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Improving the Germination and Early Seedling Growth in Melon (*Cucumis melo* L.) by Pre-sowing Salicylicate Treatments

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ABSTRACT

This study was conducted to evaluate the possibility of improvement in germination and early seedling growth by pre-sowing salicylicate treatments. Seed of melon cultivar Ravi were soaked in aerated 50 and 100 mg L^{-1} solution of salicylicate for 24 h. Pre-sowing salicylicate treatments improved the germination rate and uniformity, and early seedling growth in both cucumber and melons. However, seed treatment with 50 mg L^{-1} was more effective in reducing the time to start germination, time to 50% germination and mean germination percentage, and improving the final emergence, emergence energy, emergence index, root and shoot length and number of roots. However, maximum seedling fresh and dry weights were recorded from seed treatment with 100 mg L^{-1} salicylicate. But none of the priming treatments improved the leaf score.

Key Words: Germination; Melons; Seedling growth; Salicylicate; Seed treatment

INTRODUCTION

Salicylic acid (SA) is an endogenous growth regulator of phenolic nature with ubiquitous distribution among plants. It influences a range of diverse processes in plants, including seed germination (Cutt & Klessig, 1992), stomatal closure (Larque-Saaveda, 1979), ion uptake and transport (Harper & Balke, 1981), membrane permeability (Barkosky & Einhellig, 1993), photosynthesis and growth rate (Khan *et al*., 2003). In addition, SA also induces an increase in the resistance of seedlings to osmotic stress (Borsani *et al.*, 2001), low or high temperature by activating glutathione reductase and guaiacol peroxidase (Kang & Saltveit, 2002). SA plays an important role in abiotic stress tolerance, and considerable interests have focused on SA due to its ability to induce a protective effect on plants under stress. Many studies support the SA-induced increases in the resistance of wheat to salinity (Shakirova & Bezrukova, 1997; Sakhabutdinova *et al.,* 2003; Shakirova *et al.*, 2003) and osmotic stress (Bhupinder & Usha, 2003) and of rice on heavy metal stress (Mishra & Choudhuri, 1999; Pa´l *et al*., 2002).

Seed priming allows for some of the metabolic processes necessary for germination to occur without actual germination. Primed seeds usually exhibit increased germination rate, greater germination uniformity, and sometimes greater total germination percentage (Basra *et al*., 2004). Increased germination rate and uniformity have been attributed to metabolic repair during imbibition (Bray *et al*., 1989), a buildup of germination-enhancing metabolites (Basra *et al*., 2005), osmotic adjustment (Bradford, 1986), and, for seeds that are not re-dried after treatment, a simple reduction in the lag time of imbibition (Bradford, 1986).

Normally priming is done either in low water potential solution (osmopriming) or in tap water (hydropriming), however, incorporation of plant growth regulators during priming have been reported to improve the effectiveness of seed priming in many crops (Afzal *et al*., 2002). Plants produce proteins in response to abiotic and biotic stress and many of these proteins are induced by phytohormones such as ABA (Jin *et al*., 2000) and salicylic acid (Hoyos & Zhang, 2000).

In an earlier study, Basra *et al.* (2006) investigated the possibility of seed invigoration by seed treatments with salicylicate and ascorbate in coarse and fine rice. Although, ascorbate was more effective in vigor enhancement, salicylicate also improved the germination rate and seedling growth.

This study was carried out with the objective to evaluate the influence of pre-sowing salicylicate seed treatments on the germination and early seedling growth of melons.

MATERIALS AND METHODS

Seed materials. Melon cultivar Ravi was used in the present study. Seed was obtained from Vegetable Research Institute, Ayyub Agricultural Research Institute, Faisalabad, Pakistan. The initial seed moisture contents were 9.11% (on dry weight basis).
Osmopriming. Seeds were soaked in aerated 10 and 20 ppm solutions of salicylicate for 24 h. The ratio of seed weight to solution volume was 1:5 (g mL^{-1}) (Basra *et al.*, 2004).
Post treatment operations. After priming, seeds were

given three surface washings with distilled water and re-dried to original weight with forced air under shade at 27± 3 °C (Basra *et al.*, 2002). These seeds were then sealed in polythene bags and stored in refrigerator at 5°C before further use.

