J. of Plant Production, Vol. 1 (2): 159 - 170, 2010

SEED PRIMING INFLUENCES SEED GERMINATION AND SEEDLING GROWTH OF TOMATO UNDER DIFFERENT SALINITY LEVELS

El-Saifi, S. K.[1]; H. M. I. Ahmed[2]*; Sawsan M. Hasan[1]; M. M. Morsi[1] and Rowaa S. El-Shatoury[1]

[1] Horticulture Dept., Fac. of Agric. (Ismaila), Suez Canal Univ., Egypt.

[2] Vegetable Crops Seed Production and Technology Dept., Horticulture Res. Inst., Agric. Res. Center, Giza, Egypt.

*** Corresponding Author E-Mail: hamdino@yahoo.com**

ABSTRACT

This study was conducted during the years of 2007, 2008 and 2009 in the green house and Laboratory of the Department of Horticulture, Faculty of Agriculture, Suez Canal University, Ismalia, Egypt. This experiment was carried out to study the effect of seed priming under different levels of salinity on seed germination, seedling growth and field behavior of tomato.

Under laboratory conditions**,** low salinity level (1500 ppm) or un saline (control) recorded maximum values of germination percentage (GP%), germination performance index (GPT) and coefficient of velocity and minimum values of mean germination time (MGT) , uniformity germination and T50 % and tallest seedling. Maximum values of fresh and dry weight/ seedling, total carbohydrate, total phenol and peroxidase enzyme activity were also recorded under low salinity level. Seed priming in KCl was the superior treatment for enhancing GP%, GPI, coefficient of velocity, both fresh and dry weight with no significant differences with NaCl with respect to coefficient of velocity.

Under green house conditions, low salinity at 1500 ppm significantly increased growth rate, leaf production per week, both fresh and dry weight as well as number of leaves / plant, concentration of chlorophyll a and b as well as carotenoides in leaf tissues of tomato compared with other treatments or control**.** Seed priming in PEG significantly increased growth rate, leaf production per week, both fresh and dry weight and number of leaves/ plant**,** concentration of chlorophyll a and b as well as carotenoides in leaf tissues of tomato**.**

The interaction between seed priming and salinity levels showed a significant effect on seedling growth and chemical constituents of germinated seeds of tomato**.**

Keywords: Tomato, seed priming, salinity, germination percentage, seedling growth.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) is a herbaceous annual. Seed priming as a presowing treatment in which seeds are soaked in a osmotic solution that allows them to imbibe water and go through the first stages of germination, but dose not permit radical protrusion through the seed coat. The seeds then can be dried to their original moisture contents and stored or planted via conventional technique (Heydecker, 1973).

Faster emergence rate after osmopriming may be explained by an increased rate of cell division in the root tips (Bose and Mishra, 1992). The beneficial aspects of priming are primarily due to preenlargement of the embryo (Khan, 1992) and improvement of germination rate (Gray and

Steckie, 1997). The earlier and better germination is associated with increased metabolic activities in the osmoprimed seeds (Lui *et al*., 1996).

Salinity is the major environmental factor limiting plant growth and productivity (Allakhverdiev *et al.*, 2000). The detrimental at the whole plant level as the death of plants and / or decreases in productivity. During the onset and development of salt stress within a plant, all the major processes such as photosynthesis, protein synthesis and energy and lipid metabolism are affected. Salt stress results in considerable decreases in the fresh and dry weights of leaves, stems and roots (Hernandez *et al*., 1995). In leaves of tomato, the contents of total chlorophyll chl (a+b), chl. a and chl. b and carotenoides decreased by NaCl stress (Khavarinejad and Mostofi, 1998).

The objective of this work was to improve emergence and seedling growth of tomato under different levels of salinity by using seed priming.

MATERIALS AND METHODES

To assess the priming effects on tomato seeds germination parameters, cultivar Castle Rock, this study have been conducted during the years of 2007, 2008 and 2009 in the green house and Laboratory of the Department of Horticulture, Faculty of Agriculture, Suez Canal University, Ismalia, Egypt. This experiment was designed to study the effect of seed priming on germination behavior and seedling growth of tomato under different salinity stress levels in the laboratory, and under nursery conditions.

