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PERFORMANCE OF SOME QUINOA (*Chenopoduim quinoa* Willd.) GENOTYBES UNDER DIFFERENT LEVELS OF SALINITY

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ABSTRACT

An experiment was conducted at greenhouse, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate, Egypt, during two consecutive winter seasons (2016/2017 & 2017/2018) to investigate the effect of four levels of salinity (control 60, 80, 120, 160 Mm Sodium Chloride) on five genotypes of quinoa plant (M-28, Q-37, S-10, Regeolone-3, Line-6). Complete randomized design (CRD) was used in three replicates in this experimental work. Petri dishes of three replicate were used to determine the proportion and rate of quinoa germination ability. The results of the experiment indicated that germination rate and germination percentage of quinoa genotypes were significantly affected by salinity levels. The highest germination rate and percentage were 77.27, 93.76% at 2016/2017 and 92.18, 93.76% at 2017/2018 which obtained by M-28 genotype under control treatment (60 Mm) at both seasons. However, the lowest germination rate and percentage were 40.35, 34.73% at 2016/2017 and 55.27, 35.04% at 2017/2018 which achieved by Line-6 genotype under 160 Mm treatment at the both seasons. The all studied characters were significantly reduced by increasing the levels of salinity. The characters of grain weight/plant, harvest index and 1000 seeds weight were reduced significantly and gradually by increasing salinity levels from control treatment to 160 Mm treatment.

Key words: *Chenopoduim quinoa*, Germination, Harvest Index (HI%) and Salinity.

INTRODUCTION

Quinoa **(***Chenopoduim. quinoa* Willd.) is an allotetra ploid plant species displaying disomic inheritance and belongs to the amaranthaceae family in the subfamily Chenopodioideae, which widely cultivated in South America, mainly in the arid and semiarid areas of the Andean region **(Stevens *et al.,* 2006).** It has multi economic uses quinoa; highly nutritive values are being used to make flour, soup, breakfast and alcohol, while, quinoa flour, in combination with wheat flour or corn meal is used in making biscuits, bread and processed food**.** Salinity is one of the most widespread environmental threats to global crop production, especially in arid and semi-arid climates, where land degradation, water shortage and population. Growth is a major concern of salt tolerance in *C. quinoa*, which a prerequisite for its sustainable utilization as non-conventional crop using alternative water sources on marginal lands **(Eisa *et al.,* 2012).** This crop is well adapted to different environmental conditions, including water scarcity, low temperatures, salinity and poor soils **(Bascunan-Godo *et al.,* 2015).** So, it has been considered an important crop with the potential of contributing to food security worldwide **(FAO, 2011).**

Begum *et al.* (2010) investigated the response of wheat growth to different salinity levels (0.0, 4, 8, 12, 16 dsm^{-1}). They used 50 grains per petri dish and illustrated that the germination percentage decreased in high salinity level. Also water uptake decreased with an increase of

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salinity level, but it was not so much drastic up to 8dsm^{-1}. Accumulation of Na^+ and CI^- increased, when the grains were treated with 4dsm^{-1} to 16dsm^{-1} saline solutions.

In quinoa plant, **Hirich *et al.* (2014)** evaluated its response to different irrigation water salinity treatments (1, 10, 20 and 30 ds m^{-1}). They showed that increasing salinity affected significantly grain yield, harvest index (HI). The highest HI was obtained under most stressed treatment (30 ds m^{-1}), while, the lowest values were obtained under treatment received saline water with an EC value equal to 10 ds m^{-1}.

Panuccio *et al.* (2014) evaluated the effect of saline water on seed germination of the halophyte quinoa. Seeds were germinated in Petri dishes with sea water (SW) solutions (25, 50, 75, and 100%) of Na Cl, Ca Cl_2, KCl and Mg Cl_2 individually, at the concentrations in which they are present in SW. They were found that all salts, at lower concentrations, increased the germination rate, but not the germination percentages, compared with control (pure water). Conversely, seedlings were differently affected by treatments in respect to salt type and concentration.

