www.sospublication.co.in Journal of Advanced Laboratory Research in Biology

We- together to save yourself society e-ISSN 0976-7614

Volume 3, Issue 3, July 2012 Research Article

Effect of Seed Priming on Some Characteristic of Seedling and Seed Vigor of Tomato (*Lycopersicon esculentum*)

Elaheh Mirabi* and Mahmud Hasanabadi

**Department of Horticulture, Applied Agricultural Science Education Center of Shahrood, Iran.*

Abstract: In order to investigate the effect of seed priming on some characteristic of seedling and seed vigor of tomato cultivar: ZD 610, an experiment was conducted base on randomized complete design with four replications at the applied agricultural science education center of Shahrood (Iran) greenhouse during 2010. Traits such as fresh weight of seedling, root length, shoot length, mean germination time (MGT) and final germination percentage (FGP). Treatment included Distilled water (dH_2O), sodium chloride (NaCl-2%), salicylic acid (SA-60 ppm), acetylsalicylic acid (ASA-60 ppm), ascorbic acid (AsA-60 ppm), PEG-6000 and potassium nitrate (KNO_3-5%), in darkness for 48 hours. The results indicated that the effect of priming treatments was significant. KNO_3 in all of traits was better than other priming. The lowest fresh weight of seedling was observed in control and then H_2O and NaCl. The minimum of root and shoot length was observed in NaCl treatment. The KNO_3 treatment as a superior treatment introducing this experiment.

Keywords: Osmopriming, Tomato CV. ZD 610, Seedling, Seed Vigor.

1. Introduction

The tomato is a major vegetable crop that has achieved tremendous popularity over the last century. It is grown practically in every country of the world in outdoor fields, greenhouses and net houses. Aside from being tasty, tomatoes are a very good source of vitamins A and C. Vitamin A is important for bone growth, cell division and differentiation, for helping in the regulation of the immune system and maintaining surface linings of the eyes, respiratory, urinary and intestinal tracts. Vitamin C is important in forming collagen, a protein that gives structure to bones, cartilage, muscles and blood vessels. It also helps maintain capillaries, bones and teeth and aids in the absorption of iron. Freshly harvested tomato seeds often fail to germinate due to presence of dormancy. Dormancy has also been reported even in one-year-old seeds. This all has resulted in problems in tomato production all over the world. Controlled hydration of seeds followed by drying (seed priming) is used to break dormancy, speed germination and improve uniformity of radical emergence (Liu *et al.*, 1996). Seed priming treatments using salts such as KNO_3 have been effective in improving watermelon germination at low temperatures (Demir and Van de Venter, 1999). Osmopriming is a special type of seed priming that has been used to invigorate many horticultural (Bradford, 1986; Bray, 1995) and agronomic crops (Basra *et al.*, 2002; Farooq *et al.*, 2005). In osmopriming seeds are soaked in aerated low water potential solutions, which allow pre-germinative activities to proceed, followed by refrying before actual germination (Cheng and Bradford, 1999) priming of tomato seed with NaCI induces physiological changes in plants grown under salt stress. They concluded that tomato seedlings from primed seeds emerged earlier than non-primed seeds while shoot and root dry weight reduction was found in primed seeds at different harvest. Priming can be a valuable process for improving germination and uniformity of heterogeneously matured seed lots (Olouch and Welbaum, 1996). Seed priming has been successfully demonstrated to improve germination and emergence in the seeds of many crops, particularly

*Corresponding author:
E-mail: elahe.mirabi@yahoo.com.

seeds of vegetables and small-seeded grasses (Bradford, 1986). Osmopriming with KNO_3 has been reported to increase the embryo length in tetraploid watermelon seeds (Nerson *et al.*, 1985). In another study, Sung and Chiu (1995) found that primed watermelon seeds had higher seedling emergence force. Jumsoon *et al.*, (1996) studied the effect of priming (150mM $KN0_3$ at 20°C for 4 days) of tomato seeds under water or saline stress. They concluded that primed seeds had higher percentage germination than unprimed seeds at 15 or 20°C under both water and saline stress. Seed maturation stage can also be an influential factor in germination performance at low temperatures and the response to priming treatment (Olouch and Welbaum, 1996). Positive effects of priming with NaCl have been reported on growth and yield of mature tomato plants when salt treatments were applied with seed sowing (Cano *et al.*, 1991). Rivas *et al*., (1984) found increased germination rates in Jalapeno and Tabasco tomato seeds primed in PEG-6000 solution.

