



EFFECT OF POTASSIUM AND SOME ANTIOXIDANTS ON YIELD AND ITS COMPONENTS OF MAIZE UNDER DROUGHT CONDITIONS

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ABSTRACT

This study was carried out during 2012 and 2013 seasons in a private farm at El – bayho Village, Samalout district, Minia governorate. to study the effect of skipping irrigation, antioxidants and potassium application on growth, yield and yield components of yellow maize three way cross (352) . Skipping the first irrigation had an inferior effect on growth characters, while skipping the fifth irrigation resulted in an obvious reduction in yield and its components. Treating with any antioxidant (salicylic acid, ascorbic acid and citric acid) and K fertilizer were very effective in enhancing plant height, ear weight, number of grains / row, 100 kernel weight and grain yield / fed over the control treatment . Normal irrigation and application of citric acid at 500 ppm and K fertilizer at 37 kg / fed gave the best results with regard to yield and its components of maize plants.

Keyword: Irrigation, skipping, antioxidant, K,

INTRODUCTION

In Egypt, maize is an important major grain crop in terms of total production and area. Maize is essential for human consumption and many other purposes such as a forage crop for livestock and row material in many industries.

An increase in the maize production will certainly ensure welfare of the farming community and use of hybrids seed offers a promising tool for this.

The positive action of K fertilizer on grain yield might be attributed to one or more of the following topics:

- 1- It regulates enzyme activities.
- 2- It improves photosynthesis process and translocation of sugars, CO₂ assimilation, water use efficiency and cell division, absorption of water root development and (Mengel. and Kirkby 2001).

Application of K was responsible for promoting growth, yield and yield components of crops (Kuan *et al.*, 2000; Li *et al.*, 2001; Bly *et al.*, 2002; Brus and Behal, 2006; William, 2008 Amed *et al.*, 2009 and Thabet, 2012).

Antioxidants were beneficial in preventing reactive oxygen species such as superoxide, anion radicals, H₂O₂ and OH radicals. They were responsible for increasing the tolerance of plants to biotic and abiotic stresses, cell division and the biosynthesis of organic foods (Zhu, 2000 and Pignocchi and Foyer, 2003).

Using antioxidants were favourable in enhancing growth, yield and yield components of different crops (Mohamed, 2004; Afzal, 2005; El-Tayeb, 2005; Abd El-Wahed *et al.*, 2006; Amin *et al.*, 2008; Sadik-Mervet *et al.*, 2013; Osman *et al.*, 2014 and Ali *et al.*, 2015).

Drought had inferior effects on growth, yield and its components of different crops (Kandil *et al.*, 2000; Sharaan *et al.*, 2002a; El-Hifny *et al.*, 2003; Mahfouz, 2003; Khaled, 2006; Darvishan, 2013 and Zare *et al.*, 2014).

The target of this study was to test the effect of irrigation regime, some antioxidants and K fertilizer rates on yield and its components of maize plants.

MATERIAL AND METHODS

The present study was conducted during the two growing seasons of 2012 and 2013 in a private farm located at El-Bayho village, Samalout district, Minia Governorate.

This study aimed at measuring the effect of skipping irrigation regime (A), some antioxidants (B) and potassium fertilizer rates (C) on growth, yield and yield components of yellow hybrid maize T.W.C..(352) variety

The soil type was clay loam in texture; values of pH, N, P and K were 7.95, 0.09, 4.1 and 480 respectively. This experiment included 72 treatments from the following three factors:

A- Irrigation regime : six skipping irrigation treatment :

- a₁ Normal irrigation every 12 days.
- a₂ Skipping 1st irrigation at 24 days age.
- a₃ Skipping 2nd irrigation at 36 days age
- a₄ Skipping 3rd irrigation at 48 days age
- a₅ Skipping 4th irrigation at 60 days age
- a₆ Skipping 6th irrigation at 72 days age

B- Antioxidants treatments : three antioxidants :

- b1 without antioxidants
- b2 spraying salicylic acid at 100 ppm
- b3 spraying ascorbic acid at 500 ppm

b4 spraying citric acid at 500 ppm

C- Potassium fertilizer : three potassium rates :

C1 untreated (control)

C2 36 kg K₂O/ fed

C3 72 kg K₂O/ fed

The experimental design used in this study was randomized complete blocks in split split plot arrangement whether the six irrigation treatments; four antioxidant treatments and three potassium levels allocated randomly in the main plots, sub - plots and sub - sub - plots , respectively in three replications . Each experimental unit area was 10.5 m² and included five revidg 3.5m length with 60cm apart. Grains were sown at the first week of May in both seasons.

The preceding crop was Egyptian clover (Berseem). First irrigation was done at 12 days after sowing and then plants were irrigated every 12 days till the dough stage. Withholding of irrigation was established on the first, second, third, fourth and fifth irrigations when the ages of plants reached 24 , 36, 48, 60 and 72 days, respectively. The three antioxidants namely citric acid and ascorbic acid each at 500 pm and salicylic acid at 100 ppm were sprayed three times at 45 & 60 and 75 days from sowing. Triton B as a wetting agent was added at 0.05% to all solution of these antioxidants and spraying was done till runoff. Potassium was spilted into equal doses , the first was added after 30 days from sowing then the second one was applied at 30 days later. It was

added in the form of potassium sulphate (48% K₂O) at rates of 36 and 72 Kg K₂o / fed.

