

EFFECT OF WATER PRIMING DURATION ON RICE (*Oryza sativa* L.) GERMINATION AND SEEDLING GROWTH UNDER ISO-OSMOTIC SOLUTIONS OF NaCl AND PEG.

Khafagy, M. A; M. M. Darowish; S. M. Salama and El-Shimaa A. M. Abo-El-Kheer.

Department of Agricultural Botany, Faculty of Agriculture, Mansoura University,

ABSTRACT

Two factorial experiments were conducted to study the effect of grain priming treatment on two rice cultivars namely, Sakha 101 and Giza 178 on germination indices under salinity (NaCl) or draught (PEG) condition at the same water potentials. The treatments were done 4 times of hydro-priming 12, 24, 36 and 48 h. The osmotic potential levels of 0.0, -4, -8 and -12 bar were induced by NaCl or PEG-6000. The results showed that hydro-priming for 48 h caused significant improvement of germination indices under water stress condition in comparison with other priming treatments. Also NaCl or PEG, in general, inhibited the germination process as reflected by a decrease in the germination percentage, root and shoot lengths as well as fresh and dry weight. The studied rice cultivars Sakha 101 and Giza 178 and the reduction was significantly higher in Sakha101 compared to Giza178. It could be concluded that Giza 178 proved to be more tolerant against drought and salt stress conditions than Sakha 101. In addition, germination process and seedling growth may be enhanced by priming rice grains in water for 48 h.

Keywords:rice, salinity (NaCl), draught (PEG), duration, iso-osmotic solutions, seed germination, seedling growth.

INTRODUCTION

Water stress due to drought and salinity is probably the most significant abiotic factor limiting plant and also crop growth and development. Salinity and drought stresses are physiologically related, because both induce osmotic stress and most of the metabolic responses of the affected plants are similar to some extent. Seed germination of many crops is the most sensitive stage to water deficit, which delay and reduction of germination and seedling growth and increase abnormal seedling development especially in the arid and semi-arid regions. Egypt is the driest country and placed in an arid and semi arid region and its average annual rainfall is low (<25 mm annual rainfall). Many investigators have been used NaCl and Polyethylene glycol (PEG) compounds to simulate osmotic stress effects in Petri dish (in vitro) for plants to maintain uniform water potential throughout the experimental period (Kulkarni and Deshpande, 2007). Different techniques could be used to enhance crop yield, particularly under adverse environmental conditions. One of the simple techniques which can improve seedling establishment and consequently crop performance is seed priming. Seed priming in water reduce the time between sowing, improve germination uniformity and seedling establishment (Ashraf and Foolad, 2005; Farooq et al, 2006) and also to minimize abiotic stresses during germination in wheat (Basra *et al.*, 2003; Rajpar Ahmadi *et al.*, 2006; Yari *et al.*, 2010), maize (Basra *et al.*, 2004

and Moradi *et al.*, 2008), and rice (Basra *et al.*, 2004, 2005; Farooq *et al.*, 2005, 2009 and Kaymak *et al.* 2009) .In general, seed priming is a pre-sowing seed treatment in which seeds are soaked in water and dried back to storage moisture contents until further use. (Ghassemi-Golezani *et al.*, 2008 and 2013) indicated that positive effects of seed priming on seed invigoration depended on priming duration.

Rice (*Oryza sativa* L.), the staple food of more than half of the population of the world, is an important target to provide food security and livelihoods for millions. Rice is considered sensitive specie to the several abiotic stresses mainly during seed germination (Van Heerden and Krüger, 2002). The germination stage is so important because it affects the seedling establishment, plant density and subsequently the ultimate crop yield, so it's very important to have the seeds with high germination ability at unfavorable environmental conditions (El- Keblawy and Al-Rawai, 2005). The main objective of this study was to evaluate the effect of water priming on germination seedling growth of two rice cultivars ('Sakha 101' and 'Giza 178') under salinity (NaCl) and drought (PEG) stress (at the same osmotic potentials) and find out most favourable condition for grain water priming.

MATERIALS AND METHODS

Two independent experiments were conducted at the Laboratory of the Department of Agricultural Botany, Faculty of Agriculture, Mansoura University, Egypt during the growing season .The grains of two rice (*Oryza sativa* L) cultivars namely, Sakha 101 and Giza 178 were obtained from the Agricultural Research Centre in Giza, Egypt.

Drought treatment: An external osmotic (PEG6000) polyethylene glycol of Sigma Chemical Company, USA was used to create an artificial drought stress. Osmotic solution of PEG was prepared by using of 161, 481 and 302 g was dissolved in liter of distilled water separately to create three drought stresses -4,- 8 and-12 bar, respectively

Salinity treatment; Sodium Chloride (NaCl) obtained from EL-Gomhoria Co., Egypt and was used to create salinity stress. NaCl concentrations had the electrical conductivity (EC) values of 12.3, 17.4 and 21.8 dSm^{-1} , respectively. Referred osmotic potential of NaCl solution (-4, - 8 and-12 bar) were prepared by using of 5.25, 10.5 and 15.75 g of NaCl per liter in distilled water to create three salinity stress, respectively.