Salicylic acid (SA) is a phenolic plant growth regulator having a role in regeneration of physiological processes in plants (Sakhabutinova *et al*., 2003). The role of salicylic acid in seed germination (Cutt & Klessig, 1992), enzymatic activity (Dolatabadian *et al.*, 2008), photosynthetic rate (Khan *et al.*, 2003), uptake and transport of ions (Harper & Balke, 1981; Afzal *et al.*, 2005), and plant growth and yield (Hussein *et al.*, 2007) have been described. Inducing resistance against salinity (Shakirova & Bez-Rukova, 1997) and water stress (Senaratna *et al.*, 2000; Bezrukova *et al.*, 2001) in plants is a function of salicylic acid. Moreover, salicylic acid also reduced the negative effects of salt stress by increasing levels of other plant growth regulators in plants (Sakhabutdinova *et al.*, 2003). Ascorbic acid (AsA) is among the most abundant antioxidants found in plants. Exogenous application of ascorbic acid positively affects growth and physiological activities in *Triticum aestivum* L., (Amin *et al.*, 2007). Ascorbic acid alleviates the adverse effects of salinity on plants by enhancing plant growth (Afzal *et al.*, 2005). Exogenous application of ascorbic acid induces activation of the antioxidant enzyme system in canola (*Brassica napus* L.) resulting in a reduction of detrimental effects of salinity (Dolatabadian *et al.*, 2008).

2. Material and Methods

In order to investigate the effect of seed priming on some characteristic of seedling and seed vigor of tomato cultivar: ZD 610, an experiment was conducted based on a randomized complete design with four replications at the applied agricultural science education center of Shahrood (Iran) greenhouse during 2010. Seeds of tomato cultivar ‘ZD 610’ were surface sterilized by dipping in sodium hypochlorite (5%) solution for five minutes and dried on filter paper. These surfaces sterilized seeds were primed with distilled water (dH_2O), sodium chloride (NaCl-2%), salicylic acid (SA-60 ppm), acetylsalicylic acid (ASA-60 ppm), ascorbic acid (AsA-60 ppm), PEG-6000 and potassium nitrate (KNO_3-5%), in darkness for 48 hours. Unprimed seeds (UP) served as control. Seeds were given 3 washings after priming and surface drying under forced air on filter paper. Primed and unprimed seed swore cultured in Petri dishes on a single sheet of Whatman No. 1 filter paper, moistened with 2.5ml distilled water, at 25+2°C and kept under 18-hour photoperiod. Data were recorded daily on germination for 14 days and finally on various aspects of seed vigor, fresh weight of seedling, root length, shoot length. The analyzing of the data and drawing diagrams is done by means of software like Minitab and excel. The comparison of the median values is performed by means of software like MSTAT-C and Duncan's test on possibility level 5 percent.

3. Results and Discussion

All priming treatments increased root length in primed seeds over unprimed ones (Fig. 1); being maximum in KNO_3 (2.91cm) treated seeds and minimum in seeds primed with NaCl (1.50cm). Root length was at par in seeds primed in KNO_3 (2.91cm), acetylsalicylic acid (2.50cm), PEG-6000 (2.24cm) and salicylic acid (2.50cm). Root length of unprimed seeds was mean root length almost negligible (0.5cm) as most of the seeds did not germinate during the experimental period (14 days). Priming also improve the shoot length; results showed the same pattern for shoot length as in the case of root length is maximum in seeds primed in potassium nitrate (2.56cm) followed by those primed with acetylic salicylic acid (2.43cm) and PEG-6000 (2.21cm), statistically at par with each other (Fig. 1). Seeds primed with ascorbic acid and salicylic acid also performed well over the unprimed ones.

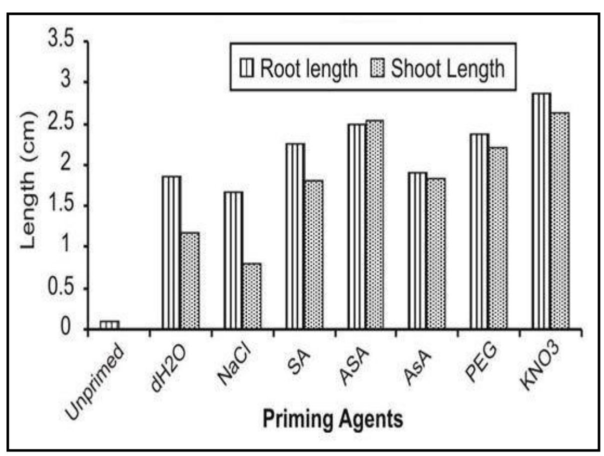

Fig. 1. Effect of priming on root and shoot length of seedlings.