Seed priming was done as follows: seeds (100 g each) were primed in eight aerated flasks in different priming agents. Treatments were applied at -1.0 Mega Pascal (MPa) of (1) PEG 6000, (2) mannitol, (3) KNO_3, (4) KCl, (5) NaCl, (6) $MgSO_4$, (7) $CaCl_2$, or (8) KH_2PO_4 beside a control treatment. Thiram was added at 0.2% to each flask to prevent fungal growth during the treatment (Zbitnew, 1984). Where, -1MPa of PEG 6000 was calculated according to (Michel and Kaufmann 1973)

The flasks were kept in a laboratory at 25˚C ± 2 for 144 hours. At the end of priming treatment, the seeds were spread on dry blotters on the laboratory bench. A portable dryer was positioned to maintain a stream of drying air above the seeds, at 25 to 30˚C temperature. The blower was left on for 6 hours, and the seeds were left overnight on the bench to dry down to a moisture content of 6-7%. Seeds were stored in paper envelopes at laboratory conditions of 25 ± 3˚C until the seed were used in the experiments.

Osmotic potential of the priming solutions was calculated according to Van't Hof expression:

$$\psi = - m \cdot i \cdot R \cdot T$$

Where ψ is the Osmotic potential, m is the molality, i is the number of dissociating ions, R is the gas constant and T is the temperature in Kelvin (273 + °C) (Lang 1967).

Laboratory experiment:

Laboratory germination tests were done on four replications of 100 seeds each. Seeds were sown on rolled filter paper moistened with 4 different salinity levels i.e. (1) control 0.00 ppm, (2)1500 ppm, (3) 3000 ppm or (4)

4500 ppm and placed in plastic boxes. The boxes were held for 14 days in a germination cabinet at a temperature of 20˚C for 16 hours and at 30˚C for 8 hours.

This experiment included 36 treatments which were the combination between 9 seed priming treatments and four salinity levels. These treatments were arranged in a randomized complete block design with four replicates for each treatment.

Green house experiment:

The tray experiment was done to measure seedling formation under green house conditions with four replications of 100 seeds each. Seeds were sown in seedling polyesterene trays with 200 inverted pyramid cells. Seeds were sown in a peat-vermiculite-perlite mixture (2:1:1, v/v/v) then watered with NaCl solutions above mentioned salinity levels.

This experiment included 20 treatments which were combination between 5 seed priming treatments (control, PEG, KNO_3, NaCl and $CaCl_2$) and four salinity levels. These treatments were arranged in a randomized complete block design, with four replicates for each treatment.

Data recorded:

A- Under laboratory conditions

I- Seed germination measurements:

1-**Germination percentage** (**GP %**): It was measured according to the ISTA rules (ISTA, 1999).

2- **Mean time to germination in days (MGT**): It was calculated according to the formula MGT=Σ nd/N where n is the number of germinated seed on each day, the number of days from the beginning of the test, and N the total number of germinated seeds (Edwards and Sundstrom, 1987).

3- Coefficient of velocity: It was calculated according to the formula

Coefficient of velocity = 1/ MGT X 100 where MGT is mean time to germination in days (Edwards and Sundstrom, 1987).

4- Germination performance index (GPI): It was calculated according to the formula

GPI= GP/MGT

Where GP is germination percentage and MGT is mean time to germination in days (Pill and Fieldhouse, 1982)

5-**Time to reach 50% germination (T_{50}), days required to 50% germination**: It was calculated according to the following formula of Coolbear *et al.* (1984) modified by Farooq *et al.* (2005):

$$T_{50} = t_i + [(N/2 - n_i)(t_j - t_i)]/(n_j - n_i)$$

Where:

N : The final number of germination.

n_i, n_j : Cumulative number of seeds germinated by adjacent counts at times when $n_i < N/2 < n_j$.

6-Uniformity of germination, the time in days occurring between 25% and 75% of germination (T75-T25).

II- Seedling growth measurements:

1- Seeding length (cm)

2- Seedling fresh weight (mg): It was measured on ten seedlings randomly taken from each replicate, weighed, and the average fresh weight per seedling was calculated.

3- Seedling dry weight (mg): The same seedlings taken for the determination of fresh weight were used for determining dry weight. They were oven-dried at 70ºC until constant weight. The average weight per dried seedling was calculated.