To determine the optimal time duration for rice grains priming, a homogenous lot, healthy and uniform size, of rice grains for two cultivars ('Sakha 101' and 'Giza 178') and before the start of experiment grains, were surface sterilized by soaking in 1.0% (v/v) sodium hypochlorite solution for 3 min for surface sterilization, Residual chlorine was eliminated by thorough washing of seeds with distilled water. Then, every cultivar sample was divided into four sub-samples. The sub-samples were soaked in distilled water at 30°C for 12, 48, 36 and 48 h (The quantity of water used 600 grains into liter of water).Soaking treatments were started from longer to shorter incubation periods and seeds were finally removed from water at the same

time. Thereafter, seeds surface moisture was removed with blotting paper and the grains were air-dried to attain initial grain weight before sub-merging in water. Then, every group divided into seven sub-groups. The treated grains (25) were transferred to sterile Petri dishes (11 cm diameter) containing two layers of the filter papers (Whitman No. 1). The solution of 10mL containing different concentrations of PEG or NaCl was added separately in each Petri dish. Grains of both rice cultivars allowed to germinating at about $25\pm 2^{\circ}\text{C}$ in the dark. Petri dishes tightly sealed with the impermeable colorless film in order to avoid water losses during the incubation. Thiram was added to the solutions at a concentration of 0.2% (w/v) to control the fungi infection. Grains considered to have germinated when shoot extended to more than 2mm from the grains. After 10 days final germination, seedlings were harvested and washed with tap water. This experiment was carried out as factorial design on completely randomized design. The treatments included two osmotic solutions (NaCl and PEG), four osmotic potentials (0, -4, -8 and -12 bar) and four hydro-primed durations (12, 48, 36 and 48 hour) with three replications and 25 grains per replicate. Data on the following parameters were recorded.

1) Germination percentage: was recorded on the 10th day after sowing and calculated using the formula **Germination percentage (%)** = Number of germinated grains / Number of total grains \times 100

2) Seedling vigor: was calculated using the formula according to following formula (Abdul-Baki & Anderson, 1970):

Seedling vigor index = Germination percentage \times Seedling length (cm) / 100

3) Seedling Growth Measurements:

Shoot and root lengths (mm) were measured on ten seedlings randomly taken from each replicate and the mean length of seedlings was calculated.

Shoot and root fresh weights (mg) were measured on ten seedlings randomly taken from each replicate (The harvested plants were partitioned into roots and shoots).

Shoot and root dry weights (mg) were measured using the same seedlings taken for the determination of fresh weight where placed in paper bags and dried at 80°C until constant weight in an oven, then the plant parts were weighed again.

Statistical analysis: The obtained data were subjected to statistical analysis of variance according to Gomez and Gomez (1984),

RESULTS AND DISCUSSION

1. Germination Percentage (%):

Data in Table (1) revealed that rice grain priming had significant positive effect on germination percentage and germination vigor index with increasing the duration time. The highest germination percentages obtained for grains primed in distilled water for 48 hours duration compared with grains primed for 12, 24 and 36 h. The lowest were obtained for grains hydroprimed with 12 hours duration. While, cultivars had different response to the duration, Sakha101 was significantly reduced compared to Giza178(Plate1). In control,

seed germination percentage varied between 53 % in Sakha101 and 75 % in Giza178. These findings support the work previously reported by Farooq et al., (2006). They found that maximum vigour enhancement as indicated by high germination and seedling vigour was noted in seeds hydroprimed for 48 h which was followed by that of 36 h in both rice types.

Table 1: Effects of hydropriming duration times on seed germination of two rice cultivars

Duration Time(h) (A)	Germination (%)	Seedling Vigour Index	Shoot length (cm)	Root length (cm)	length (cm)	Seedling F.W			Seedling D.W			
						Shoot	Root	Seedling	Shoot	Root	Seedling	
Giza178 (B)	12	59.10	4.93	4.35	3.62	7.98	319.3	248.6	567.9	28.3	23.38	47.63
	24	59.22	4.97	4.28	3.72	8.00	292.1	263.8	555.8	28.56	22.77	48.07
	36	65.65	5.71	4.42	3.88	8.30	317.7	268.2	585.9	28.96	24.76	53.71
	48	72.54	7.52	5.52	4.28	9.80	341.8	277.6	619.4	30.55	25.9	56.44
Mean	64.14	5.78	4.64	3.87	8.52	317.7	264.5	582.2	29.09	24.20	51.46	
Sakha 101 (B)	12	36.64	2.91	3.87	3.46	7.33	238.3	214.3	452.6	17.23	18.25	33.02
	24	39.56	3.05	3.76	3.29	7.05	241.0	221.1	462.1	16.01	18.45	32.17
	36	43.95	3.37	3.84	3.26	7.11	244.0	216.8	460.8	16.75	18.14	34.89
	48	48.30	4.00	4.22	3.52	7.74	267.8	242.4	510.2	19.68	20.34	40.03
Mean	42.11	3.33	3.92	3.38	7.30	247.7	223.6	471.4	17.41	18.79	35.02	
Mean	53.12	4.56	4.28	3.62	7.91	282.7	244.1	526.8	23.25	21.49	43.24	
LS D	A	1.06	0.26	0.12	0.16	0.22	4.7	2.11	4.13	1.25	1.22	2.31
	B	1.14	0.43	0.32	0.36	0.27	5.9	2.21	5.25	1.43	1.12	2.17
5%	A*b	1.63	0.56	0.41	0.48	0.44	7.8	4.34	7.21	2.56	2.42	4.91

Similarly, Basra et al., (2002) found that wheat seeds responded to different presowing seed treatments with hydropriming for 48 h showing the maximum invigoration followed by hydropriming for 24 h. In addition, Yari and Sheidaie (2011) found that all seed priming treatments improved rice germination and the highest percentage germination and the best speed of germination were observed on the treatment of 48h duration. Kumar et al. (2002) found the maximum length of time for which seed should be soaked and exceeding it could be harmful to the seed or seedling and recommended safe limits for maize and rice, chickpea and pearl millet were 24 h, 10 h and 8 h, respectively. Moreover, Ghassemi-Golezani et al. (2008) indicated that positive effects of seed priming on seed invigoration depended on priming duration and showed that hydro-priming of chickpea seeds for 8, 16 and 48 hours enhanced seedling emergence, but the best improvement was achieved with 16 hours priming duration. The observations of Parera and Cantliffe, (1994) found that the success of seed priming is influenced by the complex interaction of factors including plant species, water potentiality of priming agent, duration of priming, temperature, seed vigor and storage conditions of the primed seed. Harris et al. (2001) who reported that wheat seed soaking in tap water overnight resulted in earlier. There are numerous studies reported optimal times of hydro-priming were 7 h for pinto bean (Ghassemi-Golezani et al, 2010), 12 h for chickpea(Ghassemi-golezani et al, 2013), 18 h for maize (Mir Mahmoodi et al, 2011) ,16 h for mung-

bean(Golezani et al.,2014)and 48 h in wheat (Nayyar *et al.*, 1995), and maize (Afzal *et al.*, 2002). The increase in germination might be attributed to premobilization of seed reserves during

