.38 | 0.92 | 9.70 | 3.36 |
| **20** | 193.39 | 1.67 | 4.49 | 19.11 | 50.70 | 218.31 | 62.57 | 2270 | 6797 | 31.22 | 50.14 | 1.37 | 9.96 | 3.69 |
| **30** | 225.53 | 1.83 | 4.51 | 21.08 | 62.10 | 236.73 | 74.75 | 2692 | 7438 | 33.79 | 55.75 | 1.48 | 10.33 | 3.85 |
| **LSD at 5%** | **7.88** | **0.18** | **0.52** | **2.44** | **1.07** | **6.45** | **3.30** | **23.97** | **81.48** | **0.57** | **1.49** | **0.07** | **0.35** | **0.05** |
| **2016 Season** | | | | | | | | | | | | | | |
| **10** | 166.48 | 1.35 | 3.67 | 15.14 | 31.95 | 199.02 | 52.52 | 1098 | 4925 | 21.59 | 28.01 | 0.89 | 9.48 | 3.35 |
| **20** | 190.02 | 1.62 | 4.29 | 18.77 | 49.30 | 230.23 | 61.61 | 2257 | 6462 | 32.48 | 53.18 | 1.35 | 9.50 | 3.67 |
| **30** | 219.78 | 1.82 | 4.37 | 20.45 | 59.88 | 211.45 | 73.40 | 2657 | 7120 | 34.82 | 57.92 | 1.40 | 9.90 | 3.76 |
| **LSD at 5%** | **5.94** | **0.13** | **0.52** | **1.84** | **1.56** | **17.72** | **1.33** | **32.24** | **159.92** | **0.95** | **2.47** | **0.03** | **0.30** | **0.05** |

SDI: subsurface drip irrigation; total biomass, WUE: Water use efficiency, LSD: least significant difference.

It is worthy to mention that the differences among the studied depths of subsurface irrigation in all studied characters may be due to that subsurface drip irrigation allows uniform delivery of water directly to the plant root zone, minimizes evaporative loss, improvs vegetative growth and yield characters and increases use efficiency over other irrigation methods. These results are further evidence that drip line depth at a 30 cm is probably acceptable on this soil type and climate for maize production. These results are in accordance with those mentioned by Lamm and Trooien (2003) and (2005), Douh and Boujelben (2011), Albasha et al. (2015) and Lamm et al. (2017).

**2. Effect of Polyacrylamide, PAM**

Data in table (4) indicate that increasing PAM rates from 0 to 150 kg /feddan caused a significant increase in all studied parameters of maize plants in both seasons. The highest values of these parameters were obtained at 100 kg PAM /feddan compared with control treatment (without PAM). This is fairly true in both seasons and in all parameters, except plant height, ear diameter, water use efficiency, protein % and oil %, which were higher when using 150 kg PAM/ feddan, but the differences between the two levels were insignificant in both seasons.

The increasing percentages of these attributes with using the rate of PAM (100 kg/feddan) comparing with control treatment were 38.92 and 41.78 for plant height, 16.56 and 17.69 for number of ears/plant, 40.06 and 30.56 for ear diameter, 63.72 and 65.88 for ear length, 237.02 and 248.86 for grains weight/ ear, 60.42 and 64.68 for 1000-grain weight, 39.76 and 43.33 for shelling %, 287.27 and 286.31 for grain yield, 67.18 and 62.22 for total biomass, 127.67 and 133.84 for harvest index, 222.57 and 230.28 for crop index, 85.19 and 92.21 for water use efficiency, 14.84 and 13.19 for protein % and 9.09 and 13.07 for oil % in 2015 and 2016 seasons, respectively. The increasing in the values of these traits under this study resulted from the incorporation of polymers material with soil, can retain large quantities of water, nutrients, which are released slowly as required by the plant to improve growth under limited water supply. This may also be due to developments in the nature of root growth, like root length, root volume, rootfresh and dry weight which in turn lead to better translocation of water, nutrients and photoassimilates and finally better plant development. Similar results of incorporating polymer into the soil and its effect on the yield and its components have been reported by Sivapalan (2006), Sarvas et al. (2007), Yazdani et al. (2007), Islam et al. (2011), Rafiei et al. (2013), Adem et al. (2016) and Kumari et al. (2017).