III- Seedling enzymatic activity:

Amylase activity: It was measured according to the method described by Bernfeld (1955).

2- Peroxidase activity: It was determined according to the method described by Vetter (I958).

IV. Chemical constituents:

1- Total carbohydrates: It was estimated according to the method described by Dubois *et al., (*1956).

2- Total phenols: It was estimated according to the methods described by Kâhkônen *et al.* (1999) and Singleton and Rossi (I965).

B- Under green house conditions

I- Seed emergence measurements

1- Growth rate (mm/day): It was calculated according to the following formula:

$$\text{Growth rate (mm/day)} = \frac{\text{height at 40 DAS (Days After Sowing)} - \text{height at 20 DAS}}{20}$$

2- **Leaf production per week**: It was calculated according to the following formula:

$$\text{Leaf production per week} = \frac{\text{leaves per plant at 40DAS} - \text{leaves per plant at 20 DAS X 7}}{20}$$

II- Seedling growth measurements:

1- Number of leaves: It was measured on ten seedlings randomly taken from each replicate.

2- Seedling fresh weight (mg): It was measured on ten seedlings randomly taken from each replicate, weighed, and the average fresh weight per seedling was calculated.

3- Seedling dry weight (mg): It was measurement used the same seedlings taken for the determination of fresh weight. They were oven-dried at 70ºC until constant weight was reached. The average weight per dried seedling was calculated.

III- Photosynthetic pigments: Seedling samples from each replicate were randomly taken to determine chlorophyll a, chlorophyll b and carotenoids, according to the method described by Wettesten(1957).

Statistical analysis: The treatments mean were compared using the Duncan Multiple Range test as published by Duncan (1965).

RESULTS AND DISCUSSION

A- Under laboratory conditions

1- Germination measurements

Data in Tables 1 and 2 show that low salinity level (1500 ppm) or un saline (control) recorded maximum values of germination percentage (GP%), germination performance index (GPT) and coefficient of velocity and minimum values of mean germination time (MGT) , uniformity germination and T50 % in both seasons. This means that, low salinity or control gave more uniformity of germination and reduced the time between seed sowing and emergence.

As for the effect of seed priming treatments, it is quite clear from data in Tables 1 and 2 that tomato seed priming in KCl was the superior treatment for enhancing GP%, GPI and coefficient of velocity with no significant differences with NaCl with respect to coefficient of velocity in both seasons. Seed priming in KCl and $CaCl_2$ recorded more uniformity of germination and reduced the time between seed sowing and emergence, respectively.

The combination between seed priming and salinity levels reflected a significant differences on GP %, GPI, coefficient of velocity, uniformity of germination and T50 % in both seasons (Tables 1 and 2).

Table (1). Effect of salinity and seed priming treatment on germination percentage (GP%), mean germination time(MGT) days and germination performance index (GPI) of tomato seeds under laboratory conditions during 2008 and 2009 seasons.

Characters / Treatments	GP (%)		MGT(days)		GPI	
	First season	Second season	First season	Second season	First season	Second season
	Effect of salinity					
Control	86.67	87.77	4.47	4.55	20.32	19.46
1500 ppm	86.22	87.32	4.71	4.81	19.21	18.45
3000 ppm	80.33	81.34	5.68	5.78	14.83	14.35
4500 ppm	71.89	72.99	7.38	7.48	10.19	9.99
L.S.D 0.05	1.09	0.82	0.54	0.05	0.68	0.14
	Effect of priming agents					
Control	70.00	71.02	7.01	7.10	10.94	10.75
PEG	77.50	78.60	5.91	5.96	14.16	13.86
Mannitol	78.50	79.71	5.72	5.82	15.31	14.76
KNO_3	84.00	85.03	5.14	5.24	18.17	17.24
KCl	86.00	87.02	4.92	5.03	18.57	17.77
NaCl	86.50	87.52	5.37	5.47	16.80	16.19
$MgSO_4$	83.25	84.26	5.10	5.19	18.30	17.57
$CaCl_2$	85.25	86.35	5.18	5.28	17.23	16.68
KH_2PO_4	80.50	81.55	5.70	5.80	15.72	15.23
L.S.D 0.05	1.63	1.23	0.81	0.07	1.01	0.21
	Effect of interaction					
Salinityx Seed priming	*	*	*	*	*	*