All recommended common agricultural practices were adopted throughout in the two seasons.

Data were collected from each sub – sub – plot basis, for the following characters, plant height cm, number of fresh leaves ear height cm, ear weight (g) , number of grains / ear, shelling % and grain yield / fed

All obtained data in both seasons were subjected to statistical analysis according to the procedures outlined by Mead *et al.*, (1993) . The means of the treatments were compared using the L.S.D. test in each season.

RESULTS AND DISCUSSION

It is clear from the data in tables 1 , 2 , 3 and 5 that skipping 1st , 2nd , 3rd , 4th or 5th irrigation significantly reduced values of plant height, number of leaves, ear height and ear weight of maize comparing with normal irrigation. The great reduction on plant that left without the first irrigation (skipping 1st irrigation). Skipping 2nd , 3rd , 4th or 5th irrigation had the same trend or such growth character. The greatest values were produced with carrying out normal irrigation. These results were true during seasons.

It is clear from the obtained data that spraying salicylic acid at 100 ppm as well as citric acid and ascorbic acid each at 500 ppm significantly was followed by stimulating, plant height, number of leaves and ear characters comparing with the control treatment. The outstanding effect was

significantly attributed to using salicylic acid, ascorbic acid and citric acid, in ascending order. The untreated plants produced lowest values. The greatest values were produced when the plants treated with citric acid at 500 ppm. Similar results were found during both seasons.

Supplying the plants with K at 36 to 72 kg/ fed. significantly was accompanied with stimulating values relative to the control treatment. No significant promotion on results was observed among the two levels. These results were true during both seasons.

All interactions among the three factors had significant effect. The highest values were recorded with normal irrigation, spraying the plants with citric acid at 500 ppm and application of K at 72 kg/ fed.

Number of grains / row:

Tables (6 and 7) show the effect of irrigation skipping, some antioxidants and potassium application on the number of grains per row and shelling % of maize during 2012 and 2013 seasons.

Skipping irrigation water had significant reduction on the number of grains/ row and selling % over normal irrigation. Delaying of irrigation skipping significantly was accompanied with reducing values comparing to withholding the first irrigation. The lowest values were recorded when the fifth irrigation was skipped. Normal irrigation gave the highest values. Similar results were announced during 2012 and 2013 seasons.

Treating maize plants with an antioxidant significantly was responsible for improving the number of grains / row and shelling % over the control treatment. Spraying citric acid, ascorbic acid and salicylic acid, in descending order was accompanied with enhanced the values . The highest values are recorded on the plants treated with citric acid. The untreated plants produced the lowest values. Similar trend was noticed during both seasons.

Addition of K at 36 to 72 kg/ fed. had significant promotion on the number of grains/ row over the control treatment. No significant differences on such aspect was detected among the two levels of K. Application of 72 kg/ fed gave the highest values. The untreated plants produced the lowest values. The same trend was observed during both seasons.

All the investigated interactions had significant effect on the two characters. The maximum values were recorded with normal irrigation and application of citric acid and K at 74 kg/ fed . These results were true during both seasons.

Grain yield/ fed

Data in table (8) shows the effect of irrigation skipping, some antioxidants and potassium application on grain yield/ fed of maize during 2012 and 2013 summer growing seasons.

Skipping 1st, 2nd, 3rd, 4th or 5th irrigation significantly reduced seed yield/ fed. Relative to normal irrigation. The reduction on seed yield/

fed. was significantly increased with skipping the last irrigations (3rd, 4th or 5th irrigation) comparing with withholding any first irrigations skipping the 5th irrigation gave the lowest values. The highest values were recorded on normal irrigation treatment. These results were true during both seasons.

Seed yield/ fed was significantly improved owing to spraying the plants with an antioxidants the best antioxidant in this respect was citric acid, followed by ascorbic acid. Salicylic acid ranked the last position. Similar results were announced during both seasons.

Using K at 36 to 72 kg/ fed. was significantly associated with enhancing seed yield/ fed. rather than the check treatment. Increasing K levels from 36 to 72 kg/ fed. failed

significantly to show measurable promotion on seed yield/ fed. These results were true during 2012 and 2013 seasons.

All interactions had significant effect on seed yield/ fed. Using any antioxidant or K significantly was very effective in counteracting the adverse effects of drought on seed yield / fed. The maximum values from economical point of view (4600 & 4670 kg.) were obtained with carrying out normal irrigation besides spraying citric acid and K at 36 kg/ fed during both seasons, respectively.

CONCLUSION:

Normal irrigation and application of citric acid at 500 ppm and K at 36 kg K₂O / fed gave the best results with regard to yield and its components of maize plants.