Vigor Evaluation. Control and treated seeds were sown in 5 kg plastic pots containing moist acid/water washed sand and placed in a net-house. The number of emerged seeds was recorded daily according to the seedling evaluation Handbook of Association of Official Seed Analysts (1990) until a constant count was achieved. Time taken to 50% emergence of seedlings (E_{50}) was calculated according to the following formulae of Coolbear *et al.* (1984) modified by Farooq *et al.* (2005):

$$E_{50} = t_i + \frac{\left(\frac{N}{2} - n_i\right)}{n_j - n_i}\left(t_j - t_i\right)$$

Where N is the final number of emerged seeds, and n_i and n_j the cumulative number of seeds emerged by adjacent counts at times t_i and t_j when $n_i < N/2 < n_j$.

Mean emergence time (MET) was calculated according to the equation of Ellis & Roberts (1981) as under:

$$MET = \frac{\sum Dn}{\sum n}$$

Where n is the number of seeds, which were emerged on day D, and D is the number of days counted from the beginning of emergence.

Emergence index (EI) was calculated as described in the Association of Official Seed Analysts (1983) as the following formulae:

$$\text{EI} = \frac{\text{No. of emerged seeds}}{\text{Days of first count}} + - - - - - - - + \frac{\text{No. of emerged seeds}}{\text{Days of final count}}$$

Energy of emergence (EE) was recorded on the 4^{th} after plantation. The percentage of emerging seeds 4 days after plantation is relative to the total number of seeds tested (Farooq *et al.*, 2006). On the 15^{th} after emergence, the seedlings were tested for vigor after carefully removing from the sand. Number of roots, shoot and root length of 5 randomly selected seedlings were recorded per replicate and averaged. Seedling fresh weight was determined immediately after harvest, whereas dry weight was taken after drying at 70°C for 7 days.

RESULTS

Pre-sowing salicylicate seed treatments significantly affected germination and early seedling growth in melons.

Salicylicate seed treatments resulted in lower values of time to start germination, time to 50% emergence (E_{50}) and MET. However, soaking in 50 ppm salicylicate solution was more affective (Fig. 1a, 1b, 2a). Salicylicate (50 ppm) improved the emergence percentage, emergence energy and emergence index. While soaking in 100 ppm solution behaved similar to untreated seeds (Fig. 2b, 3a, 3b). Both salicylicate seed treatments improved the root length, 50 ppm being more affective (Fig. 4a). None of the salicylicate seed treatments could improve the shoot length and seedling fresh and dry weights (Fig. 4b, 5a, 5b). Number of leaves remained un-affected by salicylicate seed treatments (Fig. 5a). While, salicylicate seed treatments improved the root length, 50 ppm being more affective (Fig. 6b).

DISCUSSION

This study showed that pre-sowing salicylicate seed treatments can enhance the germination and early seedling growth in melon.

Salicylicate seed treatments decreased the emergence time and increased seedling emergence and seedling fresh and dry weight. Seed treatments not only resulted in earlier and more uniform emergence (as is clear from lower vales of time to start emergence, E_{50} and MET) but the emergence percentage, energy of emergence and emergence index were also improved. Earlier, Al-Hakimi and Hamada (2001) reported improved germination rate and percentage by ascorbate and sodium salicylicate treatments in wheat. Increase in germination percentage after treatment might be the consequence of breakdown of dormancy as fresh seeds were used during the investigations. The earlier and synchronized germination might be attributed to increased metabolic activities in the treated seeds (Shakirova *et al*., 2003; Basra *et al*., 2005). Seed treatments not only improved the germination rate and time but also enhanced the seedling vigor as indicated by higher root and shoot length, seedling fresh and dry weights and number of roots (Fig. 4b). Improved seedling fresh and dry weights might be due to increased cell division within the apical meristem of seedling shoots and roots, which caused an increase in plant growth. Moreover, salicylic acid treatments maintain the IAA and cytokinin levels in the plant tissues, which enhanced the cell division (Sakhabutdinova *et al*., 2003).

It has been long known that one of the main merits of soaking treatments to increase germination and emergence rate and in turn improved emergence (Heydecker & Coolbear, 1977). However, the question arises whether rapid radicle protrusion is always reflected in rapid seedling emergence. Halmer and Bewley (1984) proposed that emergence losses in the soil are not generally due to germination failure, but failure of seedlings to grow and emerge above soil surface.

An interesting finding of this study is that salicylicate treatments at lower concentration were more effective for improvement in germination uniformity and early seedling

Fig. 1. Influence of osmopriming treatments on the (a) time to start emergence and (b) time to 50% emergence.

