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Full Length Research Paper

Effect of Antioxidant and Growth Hormones on Seedling Parameters of New and Aging Seed of Some Maize Hybrids

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To study the effect of antioxidants and growth hormones on seedling parameters of new and aging of some maize hybrid seed. A laboratory experiment conducted in the Giza Central Seed Testing Laboratory of Central Administration for Seed Certification, Ministry of Agriculture Egypt during May and June 2018, to investigate the response of seedling parameters to antioxidants, and growth hormones of new and aging of some maize hybrid seed. The result clearly indicated that seed produced in 2017 season recorded highest shoot and root length, shoot and root fresh weight, shoot and root dry weight, seedling vigor index, percentages of seedling height reduction and relative dry weight compared with those produced in 2016 season showed lowest values. The highest shoot and root length, shoot and root fresh weight, shoot and root dry weight and seedling vigor index was obtained from T.W.C. 310 hybrids, Followed by T.W.C 324 and T.W.C 323. Priming in Humic acid at 500 ppm, Ascorbic acid at 100 ppm, Folic acid at 15 mM and Salicylic acid at 100 ppm and H_2O_2 at 40 ppm significantly exceeded shoot and root length, shoot and root fresh weight, shoot and root dry weight, seedling vigor index, percentages of seedling height reduction and relative dry weight compared to the control treatment. The highest shoot and root length, shoot and root fresh weight, shoot and root dry weight, seedling vigor index, seedling height reduction and relative dry weight (%) were obtained from GA3 at 50 ppm compared with 0, and GA3 at 25 ppm. It could be concluded that for improving seedling characters of old and new maize season, it must be recommended that soaking TWC 310 hybrid in humic acid at 500 ppm and moisten by GA3 at concentration of 50 ppm.

Keywords: Maize hybrids, antioxidants, growth hormones, seedling characters

INTRODUCTION

Maize (Zea mays L.) is a great and an imperative cereal crop grown all over the world. It considered also as one of the main cereal crops, comes the third after wheat and rice. Consequently, an excessive consideration should compensate to increase maize productivity by either increasing the cultivated area or exploiting yield per unit

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area in order to decrease the gap between its production and consumption. To find the role of new and old seed (aging) on maize seedling parameters. Generally, seeds are very sensitive and susceptible to the adverse circumstances. Seed deterioration can reduce of quality, viability and vigour due to either aging or effect of opposing conservation aspects **(Bailly, 2004).** During seed storage, the natural oil inside the seeds will undergo diverse biochemical changes and this will lead to the deterioration and damage of the seed **(Kausar et al., 2009).** During the priming process, catalase is the enzyme that plays great role in the retrieval of seeds during aging **(Kibinza et al., 2011).** Under salt stress, then improves in seedling maize that noticed only from ethylene (ET) priming designates that the stress tolerance in maize from ethylene priming is a fundamental process for stress tolerance attainment, which explained, however, by other biochemical mechanisms but not by changes in the antioxidant system **(Carvalho et al., 2011).** The tallest radical and plumule, seedling length and seed vigour produced by Hybrid Simon under drought stress **(Khodarahmpour, 2012).** There duction in the germination capacity, quality, viability and vigor due to either aging or role of adverse environmental conditions (**Siadat et al., 2012).** Early seedling establishment improved by ascorbic acid, salicylic acid and hydrogen peroxide application, by owing to improved antioxidant defense system and nutrient homeostasis **(Ahmed et al., 2013).** Seed pretreatment proved an effective technique to improve seedling growth of maize. The presoaking recommended harvesting better benefits compared to other methods of priming (**Tian et al., 2014).** The decline of seedling growth that inside the seed as biochemical and enzymatic changes accrued due to deterioration of maize seed **(Kapilan, 2015).** Drought stress affected all corn seed characteristics and some priming treatments were enough to invigorate the seedling growth. The hormone priming under moderate drought and osmo-priming under severe drought were the best cases for seed improvement. **(Khatami et al., 2015).** Seed priming in water or plant growth regulators decreases the storage resistance capacity of corn seed **(Pallaoro et al., 2016).**