Table 2: Effects of sodium chloride (NaCl) or polyethylene glycol (PEG6000) on seed germination of rice

Osmotic potential (bar)	Germination (%)	Seedling Vigour Index	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling F.W(mg/10 seedling)			Seedling D.W(mg/10 seedling)			
						Shoot	Root	Seedling	Shoot	Root	Seedling	
water	61.83	28.66	33.17	752.9	332.6	420.3	10.20	4.32	5.88	7.40	64.38	
NaCl	-4	66.14	33.97	36.67	725.8	338.3	387.5	10.49	4.58	5.91	8.25	77.71
	-8	46.45	20.77	25.68	527.2	212.4	314.7	7.48	3.73	3.74	4.82	53.92
	-12	29.36	12.25	16.61	343.9	146.9	197.0	5.70	2.34	2.36	1.92	36.34
Mean	47.31	22.33	26.32	532.3	232.5	299.7	7.89	3.55	4.00	4.99	55.99	
PEG	-4	41.85	20.79	21.26	538.5	309.2	229.3	9.39	4.25	5.14	6.83	56.49
	-8	31.76	18.84	15.07	430.8	215.8	215	7.55	3.65	3.9	4.69	52.65
	-12	24.41	12.09	11.96	294.6	142.3	152.3	5.32	2.40	2.92	2.37	33.26
Mean	32.67	17.24	16.09	421.3	222.4	198.8	7.42	3.43	3.98	4.63	47.46	
LS	O.P.S	2.81	1.35	2.44	5.2	3.5	3.9	1.3	0.45	0.12	0.78	0.43
D5	B	1.14	0.43	0.32	0.36	0.27	5.9	2.21	5.25	1.43	1.12	2.17
%	A*b	1.63	0.56	0.41	0.48	0.44	7.8	4.34	7.21	2.56	2.42	4.91

the priming period(Job *et al.*, 2000) and/or increased metabolic activities (Basra *et al.*, 2002) and/or absorption of water increases the leakage of electrolytes, sugars, and amino acids (Ghassemi-Golezani *et al.*, 2010a) and pre-organization of membrane structures (Bewley and Black, 1982), accelerate endosperm analysis by higher hydrolase activities (Bradford *et al.*, 2000) and/or affects the lag phase and causes early DNA replication (Bray *et al.* 1983), increased RNA and protein synthesis (Fu *et al.* 1988) and/or greater ATP availability (Mazor *et al.* 1984) and/or completion of pre-germination metabolic activities during seed priming, making the seed ready for soon germination after planting (Sadeghi *et al.* 2011) and/or the embryo expands and compresses the endosperm during priming (Liptay and Zaiffa, 1993) and/or priming are associated with the repairing and building up of nucleic acids, increased synthesis of proteins as well as the repairing of membranes and faster water uptake and earlier initiation of metabolism processes (Farooq *et al.* 2007; Kant *et al.* 2006) and enhances the activities of anti-oxidative enzymes in treated seeds (Wang *et al.*, 2003; Hsu *et al.*, 2003) and/or hydrolysis of ABA (Ajouri *et al.*, 2004), its presence in the seed does not affect the osmotic potential and/or water uptake ability of the embryonic axes (Bewley, and Black 1994). but leads to the inhibition of radicle extension in the embryo germinating and ABA has antagonistic effects

on GA activities, it is responsible for the synthesis of various hydrolytic enzymes involved in the mobilization of endosperm reserves (Jacobsen *et al.*, 1995) and inhibited activity of GA that suppress the synthesis of amylase enzymes in germinating seeds (Gomez-Cadenas *et al.*, 2001). It plays an important role in hydrolyzing the endosperm starch in to sugars as energy source for the newly developing shoot and roots (Kaneko *et al.*, 2002). and/or pre-soaking of seeds causes the hydrolysis of ABA together with the leaching of other germination inhibitors like coumarin and phenolic compounds from the seed into solution (Hopkins, 1995).Therefore, seed priming might result in diminishing the antagonistic effect of ABA on GA activity during the germination process and/or .during imbibitions, the position of certain fatty acids associated with seed dormancy is changed and does not reverse on drying (Bewley and Black, 1982). Hence, in the process of seed priming, all the necessary physiological and biochemical changes occurred in the seeds during the