Table (2). Effect of salinity and seed priming treatment on coefficient of velocity, uniformity of germination and T50 % of tomato seeds under laboratory conditions during 2008 and 2009 seasons

Characters / Treatments	Coefficient of velocity		Uniformity of germination		T50 %	
	First season	Second season	First season	Second season	First season	Second season
	Effect of salinity					
Control	23.44	22.53	3.03	4.03	4.94	5.44
1500 ppm	22.20	21.06	3.14	4.14	5.03	5.44
3000 ppm	18.25	17.55	4.08	5.08	5.86	6.11
4500 ppm	13.96	13.58	4.94	6.02	7.47	7.72
L.S.D 0.05	0.58	0.52	0.09	0.32	0.07	0.33
	Effect of priming agents					
Control	15.14	14.70	5.56	6.56	7.94	8.25
PEG	18.12	17.41	4.19	5.19	6.44	6.81
Mannitol	19.1	18.23	3.75	4.75	5.63	6.06
KNO_3	21.21	20.11	3.06	4.06	5.25	5.56
KCl	21.51	20.36	3.19	4.19	5.00	5.31
NaCl	19.38	18.55	3.25	4.25	5.52	5.81
$MgSO_4$	21.33	20.37	2.75	3.75	5.04	5.44
$CaCl_2$	20.20	20.10	3.38	4.38	4.94	5.31
KH_2PO_4	19.18	18.3	5.06	6.23	6.69	7.06
L.S.D 0.05	0.86	0.78	0.14	0.48	0.11	0.50
	Effect of interaction					
SalinityxSeed priming	*	*	*	*	*	*

2- Seedling growth

Data given in Table 3 show that low salinity at 1500 ppm or un saline (control) gave the tallest seedling and recorded maximum values of fresh and dry weight/ seedling of tomato in both seasons. On the other hand, seedling length and fresh and dray weight were significantly decreased with increasing salinity level up to 3500 ppm.

The effects of seed priming treatment on seedling growth are presented in Table 3. The obtained results in the same Table show that seed priming in NaCl gave the tallest seedling followed by $MgSO_4$, whereas seed priming in KCL or in NaCl increased fresh and dry weight of tomato seedling.

The interaction between seed priming and salinity levels showed a significant effect on seedling growth of tomato in both seasons (Table 3).

3- Chemical constituents of seedling

It is obvious from data in Table 4 that low salinity at 1500 ppm was the superior treatment for enhancing contents of total carbohydrate , total phenol and peroxidase enzyme with no significant differences with un saline (control) with respect to peroxidase enzyme, whereas medium salinity was the superior treatment for enhancing amylase enzyme in both seasons.

Carbohydrates, which among other substrates needed for cell growth, are supplied mainly through the process of photosynthesis and photosynthetic rate are usually lower in plants exposed to salinity an especially to NaCl (Parida and Das, 2005).

Table (3). Effect of salinity and seed priming treatment on seedling length, fresh weight and dry weight of tomato seeds under laboratory conditions during 2008 and 2009 seasons.

Characters / Treatments	Seedling length(cm)		Fresh weight(mg)		Dry weight (mg)	
	First season	Second season	First season	Second season	First season	Second season
	Effect of salinity					
Control	10.71	11.11	29.50	30.5	2.19	2.29
1500 ppm	10.69	11.08	29.51	30.51	2.20	2.31
3000 ppm	9.86	10.29	28.45	29.45	2.13	2.24
4500 ppm	8.51	8.74	25.56	26.73	1.98	2.09
L.S.D 0.05	0.14	0.23	0.001	0.41	0.04	0.24
	Effect of priming agents					
Control	9.00	9.38	24.71	25.71	1.86	1.91
PEG	9.90	10.26	26.45	27.50	1.96	2.14
Mannitol	9.73	10.05	29.15	30.15	2.19	2.30
KNO_3	10.35	10.73	27.38	28.38	2.05	2.16
KCl	10.08	10.47	30.40	31.40	2.28	2.40
NaCl	10.60	10.95	29.21	30.21	2.34	2.45
$MgSO_4$	10.28	10.60	27.46	28.78	2.06	2.08
$CaCl_2$	10.40	10.80	29.61	30.61	2.18	2.30
KH_2PO_4	9.15	9.53	29.96	30.94	2.24	2.35
L.S.D 0.05	0.21	0.34	0.002	0.62	0.06	0.35
	Effect of interaction					
Salinityx Seed priming	*	*	*	*	*	*

Table (4). Effect of salinity and seed priming treatment on total carbohydrate, total phenol, amylase and peroxidase of tomato seeds in the laboratory during 2008 and 2009 seasons.