Seedling growth of maize improved by seed priming with Chitosan under low temperature stress **(Guan et al., 2009).** Antioxidant enzymes protect cells against oxidative stress. Catalase and peroxidase are two antioxidant enzymes, which have an important role it decomposition of H_2O_2 in the cells **(Rahnama et al., 2011).** A significant and synergistic effect on seedling growth under drought stress due to seed soaking in 6-BA or PEG **(Yuan et al., 2014).** The higher reduction in seedling characteristics are consequence of seed deterioration due to increase aging duration, catalase, and ascorbatper oxidase enzyme decreased significantly **(Boghori and Tabatabaei, 2015).** Priming with salicylic acid at 100 ppm and ascorbic acid at 100 ppm could improve the percentage of emergence and germination rate. Salicylic acid at 100 ppm and ascorbic acid at 100 ppm enhanced root dry weight than other treatments **(Eisvand et al., 2015).** Maximum of seedlings parameters of the old or new seed of hybrid TWC 352 produced from soaking in antioxidant like ascorbic acid or citric acid or salicylic acid or natural materials like yeast, extract at the rate of 100 ppm for 18 hours **(Kandil et al., 2015).** Seed priming and aging effects onseedling percentage, seedling length, and vigor index were significantly. Priming seed with gibberellins, under non-aged conditions produced the highest normal seedling percentage, seedling length and vigor index **(Khajeh et al., 2015).** Priming seed with salicylic acid, kinetin and gibberellic acid improved seedling growth **(Nimir et al., 2015).** Priming seed can apply to improve seed quality resulting in higher vigour while partly abolishing seed aging effects **(Wojtyia et al., 2015).**Therefore, the goals of this investigation aimed to study the effect of antioxidants, and growth hormones of new and aging of some maize hybrid seed to seedling parameters.

MATERIALS AND METHODS

Treatments and Experimental Design:

A laboratory experiment conducted in the Giza Central Seed Testing Laboratory of Central Administration for Seed Certification (CASC), Ministry of Agriculture Egypt during May and June 2018. The aims of this investigation aimed to study the response of germination character to antioxidants, and growth hormones of seeds production 2016 and 2017 of some maize hybrids seed. Two factorial experiments assigned to Randomized Complete Block Design in four replications. The three types of maize seeds of production (2016 and 2017) includes a separate experiment. The three maize hybrids named 310, 323, 324 includes the first factor. The five types of antioxidants, Salicylic acid at 100 ppm, Ascorbic acid at 100 ppm, Folic acid at 100 ppm, H_2O_2 at 40 ppm and Humic acid at 500 ppm has the second factor determined at concentrations. The three concentrations of study growth hormone as GA_3 at 0, 25 and 50 ppm concentrations include the third factor studied. Selected hybrids obtained from maize section Field Crop Institute, ARC. Each hybrid was prim in the antioxidants at above concentrations of 24 hours. Each hybrid seed moistened using growth hormones as above concentrations under the chamber condition at 25±1ºc. Thereafter, seeds moistened with distilled water under control treatments. The prim seeds in antioxidants and non-primed seed of study hybrids sown in Filter paper used Twenty-five seeds per each treatment for each cultivar allowed to germinate on Filter paper. The experiment consists of 432 Filter paper arranged in a factorial experiment in Randomized Complete Block Design (RCBD) in four replicates in the Filter paper placed in a

Table 1: Means of shoot length, root length, shoot fresh weight, and root fresh weight (g) of Maize hybrids seed of 2017 and 2016 season's production.

Treatments	Shoot Length (cm)	Root Length (cm)	Shoot Fresh Weight (g)	Root fresh Weight (g)
Date of production (D):				
2017	22.01	19.31	0.55	0.25
2016	19.59	14.86	0.41	0.13
F- Test 5%	*	*	*	*

growth chamber for 8 days at 25-±1 ºc for germination according to **ISTA, 2018**.

Studied Characters:

New and old maize hybrid seed of study cultivars subjected for determination of germination characters and seedling parameters in the laboratory experiment. It measured eight seedling characters, namely shoot and radical length, shoot and radical fresh weight, shoot and radical dry weight, seedling height reduction and relative dry weight determined.

1-Shoot length (cm): Means of the shoot length of the five seedlings from the seed to the tip of the leaf blade recorded in centimeters.

2-Root length (cm): Means of the root length of five seedlings from the seed to the tip of the root in centimeters (cm).

3-Shoot fresh weight (g): Average the weight of five seedling shoots measured and expressed in milligram (g).

4-Weight of fresh root (g): Mean weight of five seedling roots measured and expressed in milligram (g) as the root fresh weight.

5-Weight of dry shoot (g): Means weight of five seedling shoots recorded and expressed in milligram (g) after oven drying at 75 º C for 48 h.

6-Weight of dry root (g): Means weight of five seedling roots recorded and expressed in milligram (g) after oven drying at 75 ºc for 48 h.

7-Total chlorophyll (SPAD): Average of total chlorophyll (SPAD) in seedling leaf samples assessed by SPAD-502 (Minolta Co. Ltd., Osaka, Japan).

8-Seedling Vigor index (SVI): It was calculated according to the following equation:

(VI) = (Average shoot length + Average root length) × Germination percentage.

9-Seedling height reduction (SHR): It was calculated using the following equation described by **Islam and Karim (2010).**

SHR (%) = Plant height at control – Plant height at saline condition/Plant height at saline condition × 100.

