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# Osmopriming Eggplant (*Solanum melongena* L.) Seeds by Using Salt Solutions

**Ahmad Shahlaei • Naser Alemzadeh Ansari* • Sasan Aliniaifard**

Department of Horticulture, Faculty of Agriculture, Shahid Chamran Univarsity, Ahvaz, Iran

*Corresponding author*: * alemzadeh_ansari@yahoo.com

## ABSTRACT

The time for germination and seedling emergence of eggplant is relatively long. To overcome this problem, osmopriming eggplant seeds with salt solutions (NaCl, $KNO_3$ and $K_2HPO_4$) at tree levels (-0.5, -1 and -1.5 MPa) was tested. The effect of solution type on germination percentage (GP), germination rate (GR) and mean germination time (MGT) was significant ($P < 0.01$). The effect of salt solutions on GP was as follows: $KNO_3$ > NaCl > $K_2HPO_4$ > control (distilled water). The highest and lowest values for GR and MGT were observed in NaCl (0.5 MPa) and distilled water (control). Also, the effect of solution concentration on mean root length (MRL) ($P < 0.05$) and MGT ($P < 0.01$) was significant but no significant differences for any other treatments were shown.

**Keywords:** germination, mineral solutions, priming

## INTRODUCTION

Seed priming is a general term that refers to several different techniques used to hydrate seeds under controlled conditions, but preventing the completion of germination (phase 3). During priming, seeds are able to imbibe or partially imbibe water and achieve elevated seed moisture content usually in phase 2 (lag phase) germination. Seeds may be kept in these conditions for a period of time that may range from less than 1 day to several weeks. Priming temperatures range from 10 to 35°C, but 15 to 20°C is most commonly used (Bradford 1986). Since seeds have not completed germination, they remain desiccation tolerant and can still be dried for long-term storage. All priming techniques rely on the controlled uptake of water to achieve critical moisture content that will activate metabolic activity in a controlled environment (Wien 1997).

Osmopriming is the most common method of priming used by solutions with low osmotic potentials. In this method many compounds have been used to achieve a solution or known water potential and include salt salts such as NaCl, $K_2HPO_4$, $KNO_3$, $MgSO_4$, $KH_2PO_4$ and low molecular weight polymers such as glycerol and mannitol and large molecular weight polymers such as polyethylene glycol (PEG 6000, 8000) (Farooq *et al*. 2006). In primed seeds usually high germination rate, high germination uniformity and in some cases high final germination is shown (Basra *et al*. 2005).

Osmopriming has been used on many plant seeds such as rice (Ruan *et al*. 2002), wheat (Giri and Schilinger 2003), tomato (Kester *et al*. 1997; Cheng and Bradford 1999; Lopes and Rossetto 2004), muskmelon (Nascimento and Aragão 2004), leek, onion and carrot (Gray *et al.* 1990), sugar beet (Carpon *et al.* 2000), canola (Ehsanfar *et al.* 2006) and *Lagenaria siceraria* (Kenenoglu *et al.* 2007).

To investigate the beneficial effects of osmopriming in eggplant, the effects of different concentrations of various salt solutions on germination percentage (GP), germination rate (GR), mean germination time (MGT) and mean root length (MRL) were studied.

## MATERIALS AND METHODS

In the beginning of the experiment, the seeds of one-year-old eggplant 'Black Beauty' were soaked in 0.5% tetrazolium solution to ensure seed viability. The result of the seed viability test showed that 100% of seeds were alive. The seeds were soaked in three salt solutions (NaCl, $KNO_3$ and $K_2HPO_4$) at three levels (-0.5, -1 and -1.5 MPa) for 96 h. These treatments were factorially combined and replicated three times based on a completely randomized design. Thirty seeds were placed in every Petri dish on Whatman filter paper No 1. 5 ml of salt solutions were added to each Petri dish daily. Distilled water was used as the control treatment. All Petri dishes were placed in the dark at 25 ± 2°C for four days. Then seeds were separated from solutions and washed with distilled water to remove the remaining salt solutions. The germination index was a 2 mm radicle length. In this experiment some germination traits (MRL, seed fresh weight, seed dry weight, GP, GR and MGT) were assessed. For weighing seed, a digital balance with 0.0001 g accuracy was used. After recording root length and fresh weight, seeds were dried at 70°C in a forced air oven for 24 h and the dry weight of seeds was recorded.