**Table (4).** Effect of polyacrylamide on yield and quality of maize plant during 2015 and 2016 growing seasons under sandy soil conditions in Baloza, North Sinai, Egypt.

| Characters / PAM (kg/fed) | Plant height (cm) | No. of ears/ plant | Ear diameter (cm) | Ear length (cm) | Grains weight/ ear (g) | 1000 grain weight (g) | Shelling (%) | Grain yield (kg/ fed) | Total biomass (kg/fed) | Harvest index (%) | Crop index (%) | WUE ($kg/m^3$) | Protein (%) | Oil (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2015 Season** | | | | | | | | | | | | | | |
| **0** | 157.93 | 1.51 | 3.37 | 13.45 | 20.96 | 160.75 | 51.43 | 770 | 4774 | 16.01 | 19.10 | 0.81 | 9.03 | 3.41 |
| **50** | 187.00 | 1.56 | 4.16 | 16.63 | 33.73 | 203.64 | 61.40 | 1382 | 5902 | 22.99 | 30.18 | 1.17 | 9.86 | 3.64 |
| **100** | 219.40 | 1.76 | 4.72 | 22.02 | 70.64 | 257.88 | 71.88 | 2982 | 7981 | 36.45 | 61.61 | 1.50 | 10.37 | 3.72 |
| **150** | 222.07 | 1.69 | 5.07 | 21.72 | 69.12 | 254.34 | 70.69 | 2958 | 7921 | 36.38 | 61.48 | 1.55 | 10.72 | 3.75 |
| **LSD at 5%** | **3.87** | **0.14** | **0.45** | **1.53** | **1.97** | **2.53** | **2.74** | **35.06** | **158.28** | **0.90** | **2.76** | **0.06** | **0.45** | **0.05** |
| **2016 Season** | | | | | | | | | | | | | | |
| **0** | 152.40 | 1.47 | 3.37 | 12.78 | 19.73 | 152.87 | 49.57 | 767 | 4574 | 16.58 | 19.95 | 0.77 | 8.87 | 3.29 |
| **50** | 181.28 | 1.53 | 3.98 | 16.30 | 31.88 | 200.43 | 59.78 | 1356 | 5405 | 24.66 | 33.09 | 1.11 | 9.36 | 3.63 |
| **100** | 216.08 | 1.73 | 4.40 | 21.20 | 68.83 | 251.74 | 71.05 | 2963 | 7420 | 38.77 | 65.89 | 1.48 | 10.04 | 3.72 |
| **150** | 218.61 | 1.64 | 4.71 | 22.21 | 67.73 | 249.23 | 69.63 | 2930 | 7277 | 38.51 | 66.55 | 1.50 | 10.24 | 3.74 |
| **LSD at 5%** | **4.95** | **0.19** | **0.29** | **1.51** | **1.15** | **17.49** | **2.01** | **40.40** | **161.09** | **0.98** | **1.93** | **0.04** | **0.22** | **0.04** |

PAM: polyacrylamide as polymers; total biomass, WUE: Water use efficiency, LSD: least significant difference.