10-Relative dry weight (RDW): It was calculated using the following equation described by **Islam and Karim (2010).**

Experimental analysis:

The data collected was an analysis of variance technique using the MSTAT–C statistical package programmed as described by a procedure of **Gomez and Gomez (1991).** The lest significant differences test (LSD) for 5 and 1 % level of probability used for comparisons between treatment means, according to **Snedecor and Cochran (1980).** The data analyzed statistically following a RCBD design by MSTAT-C computer package developed by **Russel (1986).**

RESULTS AND DISCUSSION

New and old (aging) seed:

Average numbers of shoot length, root length (cm), shoot fresh weight (g), root fresh weight (g) as affected by studied maize seed priming in growth regulators and antioxidants concentrations are presented in Table (1) the results showed that there were significant differences due to hybrids in shoot length, root length (cm), shoot fresh weight (g), root fresh weight (g) seed of 2017 and 2016 season's production.. The result clearly indicated that seed produced in 2017 season recorded highest shoot length (Cm), root length (cm), shoot fresh weight (g), root fresh weight (g) which were 22.1, 19.31, 0.55 and 0.25, respectively compared with those produced in 2016 season showed lowest Shoot Length (Cm), Root Length (cm), Shoot Fresh Weight (g), Root fresh Weight (g). In addition, shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) as affected by studied Maize hybrids are presented in Table (2). The results showed that there were significant differences due to hybrids in shoot dry weight (g) in seed of 2017 and 2016 season's production. The result clearly indicated that seed produced in 2017 season recorded highest shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) compared with those produced in 2016 season. These results are in agreement with those reported by **Kandil*, et al* (2015**). Seed deterioration can be reducing of quality, viability and vigour due to either aging

Table 2: Means of shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) of Maize hybrids of 2017 and 2016 season's production.

Treatments	Shoot Dry Weight (g)	Root Dry weight (g)	Seedling Vigor index	Seedling height reduction	Relative dry weight (%)
Date of production (D):					
2017	0.05	0.03	3827.4	16.54	154.4
2016	0.03	0.02	2964.1	27.33	175.5
F-Test 5%	*	*	*	*	*

Table 3: Means of shoot length, root length, shoot fresh weight (g), and root fresh weight (g) of studied Maize hybrids.

Treatments Hybrids	Shoot Length (cm)	Root Length (cm)	Shoot Fresh Weight (g)	Root fresh Weight (g)
T.W.C 310	22.7	18.1	0.541	0.220
T.W.C 323	19.7	16.3	0.443	0.160
T.W.C 324	19.9	16.9	0.474	0.202
LSD 5%	0.2	0.2	0.010	0.004

Table 4: Means of shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) of studied Maize hybrids.

Treatments Hybrids	Shoot Dry Weight (g)	Root Dry weight (g)	Seedling Vigor index	Seedling height reduction	Relative dry weight (%)
T.W.C 310	0.051	0.041	3607.4	18.8	153.7
T.W.C 323	0.041	0.021	3022.2	24.7	171.7
T.W.C 324	0.042	0.031	3216.2	22.2	169.5
LSD 5%	0.002	0.001	37.6	0.7	0.6

or effect of opposing conservation aspects **(Bailly, 2004).** During seed storage, the natural oil inside the seeds will undergo diverse biochemical changes and this will lead to the deterioration and damage of the seed **(Kausar et al., 2009).** During the priming process, catalase is the enzyme that plays great role in the retrieval of seeds during aging **(Kibinza et al., 2011).** These results are in agreement with those reported by **Kandil et al**. (**2015**).

Maize hybrids Performance:

The results showed that shoot length, root length (cm), shoot fresh weight (g), root fresh weight (g) as affected by studied Maize hybrids in are presented in Table (3). The results showed that there were significant differences due to hybrids in shoot length, root length (cm), shoot fresh weight (g), root fresh weight (g). The highest shoot length, root length (cm), shoot fresh weight (g), root fresh weight (g) was obtained from T.W.C. 310 hybrids, Followed by T.W.C 324 and T.W.C 323. The tallest radical and plumule, seedling length and seed vigour produced by Hybrid Simon under drought stress **(Khodarahmpour, 2012).** Similar conclusion was obtained from results of **Zahra (2012)**,**Tian (2014), Ranganathan** (**2015**) and **Kandil et al**. (**2015**). In addition, shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) as affected by studied Maize hybrids in are presented in Table (4). There are significant differences due to hybrids in shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) The highest shoot dry weight (g), root dry weight (g), seedling vigor index, was obtained from T.W.C. 310 hybrid. The highest seedling height reduction percentage was obtained from T.W.C 323 hybrids. Similar conclusion was obtained from results of **Zahra (2012)**, **Tian (2014), Ranganathan** (**2015**) and **Kandil et al**. (**2015**).