Data was analysed by analysis of variance (ANOVA) using SPSS Ver. 12 and treatments means were compared using least significant difference (LSD) test at $P < 0.05$ and $P < 0.01$.

## RESULTS

The results of variance analysis (F values) of solution types, concentration and their interaction (solution types × concentration) for all of the assessed parameters in eggplant 'Black Beauty' seeds are provided in **Table 1**. MGT ($P < 0.01$) and GP ($P < 0.05$) were significantly affected by solution type. However, different concentrations of solutions significantly affected MRL ($P < 0.05$) and MGT ($P < 0.01$). The interaction between solution type and concentrations for some traits (GR, MRL and MGT) was significant ($P < 0.01$).

The effect of solution type on GP of seeds is shown in **Fig. 1**. Highest (95%) and lowest (83%) GP were observed in $KNO_3$ and control, respectively. As depicted in **Fig. 2**, the highest GRs were obtained at -0.5 MPa NaCl and at -1 MPa $KNO_3$ while lowest GRs were obtained at -1.5 MPa $K_2HPO_4$ and in the control, respectively. Interaction effects of solu-

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**Short Communication**

**Table 1** Analysis of variance (*F* values) for assessed parameters of eggplant seeds germination.

| **Dependent Variable** | **Independent variables** | | |
|---|---|---|---|
| | **Solution types** | **Concentration** | **Solution types × Concentration** |
| Fresh weight | $1.32^{ns}$ | $1.17^{ns}$ | $0.97^{ns}$ |
| Dry weight | $0.38^{ns}$ | $1.16^{ns}$ | $0.21^{ns}$ |
| Germination rate | $16.06^{**}$ | $1.45^{ns}$ | $2.52^{*}$ |
| Germination percentage | $3.55^{*}$ | $1.16^{ns}$ | $1.42^{ns}$ |
| Mean root length | $1.79^{ns}$ | $3.69^{*}$ | $5.49^{**}$ |
| Mean time of germination | $19.96^{**}$ | $17.83^{**}$ | $16.57^{**}$ |

ns: not significant, * significant at P = 0.05, ** significant at P = 0.01.

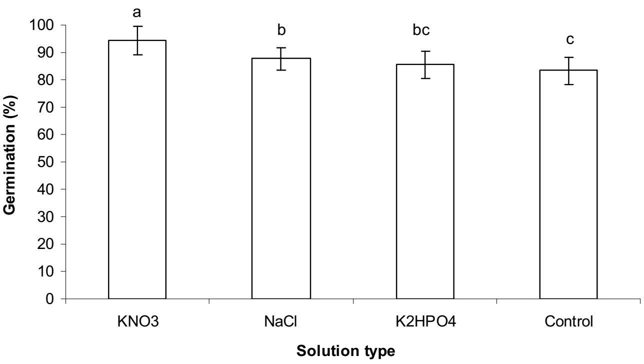


**Fig. 1 Effects of solution types on germination percentage of eggplant seeds.**

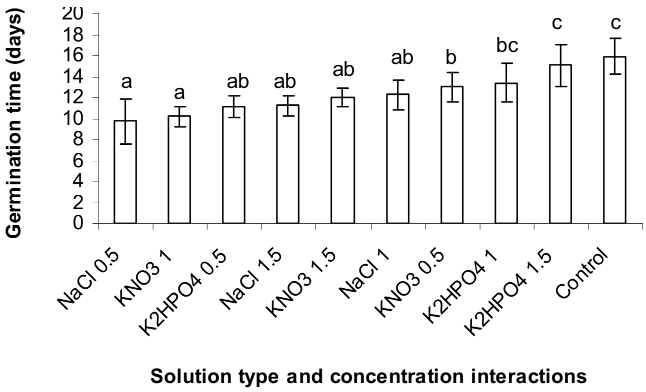


**Fig. 2 Effects of solution type and concentration on mean germination time in eggplant seeds.**

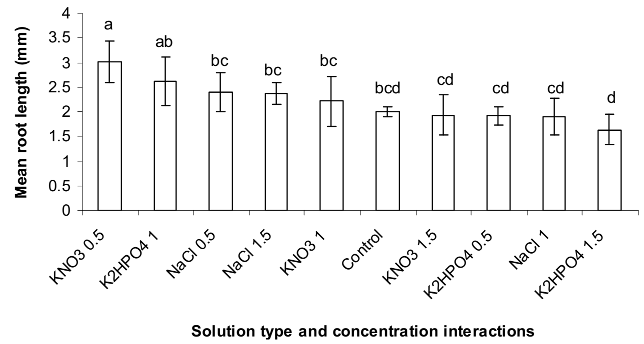


**Fig. 3 Effects of solution type and concentration interactions on mean of root length in eggplant seeds.**

tion type and concentration on MRL in eggplant seeds are shown in **Fig. 3**. The highest and lowest MRL were observed at -0.5 MPa $KNO_3$ and at -1.5 MPa $K_2HPO_4$, respectively.