Table (1): Effect of irrigation skipping, some antioxidants and potassium application on plant height (cm) of Maize plants in 2012 and 2013 seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)				K levels kg. (fed.) (C)			
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)	C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)
A ₁ Normal irrigation	b ₁	241.6	242.7	243.0	242.4	243.0	244.3	244.4	243.9
	b ₂	243.3	244.5	244.7	244.2	244.9	247.0	247.0	246.3
	b ₃	246.0	247.1	247.2	246.8	247.3	248.0	248.6	248.0
	b ₄	245.0	249.3	249.4	248.9	250.0	251.5	251.4	251.0
	Mean	244.7	245.9	246.0	245.5	246.3	247.7	247.8	247.3
A ₂ Skipping 1 st Irrig.	b ₁	227.0	228.5	228.7	228.1	228.6	229.0	229.1	228.9
	b ₂	228.5	229.6	229.7	229.3	230.0	231.0	231.5	230.8
	b ₃	230.0	231.3	231.4	230.9	232.0	233.0	233.0	232.7
	b ₄	231.3	232.5	232.6	232.1	234.0	235.0	235.3	234.8
	Mean	229.2	230.4	230.6	230.1	231.1	232.0	232.2	231.8
A ₃ Skipping 2 nd Irrig.	b ₁	228.6	229.7	230.0	229.4	229.0	230.0	230.0	229.7
	b ₂	230.3	231.5	231.6	232.1	230.0	231.3	231.4	230.9
	b ₃	231.9	233.0	233.0	232.6	232.3	233.3	233.6	233.1
	b ₄	233.0	234.1	234.2	233.8	234.3	235.6	235.7	235.2
	Mean	230.9	232.0	232.2	231.7	231.4	232.5	232.6	232.2
A ₄ Skipping 3 rd Irrig.	b ₁	229.0	230.1	230.2	229.8	229.3	230.6	230.7	230.2
	b ₂	230.0	231.4	231.5	231.0	230.3	231.6	232.0	231.3
	b ₃	232.0	233.3	233.4	232.9	232.6	233.7	234.0	233.4
	b ₄	233.0	234.4	234.5	234.0	234.7	235.9	236.0	235.5
	Mean	231.0	232.3	232.4	231.9	231.7	232.9	233.1	232.6
A ₅ Skipping 4 th Irrig.	b ₁	229.0	230.0	230.3	230.0	229.4	230.5	230.6	230.2
	b ₂	230.0	231.3	231.4	230.9	230.4	231.6	231.7	231.2
	b ₃	232.0	233.1	233.2	232.8	232.7	233.8	234.0	233.5
	b ₄	233.0	234.0	234.0	233.7	234.8	235.9	236.0	235.6
	Mean	231.0	232.1	232.2	231.8	231.8	232.9	233.0	232.6
A ₆ Skipping 5 th Irrig.	b ₁	229.0	229.9	230.0	229.6	229.5	230.5	230.6	230.2
	b ₂	230.0	231.3	231.4	230.9	230.4	231.5	231.6	231.2
	b ₃	232.0	233.1	233.3	232.8	232.7	233.8	234.0	233.5
	b ₄	233.0	234.4	234.5	234.0	235.0	236.9	237.0	236.3
	Mean	231.0	232.1	232.3	231.8	231.9	233.1	233.3	232.8
Mean B	b ₁ Control	230.7	231.8	232.0	231.5	231.4	232.4	232.5	232.1
	b ₂ Salicylic acid	232.0	233.2	233.3	232.8	232.6	234.0	234.2	233.6
	b ₃ Ascorbic acid	233.9	235.1	235.2	234.7	234.9	235.9	236.2	235.7
	b ₄ Citric acid	235.2	236.4	236.5	236.0	257.1	238.4	238.5	238.0
Mean (C)	233.0	234.1	234.3		234.0	235.2	235.4		
New L.S.D. at 5%		A 26 B1.0 AB 2.5 C 0.9 AC 2.2 BC 1.8 ABC 4.4				A 2.1 B 1.1 AB 2.7 C 1.0 AC 2.5 BC 2.0 ABC 5.0			