Antioxidants Effects:

The results showed that shoot and root length, shoot and root fresh weight (g) as affected by studied antioxidants are presented in Table (5). The results showed that there were significant differences among all studied Antioxidants. Priming in Humic acid at 500 ppm, Ascorbic acid at 100 ppm, Folic acid at 15 mM and Salicylic acid at 100 ppm and H_2O_2 at 40 ppm significantly exceeded shoot and root length, shoot and root fresh weight (g) compared to the control treatment. It could be concluded that, priming in

Table (5): Means of shoot length, root length, shoot fresh weight (g), and root fresh weight (g) of Maize hybrids under antioxidants concentrations:

Treatments	Shoot Length (cm)	Root Length (cm)	Shoot Fresh Weight (g)	Root fresh Weight (g)
Control	16.81	14.52	0.33	0.10
Humic 500 ppm	22.71	18.19	0.56	0.25
Ascorbic 100 ppm	20.82	17.63	0.55	0.24
Folic 15 mM	21.06	17.25	0.50	0.20
Salicylic 100 ppm	20.95	17.84	0.50	0.19
H_2O_2 40 ppm	22.47	17.06	0.44	0.16
LSD 5%	0.31	0.23	0.01	0.01

Table 6: Means of shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) as affected by studied antioxidants concentrations.

Treatments	Shoot Dry Weight (g)	Root Dry weight (g)	Seedling Vigor index	Seedling height reduction	Relative dry weight (%)
Control	0.021	0.011	2485.9	0.0	100.0
Humic 500ppm	0.050	0.031	3555.2	31.8	189.6
Ascorbic 100ppm	0.050	0.030	3398.9	23.9	191.5
Folic 15 mM	0.041	0.030	3298.4	23.4	173.1
Salicylic 100 ppm	0.041	0.030	3476.8	24.9	191.1
H_2O_2 40ppm	0.041	0.022	3476.2	27.5	144.6
LSD 5%	0.002	0.002	53.2	1.1	0.9

Table 7: Means of shoot and root length (cm), shoot and root fresh weight (g) of Maize hybrids as affected by GA_3 concentrations.

Treatments	Shoot Length (cm)	Root Length (cm)	Shoot Fresh Weight (g)	Root fresh Weight (g)
0 ppm	18.93	15.85	0.411	0.141
25 ppm	20.89	17.13	0.480	0.190
50 ppm	22.59	18.25	0.560	0.240
LSD 5%	0.22	0.16	0.011	0.004

Humic acid at 500 ppm surpassed H_2O_2 at 40 ppm, Folic acid at 15 mM, Salicylic acid at 100 ppm and Ascorbic acid at 100 ppm in shoot length (Cm) by 1.05, 7.26, 7.74, 8.32 and 25.97% respectively. Similar conclusion was obtained from results of **Patrícia,*et al.* (2013), Mansouri, *et al*** (**2015**), **Mahmoud, and Sayed, (2015)** and **Muhammad, *et al*** (**2015**).

The results indicated that shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) as affected by studied antioxidants concentrations are presented in Table (6). The results showed that, antioxidants are significantly exceeded shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) compared to the control treatment. Early seedling establishment improved by ascorbic acid, salicylic acid and hydrogen peroxide application, by owing to improved antioxidant defense system and nutrient homeostasis **(Ahmed et al., 2013).** Seed pretreatment proved an effective technique to improve seedling growth of maize. The pre-soaking recommended harvesting better benefits compared to other methods of priming (**Tian et al., 2014).** Similar conclusion was obtained from results of **Patrícia et al. (2013), Mansouri et al**. (**2015**), **Mahmoud, and Sayed (2015)** and **Muhammad et al.** (**2015**).

Growth hormones effects:

Average of shoot and root length (cm), shoot and root fresh weight (g) as affected by GA_3 concentrations are presented in Table (7). The results showed that there were significant differences in shoot and root length (cm), shoot and root fresh weight (g) compared with the control treatment. The highest shoot and root length (cm), shoot and root fresh weight (g) were obtained from GA_3 at 50 ppm compared with 0, and GA_3 at 25 ppm. Antioxidant enzymes protect cells against oxidative stress. Catalase and peroxidase are two antioxidant enzymes, which have important role in decomposition of H_2O_2 in the cells **(Rahnama et al., 2011)**. Similar conclusion was obtained from results of **Irfan et al. (2005)**, **Chauhan et al. (2009), Lalitha (2016) Dryelle (2016)** and **Dryelle et al.** (**2016**). In addition, shoot and

Table 8: Means of shoot and root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) as affected by GA_3 concentrations.