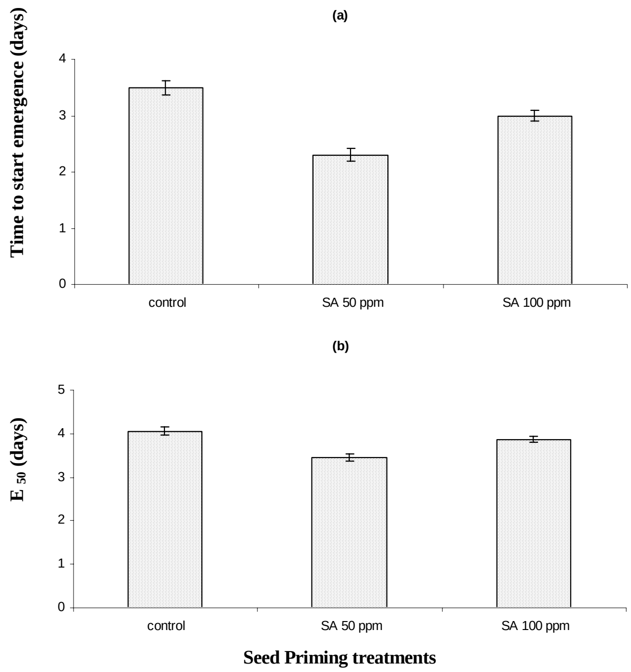


Fig. 2. Influence of osmopriming treatments on the on the (a) mean emergence time and (b) final emergence percentage.

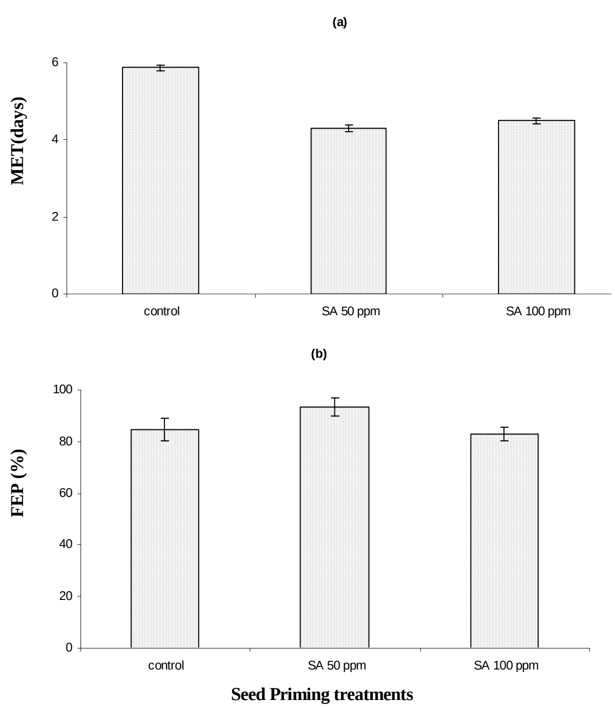


Fig. 3. Influence of osmopriming treatments on the (a) emergence energy (EE) and (b) emergence index (EI).

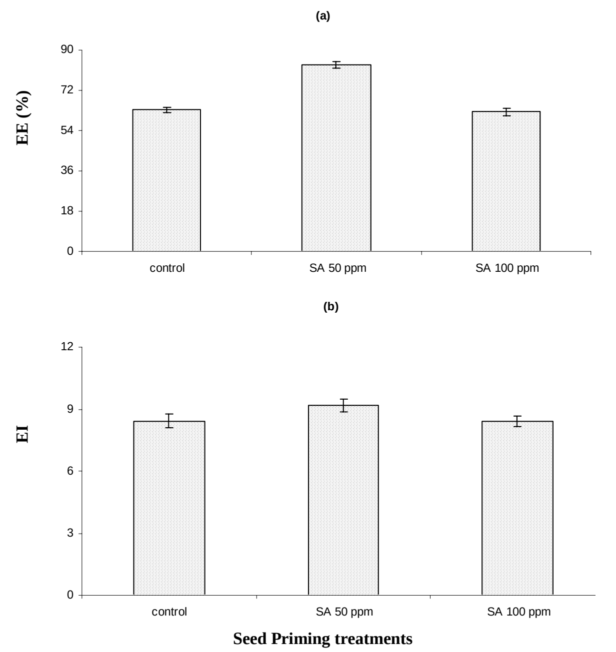
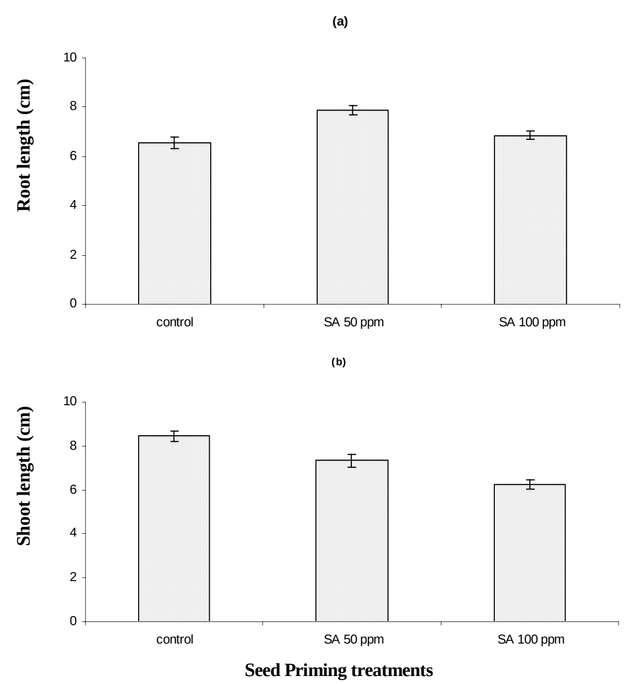