Table (2): Effect of irrigation skipping, some antioxidants and potassium application on the number of green leaves of Maize in 2012 and 2013 seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)				K levels kg. (fed.) (C)			
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)	C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)
A ₁ Normal irrigation	b ₁	17.9	18.4	18.5	18.3	17.2	17.7	17.8	17.6
	b ₂	18.7	19.3	19.4	19.1	18.3	18.8	18.9	18.7
	b ₃	19.9	20.5	20.5	20.3	19.4	19.9	20.0	19.8
	b ₄	21.2	21.7	22.8	21.9	20.3	20.8	20.9	20.7
	Mean	19.4	19.9	20.3	19.9	18.8	19.3	19.4	19.2
A ₂ Skipping 1 st Irrig.	b ₁	10.0	10.6	10.6	10.4	9.4	9.9	10.0	9.8
	b ₂	10.9	11.5	11.6	11.3	10.5	10.9	11.0	10.8
	b ₃	11.8	12.3	12.4	12.2	11.6	12.1	12.2	12.0
	b ₄	12.4	12.9	13.0	12.8	12.7	13.2	13.3	13.1
	Mean	11.2	11.8	11.9	11.6	11.0	11.5	11.6	11.4
A ₃ Skipping 2 nd Irrig.	b ₁	12.5	13.0	13.1	12.9	10.5	10.9	11.4	10.9
	b ₂	13.5	14	14.1	13.9	11.6	12.1	12.2	12.0
	b ₃	14.1	14.6	14.7	14.5	12.7	13.2	13.3	13.1
	b ₄	15.2	15.7	15.8	15.6	13.6	14.1	14.2	14.0
	Mean	13.8	14.3	14.4	14.2	12.1	12.5	12.7	12.4
A ₄ Skipping 3 rd Irrig.	b ₁	12.9	13.4	13.5	13.3	11.7	12.2	12.3	12.1
	b ₂	13.9	14.4	14.5	14.3	12.8	13.3	13.4	13.2
	b ₃	14.9	15.4	15.5	15.3	13.8	14.3	14.4	14.2
	b ₄	15.3	16.3	16.4	16.2	14.9	15.4	15.5	15.3
	Mean	14.3	14.8	14.9	14.7	13.3	13.8	13.9	13.7
A ₅ Skipping 4 th Irrig.	b ₁	14.1	14.6	14.7	14.5	12.9	13.4	13.5	13.3
	b ₂	15.0	15.5	15.6	15.4	14.0	14.5	14.6	14.4
	b ₃	16.0	16.5	16.6	16.4	15.0	15.5	15.6	15.4
	b ₄	16.9	17.4	17.5	17.1	15.9	16.4	16.5	16.3
	Mean	15.3	16.0	16.1	15.8	14.4	14.9	15.0	14.8
A ₆ Skipping 5 th Irrig.	b ₁	14.1	14.6	14.7	14.5	13.0	13.5	13.6	13.4
	b ₂	15.0	15.5	15.6	15.4	14.1	14.6	14.7	14.5
	b ₃	16.0	16.5	16.6	16.4	15.0	15.5	15.6	15.4
	b ₄	17.0	17.5	17.6	17.4	16.0	16.5	16.7	16.4
	Mean	15.5	16.0	16.1	15.9	14.5	15.0	15.1	14.9
Mean B	b ₁ Control	13.5	14.1	14.1	13.9	12.4	12.9	13.1	12.8
	b ₂ Salicylic acid	14.5	15.0	15.1	14.9	13.5	14.0	14.1	13.9
	b ₃ Ascorbic acid	15.4	15.9	16.0	15.8	14.5	15.0	15.1	14.9
	b ₄ Citric acid	16.1	16.9	17.1	16.7	15.5	16.0	16.1	15.9
Mean (C)		14.9	15.5	15.6		14.5	15.1	15.2	
<i>New L.S.D. at 5%</i>		A 1.0				A 1.0			
		B 1.0				B 1.0			
		AB 2.5				AB 2.5			
		C 0.5				C 0.6			
		AC 1.2				AC 1.5			
		BC 1.0				BC 1.2			
		ABC 2.4				ABC 3.0			

Table (3): Effect of irrigation skipping, some antioxidants and potassium application on the ear height (cm) of Maize plants in 2012 and 2013 seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)				K levels kg. (fed.) (C)			
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)	C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)
A ₁ Normal irrigation	b ₁	193.9	195.0	195.2	194.4	193.0	194.1	194.2	193.8
	b ₂	195.0	196.1	196.2	195.8	194.1	195.2	195.3	194.9
	b ₃	196.9	198.0	198.1	197.7	196.0	197.1	197.2	196.8
	b ₄	198.0	199.1	199.2	198.8	197.1	198.2	198.3	197.9
	Mean	195.9	197.0	197.1	196.7	195.0	196.1	196.2	195.8
A ₂ Skipping 1 st Irrig.	b ₁	180.0	181.1	181.2	180.8	179.1	180.2	180.3	179.9
	b ₂	181.0	182.1	182.2	181.8	180.1	181.2	181.3	180.9
	b ₃	182.9	183.0	183.1	183.0	182.0	183.1	183.2	182.8
	b ₄	184.0	185.1	185.2	185.1	183.1	184.2	184.3	183.9
	Mean	181.9	182.8	182.9	182.5	181.0	182.1	182.2	181.8
A ₃ Skipping 2 nd Irrig.	b ₁	181.3	182.4	182.5	182.1	180.4	181.5	182.6	181.5
	b ₂	183.3	184.4	184.5	184.1	182.4	183.5	184.6	183.5
	b ₃	184.5	185.6	185.7	185.3	183.4	184.5	184.6	184.2
	b ₄	185.6	189.7	189.8	188.4	184.5	185.6	185.7	185.3
	Mean	184.4	185.5	185.6	185.2	182.6	183.7	184.3	183.5
A ₄ Skipping 3 rd Irrig.	b ₁	184.0	185.1	185.2	184.8	182.5	183.6	184.7	183.6
	b ₂	185.0	186.1	186.2	185.8	183.5	184.6	184.7	184.3
	b ₃	186.0	187.1	187.2	186.8	184.6	185.7	185.8	185.4
	b ₄	187.3	188.4	188.5	188.1	186.0	187.1	187.2	186.8
	Mean	185.5	186.6	186.7	186.3	184.1	185.2	185.6	185.0
A ₅ Skipping 4 th Irrig.	b ₁	186.0	187.1	187.2	186.8	184.0	185.1	185.2	184.8
	b ₂	188.0	189.1	189.2	188.8	185.5	186.6	186.7	186.3
	b ₃	189.5	190.6	190.7	190.3	186.8	187.9	188.0	187.6
	b ₄	191.0	192.1	192.2	191.8	187.9	189.0	189.1	188.7
	Mean	188.6	189.7	189.8	189.4	186.0	187.1	187.2	186.8
A ₆ Skipping 5 th Irrig.	b ₁	188.0	189.1	189.2	188.8	186.0	187.1	187.2	186.8
	b ₂	189.9	191.0	191.1	190.7	187.5	188.6	188.7	188.3
	b ₃	191.0	192.1	192.2	191.8	189.9	190.1	190.2	190.1
	b ₄	192.3	192.4	192.5	192.4	191.0	192.1	192.2	191.8
	Mean	190.3	191.1	191.2	190.9	188.6	189.4	189.5	189.2
Mean B	b ₁ Control	185.5	186.6	186.7	186.3	184.1	185.2	185.7	185.0
	b ₂ Salicylic acid	187.8	188.1	188.2	188.0	185.5	186.6	186.8	186.3
	b ₃ Ascorbic acid	188.4	189.4	189.5	189.1	187.1	188.0	188.1	187.7
	b ₄ Citric acid	190.2	191.1	191.2	190.8	188.2	189.3	189.4	192.3
Mean (C)		188.0	188.8	188.9		186.3	187.3	187.5	
<i>New L.S.D. at 5%</i>		A 1.1				A1.2			
		B 1.0				B0.9			
		AB 2.5				AB2.2			
		C 0.7				C0.8			
		AC 1.7				AC2.0			
		BC 1.4				BC1.6			
		ABC 3.4				ABC4.0			