**3. Effect of the Interaction between Subsurface Drip Irrigation and Polymers, SDI x PAM**

Available data in table (5 and 6) show that all studied parameters of maize were affected significantly by the interaction between subsurface drip irrigation and polymers in both seasons, except number of ears/plant, ear diameter and ear lenght don't reach to significant level in the two seasons. The highest values for each of plant height were 253.90 and 250.97 cm, grain weight were 93.83 and 91.45 g, 1000-grain weight were 269.05 and 263.07 g, shelling were 82.78 and 81.69%, grain yield were 4028 and 3972 kg/feddan, total biomass were 8938 and 8743 kg/feddan, harvest index were 45.06 and 44.43%, crop index were 82.03 and 83.50%, WUE were 1.82 and 1.74 kg $m^3$, protein were 11.09 and 16.65% and oil were 3.92 and 3.89%, due to the interaction between subsurface drip irrigation and polymers were obtained when subsurface irrigation was used at a depth of 30 cm below the soil surface, with the rate of 100 kg polyacrylamide/feddan, in the first and seconed season, respectively. Regarding of subsurface drip irrigation, Ahmed et al. (2012) reported that subsurface drip irrigation allows highly production of crops without negative environmental impacts associated with leaching or runoff. Lamm et al. (2017) found that the highest values of yield components of maize and water use efficiency were observed under subsurface drip system, which was approximately twice and seven times than sprinkler and basin systems, respectively, for many crops production under desert condition. However, about of PAM, Adem et al., (2016) pointed out that using of polymwers as afertilizer with maize led to an increase in ear weight, 1000-grains weight, grain yield and total biomass and also increased water use efficiency in percentages ranging from 33-87%.

## CONCLUSION

The results indicate that the use of subsurface drip irrigation at a depth of 30 cm below the soil surface in combination with addition of 100 kg polyacrylamide /feddan had a significant effect on most of the parametrs under study. This may be due to the integration between the study factors to benefit each other, so that the water provided by subsurface irrigation don't lost quickly away of the plant, but is caught on the surface of the polysaccharides granules, so that the plant can absorb it by roots, thus reducing the amount of irrigation water needed for the unit area and improving its productivity.

**Table (5).** Effect of the interaction between subsurface drip irrigation and polyacrylamide on yield and quality of maize during 2015 and 2016 growing seasons under sandy soil conditions in Baloza, North Sinai, Egypt.

| SDI X PAM (Characters) | | Plant height (cm) | No. of ears/ plant | Ear diameter (cm) | Ear length (cm) | Grains weight/ ear (g) | 1000 grain weight (g) | Shelling (%) |
|---|---|---|---|---|---|---|---|---|
| **SDI (cm)** | **PAM (kg/fed)** | **2015 Season** | | | | | | |
| **10** | **0** | 149.97 | 1.33 | 3.11 | 11.23 | 18.28 | 138.04 | 41.78 |
| | **50** | 161.47 | 1.33 | 4.11 | 14.20 | 28.37 | 181.61 | 53.34 |
| | **100** | 185.30 | 1.47 | 4.25 | 18.67 | 43.51 | 246.27 | 61.17 |
| | **150** | 186.77 | 1.40 | 4.51 | 16.65 | 42.01 | 243.77 | 60.60 |
| **20** | **0** | 156.20 | 1.47 | 3.90 | 13.59 | 21.03 | 154.51 | 49.46 |
| | **50** | 169.93 | 1.53 | 4.20 | 16.55 | 33.43 | 207.34 | 59.28 |
| | **100** | 221.90 | 1.87 | 4.62 | 22.79 | 74.59 | 258.32 | 71.67 |
| | **150** | 225.53 | 1.80 | 5.24 | 23.50 | 73.74 | 253.05 | 69.88 |
| **30** | **0** | 167.63 | 1.73 | 3.10 | 15.55 | 23.57 | 189.69 | 63.06 |
| | **50** | 229.60 | 1.80 | 4.17 | 19.15 | 39.39 | 221.98 | 71.58 |
| | **100** | 253.90 | 1.93 | 5.30 | 24.61 | 93.83 | 269.05 | 82.78 |
| | **150** | 251.00 | 1.87 | 5.45 | 25.01 | 91.61 | 266.19 | 81.59 |
| **LSD at 5%** | | **6.70** | **NS** | **NS** | **NS** | **1.42** | **2.39** | **1.12** |
| | | **2016 Season** | | | | | | |
| **10** | **0** | 146.20 | 1.27 | 2.80 | 10.76 | 17.35 | 134.50 | 40.32 |
| | **50** | 156.73 | 1.33 | 3.80 | 13.70 | 26.77 | 180.48 | 50.18 |
| | **100** | 180.30 | 1.40 | 3.90 | 17.92 | 42.78 | 241.57 | 60.16 |
| | **150** | 182.67 | 1.40 | 4.19 | 18.17 | 40.88 | 239.54 | 59.43 |
| **20** | **0** | 152.77 | 1.40 | 3.97 | 13.59 | 20.72 | 217.59 | 48.67 |
| | **50** | 165.93 | 1.47 | 4.11 | 15.47 | 32.12 | 203.53 | 56.58 |
| | **100** | 219.17 | 1.87 | 4.27 | 22.37 | 72.25 | 250.57 | 71.31 |
| | **150** | 222.20 | 1.73 | 4.81 | 23.66 | 72.11 | 249.23 | 69.87 |
| **30** | **0** | 158.23 | 1.73 | 3.34 | 13.99 | 21.12 | 106.52 | 59.71 |
| | **50** | 221.17 | 1.80 | 4.02 | 19.71 | 36.75 | 217.27 | 72.58 |
| | **100** | 250.97 | 1.93 | 5.02 | 23.30 | 91.45 | 263.07 | 81.69 |
| | **150** | 248.77 | 1.80 | 5.12 | 24.79 | 90.20 | 258.93 | 79.59 |
| **LSD at 5%** | | **8.58** | **NS** | **NS** | **NS** | **0.99** | **3.29** | **0.68** |