Fig. 4. Influence of osmopriming treatments on the on the (a) root length and (b) shoot length.



growth. This might be explained by the fact that lower concentration enhances the activity of hydrolases, which increased the reserve breakdown and earlier start of germination (Senaratna *et al.*, 2000; Shakirova *et al.*, 2003).

In essence, it may be concluded from the present study that pre-sowing seed treatments with 50 mg L^{-1} salicylicate is more effective for improvement in germination and early seedling growth.

Fig. 5. Influence of osmopriming treatments on the (a) seedling fresh weight and (b) dry weight.

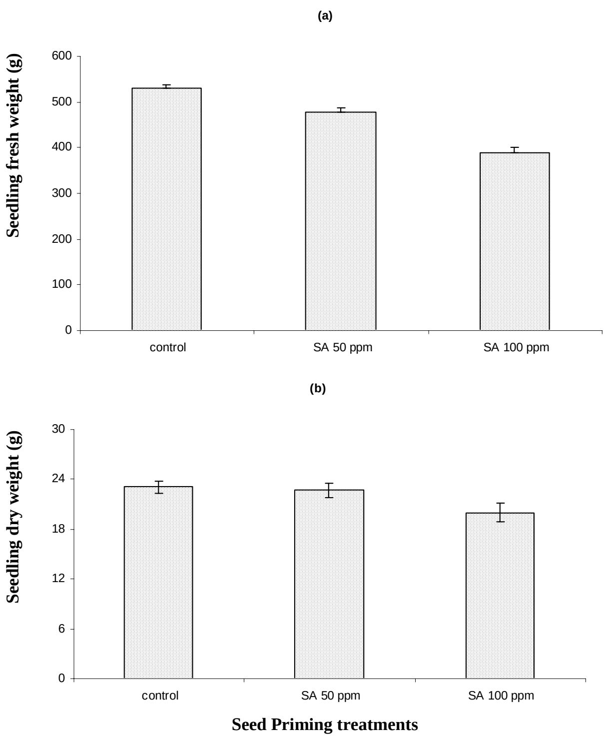
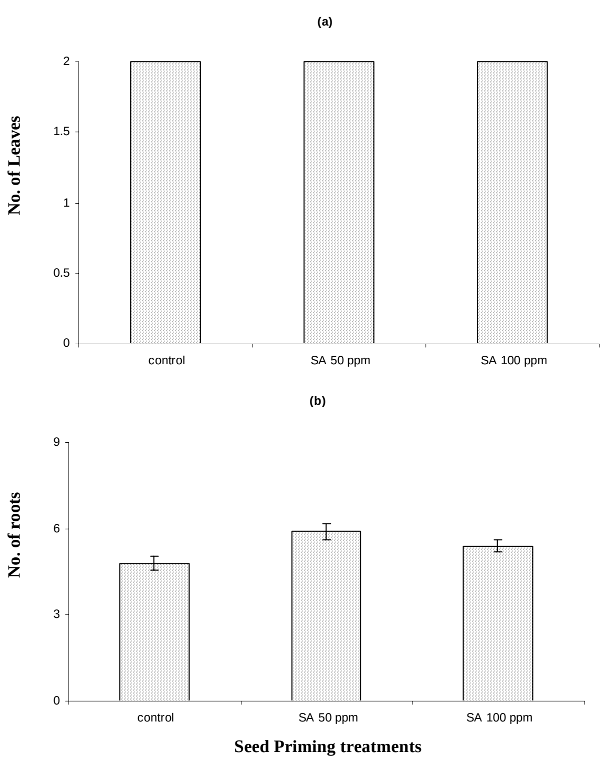


Fig. 6. Influence of osmopriming treatments on the (a) coefficient of uniformity of emergence and (b) No. of roots.



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