Characters / Treatments	Total carbohydrate (% FW)		Total phenol (mg (GA)/gm DW)		Amylase (µg glucose/min/gm FW)		Peroxidase (∆OD 405×10^3 min/gm FW)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
Effect of salinity								
Control	3.79	3.78	5.18	5.18	22.35	21.67	284.59	282.22
1500 ppm	5.66	5.66	5.93	5.92	22.80	21.04	284.44	281.56
3000 ppm	5.40	5.40	4.36	4.36	24.58	22.84	233.67	231.26
4500 ppm	4.61	4.61	3.98	3.98	14.33	12.93	178.15	175.74
L.S.D 0.05	0.001	0.001	0.001	0.001	0.04	0.4	0.15	0.46
Effect of priming agents								
Control	5.31	5.30	5.40	5.40	24.05	22.86	337.75	335.58
PEG	5.17	5.17	4.62	4.61	29.25	27.78	308.42	305.50
Mannitol	4.91	4.90	4.28	4.28	19.87	17.98	299.75	296.42
KNO_3	4.46	4.45	4.29	4.28	21.32	19.75	326.75	324.67
KCl	5.12	5.11	4.09	4.09	17.61	16.13	169.5	167.42
NaCl	4.16	4.16	4.29	4.29	17.22	15.80	217.33	214.58
$MgSO_4$	5.41	5.41	6.52	6.52	19.83	18.60	273.75	271.50
$CaCl_2$	4.80	4.80	5.20	5.19	19.38	18.27	136.25	133.83
KH_2PO_4	4.46	4.46	5.08	5.08	20.60	19.42	137.42	134.75
L.S.D 0.05	0.001	0.001	0.001	0.001	0.06	0.6	0.22	0.7
	Effect of interaction							
Salinity x Seed priming	*	*	*	*	*	*	*	*

The salinity reduced total carbohydrate in seedling may be due to that salinity reduced photosynthetic and chlorophyll a and b in leaf tissue therefore total carbohydrate decreased.

As the effect of seed priming treatment, the obtained results in Table (4) show that seed priming in $MgSO_4$ increased the content of total carbohydrate and total phenol, whereas seed priming in PEG or control treatment increased the contents of amylase and peroxidase enzymes, respectively.

The interaction between seed priming treatments and salinity at different levels had a significant effect on chemical constituents of seedling in both seasons (Table 4).

B- Under greenhouse conditions

1- Seedling growth

As for the effect of salinity levels on seedling growth of tomato under greenhouse conditions, data in Tables 5 and 6 show that low salinity at 1500 ppm significantly increased growth rate, leaf production per week, both fresh and dry weight as well as number of leaves / plant compared with other treatments or control in both seasons.

Salt stress results in a considerable decreases in the fresh and dry weights of leaves, stems and roots (Hernandez *et al*., 1995).

Decreases in photosynthetic rate are due to several factors (1) dehydration of cell membranes which reduce their permeability to CO^2 (2) salt toxicity (3) reduction of CO^2 supply because of hydroactive closure of stomata (4) enhanced senescence induced by salinity, (5) changes of enzyme activity induced by changes in cytoplasmic structure and (6) negative feedback by reduced sink activity (Parida and Das , 2005). The effect of salinity on dry weight may be due to that salinity reduced photosynthetic rate and photosynthetic pigments therefore dry weight was decreased.

Respecting the effect of seed priming treatments, the obtained results in the Tables 5 and 6 show that seed priming in PEG significantly increased growth rate, leaf production per week, both fresh and dry weight and number of leaves/ plant followed by KNO_3 in both seasons.