Also, **Algosaibi *et al.* (2015)** studied the effect of four salinity treatments (1.25, 4, 8, 16 ds m^{-1}) on grain weigh, 1000-grain weight and dry weight per plant of quinoa. Results clarified that the low values of grain yield were recorded at 16 ds m^{-1} (17.05 g/ plant), while, the highest values were recorded with 4 ds m^{-1}treatment (34.08 g/ plant). 1000-grain weight values were ranged between 2.97g at 4 ds m^{-1} treatment, and 3.49 g at treatment 1.25 ds m^{-1}.

Germination rate in Petri dishes with three replications of ten quinoa cultivars was studied by **Tan and kcay (2017).** They found that germination rates of quinoa cultivars ranged from 0 to 87.3% and 100% was determined at the Q-52 cultivar. As salinity level increases, the germination rates were decreased. Q-52 cultivar had the maximum germination rate (98%) in the salt-free conditions**.**

MATERIALS AND METHODS

This study was carried out at greenhouse, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai, Governorate, Egypt (31° 08′ 40.3 N″, 33° 49′ 37.2″), during two winter successive seasons (2016/ 2017 and 2017/ 2018), to investigate the effect of four levels of salinity [control (60), 80, 120, 160 Mm NaCl], on five genotypes of quinoa in case of germination and grain weight/plant. The serial number, name and source of the genotypes materials are presented in Table 1.

Table (1): The serial number, name and source of the genotypes materials.

No. of entry	Genotype name	Genotype Source
1	M-28	Denmark
2	Q-37	Chile
3	S-10	Denmark
4	Regeolone-3	Chile
5	Line -6	Denmark

The experimental design was completely randomized design (CRD) in split –devoted plots with three replications. The main plots were devoted to four salinity levels [control (60), 80, 120 and 160 Mm NaCl], while, the five genotypes were assigned to the sub – plots. Day. Plastic pots of 15 cm diameter and 16 cm depth were filled with 3.00 kg mixture of 1: 1 sand: clay. Planting dates were on 13th and 26th November at 2016/ 2017 and 2017/2018 seasons. After 4 days seedlings were thinned at rate of 25 seedlings/ genotype. Phosphoric acid (H_2PO_5, 85%) at rate of 1 cm/L and NPK (20: 20: 20) at rate of 1g/L were added. The salinity levels treatments were applied after 30 days from planting until three months later. The soil salinity was 4.46 dsm^{-1}. Harvesting date was after 110 days from sowing date.

Germination

The experiment was conducted *in vitro*. Grains were surface-sterilized for 20 min in 20% sodium hypochlorite, rinsed and soaked for 1h in distilled water. Germination carried out at 25±2°C under dark conditions, the germination of quinoa by using saline water with filter paper in Petri dishes. Saline water developed by using NaCl 1.35g, 3.51g, 6.03g, in 1L of distilled water to make 60, 80, 120 and 160 Mm treatments. Quinoa grains (25) were sown in the Petri dishes with 3 replicates. Germination checked regularly 3 days after sowing date.

Germination parameters

The germination parameters were calculated for all germination experiments during the first 20 days of the germination test, which consisted of:

Germination Rate (GR)

Defined according to **Barlett (1973)** as following:

$$\mathbf{GR} = \frac{a + (a + b) + (a+b+c) + \ldots + (a + b + c + m)}{n\,(a + b + c + \ldots\ldots\ldots\ldots m)}$$

Where:

(a) Number of seedlings emerged at the first count.

(b) Number of seedlings emerged at the second count.

(c) Number of seedlings emerged at the 3rd count.

(m) Number of seedlings emerged at the final count.

(n) Number of counts.

Yield and yield components

At harvest date (110 days from sowing) a random sample of ten guarded plants were taken from each pot to measure the following characters:

Grain weight (g/plant)

It was determined as an average of grain weight on plant basis.

Harvest index (%)

It was calculated as a percentage of grain weight (g/plant) divided to plant fresh weight (g).

1000-grain weight (g)

It was determined as an average of 1000-grain weight from per plant.

Statistical Analysis

Results were statistical analyzed with analysis of variance (ANOVA) procedure using the General Linear Models (GLMs) procedures using SAS **(SAS, 2004)**. Differences between means were compared by using Duncan's multiple ranged tests (**Duncan, 1955)**.