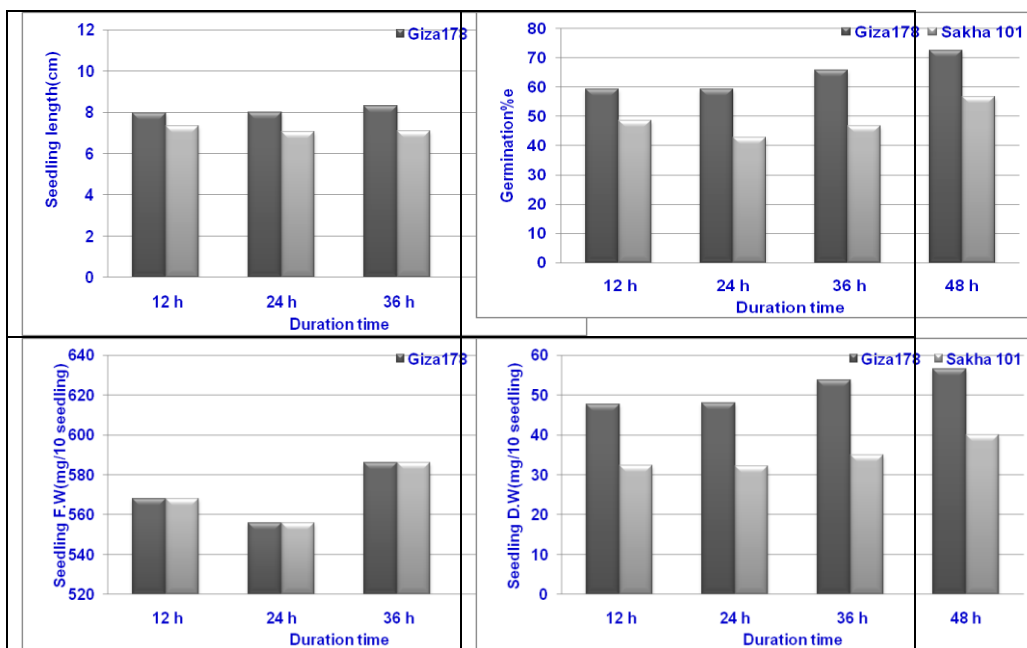
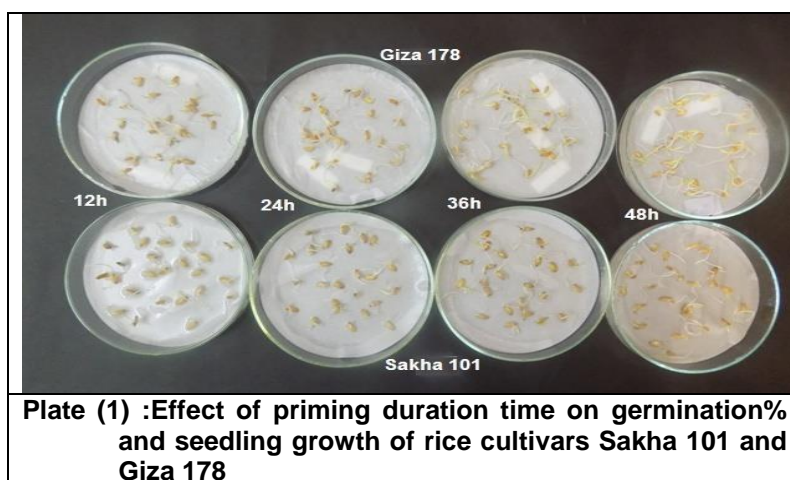


Fig 2:Effect of priming duration time on germination% and seedling growth of rice cultivars Sakha 101 and Giza 178



the priming period persist upon drying. Therefore, when a primed seed is sown, a small uptake of water can already stimulates the radicle emergence. Instead, an unprimed seed has to go through all the phases of seed germination after sowing under stress conditions, which is a possible reason for lower germination rate and seedling growth compared to primed seeds. In addition, although imbibition is vital for re-constitution of biomembranes, activation of enzymes, mobilization of storage compounds and protein synthesis in the seed, it can also induce imbibitions damage, particularly when water is taken up rapidly.

In the present study, it was observed that seed germination percentage and germination vigor index of both cultivars were reduced with increasing NaCl or PEG concentrations (decreasing water potentials of the media). However, increased NaCl or PEG concentration in the media led to the greatest decrease in germination percentage. Although, the cultivars responded differently to each of NaCl and PEG concentration, Giza178 showed better germination percentage compared to Sakha 101. Moreover, the highest germination percentages were recorded for seeds primed for duration of 48 h. At the highest NaCl or PEG concentration (-12 bar), the maximum germination percentage was observed in "Giza178"cultivar (45-46%) and the lowest one in "Sakha 101" cultivar (27-19%), respectively. Giza178 cultivar demonstrated better tolerance to drought or salt stress than Sakha 101 cultivar for germination percentage. Many investigators have been used NaCl and PEG to determine the effect of salt and drought stresses on seed germination of wheat (Almansouri *et al.*, 2001) and rice (Aqeel Ahmad *et al.*, 2007). They concluded that salinity and draught inhibited the germination percentages by causing a complete inhibition of the enzyme germination process or delaying the germination of seeds but do not prevent germination.

According to the results the minimum osmotic potential of NaCl or PEG levels (-4 bar) increasing rice germination percentage more than 75% was observed in Giza 178 cultivar, whereas in cultivar Sakha101 64%. compared

to the control, whereas decreased gradually with decreasing osmotic potentials of the media (NaCl or PEG). Similar trend in reduction of germination percentage was also observed at osmotic potential of -8 bars and the great reduction of germination was less than 50%, occurred under high level of NaCl or PEG -12 bars, germination was less than 50% for the two studied rice cultivars. The results are in line with Almansouri *et al.*, (2001) reported that moderate stress intensities only delayed germination; whereas the highest concentration of NaCl and PEG reduced final germination percentages. The inhibition germination of rice grains under conditions of NaCl and PEG stress may be related to the reduction in water absorption into seeds water uptake of seedlings (Chartzoulakis and Klapaki ,2000) and inhibits the mobilization of the seed reserves to the growing embryonic axis (Khayatnezhad and Gholamin, 2011) and reduction in the seeds water content due to low media water potential decreases the activity of hydrolytic enzymes such as alphaamylase, proteases and lipases which are responsible in hydrolyzing cotyledons and thus results in lower seed germination rate (Zayed and Zeid, 1998). In addition, the effects of NaCl was less on germination at the same osmotic potentials compared to PEG possibly due to the uptake of Na⁺ and Cl⁻ ions by the seed, maintaining a water potential gradient allowing water uptake during seed germination (Garg,2010) and with no toxicity effect of PEG (Khajeh-Hosseini *et al.*, 2003) and the lowest germination percentage obtained from PEG compared with NaCl suggests that adverse effects of PEG on germination were due to osmotic effect rather than specific ion accumulation (Foolad and Lin ,1997) and the PEG molecules did not enter the seed and hence once water potential of the seed and around were in equilibrium the seed would not continue to imbibe (Mehra, 2003). These results agree with those given by Murillo-Amador (2002) who observed that NaCl had a lesser effect on the germination and seedling growth of cowpea than did PEG. Sadeghian and Yavari (2004) stated that the lower mean germination time in sugar beet by NaCl, at the same water potential, than in PEG could be explained by more rapid water uptake in NaCl solutions. Moreover, Khajeh- Hosseini *et al.*, (2003) found faster germination in NaCl in soybean and at the same water potential, the higher final germination in NaCl than in PEG could be explained by more rapid water uptake in NaCl solutions and achievement of a moisture content that allowed germination.