The combination between seed priming treatments and levels of salinity reflected significant differences on plant growth of tomato in both seasons (Tables 5 and 6).

2- Photosynthetic pigments

It is evident from data in Table 7 that low salinity at 1500 ppm significantly increased the concentration of chlorophyll a and b as well as carotenoides in leaf tissues of tomato seedling in both seasons compared with the other treatments and control.

In leaves of tomato, the contents of total chlorophyll chl (a+b), chl. a and chl. b and carotenoides were decreased by NaCl stress (Khavarinejad and Mostofi, 1998).

The reduction in photosynthetic rate is due to the reduction in stomatal conductance resulting in restricted availability of CO_2 for carboxlylation reaction. Stomatal closure minimizes loss of water by transpiration and this affects chloroplast light- harvesting and energyconversion system thus leading to alteration in chloroplast activity (Parida and Das 2005). The inhibiting effect of salinity on photosynthetic rate in leaf tissues may be due to that high salinity showed considerable decrease in chlorophyll content, which could in turn reduce photosynthetic rate an dry weight.

Table (5). Effect of salinity and seed priming treatment on growth rate and leaf production per week of tomato seeds under green house conditions during 2008 and 2009 seasons.

Characters / Treatments	Growth rate		Leaf production per week	
	First season	Second season	First season	Second season
Effect of salinity				
Control	0.212	0.304	0.797	0.901
1500 ppm	0.236	0.340	0.848	0.952
3000 ppm	0.211	0.322	0.793	0.882
4500 ppm	0.189	0.280	0.746	0.851
L.S.D 0.05	0.02	0.005	0.023	0.011
Effect of priming agents				
Control	0.159	0.271	0.691	0.799
PEG	0.249	0.359	0.889	0.991
KNO_3	0.234	0.322	0.851	0.955
NaCl	0.198	0.284	0.749	0.853
$CaCl_2$	0.219	0.332	0.801	0.884
L.S.D 0.05	0.03	0.006	0.027	0.012
	Effect of interaction			
Salinity x Seed priming	*	*	*	*

Table (6). Effect of salinity and seed priming treatment on fresh weight, dry weight and number of leaves of tomato seeds under green house conditions during 2008 and 2009 seasons.

Characters / Treatments	Fresh weight(gm)		Dry weight (gm)		No of leaves	
	First season	Second season	First season	Second season	First season	Second season
Effect of salinity						
Control	1.74	1.78	0.28	0.31	4.34	4.46
1500 ppm	1.91	1.95	0.31	0.34	4.50	4.60
3000 ppm	1.77	1.81	0.29	0.31	4.20	4.31
4500 ppm	1.67	1.70	0.27	0.29	4.04	4.16
L.S.D 0.05	0.05	0.05	0.04	0.05	0.24	0.07
Effect of priming agents						
Control	1.38	1.42	0.24	0.26	3.85	3.96
PEG	2.19	2.24	0.36	0.39	4.56	4.66
KNO_3	1.91	1.95	0.30	0.33	4.43	4.54
NaCl	1.62	1.66	0.26	0.28	4.18	4.29
$CaCl_2$	1.76	1.80	0.29	0.32	4.35	4.47
L.S.D 0.05	0.05	0.06	0.05	0.06	0.27	0.08
	Effect of interaction					
Salinity x Seed priming	*	*	*	*	*	*

Table (7). Effect of salinity and seed priming treatment on chlorophyll (a) , chlorophyll (b)and carotenoides of tomato seeds under green house conditions during 2008 and 2009 seasons.

Characters / Treatments	Chlorophyll a		Chlorophyll b		Carotenoides	
	First season	Second season	First season	Second season	First season	Second season
	Effect of salinity					
Control	57.71	62.04	36.07	37.48	55.19	56.05
1500 ppm	59.43	62.54	42.24	43.65	60.89	59.97
3000 ppm	57.33	61.21	39.55	40.96	55.48	56.34
4500 ppm	54.18	58.06	36.58	37.68	50.80	51.66
L.S.D 0.05	0.005	0.017	0.005	0.005	0.29	0.17
	Effect of priming agents					
Control	53.07	56.57	31.90	33.31	47.14	48.00
PEG	60.43	64.48	42.81	44.13	62.29	62.65
KNO_3	58.12	61.98	41.24	42.56	57.71	58.07
NaCl	56.56	60.42	37.16	38.48	54.79	55.15
$CaCl_2$	57.64	61.38	39.93	41.24	55.79	56.17
L.S.D 0.05	0.006	0.019	0.006	0.006	0.32	0.19
	Effect of interaction					
Salinityx Seed priming	*	*	*	*	*	*

As for the effect of seed priming treatments, the obtained results in Table (7) indicate that seed priming in PEG gave the maximum concentration of chlorophyll a and b as well as carotenoides in leaf tissues of tomato in both seasons.