Table (4): Effect of irrigation skipping, some antioxidants and potassium application on the ear weight (g) of Maize cv 3- Way Cross 352 during 2012 and 2013 summer growing seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013				
		K levels kg. (fed.) (C)					C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A& B &A)
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A& B &A)					
A ₁ Normal irrigation	b ₁	280.0	286.6	286.6	284.2	281.9	290.0	291.0	287.6	
	b ₂	290.0	297.0	297.3	228.1	291.8	301.0	302.0	298.3	
	b ₃	295.0	303.0	304.0	300.7	296.9	305.0	306.7	302.9	
	b ₄	303.0	310.0	311.0	308.0	305.0	315.0	316.0	312.0	
	Mean	292.0	299.0	299.7	296.9	293.9	302.7	303.9	300.2	
A ₂ Skipping 1 st Irrig.	b ₁	260.0	267.0	268.0	265.0	262.0	271.0	271.9	268.3	
	b ₂	269.0	277.0	277.7	274.6	271.0	280.0	281.0	277.3	
	b ₃	279.0	287.0	288.0	284.7	281.6	292.0	292.9	288.8	
	b ₄	286.0	293.0	293.7	290.9	288.0	299.0	299.7	295.6	
	Mean	273.5	281.0	281.8	278.8	275.6	285.5	286.3	282.5	
A ₃ Skipping 2 nd Irrig.	b ₁	244.0	252.0	253.0	249.7	246.0	255.0	256.0	252.3	
	b ₂	252.0	260.0	260.6	257.5	254.0	260.0	260.9	258.3	
	b ₃	260.0	266.0	267.0	264.3	261.9	271.0	272.0	268.3	
	b ₄	269.0	275.0	276.0	273.3	271.0	280.0	280.5	277.2	
	Mean	256.2	263.2	264.1	264.2	258.2	266.5	267.3	264.0	
A ₄ Skipping 3 rd Irrig.	b ₁	236.0	243.0	244.0	241	238.0	247.0	248.0	244.0	
	b ₂	243.0	250.0	250.6	247.9	245.0	255.0	256.0	252.0	
	b ₃	250.0	256.0	256.6	254.2	252.0	264	265.0	260.3	
	b ₄	256.0	262.0	262.3	260.1	259.0	269.0	270.0	266.0	
	Mean	246.2	252.7	253.3	250.7	248.5	258.7	259.7	255.6	
A ₅ Skipping 4 th Irrig.	b ₁	226.0	232.0	233.0	230.3	227.5	238.0	239.0	234.8	
	b ₂	235.0	242.0	243.0	240	237.0	247	248.0	244.0	
	b ₃	244.0	253.0	254.0	250.3	246.0	260.0	261.0	255.7	
	b ₄	251.0	260.0	261.0	257.3	252.5	262.5	263	259.3	
	Mean	239.0	246.7	247.7	244.5	240.7	251.8	252.7	248.4	
A ₆ Skipping 5 th Irrig.	b ₁	220.0	226.5	227.0	224.5	222.0	231.0	232.0	228.3	
	b ₂	226.3	233.0	234.5	231.1	228.9	239.0	240.0	236.0	
	b ₃	232.9	240.0	240.5	237.8	235.0	245.0	246.0	242.0	
	b ₄	238.9	244.0	245.0	242.6	240.9	249.9	250.0	246.9	
	Mean	229.5	235.8	236.6	234.0	231.7	241.2	242.0	238.3	
Mean B	b ₁ Control	244.3	251.0	251.9	248.8	246.2	255.3	256.3	252.6	
	b ₂ Salicylic acid	252.5	259.8	260.5	257.6	254.6	263.6	264.6	260.9	
	b ₃ Ascorbic acid	260.1	267.5	268.3	265.3	262.2	272.8	273.9	269.6	
	b ₄ Citric acid	267.3	274.0	274.8	272.0	269.4	279.2	279.8	274.6	
Mean (C)	256.1	263.1	263.9		258.1	267.8	268.7			
<i>New L.S.D. at 5%</i>		A 3.0			A 3.4					
		B 2.8			B 3.0					
		AB 6.9			AB 6.7					
		C2 .6			C 2.7					
		AC 6.4			AC 6.6					
		BC 5.2			BC 3.4					
		ABC 12.8			ABC 13.2					