2- Seedling growth

Data in Table (2) revealed that rice grain hydropriming had significant positive effect on seedling growth (seedling length as well as fresh and dry weight) with increasing the duration time. The maximum root and shoot lengths were noted in seeds hydroprimed for 48 h. Minimum root and shoot length were observed in seeds hydroprimed for 12 h. All other seed treatments resulted in higher root and shoot length (table 2). All treatments, except hydropriming for 12 h, resulted in higher seedling fresh and dry weight (tables 3, 4). Maximum seedling fresh and dry weight was recorded from seeds hydroprimed for 48 h with similar values for seeds hydroprimed for 36 h (table 2). These findings support the earlier work observed following hydropriming for 48 h in wheat (Basra *et al.*, 2002; Nayyar *et al.*, 1995),

maize and gourd seeds (Afzal *et al.*, 2002). This might be attributed to increased metabolic activities in the hydroprimed seeds (Basra *et al.*, 2002). Hydropriming treatments enhanced the seedling vigour as indicated by root and shoot length and seedling fresh and dry weights (tables 3, 4). Enhanced replication in root tips has also been reported by hydropriming (Bose and Mishra 1992).

Data in Tables (2-4) revealed that low levels of osmotic potentials (NaCl or PEG) -4ba, in most cases, did not show any significant in seedling growth (seedling length as well as fresh and dry weight). While, this parameter was significantly decreased at -8 bar of water potential and the decrease was frequently dependent on NaCl and PEG concentration. The results are in agreement with the observations of Bahaji, *et al.*, (2002) and Azooz *et al.*, (2004). Moreover, the same data revealed that rice grain priming had significant positive effect on seedling growth and the highest seedling growth obtained for seeds primed in distilled water 48 or 36 hours duration. The lower seedling growth was obtained for seeds hydroprimed with 24 or 12 hours duration (Tables: 2). The reduced seedling growth under stress conditions could be attributed to the physiological drought induced by the low water potential of the solution and osmotic adjustments in plants as a result of increased ionic concentration in their cells, which result in deformation of macromolecules by disrupting their shell or bound water (Schwarz, 1985). The decrease in seedling growth is caused by a diversion of the plant assimilates from growth to maintenance, e.g. to meet the higher energy requirement of various mechanisms involved in adjustment to unfavorable ionic conditions to unfavorable ionic conditions (Helal and Mengel, 1981) or for compartmentation secretion and repair of cellular damage used by high salinity (Penning de Vries, 1975). Moreover, the effect earlier investigations (Abraham and Kiran, 2003 and Silva *et al.*, 2003) of salinity on plant growth is complex syndrome that involves osmotic stress, ion toxicity and mineral deficiency (Munns, *et al.*, 2000), ion imbalance, hormonal imbalance or a combination of these factors (Kurth, *et al.*, 1986).

In addition, the seedling growth of the two studied cultivar responded differently with solutions and doses, Giza 178 cultivar showed the highest seedling growth compared to cultivar Sakha101 under the same level of water potential. It seems that the effect of cultivar was more obvious than hydropriming duration time as compared to osmotic potentials. And also turning point of hydropriming positive effect was more than the level of osmotic potentials. It means that for hydropriming rice seeds at higher osmotic potentials, time of hydropriming must be almost 48 hours not higher. Furthermore, hydro priming resulted in increase of normal germination. Results showed that the effect of hydro on germination percentage of rice was significant. Hydropriming clearly improved rate of germination and mean germination time under salt stress conditions. Furthermore, hydropriming resulted in increase of normal germination percentage (Redy and Vora, 1983). The efficiency of seed hydro-priming for better seedling establishment, also reported in barley, lentil and chickpea (Chinusamy *et al.* 2006).

The positive effect of priming probably due to increase in the number and/or size of the cell. Although, there is no known relationship between cell division and seed priming in rice, but replicative DNA synthesis in radicle meristem nuclei often occurs in tomato during seed priming, although this is not essential to advance germination. In addition, hydropriming improved the seedling growth (seedling length, fresh and dry weight) of rice cultivars under drought and salinity stress. However hydropriming had better effects under drought stress (PEG) up to -8 bars osmotic potential, due to more increase in seedling growth in the two studied cultivars. Meanwhile the cultivar Giza178 showed a better response to hydropriming treatment than Sakha101 cultivar. Generally, priming time and cultivar interaction had significant effect on seedling growth (seedling length, fresh and dry weight) and the highest values were obtained from water treatments in priming times of 48 h and 36 h compared with others. In addition, seedling shoot length under PEG resulted to a greater than NaCl under the same level of water potential. Inhibition of NaCl was less than that of PEG.

In conclusion, the obtained results of the present study revealed that osmotic potentials by NaCl or PEG in general inhibited the germination and decreased the germination percentage, root and shoot lengths as well as fresh and dry weight of rice cultivars Sakha 101 and Giza 178. This reduction was significantly higher for Sakha101 as compared to Giza178. It seems that Giza 178 under drought and salt stress conditions showed more tolerance than Sakha 101 and can be enhanced germination and seedling growth by priming rice grains for 48 h in water. It could be suggested that more experiments are necessary to be carried out on such cultivars to determine the effect of different priming treatments on germination seedling growth under drought and salinity stress and find out the suitable Chemicals required for the same purpose.