**Table (6).** Effect of the interaction between subsurface drip irrigation and polyacrylamide on yield and quality of maize during 2015 and 2016 growing seasons under sandy soil conditions in Baloza, North Sinai, Egypt.

| SDI X PAM / Characters | | Grain yield (kg/fed) | Total biomass (kg/fed) | Harvest index (%) | Crop index (%) | WUE (kg/m$^3$) | Protein (%) | Oil (%) |
|---|---|---|---|---|---|---|---|---|
| **SDI (cm)** | **PAM (kg/fed)** | **2015 Season** | | | | | | |
| **10** | **0** | 587 | 3904 | 15.04 | 17.72 | 0.68 | 8.73 | 3.21 |
| | **50** | 893 | 4863 | 18.40 | 22.57 | 0.90 | 9.74 | 3.37 |
| | **100** | 1492 | 7069 | 21.11 | 26.76 | 0.98 | 10.11 | 3.40 |
| | **150** | 1456 | 6959 | 20.93 | 26.48 | 1.10 | 10.22 | 3.46 |
| **20** | **0** | 779 | 5083 | 15.33 | 18.10 | 0.82 | 9.10 | 3.28 |
| | **50** | 1429 | 6211 | 23.05 | 29.99 | 1.22 | 9.75 | 3.74 |
| | **100** | 3427 | 7937 | 43.18 | 76.03 | 1.71 | 10.14 | 3.85 |
| | **150** | 3446 | 7957 | 43.31 | 76.42 | 1.72 | 10.83 | 3.87 |
| **30** | **0** | 943 | 5335 | 17.68 | 21.48 | 0.93 | 9.25 | 3.74 |
| | **50** | 1822 | 6631 | 27.50 | 37.97 | 1.38 | 10.10 | 3.71 |
| | **100** | 4028 | 8938 | 45.06 | 82.03 | 1.82 | 11.09 | 3.92 |
| | **150** | 3973 | 8335 | 43.91 | 79.52 | 1.76 | 10.74 | 3.80 |
| **LSD at 5%** | | **20.34** | **174.14** | **1.05** | **1.78** | **0.05** | **0.26** | **0.09** |
| | | **2016 Season** | | | | | | |
| **10** | **0** | 569 | 3860 | 14.74 | 17.29 | 0.66 | 8.64 | 3.21 |
| | **50** | 886 | 4505 | 19.72 | 24.59 | 0.88 | 9.53 | 3.37 |
| | **100** | 1486 | 5781 | 25.72 | 34.62 | 0.99 | 9.80 | 3.40 |
| | **150** | 1450 | 5553 | 26.18 | 35.53 | 1.02 | 9.96 | 3.44 |
| **20** | **0** | 754 | 4774 | 15.81 | 18.78 | 0.80 | 8.93 | 3.28 |
| | **50** | 1426 | 5679 | 25.11 | 33.55 | 1.16 | 9.03 | 3.69 |
| | **100** | 3432 | 7735 | 44.37 | 79.78 | 1.71 | 9.94 | 3.85 |
| | **150** | 3417 | 7661 | 44.62 | 80.61 | 1.73 | 10.12 | 3.87 |
| **30** | **0** | 977 | 5089 | 19.21 | 23.78 | 0.85 | 9.03 | 3.38 |
| | **50** | 1756 | 6030 | 29.14 | 41.14 | 1.28 | 9.52 | 3.82 |
| | **100** | 3972 | 8743 | 44.43 | 83.50 | 1.74 | 10.65 | 3.89 |
| | **150** | 3922 | 8619 | 43.50 | 81.26 | 1.68 | 10.41 | 3.77 |
| **LSD at 5%** | | **25.63** | **119.02** | **1.70** | **1.33** | **0.06** | **0.18** | **0.08** |