RESULTS AND DISCUSSION

Germination rate (GR%) and germination percentage (GP %)

Resuls in Table 2 illustrate that there were significant differences between salinity levels on germination rate and germination percentage.

They were decreased, when salt concentration increased. The highest values of germination rate (61.22, 80.80%) were obtained by 60 Mm treatment at both seasons. While, the lowest germination rate

Table (2): Effect of salinity levels on Quinoa germination rate (GR%) and germination percentage (GP%) at 2016-2017 and 2017-2018 seasons.

Salinity NaCl (Mm)	Germination rate (GR (%)		Germination percentage (GP) (%)	
	2016/2017	2017/2018	2016/2017	2017/2018
60	61.22[a]	80.88[a]	71.81[a]	78.40[a]
80	58.86[ab]	78.28[a]	58.86[ab]	70.51[ab]
120	55.90[ab]	74.28[ab]	56.24[bc]	59.56[bc]
160	52.89[b]	69.83[b]	48.36[c]	55.60[c]

*Means followed by the same letters within the same column are not significantly different according to Duncan's multiple range test at ($P \leq 0.05$)

(52.89, 69.83%) were found with 160 Mm treatment at the both seasons (2017 and 2018). This may refers to the osmotic potential may be the reason for germination delay. The reduction of radicle growth under salt stress conditions may due to the diminution in the turgor of radicle cells. These results are in agreement with those found by **Panuccio *et al.* (2014)**.

The highest values of GP (71.81, 78.4%) were obtained by 60 Mm treatment at both seasons While, the lowest (48.36, 55.60%) were achieved by irrigated water with salinity level of 160 Mm at the both seasons. These results are in harmony with those detected by **Begum *et al.* (2010)**. Also, **Arshadullah *et al.* (2016)** found that the germination percentage ranged from 90 to 100% by14 dSm^{-1} and drastically reduced to 65% at 16 dSm^{-1}. There were significant differences between genotypes on germination rate and germination percentage (Table 3). The highest values of GR (71.72, 87.9%) were found with the M-28 genotype at the first and second seasons. While, the lowest (44.08, 60.23%) were achieved with the Line-6 genotype at the both seasons. These results were in coordinate with those reported by **Tan and kcay, 2017.** In addition**, Sanghera *et al.* (2016)** on sugar beet genotypes revealed that the germination rates (%) varied from 60% (Calixta) to 89.67% (Cauvery).

Regjnding to germination percentage of quinoa seeds. The maximum value of GP79.8 % was obtained by the M-28 genotype at first season, but each of M-28 and Q-37 genotypes gave valued (87.07% and 78.90%) at the second season. However, the minimum value was scored by the Line-6genotype at the both seasons (45.74, 50.33%), respectively. These results coincided with those obtained by **Sourour *et al.* (2014)** on wheat, whereas they showed that the increase in NaCl concentrations decreased germination percentage.

Also, the results in Table 4 indicate a significant interaction differences between salinity and genotypes on germination rate and germination percentage. The highest GR and GP% (77.27, 65.21 and 93.76, 96.33%, in respectively) were obtained by the M-28 genotype under 60 Mm treatment at both seasons (2016/2017 and 2017/ 2018). While, the lowest GR and GP% (40.35, 55.2% and 34.73, 35.04%, in respectively) were obtained by the Line-6 genotype under 160 Mm treatment at the both seasons.

Results in Table 5 illustrate that there were significant differences between salinity levels on grain weight, harvest index and 1000-grain weight. The highest values of the harvest index (33.0 & 42.0% and 33.0 & 41%), respectively were attained at the 60, 80 Mm treatments at both

Table (3): Germination rate (GR %) and germination percentage (GP %) for the five genotypes at 2016-2017 and 2017-2018 seasons.

Genotype	Germination rate (GR) (%)		Germination percentage (GP) (%)	
	2016/2017	2017/2018	2016/2017	2017/2018
Q-37	61.71^{b}	82.01^{b}	69.44^{b}	78.90^{a}
Regeolona-3	56.75^{c}	76.82^{c}	55.15^{c}	61.98^{b}
S-10	51.83^{d}	72.05^{d}	48.50^{cd}	51.81^{c}
M-28	71.72^{a}	87.97^{a}	79.81^{a}	87.07^{a}
Line-6	44.08^{e}	60.23^{e}	45.74^{d}	50.33^{c}

*Means followed by the same letters within the same column are not significantly different according to Duncan's multiple range test at ($P \leq 0.05$)

Table (4): Effect of interaction between salinity levels and genotypes on germination rate (GR %) and germination percentage (GP %) at 2016-2017 and 2017-2018 seasons.