REFERENCES

- Abdul-Baki ,A .A & Anderson, J. D. (1970): Viability and leaching of sugars from germinating barley. *Crop Science*. 10: 31-34.
- Abraham, L. and Kiran, G.S. (2003): Effect of NaCl stress on growth of *Sorghum bicolor (L.) Monech*. *J. of Eco.Physiol*. 6: (3/4), 137-140.
- Afzal, I., Basra, S.M.A, Ahmad, N., Cheema, M.A., Warriach, E.A. and Khaliq, A. (2002) ; Effect of priming and growth regulator treatment on emergence and seedling growth of hybrid maize (*Zea mays L.*). *International Journal of Agriculture and Biology*, 4, 302–306.
- Ajouri, H. Asgedom ,H. Becker ,M. (2004): Seed priming enhances germination and seedling growth of barley under conditions of P and Zn deficiency. *J Plant Nutr Soil Sci*. 167:630-636.
- Aqeel Ahmad, M.S; F. Javed and M. Ashraf, (2007): Iso-osmotic effect of NaCl and PEG on growth, cations and free proline accumulation in callus tissue of two indica Rice (*Oryza sativa L.*) genotypes. *Plant Growth Regul.*, 53: 53-63.

Almansouri, M., J. M. Kinet and S. Lutts (2001): Effect of salt and osmotic stresses on germination in durum wheat (*Triticum durum Desf.*). Plant and Soil. 231: 243-254.

Ashraf ,M .and Foolad, M.R. (2005) :Pre-sowing seed treatment-A shotgun approach to improve germination growth and crop yield under saline and none-saline conditions. Advances in Agronomy 88: 223-267.

- Azooz, M.M., Shaddad, M.A. and Abdel-Latef, A.A.(2004): Leaf growth and K⁺/Na⁺ ratio as an indication of the salt tolerance of three sorghum cultivars grown under salinity stress and IAA treatment. *Acta Agronomica Hungarica*. 52: (3), 287-296.
- Bahaji, A. Mateu, I., Sanz, A. and Cornejo, M.J.(2002): Common and distinctive responses of rice seedlings to saline- and osmotically-generated stress. *Plant Growth Regulation*. 38:
- Basra, S.M.A., M.N. Zia, I. Mahmood, I. Afzal and A. Khaliq. (2002): Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.). *Pak. J. Arid Agric.*, 5: 325-329.
- Basra, S.M.A., M. Farooq, K. Hafeez and N. Ahmed. (2004): Osmohardening: a new technique for rice seed invigoration. *Int. Rice Res. Notes*, 29: 80-81,
- Basra, S.M.A., M. Farooq and A. Khaliq. (2003): Comparative study of pre-sowing seed enhancement treatments in indica rice (*Oryza sativa* L.). *Pak. J. Life Soc. Sci.*, 1: 5-9.
- Basra, S.M.A., M. Farooq, R. Tabassum and N. Ahmed. (2005): Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.). *SeedSci. Technol.*, 33: 623-628.
- Basra, S.M.A., M.N. Zia, T. Mahmood, I. Afzal and A. Khaliq.(2002): Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.) seeds. *Pak. J. Arid Agric.*, 5: 11-16.
- Bewley, J. D., and Black, M. (1994): *Seeds: Physiology of Development and Germination.* Plenum Press, New York.
- Bewley JD, Black M. (1982): *Physiology and biochemistry of seeds*. Vol. 2, Viability, dormancy and environmental control. Springer-Verlag, Berlin.
- Bose, B. and Mishra, T. (1992): Response of wheat seed to pre-sowing seed treatments with Mg (NO₃). *Annals of Agricultural Research*, 13, 132–136.
- Bradford, K.J., F. Chen, M.B. Cooley, P. Dahal, B. Downie, K.K. Fukunaga, O.H. Gee, S. Gurusinghe, R.A. Mella and H. Nonogaki. (2000): Gene expression prior to radicle emergence in imbibed tomato seeds. In: *Seed Biology: Advances and Applications*. (Eds.): M. Black, K.J. Bradford, J. Vázquez-Ramos. CABI Int., Wallingford, UK. pp 231-251.
- Bray CM, Davison P-A, Ashraf M, Taylor M-R (1989): Biochemical events during osmopriming of leek seed. *Ann Appl Biol* 102:185-193.
- Chartzoulakis, K., and Klapaki, G. (2000): Response of two greenhouse pepper hybrids to NaCl salinity during different growth stages. *Sci Horti*, 86, 247–260.
- Chinusamy V, Zhu J, Zhu JK, (2006): Salt stress signaling and mechanisms of plant salt tolerance. In *Genetic engineering* (p. 141-17). Springer US.
- El-Keblawy, A. and A. Al-Rawai, (2005): Effects of salinity, temperature and light on germination of invasive *Prosopis juliflora* (Sw.) D.C. *J. Arid Environ.*, 61: 555-565.
- Farooq M, Basra, SMA Wahid, A, Khaliq A, Kobayashi N (2009): Rice seed invigoration. In *Sustainable Agriculture Reviews*. Book Series, ed. E. Lichtfouse. Berlin, Germany: Springer

