Salt Priming Increase Germination of Cucumber at Low Temperatures

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Abstract
Poor seed germination is a common phenomenon at sub-optimal temperatures which causes a great concern for growers. Several priming treatments have been reported to enhance germination percentage under low temperature sowings in various crop seeds. In this study, seed priming was carried out with three solution materials (KNO_3, K_2HPO_4, and NaCl) in four different concentrations (0, 1, 2.5 and 5 % w/v) by two various temperatures (15 and 25 °C) on cucumber seeds (Cucumis sativus L. cv. Super dominos), using a completely randomized design with three replications. Results showed an interaction between priming solution material, priming solution concentration and temperature significantly affect the germination percentages ($P<0.01$), seedling fresh weight and seedling dry weight ($P<0.05$) as well as root volume ($P<0.01$). The highest germination rate in low temperature (15 °C) was obtained from 5 % KNO_3 and 1 % K_2HPO_4 showed the highest seedling fresh weight and the highest seedling

Introduction
Optimum seed germination and seedling growth in cucumber occur at 20-25˚C. Poor seed germination is a common phenomenon at sub-optimal temperatures which causes a great concern for growers that grow this crop at early spring in cool regions in North of Iran. Delayed and reduced germination and seedling emergence cause non-uniform stand establishment and tender seedling subjected to soil-borne pathogens for long time. Priming treatments have been reported to enhance germination percentage of cantaloupe, pepper, gourd, and watermelon seeds under low temperature sowings. Salt solutions have been used for such aims and particularly KNO_3 and KH_2PO_4 treatments were found promoting the germination percentage of vegetables seeds at low temperatures (Shik et al. 1999). The objective of the research was to study the effects of using KNO_3, KH_2PO_4 on cucumber seed germination by low temperature.

Materials and Methods
The Experiment was conducted in 2009 using a completely randomized design with three replications. Three priming substrate each 5 percent (KNO_3, K_2HPO_4 and NaCl) were used on Cucumber seeds with four different concentrations (0, 1, 2.5 and 5 % w/v) and by two various temperatures (15 and 25 °C). Seed priming was carried out on top of filter paper moistened with 30 ml of KNO_3, K_2HPO_4 and NaCl solutions and kept at 20 ^{o}C for 24 hours in the dark in sandwich boxes (18×9×5 cm). One hundred seeds were used for each priming solution. At the end of the treatment, seeds were washed under tap water for 30 seconds and dried to the original weight on top of filter paper on laboratory bench for two days. Germination tests were conducted within two days after the treatment and seeds were stored at 4 ^{o}C during that period. Seeds with two mm radicle protrusion were considered to have germinated. Counts were start 1 day after the test was set up and finished after 7 days. The data were subjected to GLM in SAS (ver. 9.1, SAS Institute, Inc.) where appropriate means were separated using the Tukey test.

Results and Discussion

Interaction between priming solution material, priming solution concentration and temperature significantly affect on germination percentages ($P<0.01$) and the highest germination percentage in low temperature (15 °C) was obtained from 5 % KNO_3. Interaction between priming solution material and priming solution concentration significantly affect on seedling fresh weight ($P<0.05$). 1 % K_2HPO_4 showed the highest seedling fresh weight. Interaction between priming solution concentration and temperature significantly affect on seedling fresh and dry weight as well as root volume ($P<0.01$). Interaction between priming solution material and temperature significantly affect on seedling dry matter percent ($P<0.05$). The highest seedling dry matter percent was obtained by KNO_3 and the lowest was related to NaCl. Between priming matter the highest seedling dry weight obtained from K_2HPO_4 and the lowest obtained from NaCl. Priming seeds for germination under unfavorable temperatures reported in various crop seeds (Pill 1995). Specifically, salt-priming in which various salts were used were found enhancing germination at low temperatures in cucurbits (Korkmaz et al. 2005). Our results with salt priming confirmed the mentioned works. One of the clear findings of the present work is that NaCl treated seeds gave worse performance than those of control seeds. NaCl hinders DNA and RNA synthesis (Bliss et al. 1986) and Ca and K uptake during treatment (Durrant et al. 1983).

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