Seedling fresh weight was significantly affected by different priming agents. Seeds primed in KNO_3 produced seedling having maximum fresh weight i.e. 0.2038mg per seedling (Fig. 2). Seedlings raised from seeds primed in PEG-6000, salicylic acid and acetylsalicylic acid had fresh weight, statistically at par with each other. Seeds primed in distilled water and NaCl produced seedlings with statistically similar fresh weight.

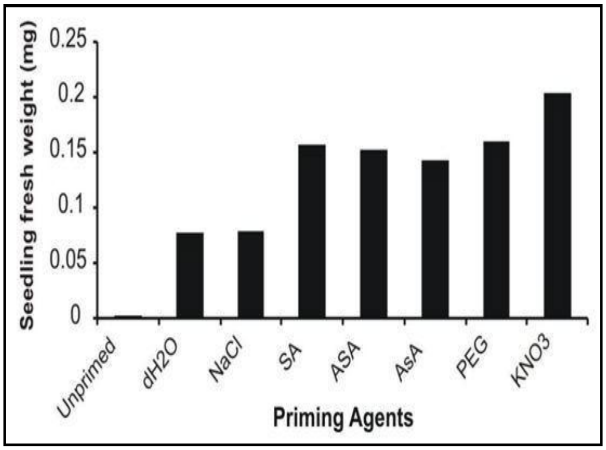

Fig. 2. Effect of priming on seedling fresh weight.

Seed priming decreased mean germination time over the unprimed treatment (Fig. 3). Seeds primed in potassium nitrate took minimum time to germinate i.e. 5.63 days, while the time for unprimed seeds was 14 Days. All the priming treatments were statistically alike. Final germination percentage (FGP) of tomato seeds was significantly improved by different priming treatments over the control (Fig. 3). Seeds primed in KNO_3, ascorbic acid, salicylic acid and acetylsalicylic acid showed the maximum value of FGP i.e. 100% in each.

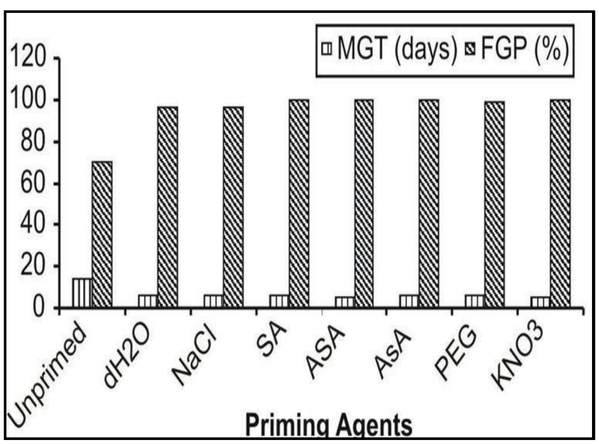

Fig. 3. Effect of priming on germination behavior.

All priming treatments significantly improved MGT, FGP, root length, shoot length, seedling fresh weight and vigor in tomato CV. ZD 610. Priming with KNO_3, ASA, PEG-6000, significantly improved MGT, root length, shoot length and vigor in tomato CV. ZD 610 (Fig. 1, 2, 3) over other treatments. Earlier and synchronized germination was observed in primed seeds compared with that of unprimed as depicted by lower MGT. These findings are in accordance with the findings of Demir and Van Deventer (1999) who observed improved shoots length in watermelon seeds due to seed priming. Osmopriming has been found to improve germination rate and speed in tomato, especially when freshly harvested seeds are used (Liu *et al.,* 1996). Osmotically primed tomato seeds showed improved stand establishment, early seedling growth and yield, seedlings from primed seed emergence earlier and mound formerly seedling from untrue seeds (Alvardo *et al.,* 1987). Enhanced seed germination and improved seedling performance has also been recorded in freshly harvested tomato seeds compared with the untreated control (Liu *et al.*, 1996).

References

[1]. Afzal, I., Basra, S.M.A., Ahmad, N. and Farooq, M. (2005). Optimization of hormonal priming techniques for the alleviation of salinity stress in wheat (*Triticum aestivum* L.). *Caderno de Pesquisa Ser. Bio., Santa Cruzdo Sul.*, 17: 95-109.