- Farooq, M., S.M.A. Basra and A. Wahid, (2007):Improving the performance of transplanted rice by seed priming. *Plant Growth Regul.*, 51: 129-137.
- Farooq M, Basra SMA, Rehman H. (2006): Seed Priming enhances emergence, yield, and quality of direct-seeded rice. *Crop Manag & physiol* 3:42-44.35: 15-29.
- Farooq M, Basra SMA, Hafeez K (2005) :seed invigoration by osmohardening in indica and japonica rice .*Seed Sci Technol* 33 :(3).
- Foolad, M. R., Lin, G. Y. (1997):Genetic potential for salt tolerance during germination in *Lycopersicon* species. *Hortsci*, 32, 296-300.
- Fu JR, Lu SH, Chen RZ, Zhang BZ, Liu ZS, Cai DY (1988): Osmoconditioning of peanut (*Arachis hypogaea* L.) seed with PEG to improve vigor and some biochemical activities. *Seed Sci and Tech* 16: 197-212.
- Garg, G.(2010) :Response in germination and seedling growth in *Phaseolus mungo* under salt and drought stress. *Journal of Environmental Biology*. 31: 261-264.
- Ghassemi-Golezani K, Sheikhzadeh-Mosaddegh P, Valizadeh M. (2008): Effects of hydro-priming duration and limited irrigation on field performance of chickpea. *Res J Seed Sci* 1:34-40.
- Ghassemi-Golezani K, Zafarani-Moattar P, Raey Y, Mohammadi A. (2010): Response of pinto bean cultivars to water deficit at reproductive stages. *J of Food Agri Environ* 8:801-804.
- Ghassemi-Golezani, K., Dastborhan, S., Zehtab-Salmasi, S. (2013): Seed priming and field performance of Borage (*Borago officinalis* L.) under different irrigation treatments. *International Journal of Agronomy and PlantProduction*, 4, pp. 82-87.
- Golezani K. G., Hassanpour-Bourkheili S., Bandeh-Hagh A. , Abriz S. F. (2014): Seed hydro-priming, a simple way for improving mung-bean performance under water stress . *International Journal of Biosciences*. Vol. 4, No. 12, p. 12-18.
- Gómez-Cadenas A, Pozo OJ, García-Agustín P, Sancho JV (2002) :Direct analysis of abscisic acid in crude plant extracts by liquid chromatography-electrospray/tandem mass spectrometry.*Phytochem Anal* 13: 228–234
- Gomez, K.A. and A.A. Gomez, (1984): *Statistical Procedures for Agricultural Research*. 2nd Edn., John Wiley and Sons, USA., ISBN: 978-0-471-87092-0, , pp:704.
- Harris, D., B.S. Raghuvanshi, J.S. Gangwar,S.C. Singh, K.D. Joshi, A. Rashid, P.A.Hollington, (2001): Participatory evaluation by farmers of on-farm seed priming in wheat in India, Nepal, and Pakistan. *Exp. Agric.*, 37: 403-415.
- Helal, H.M. and Mengel, K. (1981): Interaction between light intensity and NaCl salinity and their effects on growth, Co₂ assimilation and photosynthate conversion in young board beans. *Plant Physiol*. 67: 999-1002.
- Hopkins WG. (1995). *Introduction to plant physiology*. Wiley, New York
- Hsu, C. C., C. L. Chen, J. J. Chen and J. M. Sung (2003): Accelerated aging-enhanced lipid peroxidation in bitter gourd seeds and effects of priming and hot water soaking treatments. *Sci. Horti*. 98:201-212.

- Jacobsen, J.V., Gubler, F., Chandler, P.M.,(1995): Gibberellin action in germinated cereals. In: Plant Hormones, Davies P.J., E.2. Boston, pp. 246-271.
- Job, D., I. Capron, C. Job, F. Dacher, F. Corbineau and D.Côme (2000): Identification of germination-specific protein markers and their use in seed priming technology, pp. 449- 459. In: Black M., Bradford K. J. and Va´zquez-Ramos J. (Eds.). Seed Biology: Advances and Applications. CABInternational. Wallingford, UK
- Kant S, Pahuja SS, Pannu RK. (2006): Effect of seed priming on growth and phenology of wheat under late- sown conditions. Trop Sci. 44: 9-15.
- Kaymakanova M. 2009. Effect of salinity on germination and seed physiology in bean (*Phaseolus vulgaris* L.). XI Anniversary Scientific Conference. Biotechnol Biotechnol Eq, p. 326-329.
- Khajeh-Hosseini, M.; Powell, A.A. and Bingham, I.J.(2003): The interaction between salinity stress and seed vigour during germination of soybean seeds. Seed Sci. & Technol, 31: 715-725.
- Khayatnezhad M, Gholamin R (2011). Effects of water and salt stresses on germination and seedling growth in two durum wheat (*Triticum durum* Desf.) genotypes. Science. Res. essay. 6(21), pp. 4597-4603.
- Kulkarni M, Deshpande U, 2007: In vitro screening of tomato genotypes for drought resistance using polyethylene glycol. Afr J Biotech. 6(6): 691-696.
- Kurth, E., Cramer, G.R., Läuchli, A. and Epstein, E. (1986): Effects of NaCl and CaCl₂ on cell enlargement and cell production in cotton roots. Plant Physiol.. 82: 1102-1106
- Kumar, A., J.S. Gangwar, S.C. Prasad, D. Harris, (2002): 'On-farm' seed priming increases yield of direct-sown finger millet (*Eleusine coracana*) in India. Int. Sorghum Millets Newslett., 43: 90-92.
- Liptay A, Zariffa N (1993): Testing the morphological aspects of polyethylene glycol-primed tomato seeds with proportional odds analysis. Hort Sci 28:881-883.
- Mazor L, Perl M, Negbi M (1984):Changes in some ATP-dependent activities in seed during treatment with polyethylene glycol and during redrying process. J Exp Bot 35: 1119-1127
- Mehra V., Tripathi J. and Powell A.A.(2003) :Aerated hydration treatment improves the response of *Brassica juncea* and *Brassica campestris* seeds to stress during germination // Seed Sci. Technol.. Vol. 31. P. 57 – 70.
- Mir-mahmudi T, Ghassemi-Golezani K, Habib D, Paknezhad F, Ardekani MR(2011) :Effects of of priming techniques on seed germination and seedling emergence of maize (*Zea mays* L.) J food Agric Environ 9(2):200-202.
- Moradi, A., O. Younesi, (2009): Effects of Osmo- and Hydro-priming on Seed Parameters of Grain Sorghum (*Sorghum bicolor* L.). Australian Journal of Basic and Applied Sciences, 3(3): 1696-1700.
- Murillo-Amador, B., R. Lopez-Aguilar, C.; Kaya, J. Larrinaga-Mayoral and A. Flores-Hernandez. (2002): Comparative effects of NaCl and polyethylene