Tale (5): Effect of irrigation skipping, some antioxidants and potassium application on the number of grains / row of Maize cv 3- Way Cross 352 during 2012 and 2013 summer growing seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)				K levels kg. (fed.) (C)			
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A& B& AB)	C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A& B &AB)
A ₁	b ₁	44.0	44.6	44.7	44.4	44.6	45.0	45.0	44.9
Normal irrigation	b ₂	44.9	45.5	45.5	45.3	45.6	46.1	46.2	46.0
	b ₃	45.6	46.2	46.3	46.0	46.2	47.0	47.1	46.8
	b ₄	46.3	47.0	47.1	46.8	47.0	47.5	47.7	47.4
	Mean	45.2	45.8	45.9	45.6	45.8	46.4	46.5	46.2
	A ₂	b ₁	42.6	43.2	43.3	43.0	43.2	44.0	44.1
Skipping 1 st Irrig.	b ₂	43.1	43.7	43.8	43.5	43.7	44.1	44.0	43.9
	b ₃	44.0	44.6	45.2	44.6	44.5	45.0	45.0	44.8
	b ₄	44.4	44.8	45.0	44.7	45.0	45.6	45.7	45.4
	Mean	43.5	44.0	44.3	43.9	44.1	44.6	44.7	44.5
	A ₃	b ₁	41.5	42.0	42.0	41.8	42.2	43.0	43.1
Skipping 2 nd Irrig.	b ₂	42.0	42.6	43.2	42.6	42.6	43.4	43.5	43.2
	b ₃	42.6	43.1	43.4	43.0	43.3	44.0	44.1	44.8
	b ₄	43.1	44.0	44.2	43.8	43.7	44.0	44.1	43.9
	Mean	42.3	42.9	43.2	42.8	42.9	43.6	43.7	43.4
	A ₄	b ₁	39.5	40.0	40.1	39.9	40.1	40.5	40.5
Skipping 3 rd Irrig.	b ₂	40.1	40.7	40.8	40.5	40.7	41.2	41.2	41.0
	b ₃	40.6	41.2	41.3	41.0	41.3	42.2	42.3	41.9
	b ₄	41.0	41.6	41.7	41.4	41.6	42.0	41.1	41.9
	Mean	40.3	40.8	40.9	40.7	40.9	41.4	41.5	41.3
	A ₅	b ₁	38.6	39.5	39.6	39.2	39.2	40.0	40.4
Skipping 4 th Irrig.	b ₂	39.2	40.0	40.1	39.8	39.9	40.5	40.6	40.3
	b ₃	40.0	40.5	40.6	40.4	40.3	40.8	41.0	40.7
	b ₄	40.5	40.9	41.0	40.8	41.2	41.2	41.2	41.2
	Mean	39.5	40.2	40.3	40.0	40.1	40.6	40.8	40.5
	A ₆	b ₁	38.0	38.6	38.6	38.4	38.7	39.0	39.1
Skipping 5 th Irrig.	b ₂	38.5	39.0	39.1	38.9	39.2	40.0	40.0	39.7
	b ₃	39.0	39.9	40.0	39.6	39.9	40.5	40.6	40.3
	b ₄	39.5	40.1	40.2	39.9	40.4	40.9	41.0	40.8
	Mean	38.7	39.4	39.4	39.2	39.5	40.1	40.1	39.9
	Mean B	b ₁ Control	40.7	41.3	41.3	41.1	41.3	41.9	42.0
	b ₂ Salicylic acid	41.3	41.9	42.0	41.7	41.9	42.5	42.5	42.3
	b ₃ Ascorbic acid	41.9	42.5	42.8	42.4	42.5	43.2	43.3	43.0
	b ₄ Citric acid	42.4	43.0	43.2	42.9	43.1	43.0	43.6	43.2
Mean (C)		41.6	42.2	42.4		42.2	42.7	42.8	
<i>New L.S.D. at 5%</i>		A1.1			A1.0				
		B0.6			B0.5				
		AB1.5			AB1.2				
		C0.5			C0.5				
		AC1.2			AC1.2				
		BC1.0			BC1.0				
		ABC2.4			ABC2.4				