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# تأثير البوليمرات والري تحت السطحي على إنتاجية الذرة الشامية تحت ظروف الأرض الرملية بمنطقة بالوظة بمصر

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أقيمت تجربتان حقليتان بالمحطة البحثية بمنطقة بالوظة التابعة لمركز بحوث الصحراء بمحافظة شمال سيناء، خلال موسمي ٢٠١٥ و٢٠١٦، لدراسة تأثير الري تحت السطحي على أعماق مختلفة ١٠، ٢٠ و٣٠ سم تحت سطح التربة وإضافة البوليمرات إلى التربة في صورة بولي أكريلاميد بمعدلات صفر، ٥٠، ١٠٠ و١٥٠ كجم للفدان تحت ظروف الأراضي الرملية بشمال سيناء.

وكانت النتائج المتحصل عليها كالتالي:

١. تشير النتائج أن جميع الصفات تحت الدراسة تأثرت معنويًا بالري تحت السطحي فى كلا الموسمين. أعلى القيم لهذه الصفات تم الحصول عليها عند إستخدام الري تحت السطحي على عمق ٣٠ سم تحت سطح التربة، بينما أقل القيم كانت عند إستخدام الري تحت السطحي على أقل عمق (١٠ سم) في كلا الموسمين.
٢. أدت زيادة معدل إضافة البوليمرات (بولي أكريلاميد) من صفر إلى ١٥٠ كجم/فدان إلى زيادة معنوية بجميع صفات الذرة الشامية تحت الدراسة في كلا الموسمين. أعلى القيم لهذه الصفات أمكن الحصول عليها عند إضافة البوليمرات بمعدل ١٠٠ كجم بولي أكريلاميد للفدان بالمقارنة بمعاملة الكنترول (بدون إضافة) في كلا الموسمين، ولجميع الصفات بإستثناء طول النبات، قطر الكوز، كفاءة إستخدام الماء، نسبة البروتين بالحبوب ونسبة الزيت بالحبوب، حيث كانت أعلى بإستخدام أعلى معدل بوليمرات وهو ١٥٠ كجم بولي أكريلاميد للفدان. ولكن الزيادة في هذه الصفات نتيجة إضافة هذا المعدل والمعدل الأقل منه لم تكن معنوية في كلا موسمي الزراعة ٢٠١٥ و٢٠١٦.
٣. جميع صفات الذرة الشامية التي تم دراستها تأثرت معنويًا نتيجة التفاعل بين معاملات الري تحت السطحي والمعدلات المختلفة من البوليمرات في كلا الموسمين بإستثناء عدد الكيزان/ نبات، قطر الكوز وطول الكوز لم تتأثر معنويًا بالتفاعل بين عاملي الدراسة في كلا الموسمين. أعلى القيم نتيجة التفاعل بين عاملي الدراسة أمكن الحصول عليها عند إستخدام الري تحت السطحي على عمق ٣٠ سم تحت سطح التربة وإضافة البوليمرات بمعدل ١٠٠ كجم بولي أكريلاميد للفدان في كلا الموسمين تحت ظروف الأراضي الرملية.