Treatments	Shoot dry weight (g)	Root dry weight (g)	Seedling vigor index	Seedling height reduction	Relative dry weight (%)
0 ppm	0.030	0.020	2859.6	11.6	133.0
25 PPm	0.041	0.030	3271.1	22.4	167.1
50 PPm	0.051	0.031	3715.2	31.7	194.9
LSD 5%	0.002	0.001	37.6	0.8	0.7

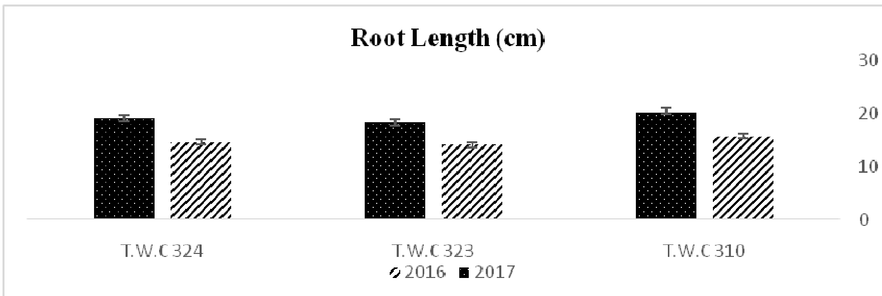

Figure 1: Means of root length (Cm) as affected by the interaction between date of seed production and maize hybrids.

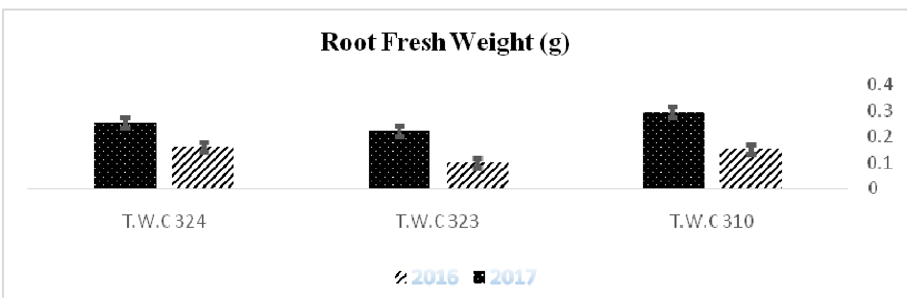

Figure 2: Average of root fresh weight (g) as affected by the interaction between date of seed production and maize hybrids.

root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) as affected by GA_3 concentrations are showed in Table (8). There were significant differences on shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) due to increase GA_3 concentrations. The highest shoot dry weight (g), root dry weight (g), seedling vigor index, seedling height reduction (%) and relative dry weight (%) was obtained from GA_3 at 50 ppm. Similar conclusion was obtained from results obtained by **Irfan et al. (2005)**, **Chauhan et al. (2009), Lalitha (2016) Dryelle (2016)** and **Dryelle et al.** (**2016**).

Interaction Effects:

Interaction between date of production and hybrids effect:

With respect to the effect of the interaction between date of seed production (2016 and 2017) and maize hybrids on shoot length, root fresh weight (g), dry **s**hoot dry weight and seedling vigor index are shown in Fig. 1, 2, 3 and 4. The results clearly indicated that tallest shoot (21.0 and 24.5 cm), root fresh weight (0.15 and 0.29 g) and dry **s**hoot dry weight (0.3 and 0.4 g) and seedling vigor index (3043.7 and 4171.0) was obtained from the new and old seed of

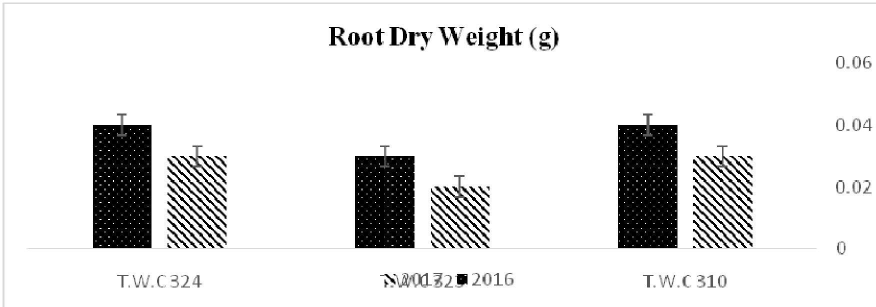

Figure 3: Average of **s**hoot dry weight (g) as affected by the interaction between date of seed production and maize hybrids.

Figure 4: Means of seedling vigor index as affected by the interaction between date of seed production and maize hybrids.

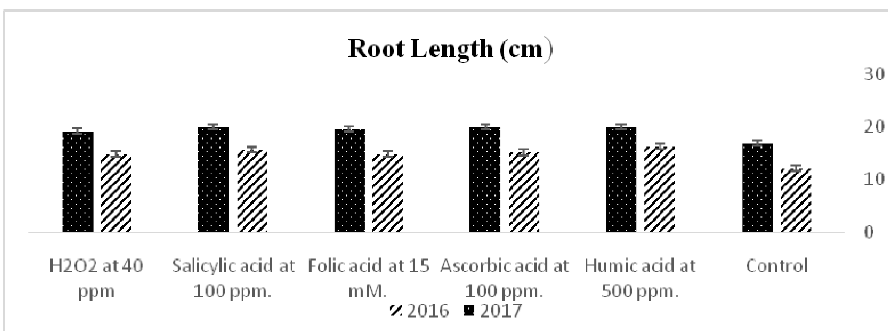

Figure 5: Means of root length (cm) as affected by the interaction between date of seeds production (2016 and 2017) and antioxidants.