Table (6): Effect of irrigation skipping, some antioxidants and potassium application on the percentage of shelling of Maize cv 3- Way Cross 352 during 2012 and 2013 summer growing seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)			Mean (A& B& AB)	K levels kg. (fed.) (C)			Mean (A& B & AB)
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	
A ₁ Normal irrigation	b ₁	84.1	84.6	84.7	84.5	83.9	84.4	84.5	84.3
	b ₂	84.6	85.2	85.3	8/5.0	84.4	84.9	85.0	84.8
	b ₃	85.2	85.8	85.9	85.6	85.0	85.5	85.6	85.4
	b ₄	86.0	86.5	86.5	86.3	85.8	85.3	85.4	85.5
	Mean	84.9	85.5	85.6	85.3	84.7	85.0	85.1	84.9
A ₂ Skipping 1 st Irrig.	b ₁	83.6	84.1	84.2	83.9	83.4	83.9	84.0	83.8
	b ₂	84.2	84.6	84.7	84.5	84.0	84.5	84.6	84.4
	b ₃	84.6	84.9	85.0	84.8	84.4	84.9	85.0	84.8
	b ₄	85.0	85.4	85.5	85.3	84.8	84.3	84.4	84.5
	Mean	84.3	84.7	84.8	84.6	84.1	84.4	84.5	84.3
A ₃ Skipping 2 nd Irrig.	b ₁	83.0	83.4	83.5	83.3	82.8	83.2	83.3	83.1
	b ₂	83.6	84.0	84.1	83.9	83.4	83.9	84.0	83.9
	b ₃	84.2	84.6	85.0	84.6	84.0	84.5	84.6	84.4
	b ₄	85.7	86.3	96.4	96.1	95.5	96.0	96.1	95.9
	Mean	84.1	84.5	84.7	84.4	83.9	84.4	84.5	84.3
A ₄ Skipping 3 rd Irrig.	b ₁	82.2	83.1	83.2	82.8	82.0	82.5	82.6	82.4
	b ₂	83.0	83.5	83.6	83.4	82.8	83.3	83.4	83.2
	b ₃	83.6	84.0	84.1	83.9	83.4	83.9	84.0	83.8
	b ₄	84.0	84.6	84.7	84.4	83.8	84.3	84.4	84.2
	Mean	83.2	83.8	83.9	83.6	83.0	83.5	83.6	83.4
A ₅ Skipping 4 th Irrig.	b ₁	81.0	81.5	81.5	81.3	80.8	81.3	81.4	81.2
	b ₂	81.6	81.9	82.0	81.8	81.4	81.9	82.0	81.8
	b ₃	82.2	82.6	82.7	82.5	82.0	82.5	82.6	82.4
	b ₄	83.0	83.5	83.5	83.3	82.8	83.3	83.4	83.2
	Mean	81.9	82.3	82.4	82.2	81.7	82.2	82.3	82.1
A ₆ Skipping 5 th Irrig.	b ₁	80.0	80.5	80.5	80.3	79.7	80.2	80.3	80.1
	b ₂	80.5	81.0	81.1	80.9	80.3	80.8	80.9	80.7
	b ₃	81.0	81.7	81.8	81.5	80.8	81.3	81.4	81.2
	b ₄	81.4	82.0	82.1	81.8	81.2	81.7	81.8	81.6
	Mean	80.7	81.3	81.3	81.1	80.5	81.0	81.1	80.9
Mean B	b ₁ Control	82.3	82.8	82.9	82.7	82.1	82.5	82.6	82.4
	b ₂ Salicylic acid	82.9	83.3	83.4	83.2	82.7	83.2	83.3	83.1
	b ₃ Ascorbic acid	83.4	83.9	84.0	83.8	83.2	83.7	83.8	83.6
	b ₄ Citric acid	84.1	84.7	84.7	84.5	83.9	84.1	84.2	84.1
	Mean (C)	83.2	83.7	83.8		83.0	83.4	83.5	
<i>New L.S.D. at 5%</i>		A0.5 B0.4 AB0.9 C0.5 AC1.3 BC1.0 ABC2.6				A0.5 B0.4 AB1.0 C0.3 AC0.7 BC0.6 ABC1.4			

Table (7): Effect of irrigation skipping, some antioxidants and potassium application on the grain yield / fed (kg.) of Maize in 2012 and 2013 seasons.