Finally, as depicted in **Fig. 4**, the highest MGT was obtained at -0.5 MPa NaCl, -0.5 MPa $K_2HPO_4$ and at -1 MPa

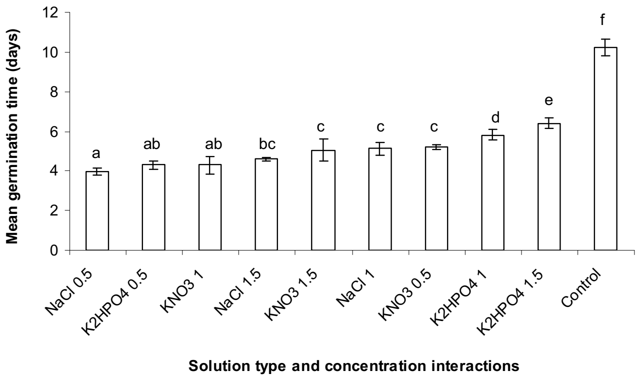


**Fig. 4 Effects of solution type and concentration interactions on mean germination time in eggplant seeds.**

$KNO_3$, respectively while lowest GR was obtained in the control. The values of GR at -1.5 MPa NaCl, -1.5 MPa $KNO_3$, -1 MPa NaCl and -0.5 MPa $KNO_3$ were higher than the corresponding values at -1 MPa $K_2HPO_4$, -1.5 MPa $K_2HPO_4$ and control, respectively.

## DISCUSSION

Osmopriming has beneficial effects on improving germination of eggplant seeds (**Table 1**). In this study, different salt solutions at various concentrations had beneficial effects on seed germination as compared with control (distilled water). Germination parameters increased at low concentrations of salt solutions more than at high concentrations. Earlier studies showed that the success of seed priming is influenced by a complex interaction of factors, including plant species, water potential of the priming agent, duration of priming, temperature, seed vigor and dehydration and storage conditions of the primed seed (Moradi Dezfuli *et al.* 2008). Demir *et al.* (1994) studied the effects of different concentrations of kinetin, $GA_3$, $KNO_3$ and PEG on germination of two- and five-years-old eggplant seeds. They showed that $GA_3$ and $KNO_3$ treatments, in particular, and unlike the control, significantly influenced GP and GR. These results are in agreement with our findings. $KNO_3$ can improve seed germination in cucumber (3% $KNO_3$) (Ghassemi-Golezani and Esmaeilpour 2008), pepper (Bradford *et al.* 1990), corn (-0.5 MPa $KNO_3$) (Ghiyasi *et al.* 2008), muskmelon (-1.3 MPa $KNO_3$) (Nascimento 2003) and *Lagenaria siceraria* (4% $KNO_3$) (Kenanoglu *et al.* 2007).

Induction of germination by $KNO_3$ occurs through uptake of excessive $O_2$ and phosphate (Bliss *et al.* 1986). Nerson *et al.* (1985) found that $KNO_3$ priming caused an increase in embryo length in tetrapeloid watermelon seeds. Treated seeds had stronger embryos and in turn broke up the seed coat blockage. The beneficial effects of $KNO_3$ priming were more than NaCl priming, a similar result to that found for watermelon (Sachs 1977; Nerson *et al.* 1985; Demir and Van de Venter 1999; Demir and Ozokat 2003) and muskmelon (Bradford 1985). According to Alevarado and Bradford (1988) and Belleti *et al.* (1993), the superiority of $KNO_3$ priming to NaCl priming is related to more nitrogen and potassium accumulation in seeds treated with $KNO_3$.

In conclusion, the results of this experiment suggest that seed priming with salt solutions, especially with $KNO_3$ and NaCl, could be used as a good procedure to increase eggplant seed germination traits.

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