T.W.C 310 cultivar, respectively. These results are in agreement with those reported by **Tian (2014)**, and **Kandil et al**. (**2015**).

Interaction between date of production and antioxidants effect:

With respect to the effect of the interaction between date of seeds production (2016 and 2017) and antioxidants on root length, shoot fresh weight and height reduction (%) are showed in Fig. 5, 6 and 7. The results clearly indicated that tallest root (16.3 and 20.0 Cm), the highest shoot fresh weight (0.51 and 0.63 g) and height reduction (38.5 and 25.2%) as affected by the interaction between date of seeds production (2016 and 2017) and priming in Humic at 500 ppm, respectively. Priming with salicylic acid at 100 ppm and ascorbic acid at 100 ppm could improve the percentage of emergence and germination rate. Salicylic acid at 100 ppm and ascorbic acid at 100 ppm enhanced root dry weight than other treatments **(Eisvand et al., 2015).** Seed priming and aging effects on seedling percentage, seedling length, and vigor index were significantly. Priming seed with gibberellins, under non-aged conditions produced the highest normal seedling percentage, seedling length and vigor index **(Khajeh et al., 2015).** These results are in agreement with those reported by **Chauhan et al. (2009)**, **Franklin et al. (2010), Gomaa**

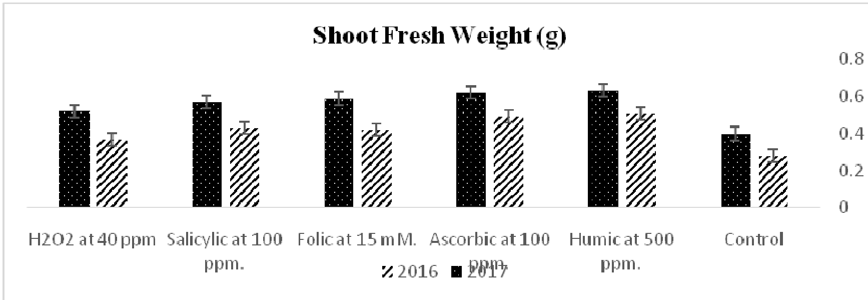

Figure 6: Average shoots fresh weight (g), as affected by the interaction between date of seeds production (2016 and 2017) and antioxidants.

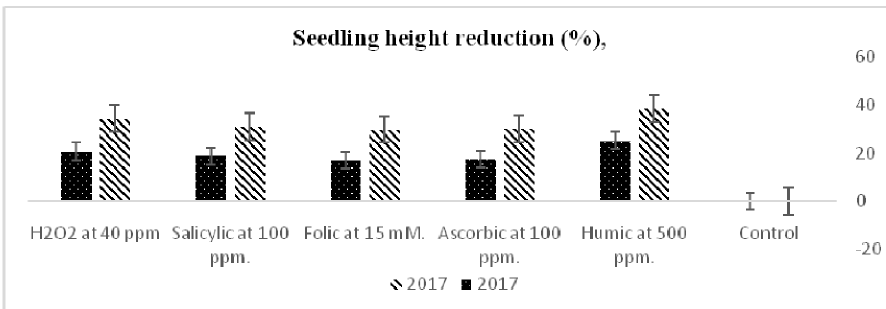

Figure 7: Means of seedling height reduction (%) as affected by the interaction between date of seeds production (2016 and 2017) and antioxidants.

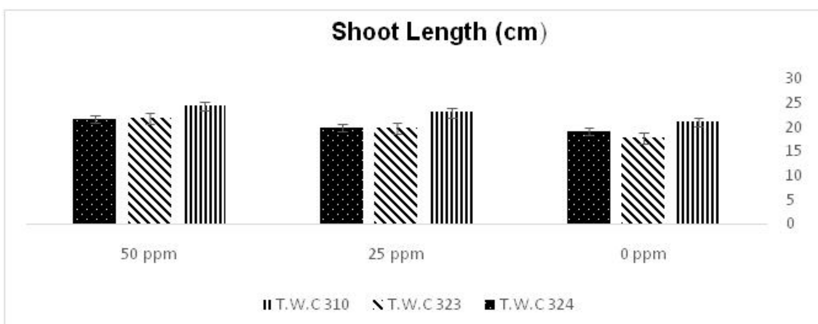

Figure 8: Averages of **s**hoot length (cm) as affected by the interaction between maize hybrids and growth regulators concentrations

et al. (2014), Hamid et al. (2014) and Mahdieh and Elham (2016).