The interaction between seed priming and salinity levels had significant effect on photosynthetic pigments in leaf tissues of tomato in both seasons (Table 7).

REFERENCES

Allakhverdiev, S.L., A.Sakamoto, Y. Nishiyama, M. Inaba and N. Murata (2000). Ionic osmotic affects of NaCl- induced inactivation of photosystems I and II in *Synechococcus sp*. Plant Physiol.123:1047-1056.

Bernfeld P.(1955). Amylases,α and β. In Methods in Enzymology,Vol. 1(Ed. by Colowick S. P. and Kaplan N. o.) , pp. 149-158. Academic press , New York.

Bose, B. and T. Mishra (1992). Responses of wheat seed to presowing seed treatment with Mg $(NO_3)_2$. Ann. Agric. Res. 13, 132-136.

Coolbear P., A .Francis, D.Grierson (1984). The effect of low temperature pre–sowing treatment on the germination performance and membrane integrity of artificially aged tomato seeds. Journal of Experimental Botany, 35, 1609–1617.

Dubios,M.;Gilles,K.A.;Hamilton,J.K.;Rebers,P.A.andSmith,F.(1956).Colorimetric method for determination of sugars and related substances. Analyt.Chem, 28:350-356.

Duncan, D.B. 1965. Multiple range and multiple F. Test. Biometrics. 11, 1 - 42.

Edwards, R.L. and Sundstrom, F.J. (1987). After ripening and harvesting effects on Tabasco pepper seed germination performance. HortScience, 22:473-475.

Farooq, M., S.M.A. Basra, B.A. Saleem, M. Nafees and S.A. Chishti. (2005). Enhancement of Tomato seed germination and seedling vigor by Osmopriming. Pakistan. J. Agri. Sci., 42(3-4).

Gray, D. and J.R.A. Steckel (1977). Effects of presowing treatments on the germination and establishment of parsnips. J. Hort. Sci., 52:525-534.

Hernandez, J.A., E.Olmos, F.J.Corpas, F. Sevilla L.A. Delpio (1995). Salt-induced oxidative strees in chloroplasts of pea plants. Plant Sci. 105:151-167.

Heydedker, W. (1973). Germination of an idea: The priming of seeds. University of Nottingham, school of Agriculture Rep. 1973/1974.

ISTA (1999). International Rules for Seed Testing. Seed Science and Technology, 27:1-333.

Kâhkônen ,M.P.;Hopia,A.I.;Vuorela, H.J.; Rauha,J.P.; Pihlaja,K.; Kujala,T.S.and Heinonen, M (1999). Antioxidant activity of plant extracts containing phenolic compounds.J.Agric,food chem..,47 :3954-3962.

Khan, A.A. (1992). Pre-plant physiological seed conditioning in Horticultural Reviews. J. Janick (ed), John Willey and Sons, NY, pp.131-181.

Khavarinejad, R.A. and Y. Mostafi (1998). Effects of NaCl on photosynthestic pigments, saccharides and chloroplast ultrastructure in leaves of tomato cultivars. Photosynthtica , 35:151-154.

Lang, A.R.G. 1967. Osmotic coefficients and water potentials of sodium chloride solutions from 0 to 40ºC. Aust. J. Chem. 20, 2017-23.

Lui, Y.O., R.J. Bino, W.S. Vanderbung, S.P.C. Groot and H.W.M. Hilhorst (1986). Effects of osmotic (*Lycopersicon esculentum* Mill) seeds. Seed Sci. Res. 6, 49-55.

Michel,E.B and M.R. Kaufmann.(1973). The osmotic potential of polyethylene glycol 6000. Plant Physiol. 5(5): 914–916.