Salinity NaCl (Mm)	Genotype	Germination rate (GR) (%)		Germination percentage (GP) (%)	
		2016/2017	2017/2018	2016/2017	2017/2018
60	**Q-37**	65.12^{d}	87.29^{c}	85.80^{b}	91.16^{ab}
	Regeolona-3	61.21^{f}	82.33^{e}	66.13^{e}	76.46^{cd}
	S-10	55.27^{i}	77.40^{h}	58.06^{f}	67.00^{def}
	M-28	77.27^{a}	92.18^{a}	93.76^{a}	96.33^{a}
	Line-6	47.22^{n}	65.21^{m}	55.30^{fg}	61.06^{fg}
80	**Q-37**	63.30^{e}	85.21^{d}	71.13^{d}	84.36^{bc}
	Regeolona-3	58.21^{h}	79.34^{g}	57.90^{f}	64.60^{ef}
	S-10	53.32^{j}	74.35^{j}	52.33^{gh}	58.10^{fgh}
	M-28	74.19^{b}	90.21^{b}	82.83^{b}	94.00^{ab}
	Line-6	45.28^{o}	62.28^{n}	48.33^{hij}	51.50^{ghi}
120	**Q-37**	60.21^{g}	80.33^{f}	64.76^{e}	74.50cde
	Regeolona-3	55.21^{i}	75.30^{i}	51.06^{hi}	56.13fgh
	S-10	50.41^{L}	70.35^{k}	47.43^{ij}	47.36hi
	M-28	70.21^{c}	87.26^{c}	76.10^{c}	84.76bc
	Line-6	43.47^{p}	58.16^{o}	41.8^{kl}	47.10hi
160	**Q-37**	58.23^{h}	75.21^{i}	56.06^{fg}	65.56^{def}
	Regeolona-3	52.36^{k}	70.31^{k}	45.50^{jk}	50.73^{ghi}
	S-10	48.31^{m}	66.11^{L}	38.96^{l}	41.40^{ij}
	M-28	65.22^{d}	82.22^{e}	66.56^{e}	73.20^{de}
	Line-6	40.35^{q}	55.27^{p}	34.73^{m}	35.04 ^{j}

*Means followed by the same letters within the same column are not significantly different according to Duncan's multiple range test at ($P \leq 0.05$)

Table (5): Effect of salinity levels on grain weight, harvest index and 1000- Grain weight at 2016-2017 and 2017-2018 seasons.

Salinity NaCl (Mm)	Grain weight (g/plant)		Harvest Index (%)		1000-Grain weight(g)	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
60	6.69[a]	9.43[a]	33.00 [a]	42.00[a]	1.68[a]	1.87[a]
80	6.29[ab]	8.75[a]	33.00[a]	41.00[a]	1.55[ab]	1.76[a]
120	4.74[b]	6.49[b]	30.00[a] 21.00[b]	35.00[b] 30.00 [c]	1.48[b]	1.54[b]
160	2.87[c]	4.64[c]			1.00[c]	1.11[c]

*Means followed by the same letters within the same column are not significantly different according to Duncan's multiple range test at($P \leq 0.05$)

seasons. When, the minimum harvest index was found by 160 Mm NaCl at both seasons (21.0, 30.0%). These results were in agreement with those detected by **Hirich *et al.* (2014)**.