Interaction between date of production and growth hormone effect:

With respect to the effect of the interaction between maize hybrids and growth regulators concentrations on shoot length, shoot fresh weight (g) and shoot dry weight are shown in Fig. 8, 9 and 10. The results clearly indicated that tallest shoot (24.3 Cm), the highest shoot fresh weight (0.62 g) and shoot dry weight (0.06 g) was produced from T.W.C 310 hybrids with GA_3 at 50 ppm compared with other concentration and control treatment**.** Priming seed with salicylic acid, kinetin, and gibberellic acid improved seedling growth **(Nimir et al., 2015).** Seed priming and aging effects on seedling percentage, seedling length, and vigor index were significantly. Priming seed with gibberellins, under non-aged conditions produced the highest normal seedling percentage, seedling length and vigor index **(Khajeh et al., 2015).**Seed priming in water or plant growth regulators decreases thestorage resistance capacity of corn seed **(Pallaoro et al., 2016).**These results are in agreement with those reported by **Chauhan et al. (2009) and Franklin et al. (2010) Tian (2014)**, **Ameeta and Nikita (2016)** and **Lalitha (2016).**

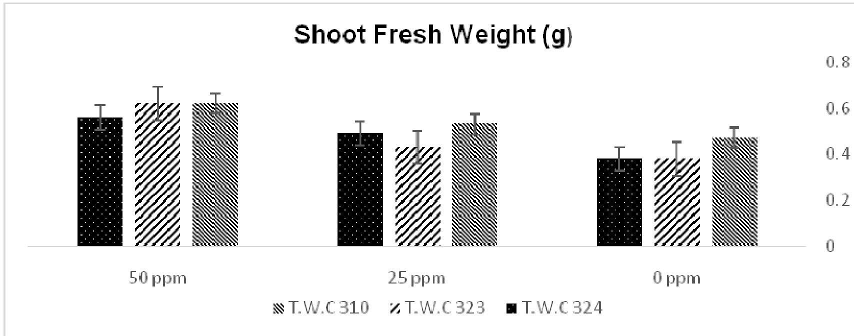

Figure 9: Means of shoot fresh weight (g) as affected by the interaction between maize hybrids and growth regulators concentrations.

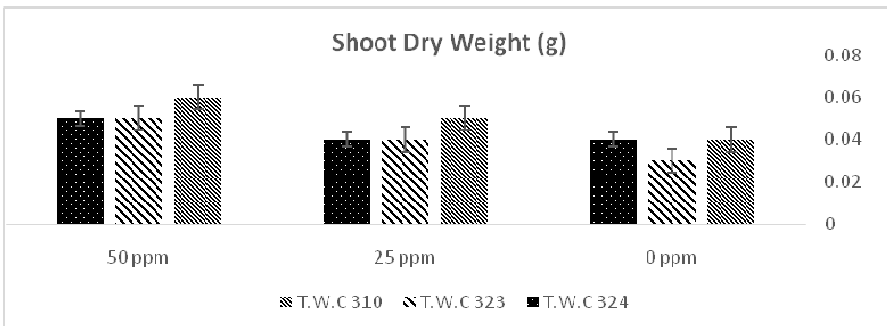

Figure 10: Means of shoot dry weight as affected by the interaction between maize hybrids and growth regulators concentrations.

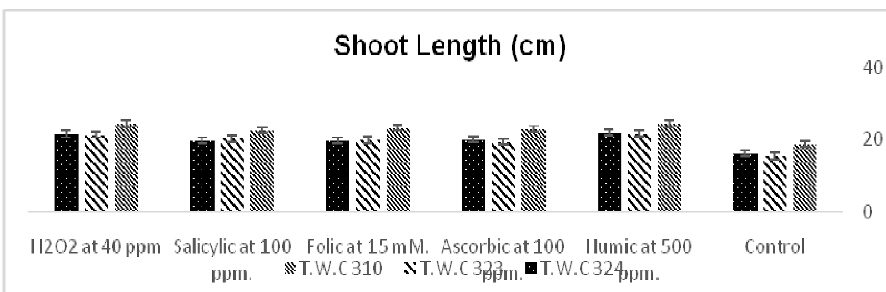

Figure 11: Average of shoot length (cm) as affected by the interaction between maize hybrids and antioxidant.