Irrigation skipping (A)	antioxidant treatments (B)	2012				2013			
		K levels kg. (fed.) (C)				K levels kg. (fed.) (C)			
		C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)	C ₁ 0.0 kg	C ₂ 36 kg	C ₃ 72 kg	Mean (A&B &AB)
A ₁ Normal irrigation	b ₁	4000.0	4150.0	4155.0	4101.6	4010.0	4110.0	4230.0	4150.0
	b ₂	4190.0	4350.0	4400.0	4313.3	4200.0	4400.0	4420.0	4340.0
	b ₃	4300.0	4450.0	4500.0	4416.6	4320.0	4520.0	4530.0	4456.6
	b ₄	4450.0	4600.0	4650.0	4566.6	4470.0	4670.0	4690.0	4610.0
	Mean	4235.0	4387.5	4426.2	4349.57	4250.0	4450.0	4467.5	4389.1
A ₂ Skipping 1 st Irrig.	b ₁	3600.0	3700.0	3750.0	3683.3	3620.0	3820.0	3830.0	3756.6
	b ₂	3800.0	3960.0	3970.0	3910.0	3820.0	4020.0	4040.0	3960.0
	b ₃	4000.0	4140.0	4150.0	4096.6	4030.0	4230.0	4250.0	4170.0
	b ₄	4150.0	4300.0	4310.0	4253.3	4170.0	4370.0	4380.0	4306.6
	Mean	3887.5	4025.0	4045.0	3985.83	3910.0	4110.0	4125.0	4048.3
A ₃ Skipping 2 nd Irrig.	b ₁	3450.0	3600.0	3601.0	3550.3	3470.0	3670.0	3690	3610.0
	b ₂	3600.0	3750.0	3796.0	3706.6	3620.0	3820.0	3853.0	3758.3
	b ₃	3900.0	4050.0	4060.0	4003.3	3930.0	4130.0	4140.0	4066.6
	b ₄	3950.0	4100.0	4120.0	4056.6	3470.0	3670.0	3685.0	3608.3
	Mean	3725.0	3875.0	3887.7	3829.23	3622.5	3822.5	3827.5	2760.8
A ₄ Skipping 3 rd Irrig.	b ₁	3300.0	3450.0	3470.0	3406.6	3320.0	3520.0	3530.0	3456.6
	b ₂	3500.0	3650.0	3665.0	3605.0	3520.0	3720.0	3735.0	3658.3
	b ₃	3800.0	3950.0	3955.0	3901.6	3820.0	4020.0	4035.0	3958.3
	b ₄	395.0	4100.0	4120.0	4056.6	3970.0	4170.0	4180.0	4106.6
	Mean	3637.5	3787.5	3802.5	3742.5	3657.5	3857.5	3870.0	3795.0
A ₅ Skipping 4 th Irrig.	b ₁	3200.0	3350.0	3370.0	3306.6	3220.0	3420.0	3430.0	3356.6
	b ₂	3450.0	3600.0	3630.0	3560.0	3470.0	3670.0	3685.0	3608.5
	b ₃	3700.0	3850.0	3870.0	3806.6	3720.0	3920.0	3940.0	3860.0
	b ₄	3850.0	4000.0	4050.0	3966.6	3870.0	4070.0	4085.0	4008.5
	Mean	3550.0	3700.0	3730.0	3660.0	3570.0	3770.0	3785.0	3708.3
A ₆ Skipping 5 th Irrig.	b ₁	3111.0	3160.0	3180.0	3150.3	3131.0	3331.0	3345.0	3269.0
	b ₂	3400.0	3550.0	356.0	3503.3	3420.0	3620.0	3630.0	3556.6
	b ₃	3650.0	3800.0	3820.0	3756.6	3670.0	3870.0	3880.0	3806.6
	b ₄	3800.0	3950.0	3970.0	3906.6	3820.0	4020.0	4040.0	3960.0
	Mean	3490.2	3615.0	3632.5	3579.2	3510.2	3710.2	3723.7	3648.0
Mean B	b ₁ Control	3443.5	3568.3	3587.6	3533.1	3461.8	3661.8	3675.8	3599.8
	b ₂ Salicylic acid	3656.6	3810.0	3832.5	3766.3	.675.0	3875.0	3890.8	3813.6
	b ₃ Ascorbic acid	3891.6	4040.0	4059.1	3996.9	3915.0	4115.0	4129.1	4053.0
	b ₄ Citric acid	4025.0	4175.0	4203.3	4134.4	3961.6	4161.6	4176.6	4099.9
Mean (C)		3754.9	3898.3	3920.6		3753.4	3953.4	3968.1	
<i>New L.S.D. at 5%</i>		A96.9				A99.9			
		B82.2				B79.3			
		AB201.4				AB194.3			
		C71.0				C 69.3			
		AC173.9				AC169.8			
		BC142.0				BC138.6			
		ABC				ABC138.6			

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الملخص العربى

تأثير البوتاسيوم وبعض مضادات الأكسدة على المحصول ومكوناته فى الذرة الشامية تحت ظروف الجفاف

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أقيمت تجربتان حقليتان فى مزرعة خاصة بقرية البيهو مركز سمالوط - محافظة المنيا خلال الموسمين 2012 ، 2013 بهدف دراسة مدى تأثر المحصول ومكوناته فى الذرة الشامية الصفراء هجين ثلاثى 352 لمعاملات تقويت بعض الريات واستخدام بعض مضادات الأكسدة ومعدلات السماد البوتاسى. وكان لتقويت الريه الأولى تأثيرات ضارة على صفات النمو الخضرى بينما كان لاسقاط الريه الخامسة تأثيرات ضارة على المحصول ومكوناته بالمقارنة بمعاملة الكنترول وكانت المعاملة باحدى مضادات الاكسدة (حامض السلسليك- حامض الاسكوريك- وحامض الستريك) إلى جانب البوتاسيوم فعالة جدا فى تحسين ارتفاع النبات ووزن الكوز وعدد الحبوب فى الصف وكمية محصول الذرة وذلك مقارنة بمعاملة الكونترول. التوصية إجراء الري العادى (بدون تقويت أى رية) مع استخدام حامض الستريك بتركيز 500 جزء فى المليون والتسميد بالبوتاسيوم بمعدل 37 كجم بوتاسيوم للفدان يعطى أفضل النتائج بخصوص المحصول ومكوناته فى الذرة الشامية الصفراء (هجين ثلاثى 352) .