As for grain weight and 1000-grain weight, the result in Table 5 showed that maximum value of grain weight and 1000-grains weight were (6.69, 9.43 g and 1.68, 1.87 g, respectively) with 60 Mm treatment at both seasons. Followed in ding the salts in Table 5 by (8.75, 1.76 g) which obtained by 80 Mm treatment at the second season. While, the minimum value was obtained from160 Mm treatment at the both seasons (2.87, 4.64 and 1.00, 1.11g), respectively. These results were in the same line with those stated by **Algosaibi *et al.* (2015).** There were significant differences between genotypes on grain weight, harvest index and 1000-grain weight (Table 6). The highest grain weight (g/plant) and 1000-grains weight (8.00, 11.02 g and 1.88, 2.00 g, respectively) were obtained by M-28 genotype at both seasons. When, the lowest values 2.63, 4.83 g and 1.22, 1.62 g, respectively were found by Line-6 genotype at both seasons. As for harvest Index, the result in Table 6 showed that maximum harvest index value was obtained by 32.0% with M-28 genotype followed by 30.0% with Q-37 genotype at the first season, but that maximum value obtained by the M-28 genotype was 42.0% at second season. While, the lowest harvest index scolded (29.0 & 34.0%), (29.0 & 0.36%) and (28.0 & 36.0%), respectively were found by the Regeolona-3, S-10 and Line-6 genotypes at both seasons. These results were alleged with the previous results, which obtained by **Miranda *et al.* (2013)** and they were showed that in the case of 'Regalona Baer' and 'Villarrica' genotypes a significant increase in grain yield (4.2 and 5.1 t ha-^{1}, respectively) and 1000 grain weight (3.08 ± 0.08 and 3.29 ± 0.08 g, respectively).

Results in Table 7 indicat a significant differences interaction between salinity levels and genotypes quinoa on grain weight, harvest index and 1000-grain weight. The highest grain weight (g/plant) (10.35, 13.29 g), harvest index (37.0, 47.0%) and 1000- grain weight (2.80, 3.84), respectively were obtained by M-28 genotype with 60 Mm treatment (60 Mm) at both seasons, while the lowest (1.7, 2.63 g), (21.0, 28.0%) and (0.91, 1.03 g), respectively for Line-6 genotype with160 Mm treatment through both seasons.

Table (6): Differences among quinoa genotypes in concern of grain weight, harvest index and 1000- Grains weight at 2016/2017 and 2017/2018 seasons.

Salinity NaCl (Mm)	Genotypes	Grain weight (g/plant)		Harvest Index (%)		1000- Grain weight(g)	
		2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
60	Q-37	8.37^{b}	10.51^{b}	36.00^{abc}	39.00^{cd}	2.37^{b}	2.73^{c}
	Regeolona-3	4.75^{f}	7.45^{e}	31.00^{c-e}	38.00 ^{de}	2.09^{cde}	2.17^{efg}
	S-10	6.65^{d}	9.29^{c}	34.00^{cbd}	41.00^{cbd}	2.15^{cbd}	2.40^{de}
	M28	10.35^{a}	13.29^{a}	37.00^{ab}	47.00^{a}	2.80^{a}	3.84^{a}
	Line-6	3.33^{h}	6.62f	28.00^{def}	42.00^{cb}	1.73^{fg}	2.13^{fg}
80	Q-37	8.10^{b}	9.48^{c}	36.00^{abc}	40.00^{cbd}	2.25^{cbd}	2.48^{d}
	Regeolona-3	4.13^{g}	6.49^{f}	23.00^{fg}	39.00^{cd}	1.86^{ef}	2.11^{fg}
	S-10	6.05^{e}	8.45^{d}	38.00^{d}	41.00^{cbd}	2.08^{cde}	2.30^{def}
	M-28	10.07^{a}	13.13^{a}	42.00a	43.00^{b}	2.34^{cb}	3.38^{b}
	Line-6	3.10^{hi}	6.20^{f}	23.00^{fg}	40.00^{d}	1.23^{ij}	2.03^{g}
120	Q-37	6.26^{ed}	7.30^{e}	32.00^{c-e}	35.00^{ef}	2.10^{c-e}	2.13^{fg}
	Regeolona-3	4.32^{fg}	4.43^{h}	37.00^{ab}	0.30^{ghi}	1.42^{hi}	1.38^{i}
	S-10	3.46^{h}	6.52^{f}	22.00^{fg}	0.35^{ef}	2.13^{c-e}	1.74^{h}
	M-28	7.28^{c}	10.38^{b}	31.00^{c-e}	42.00^{cb}	2.24^{bcd}	2.35^{def}
	Line-6	2.40^{j}	3.85^{ij}	22.00^{fg}	31.00^{ghi}	1.03^{jk}	1.31^{i}
160	Q-37	3.25^{h}	5.53^{g}	25.00^{efg}	32.00^{fgh}	1.52^{gh}	1.28i
	Regeolona-3	2.44^{j}	3.47^{j}	21.00^{g}	28.00 ^{hi}	1.14^{jk}	1.13^{ij}
	S-10	2.64^{ij}	4.28^{ih}	20.00^{g}	28.00^{hi}	1.12^{jk}	1.16^{ij}
	M-28	4.30^{fg}	7.30^{e}	26.00^{efg}	34.00^{fgh}	2.04^{de}	2.01^{g}
	Line-6	1.71^{k}	2.63^{k}	13.00^{h}	27.00^{i}	0.91^{k}	1.03^{j}