Interaction between hybrids and antioxidants effect:

With respect to the effect of the interaction between maize hybrids and antioxidant on shoot length and shoot fresh weight are shown in Fig. 11 and 12. The results clearly indicated that tallest shoot (24.5 cm) and shoot fresh weight (0.64 g) was produced from T.W.C 310 hybrid when soaking in Humic acid at 500 ppm compared with other antioxidants and the control treatment. Maximum of seedlings parameters of the old or new seed of hybrid TWC 352 produced from soaking in antioxidant like ascorbic acid or citric acid or salicylic acid or natural materials like yeast, extract at the rate of 100 ppm for 18 hours **(Kandil et al., 2015).** These results are in agreement with those reported by **Farooq, *et al.* (2007)**, **Rogério et al. (2011)**, **Ijaz et al. (2015)** and **Bobak et al. (2015).**

Interaction between maize hybrids and growth hormone effect:

Regarding the effect of the interaction between maize hybrids and concentrations on shoot length and **r**oot fresh weight (g) are shown in Fig. 13 and 14. The results clearly indicated that the tallest shoot (24.0 cm) and **r**oot fresh weight (0.27 g) were obtained from T.W.C 310 hybrid and soaking in $GA_{3.}$ at rate of 50 ppm compared with other concentrations and control treatment. These results are in agreement with those reported by **Chauhan et al. (2009)**

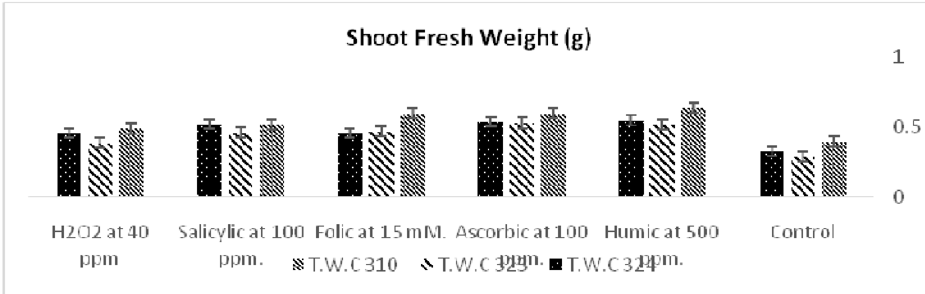

Figure 12: Means of shoot fresh weight (g) as affected by the interaction between maize hybrids and antioxidant.

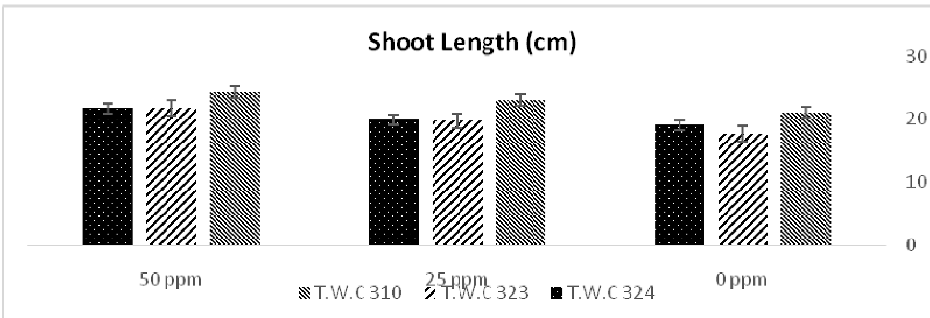

Figure 13: Means of shoot length (cm) as affected by the interaction between maize hybrids and concentrations.

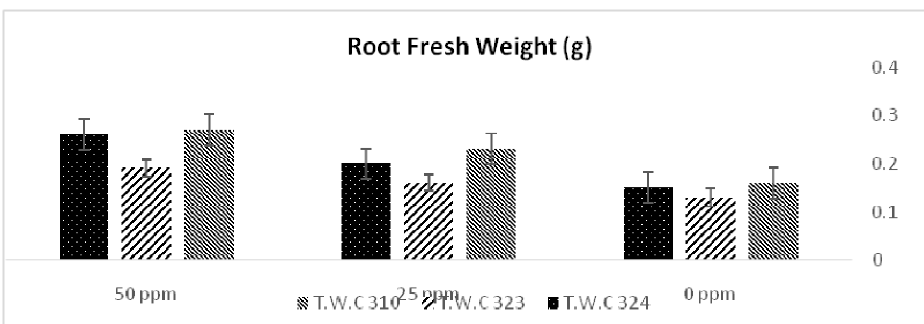

Figure 14: Average **r**oot fresh weight (g) the interaction between maize hybrids and concentrations

and Franklin et al. (2010) Tian (2014), **Ameeta Nikita (2016)** and **Lalitha (2016).**

Interaction between maize hybrids, priming in antioxidant and growth hormone effect:

There is no significant interaction between studied maize hybrids, priming in antioxidant and growth hormone on studied traits.

CONCLUSION

For maximizing seedling characters of date of seed production (2017 or 2016) season, it could be recommended that soaking hybrid TWC 310 in humic acid at 500 ppm and moisten by GA3 at concentration of 50 ppm.

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