Parida, A.K. and A.B. Das (2005).Salt tolerance and salinity effects on plants: a review. Ecotoxicology and Environmental Safety 60:324-349.

Pill, W.G. and D.G. Fieldhouse (1982). Emergence of pre-germinated tomato seed stored in gels up to twenty days at low temperatures . Journal of the American Society for Horticultural Science. 107: 4, 722-725.

Singleton,V.L. and J.A.Rossi (I965). Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am.J.Enol. Vitic., 16: 144-158.

Vetter ,D.S. (1958), Quantitative determination of peroxidaese in sweet corn. Agric. and food chem., vol.6, No.1:39-41.

Wettestien, D.V. 1957. Chlorophyll- Lethate under submikroskopische form wechel der plastiden. Exptl. cell. Reso., 12:427.506.

Zbitnew, K.D.W. (1984). The effect of osmoconditioning on the germination and development of onion (*Allium cepa* L.). M.Sc. thesis, Faculty of Graduate Studies, The University of Guelph, Canada .

تأثير مهيئات الإنبات على إنبات البذور ونمو البادرات فى الطماطم تحت مستويات مختلفة من الملوحة

سمير كامل الصيفى[1]، حمدينو محمد إبراهيم أحمد[2] ، سوسن محمد حسن[1] ، محمد محمد مرسى[1] ، رواء صلاح الشطورى[1]
[1] قسم البساتين- كلية الزراعة بالاسماعلية- جامعة قناة السويس-مصر
[2] قسم بحوث تقاوى الخضر - معهد بحوث البساتين- مركز البحوث الزراعية- الجيزة-مصر

أجريت هذه الدراسة خلال عامي ٢٠٠٧ – ٢٠٠٨ و ٢٠٠٨- ٢٠٠٩ فى معمل وصوب كلية الزراعة بالاسماعيلية- جامعة قناة السويس - مصر . وذلك لدراسة تأثير مهيئات الانبات على الانبات ونمو الشتلات فى الطماطم النامية تحت ظروف مستويات مختلفة من الملوحة.

وكان أهم النتائج المتحصل عليها تحت ظروف المعمل أن معملة الكنترول أو المستوى المنخفض من الملوحة (١٥٠٠ جزء فى المليون) أعطى أحسن القيم فى معظم قياسات الانبات (نسبة الانبات – دليل كفاءة الانبات – معمل سرعة الانبات – الوقت الازم لاتمام الانبات – تماثل الانبات) . كما سجلت هذه المعاملة أعلى القيم فى صفات البادرات مسجلة أعلى طول ووزن طازج وجاف للبادرات ومحتوى البادرات من الكربوهيدرات والفينولات الكلية ونشاط انزيم البيروكسيديز .

تهيئة بذور الطماطم فى كلوريد البوتاسيوم كانت هى المعاملة المتفوقة فى تحسين نسبة الانبات ودليل كفاءة الانبات ومعامل سرعة الانبات وزيادة الوزن الطازج والجاف . وتحت ظروف الصوب فان مستوى الملوحة المنخفض (١٥٠٠ جزء فى المليون) ذاد معنويا من معدل النمو ومعدل انتاج الاوراق على الشتلات فى الاسبوع الاول وكذلك الوزن الطازج والجاف وعدد الاوراق على الشتلة ومحتوى الاوراق من الكلوروفيل مع مقارنته بمستويات الملوحة تلاخرى أو الكنترول.

اذداد معنويا معدل النمو ومعدل انتاجالاوراق فى الاسبوع والوزن الطازج والجاف للشتلة وكذلك محتوى الاوراق من الصبغات النباتية نتيجة لتهيئة بذور الطماطم فى البولى ايثلين جليكول.

وبصفة عامة فان التفاعل بين مهيئات الانبات ومستوى الملوحة المختلفة أظهرت تأثيرات معنوية على صفات الانبات والشتلات والمحتوى الكيماوى فى الطماطم .

قام بتحكيم البحث

أ.د / سمير طه محمود العفيفى	**كلية الزراعة – جامعة المنصورة**
أ.د / عبدالله برديسى احمد	**كلية الزراعة – جامعة الزقازيق**