Table (7): Effect of interaction between salinity levels and genotypes on grain weight, harvest index and1000- Grains weight at 2016-2017 and 2017-2018 seasons.

Genotypes	Grain weight (g/plant)		Harvest Index (%)		1000-Grain weight(g)	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Q-37	6.50^{b}	8.20^{b}	30.00^{a}	36.00^{b}	1.77^{ab}	1.16^{b}
Regeolona-3 S-10	3.91^{cd}	5.46^{c}	29.00^{b}	34.00^{b}	1.62^{c}	1.70^{bc}
M-28	6.50^{c}	7.13^{b}	29.00^{b}	36.00^{b}	1.72^{bc}	1.90^{bc}
Line-6	8.00^{a}	11.02^{a}	32.00^{a}	42.00^{a}	1.88^{a}	2.00^{a}
	2.63^{d}	4.83^{c}	28.00^{b}	36.00^{b}	1.22^{d}	1.62^{c}

*Means followed by the same letters within the same column are not significantly different according to Duncan's multiple range test at (P≤ 0.05).

REFERENCES

Algosaibi, A.M.; El-Garawany, M.M.; Badran, A.E.; A.M. Almadini (2015). Effect of irrigation water salinity on the growth of quinoa plant. J. Agric. Sci., 7 (8): 205.

Arshadullah, M.; Suhaib, M.; Usama, M.B.; Mahmood, I.A. and Hyder, S.I. (2016). Effect of salinity on growth of *Chenopodium quinoa* Willd. J. Res. Agaric, Forestry, 11(3): 21-24.

Barlett, M.S (1973). Some samples of statistical method of research in agriculture and applied biology. J. Roy. Soc., 4: 2.

Bascunan-Godo, L.; Reguera, M.; Abdel-Tawab, Y.M. and Blumwald, E. (2015). Water deficit stress-induced changes in carbon and nitrogenpartitioning in

Chenopodium quinoa Willaad. Planta, 1: 13.

Begum, F.; Ahmed, I.M.; Nessa, A. and Sultana, W. (2010). The effect of salinity on seed quality of wheat. J. Bangladesh Argic. Univ., 8 (1): 19–22.

Duncan, B.D. (1955). Multiple ranges and multiple F test. Biomet., 11: 1-42.

Eisa, S.; Hussin, S.; Geissler, N. and Koyro, H.W. (2012). Effect of NaCl salinity on water relations, photosynthesis and chemical composition of quinoa (*Chenopodium quinoa* Willd.) as a potential cash crop halophyte. AJCS. 6 (2): 357-368. (Aust. J. Crop Sci.).

FAO (2011). Quinoa: an ancient crop to contribute to world food security. Food and Agric. Organization of the United Nations.

Hirich, A.; Jelloul, A.; Choukr-Allah, R. and Jacobsen, S.E. (2014). Saline Water Irrigation of Quinoa and Chickpea: seedling rate, stomata conductance and yield responses. J. Agro. Crop. Sic., 200: 378–389.

Miranda, M.; Vega-Gálvez, A.; Martínez, E.A.; López, J.; Marín, R.; Aranda, M. and Fuentes, F. (2013). Influence of contrasting environments on seed composition of two quinoa genotypes: nutritional and functional properties. J. Agro. Res., 73 (2): 108-116.