[2]. Amin, A.A., Rashad, M., EL-Sh, EL-Abagy, H.M.H. (2007). Physiological effect of indole-3-butyric acid and salicylic acid on growth, yield and chemical constituents of onion plants. *J. Appl. Sci. Res.*, 3(11), 1554−1563.

[3]. Alvarado, A.D. and Bradford, K.J. (1988). Priming and storage of tomato *Lycopersicon lycopersicum* seeds i. effects of storage temperature on germination rate and viability. *Seed Sci. Technol.*, 16:601-612.

[4]. Bradford, K.J., Steiner, J.J., Trawatha, S.E. (1990). Seed priming influence on germination and emergence of pepper seed lots. *Crop Science*, 30: 718-721.

[5]. Bray, C.M. (1995). Biochemical processes during the osmopriming of seeds. In: Kigel, J., Galili. G. (Ed.) Seed development and germination. New York: Marcel Dekker, p.767-789.

[6]. Basra, S.M.A., Farooq, M. and Tabassum, R. (2005). Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (Oryza sativa L.). *Seed Sci. Technol.*, 33: 623-628.

[7]. Cano, E.A., Bolarin, M.C., Perez-Alfocea, F. and Caro, M. (1991). Effect of NaCl priming on increased salt tolerance in tomato. *J. Hort. Sci.*, 66: 621-628.

[8]. Cutt, J.R. and Klessig, D.F. (1992). Salicylic acid in plants: A changing perspective. *Pharmaceutical Tech.*, 16: 26-33.

[9]. Demir, I. and Van de Venter, H.A. (1999). The effect of priming treatments on the performance of watermelon (*Citrullus lanatus* (Thunb.) Matsum. and Nakai) seeds under temperature and osmotic stress. *Seed Sci. and Technol.*, 27: 871–876.

[10]. Dolatabadian, A., Sanavy, S.A.M.M. and Chashmi, N.A. (2008). The effects of foliar application of ascorbic acid (Vitamin C) on antioxidant enzyme activities, lipid peroxidation and proline accumulation of canola (*Brassica napus* L.) under conditions of salt stress. *J. Agron. Crop Sci.*, 194: 206-213.

[11]. Farooq, M., Basra, S.M.A., Hafeez, K. and Ahmad, N. (2005). Thermal hardening: a new seed vigor enhancement tool in rice. *Acta. Bot. Sinica*, 47: 187-193.

[12]. Hosseini, G. and Thengane, R.J. (2007). Salinity tolerance in cotton (*Gossypium hirsutum* L.) genotypes. *Int. J. Bot.*, 3: 48-55.

[13]. Khan, W., Prithiviraj, B. and Smith, D.L. (2003). Photosynthetic responses of corn and soybean to foliar application of salicylates. *J. Plant Physiol*., 160: 485-492.

[14]. Harper, J.R. and Balke, N.E. (1981). Characterization of the inhibition of K^+ absorption in oat roots by salicylic acid. *Plant Physiol*., 68: 1349-1353.

[15]. Liu, Y., Bino, R., Van der Burg, W., Groot, S. & Hilhorst, H. (1996). Effects of osmotic priming on dormancy and storability of tomato (Lycopersicon esculentum Mill.) seeds. Seed Science Research, 6(2), 49-55.

[16]. Nerson, H., Paris, H., Karchi, Z., Sachs, M. (1985). Seed treatments for improved germination of tetraploid watermelon. *HortScience*, 20. 897-899.

[17]. Oluoch, M.O. and Welbaum, G.E. (1996). Effect of postharvest washing and post-storage priming on viability and vigor of 6-year old muskmelon (*Cucumis melo* L.) seeds from eight stages of development. *Seed Sci. Technol.*, 24:195–209.

[18]. Rivas, M., Sundstrom, F.J., Edwards, R.L. (1984). Germination and crop development of hot pepper after seed priming. HortScience, 19:279-281.

[19]. Sakhabutdinova, A.R., and Fatkhutdinova, D.R. and Bezrukova, M.V. & Shakirova, F.M. (2003). Salicylic acid prevents the damaging action of stress factors on wheat plants. *Bulg. J. Plant Physiol.*, special issue: 314- 319.

[20]. Shakirova, F.M., Bezrukova, M.V. (1997). Induction of wheat resistance against environmental salinization by salicylic acid. Biology Bulletin, 24: 109–112.

[21]. Senaratna, T., Touchell, D., Bunn, E., Dixon, K., (2000). Acetylsalicylic acid (Aspirin) and salicylic acid induce multiple stress tolerance in bean and tomato plant. *Plant Growth Regulation*, 30: 157–161.