- glycol on germination, emergence and seedling growth of cowpea. *J. Agronomy & Crop Science*, 188: 235-247.
- Munns R., Guo J., Passioura J.B. & Cramer G.R. (2000): Leaf water status controls day-time but not daily rates of leaf expansion in salt-treated barley. *Australian Journal of Plant Physiology*.27, 949–957.
- Nayyar, H., Walia, D.P. and Kaishta, B.L. (1995): Performance of bread wheat (*Triticum aestivum* L.) seeds primed with growth regulators and inorganic salts. *Indian Journal of Agricultural Sciences*, 65, 112–116.
- Parera, C. A. and D. J. Cantliffe (1994): Pre-sowing seed priming. *Hort. Rev.* 16:109-141.
- Penning de Vries, F.W.T. (1975):the cost of maintaine processes in plant cells. *Annals of Bot.* 39: 77-92.
- Rajpar, I., Khanif Y.M. & Memon A.A. (2006): Effect of Seed Priming on Growth and Yield of Wheat (*Triticum aestivum* L.) Under Non-Saline Conditions. *International Journal of Agricultural Research*, 1 (3): 259-264
- Redy MP, Vora AB, (1983): Efect of salinity on germination and fre proline contente of bajra (*Penisetum typhoides* S & H) sedlings. In *Proc. Indian. Nat. Sci. Acad. B* (Vol. 49, p. 702-705).SAS Instiute, 192.SASSTAT User's Guide. SAS Instiute Inc, Cary.
- Sadeghian, S.Y. and N. Yavari,(2004): Effect of water deficit stress on germination and early seedling growth in sugar beet. *J. Agron. Crop Sci.*, 190: 138-144.
- Sadeghi H, Khazaei F, Yari L, Sheidaei S (2011): Effect of seed osmopriming on seed germination behavior and vigor of soybean (*Glycine max* L.). *ARPN J Agricult Biol Sci* 6(1):39-43.
- Shaha R, Mandal AK, Basu RN (1990) :Physiology of seed invigoration treatments in soybean (*Glycine max* L). *Seed Sci and Tech* 18: 269-276.
- Schwarz, M (1985):The use of saline water in hydroponics. *Soiless Cult.* 1: 25-34.
- Silva, C., Vinuesa, P., Eguiarte, L.E., Esperanza-Martinez, R., and Souza, V. (2003):*Rhizobium etli* and *Rhizobium gallicum* nodulate common bean (*Phaseolus vulgaris*) in atraditionally managed milpa plot in Mexico, population genetics and biographic implications. *Applied and Environmental Microbiology* 69: 884–893

- Van Heerden PD, Krüger GHJ (2002): Separately and simultaneously induced dark chilling and drought stress effects on photosynthesis, proline accumulation and antioxidant metabolism in soybean. *J Plant Physiol* 159: 1077–1086.
- Wang, H. Y., C. L. Chen and J. M. Sung (2003): Both warm water soaking and solid priming treatments enhance anti-oxidation of bitter gourd seeds germinated at sub-optimal temperature. *Seed Sci. Technol.* 31:47-56.
- Yari, L., & Sheidaie, S. (2011): Effect of seed priming on seed germination's behavior of rice (*Oryza sativa* L.). *Journal of Agricultural and Biological Science*, 1(June), 45-51.
- Yari L, Aghaalikani M, Khazaei F (2010): Effect of seed priming duration and temperature on seed germination behavior of bread wheat (*Triticum aestivum* L.). *Journal of Agricultural and Biological Science* 5: 7-15
- Zayed MA and Zeid I M (1998): Effect of water and salt stress on growth, chlorophyll, mineral ions and organic solutes and enzymes activity in mung bean seedlings. *Biologia Plantarum* 40 351-356.

تأثير فترات النقع بالماء على إنبات ونمو بادات الارز تحت محلول متساوى
الاسموزية من كلوريد الصوديوم والبولي ايثيلين جلايكول.
محمود عبد المنعم خفاجى ومحمود محمد درويش وسمير محمد سلامة و
الشيماة عبدالله محمد ابو الخير
قسم النبات الزراعى - كلية الزراعة - جامعة المنصورة- مصر

اجريت تجربتين بغرض تحديد فترات النقع بالماء لصنفى الارز جيزة ١٧٨ و سخاء ١٠١ تحت
تأثير محلول متساوى الاسموزية لكل من كلوريد الصوديوم والبولي ايثيلين جلايكول على
نسبة الانبات ونمو البادات . ولقد اوضحت الدراسة ان نقص الضغط الاسموزى الناتج عن الملوحة
او الجفاف تؤدى الى نقص فى نسبة الانبات وكذلك نمو البادات ويعتمد ذلك على الملوحة او
الجفاف . كما أثبتت الدراسة أن نقع البذور فى الماء لمدة ٤٨ ساعة ثم تجفيفها حتى تعود للوزن
الطبيعى قبل الزراعة كانت فعالة فى زيادة نسبة الانبات وصفات النمو للبادرات المتمثلة فى طول
البادرة و الوزن الطازج و الجاف للبادرة تحت الظروف الملوحة والجفاف مقارنة بالبذور التى نقعت
فى فترات اقل. كما ثبت ان صنف جيزة ١٧٨ اكثر تحملا لكل من الجفاف والملوحة عن صنف
سخاء ١٠١.