Panuccio, M.R.; S.E. Jacobsen; S.S. Akhta; A. Muscolo (2014). Effect of saline water irrigation on seed germination and early seedling growth of the halophyte quinoa. J. Agri. Sci., 1-18.

Sanghera, G.S.; Singh, R.P.; Kashyap, L.; Tyagi, V. and Sharma, B. (2016). Evaluation of sugar beet genotypes (*Beta Vulgaris* L.) for root yield and quality traits under subtropical conditions. Punjab. Agric. Univ. Regional. Res. Station, Kapurthala. J. Krishi. Vigyan., 5 (1): 67-73.

SAS (2004). SAS/STAT User's Guide. SAS Institute Inc., Cary, N.C.

Stevens, M.R.; Coleman, C.E.; Parkinson, S.E.; Maughan, P.J.; Zhang, H.B.; Balzotti, M.R.; Kooyman, D.L.; Arumuganathan, K.; Bonifacio, A.; Fairbanks, D.J.; Jellen, E.N. and Stevens, J.J. (2006). Construction of a quinoa (*Chenopodium quinoa* Willd.) BAC library and its use in identifying genes encoding seed storage proteins. Theory. Appl Genet., 112: 1593–1600.

Sourour, A.; Neila, R.; Zoubeir, C.; Saddreddine, B.; Feker, K.; Themir, B.; Mayada, M. and Mongi, B.Y. (2014). Effect of salt stress (sodium chloride) on germination and seedling growth of durum wheat (*Triticum durum* Desf.) genotypes. Int. J. Biodivers. Conserv., 6 (4): 320-325.

Tan, M. and Kcay, E.A. (2017). Temperature and salinity effects on germination of some quinoa *(chenopodium quinoa* Willd.) cultivars. Proc. of 89th the IRES Int. Conf., Helsinki, Finland: 3-5.

الملخص العربي

أداء بعض التراكيب الوراثية لنبات الكينوا تحت مستويات مختلفة من الملوحة

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أجريت تجربة بالصوبة الزراعية بالمزرعة التجريبية لكليه العلوم الزراعية البيئية، جامعة العريش، محافظة شمال سيناء، مصر، خلال الموسمين الشتويين المتتاليين ٢٠١٧/٢٠١٦ و٢٠١٨/٢٠١٧ بهدف التعرف علي تأثير أربعة مستويات ملوحة (٦٠، ٨٠، ١٢٠، ١٦٠ مللي مول كلوريد الصوديوم) على خمسة تراكيب وراثية من نبات الكينوا (M28, Q37, S10, Regeolone3, Line 6) في حالة الإنبات ووزن الحبوب للنبات، حيث تم إستخدام التصميم العشوائي التام (CRD) بثلاث مكررات. تم إنبات الكينوا تحت المستويات المختلفة من الملوحة بإستخدام ورقة الترشيح في أطباق بتري مع ٣ مكررات، أسفرت نتائج التجربة إلى أن معدل ونسبة الإنبات الكينوا تأثرت بشكل كبير تحت جميع مستويات الملوحة، حيث أعطت معاملة الكنترول (٦٠ مللي مول كلوريد صوديوم) أعلى نسبة إنبات ومعدل إنبات هي ٧٧,٢٧، ٦٥,٢١ في الموسم الأول و ٩٣,٧٦ ، ٩٦,٣٣% في الموسم الثانى، حيث أعطي هذه النسب التركيب الوراثي M-28، في حين أن أقل نسبة إنبات ومعدل إنبات هو ٠,٣٥، ٥٥,٢% في الموسم الأول و٣٤,٧٣، ٣٥,٠٤% في الموسم الثاني مع التركيب الوراثي Line-6 تحت معاملة (١٦٠مللي مول). أظهرت النتائج أيضًا أن مؤشرات الصفات التي خضعت للدراسة انخفضت تحت المستويات المختلفة من الملوحة، حيث كانت المستويات التى تقل عن ١٦٠ مللي مول كلوريد الصوديوم هى الأكثر تأثيراً وبشكل كبير على صفات وزن الحبوب للنبات، دليل المحصول، و وزن ١٠٠٠حبة.

الكلمات الإسترشادية: الإنبات، دليل الحصاد، الملوحة، نبات الكينوا.